University Design Guidelines

2021 Edition
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The University of North Carolina at Chapel Hill continues to evolve to meet dynamic campus growth and the evolution of technology. The University Design Guidelines incorporate the unique principles of the University to support Carolina’s mission of teaching, research, and public service, and to promote its spirit and culture.

In planning for the University’s future, the Main Campus master plans were completed in 2001, 2006, 2009, and 2017. The first phase of the master plan for the Carolina North campus was completed in 2009, and the Mason Farm Road campus master plan is on-going. These three campuses are efficiently and effectively integrated to meet the University’s divergent needs.

The Design Guidelines reflect the University’s flexibility without compromising the goal of excellence in providing sustainable development and operations, accessibility for all campuses, and environmental stewardship. Coherent transportation and infrastructure, juxtaposed with the expanding open space network, underpins the integration of the three campuses.

Design Guideline Compliance
Beginning with the programming phase contracted design teams are expected to use and reference any exceptions to the latest version of the Design Guidelines. The front of each phase of the documents submitted for review is to note the date stamp of the version of the Design Guidelines used for the project. In addition, the Designer is to use other requirements by the State of North Carolina.

The Guidelines are generally organized to follow the sequence of the design process. They are to be used as a core tool by the contracted design team to direct them through project development, but they do not substitute for the optimum design solution. The Guidelines are a baseline outlining the unique requirements of the University. They allow the contracted designer to introduce alternative or improved concepts, methods, and products.

Any and all exceptions to the Design Guidelines shall be reviewed and approved by the University’s Project Manager prior to implementation.

2021 Edition
This year’s edition of UNC’s Design Guidelines reorganizes the design guidelines content into three categories beginning with a broad administrative view and progressing towards a narrow focus on specifics buildings systems as one continues through the document.

“Section A – Capital Project Administration” contains sections related to capital project processes, phases of design & construction, as well as pan-University guidelines.

“Section B – Campus Wide Site Design Guidelines” focuses on guidelines, principles, and procedures related to the campus utilities, site hardscape and landscape.

“Section C – Building Design Guidelines” moves to the build form and provides specificity on building envelope, building systems, and special construction elements.
2019 UNC Master Plan & Open Space Plan

General Overview
Celebrating the University of North Carolina at Chapel Hill’s Natural Landscape and Historic Core, the UNC-Chapel Hill campus has long been praised as among the most beautiful in America. The essence of this beauty resides not only in its topography, but also in the character of its buildings, open space, and landscape. The older buildings of North Campus, which line McCorkle and Polk Places, epitomize the University’s aesthetic. The purpose of these Guidelines is to ensure that future buildings and grounds continue the same thoughtful planning and architectural vocabulary of the historic core of north campus.

“A vision for the present and future Carolina campus landscape.”

At Carolina, natural beauty is as basic as the air we breathe. Prospective students and faculty members feel it when they first visit – the natural beauty of Carolina is a potent recruiting tool. Alumni love the campus landscape – even if only in memory – because it remains forever the beautiful setting for an important period in their lives. In the present-day university community, we value the landscape because it gives us pleasure. It offers a setting where all of us – faculty, staff and students – can do our best work. We are inspired and we are blessed by its beauty. Only by understanding the nature of this precious asset can we preserve it and hand it on to future generations of students, staff and faculty.

Thus, our vision is of a landscape that will be as beautiful at the university’s tricentennial in 2093 as it was at the bicentennial in 1993. Our vision is of a landscape that will continue to be as unique as it is appealing – as nourishing as it is functional. We believe that the campus landscape has lessons to teach us; it is not only the setting for learning but also part of our course of study. Perhaps most important, we imagine a university community that will continue to value UNC’s deep roots in the natural world – a community that consciously will safeguard its irreplacable legacy of trees, rock walls, and brick paths on a hilltop site carved out of the ancient forest.

The open space network and types of campus landscapes are best described in the 2019 University Master Plan report within pages 50-55. The campus systems, including the street network, the open space network, the bike, transit, and utility networks are described on the page 56-63. Coordination with all these networks is required.

Refer to the following documents for further details:

1. 2019 University Master Plan
2. The Landscape Heritage and Plant Diversity Task Force Report
3. “The Dignity of Restraint,” the Historic Landscape Master Plan
4. Site and Site Furnishings
A-10 - PROJECT DEVELOPMENT PROCESS

Project Initiation
Upon the identification of a tentative facility need by a school, department, institute, or supportive function of the University, Facilities Planning and Design conducts an analysis of the new space and/or renovation requirements including examination of the existing space, use, and condition.

The Facilities Planning Committee reviews the proposed project to ensure that it is consistent with the goals, objectives, and priorities of the University.

A project description and cost estimate is prepared (cost estimate is verified by the State Construction Office) and evaluated by the Facilities Planning Committee and Chancellor with a decision to proceed or cancel the project.

A project budget is prepared, submitted and the project priority established for funding authorization according to the prescribed steps as outlined by the State Construction Office.

Site Selection Process
The Campus Master Plan for the University sets forth the parameters to be used in considering building sites and suggests areas on the campus that are appropriate for development. The site recommendation is reviewed for approval by the Chancellor’s Buildings and Grounds Committee, the Chancellor, and the Board of Trustees.

The University has an established Campus Master Plan. Designers shall refer to this plan for specific information on the intended use and character of the buildings and other improvements on campus.

The current version, the 2019 Campus Master Plan, is located here: https://facilities.unc.edu/news/2019/05/30/campus-master-plan-approved-by-university-board-of-trustees/

The Facilities Planning and Design Department will manage the site selection process which involves the approval by the Chancellor’s Building and Grounds Committee and the Board of Trustees before a project is initiated and design services are sought.

Once a Designer is selected, an initial meeting is held with the Director of Facilities Planning, the Project Manager, users and designers to discuss the Campus Master Plan, building siting, massing, and design guidelines. While the site selection process has determined the general site for the building, the designer must determine the exact location on that site.

Building Removal
The removal of any building requires the approval of the UNC Board of Trustees.

Reuse of building materials in the new project must be considered. Recycling and salvage of materials must be coordinated through the project manager, OWRR, and Surplus Property.
A-11 - DESIGNER PROCUREMENT

A-11.1 - Designer Selection Process

Advertisement for Designer
The University through Facilities Planning and Design project managers, places a notice for solicitation of design services on two web sites, one for the University of North Carolina- Chapel Hill thru the State-wide University System, and one for the State of North Carolina Interactive Purchasing System.

Current web addresses for these sites are:
http://www.northcarolina.edu/info/vendors/opportunities.htm
https://www.ips.state.nc.us/IPS/Default.aspx

The Facilities Planning and Design Project Manager prepares a Request for Qualifications (RFQ) of additional information about the project to forward to all Design Teams upon request. A pre-proposal meeting shall be scheduled (contingent on project scope) and facilitated by the Project Manager either via web conference OR in-person at the project site in order for the design community to become familiar with the project intent, submittal protocols, and owner and end user needs prior to the RFP submittal date. The pre-proposal meeting typically occurs 14 days after advertisement and before submittal date.

Selection Process
Upon receipt of letters of interest, a Selection Committee will convene to review the Design Team’s proposals. The Selection Committee will select a short list of Design Teams to invite to campus for an interview session.

The Selection Committee will then conduct the interviews either via Web Conference or in-person. Following the interviews and the Selection Committee convenes to rank order the designers and then issues a recommendation, with the priority order, for the selection of the Project Designer. This list is presented to the Chancellor’s Building and Grounds Committee who in turn issue a recommendation to the University’s Board of Trustees for final selection.

Upon final selection, the University’s Project Manager will notify the selected Designer and schedule the Initial Planning Conference.

University as Client
Project planning and design for the University involves many persons within the University, the North Carolina State Construction Office, and other reviewing agencies. Nevertheless, the Designer should understand that the University is the project’s owner and client.

Project Manager
A Project Manager is assigned as the single University representative for each project. The Designer is required to work through the Project Manager and must turn to this person for authoritative information on all matters.
and questions involving the University. The University representative is the sole point of contact for the Designer and all project correspondence and decisions shall be coordinated through this representative. The nature of that representative will shift according to the design phase.

The University's Project Manager is the Designer’s contact person from the project’s advertisement through bidding. The Project Manager is an employee of the University’s Facilities Planning Department.

After the construction contract is awarded, the Designer’s contact person becomes the Construction Manager, an employee of the University’s Department of Construction Management.

**Designers’ Representative**
The Designer shall designate an individual within the Designer’s firm who is directly responsible for the project, and who can be contacted directly on any matter pertaining to the project.

**Payment Approval**
Payments to Designer: The Designer shall submit invoices for approval to the University’s Project Manager through the Bidding Phase and to the Construction Manager through the Construction Phase.

**Initial Planning Conference**
The University’s Project Manager will schedule an initial planning conference with the Designer to discuss requirements for facilitating the Designer’s work. This conference is held as soon as possible after a Designer is selected for the project.

**Design Contract Negotiation**
The University’s Project Manager will request the selected Designer to submit a preliminary design proposal and project schedule to the Project Manager for review.

Upon review and comment, the Project Manager sends the design proposal to the State Construction Office to review the design contract for approval. For projects under the budget limits noted in the SCO Manual, the Project Manager shall prepare the design contract Letter of Agreement. The document will be forwarded to the UNC General Administration for execution.
A-11.2 - Capital Project Types

All UNC Chapel Hill capital improvement projects are classified into one of the following three categories, each with distinct designer and contractor procurement requirements as well as FPD & SCO review requirements:

1. **Study and Advance Planning Efforts**
   An effort that examines and/or analyzes a situation that may or may not lead directly to a design and construction project.

   Studies may include, but are not limited to: Programming, Space Planning, Schematic Design, Design Development, Construction Documents, Construction Cost Estimation, and/or Life-cycle Cost Analysis. The total cost on any study shall not exceed fifty-thousand dollars (\(\leq 50,000.00\)).

   *No construction work is expected or authorized as part of this project type.*

   Designers may be directly selected from the Open-Ended Designer Agreement (OEDA) List. Designer Agreements are negotiated directly with Facilities, Planning & Design (FPD). FPD Approves Designer Agreements.

2. **Customer Funded Project (CFP)**
   Also called Informal, includes Open Ended Design Agreements (OEDA). Any Project (New or Renovation) with a total project cost (design, construction, & contingencies) that is less than three-hundred thousand-dollars (\(\leq 300,000.00\)).

   Designers are directly selected from the Open-Ended Designer Agreement (OEDA) List. Designer Agreements are negotiated directly with Facilities, Planning & Design (FPD).

   Contractors may be direct selected if the cost of the work is less than thirty-thousand dollars (<30,000.00). Contractor selection is performed through the Informal (ICC) Contractor Bidding Pool (\(\leq 500,000.00\)).


3. **Code Item Project (CIP)**
   Also called Formal, includes Download & Full SCO Oversight. There are two types:

   **Download Project**
   Any Project (New or Renovation) with a total project cost (design, construction, & contingencies) that is greater than or equal to three-hundred thousand-dollars (\(\geq 300,000.00\)) AND less than two-million dollars (<2,000,000.00).

   If the project cost is greater than $300,000 and less than $500,000, Designers are directly selected from the Open-Ended Designer Agreement (OEDA) List. If the total project cost is greater than or equal to $500,000, Designers are selected through the State required Public Advertisement and Interview Process.

   Designers Contracts are with UNC Chapel Hill and are negotiated with FPD.
SCO Full Oversight Project
Any Project (New or Renovation) with a total project cost (design, construction, & contingencies) that is
greater than or equal to two-million dollars (>= $2,000,000.00)

Designers are selected through the State required public Advertisement and Interview Process.

Designer Contracts are with SCO, are negotiated with FPD and the assistance of SCO. SCO has ratios for
specific percentages of construction cost for design contract values which must be met.

Contractor selection for Code Item Projects is performed through the State required Public Bidding process. For
select projects of significant value (greater than $10,000,000), Facilities will make a determination whether the
use of a Construction Manager at Risk (CMaR) delivery method is to the benefit of the University.

If the total project cost is less than $2,000,000, then the System Office Approves Designer Agreements &
Amendments, as well as the Construction Contract & Change Orders. If the Total project cost is greater than
$2,000,000, then the SCO Approves Designer Agreements & Amendments, as well as the Construction Contract
& Change Orders.
A-12 – CONSTRUCTION CONTRACTOR PROCUREMENT & CONTRACT TYPES

A-12.1 - Construction Contracts

Construction Manager-at-Risk and Construction Manager-as-Agent are the preferred contracting methods for large capital projects. It is the policy of the University to select Construction Manager-at-Risk for State capital improvement projects as defined in G.S. 143-128.1 and G.S. 143-128.2 on project specific criteria.

Construction Manager-at-Risk has been authorized as an approved Construction procurement method. The State Law may be accessed in its entirety at www.ncleg.net and searching for ‘Senate Bill 914/S.L. 2001-496’. Consideration of the Construction Manager at Risk construction procurement method is encouraged for projects costing $5 million or more. The Construction Manager undertakes to act as the Owner’s fiduciary and to furnish professional construction management services during the design and construction phases of the project.

Forms of Delivery

1. Single/Prime Contract
   The single contract is the most commonly used contract type. Plans and specifications are prepared by the design professional and become part of the bidding documents. A single contractor is then selected by the University to perform the work. The standard Long Form, Short Form, and Brief Form construction documents have been prepared for those cases where a single contract is awarded. Samples of construction documents developed for CMR/Agent and Single Prime contracts are available from the State Construction Website.

2. Construction Manager-at-Risk (or as Agent)
   Once Facilities Planning has chosen the Construction Manager Delivery method, the University will advertise and select a Construction Manager during the initial stages of the project’s design. The Construction Manager will be contracted to provide Pre-Construction Services, and thus will attend regularly scheduled meetings with the Project Designer and other consultants to advise on matters relating to site use, improvements, selection of materials, building methods, construction details, building systems and equipment, and construction phasing and sequencing. The Construction Manager will work closely with the University’s Commissioning Coordinator to plan and schedule staff training and equipment testing.

Guaranteed Maximum Price

Shortly after the submission of the construction documents to the State Construction Office for final review, the Construction Manager will develop and provide to the Owner a Guaranteed Maximum Price, which will include all construction costs, and all other projected costs including the Construction Manager’s fees, the Guaranteed Maximum Price contingency and General Conditions Allowance. The Guaranteed Maximum Price will set out each anticipated trade contract amount, the Construction Manager’s fixed fee, General Conditions reimbursable costs items including on-site field staff, and all project related costs.

Construction Phase Services

During the Construction Phase, the Construction Manager will provide services as required to affect the complete construction of the Project and to maintain the established Guaranteed Maximum Price of the Project.
A-12.2 - Capital Project Construction Contracts

UNC Chapel Hill utilizes several forms of construction contracts for scopes of work including: general construction; installation of equipment; moving or storage of equipment, furniture, or other materials. Procurement of specialty Equipment and Furniture falls under the UNC State Procurement Guidelines for public, competitive pricing, unless a sole-source authorization process is pursued.

Construction Contract Types

Project Managers from Facilities Planning & Design and Construction managers from Facilities Construction Management coordinate four distinct contract documents as approved by OUC and SCO for engaging contractors for capital projects.

1. **Sole Source Justification Letter**  
   For any Contractor, Sole Source Selection is allowed if Contract Value is <$30,000

   PM/CM must provide written justification to substantiate a waiver of competition by the University. It is recommended that the PM/CM consult with Sid Stone or Greg Driver to validate the waiver of competition, prior to completing required forms.

2. **Informal Construction Contract (ICC)**  
   For all Contractors with a project value <$500,000. Signature approval is by UNC-Facilities. All Change Orders, as needed, shall follow the same workflow as the Agreement.

3. **Standard Construction Contract (Download Project)**  
   For all Contractors with a project value >$500,000 and <$2,000,000. Signature Approval by the System Office (formerly General Administration), followed by UNC-Facilities. All Change Orders, as needed, shall follow the same workflow as the Agreement.

4. **State Construction Office (SCO) Construction Contract (SCO full oversight project)**  
   For all Contractors with a project value >$2,000,000. Signature Approval by State Construction Office, followed by UNC-Facilities. All Change Orders, as needed, shall follow the same workflow as the Contract.
A-12.3 – Historically Underutilized Businesses

General
UNC Chapel Hill abides by G.S. 143-128.2 which has a verifyable 10% goal for participation by minority or socially and economically disadvantaged businesses in the total value of work for each State building project.

Minority is defined as a citizen or lawful permanent resident of U.S. who is: Black, Hispanic, Asian American, American Indian or Female. Socially and economically disadvantaged person is defined by 15 U.S.C 637. To be considered toward the statutory goal of 10%, minority businesses must be certified with the State HUB Office.

- To verify certification prior to submitting a bid package, please go to https://www.ips.state.nc.us/vendor/searchvendor.aspx?h
- If not currently certified, it is recommended that minority businesses become certified with the State HUB Office by going to https://ncadmin.nc.gov/businesses/hub/hub-certification

Designers, Contractors and Subcontractors are reminded to carefully read the State Minority Guidelines and forms that are in the specifications. Each has responsibilities outlined within. The Designer is to review the information and links to web sites listed under http://facilities.unc.edu/historically-underutilized-businesses/ regarding the University’s commitment to recruit and select minority businesses for participation in University construction contracts.

Designers are encouraged to advertise public bids for construction contractors in newspapers that satisfy the requirements of the North Carolina Construction Manual for HUB (http://www.doa.nc.gov/hub/documents/cmanual.pdf).

Bid Process
Contractors shall submit with their formal bids prior to Bid Opening:

- For ALL Construction Contracts
  - Identification of HUB Certified/Minority Business Participation Form
    If this form is not submitted with the bid package than the bid shall be deemed non-responsive.
  - Either:
    State of NC Affidavit A – Listing of Good Faith Efforts (must total 50 points for bid to be considered responsive)
    -or-
    State of NC Affidavit B – Intent to Perform Contract with Own Workforce

*If the Identification of HUB Businesses Form and Affidavit A or Affidavit B are not submitted with the bid, then the bid shall be deemed non-responsive.
After the Bid Opening, upon being named the apparent lowest responsible, responsive bidder, contractors shall provide one of the following:

State of NC **Affidavit C – Portion of the Work to be Performed by HUB Certified/Minority Businesses** provide within 72 hours [business days] if the work to be executed by HUB firms is **equal to or greater than 10%** of bidder’s **total contract price**.

-or-

State of NC **Affidavit D – Good Faith Efforts** provide if work to be executed by HUB firms is **less than 10%** of bidder’s **total contract price**. **All evidentiary documents to prove Good Faith Efforts as outlined in paragraphs A-I on the form must also be provided.**

During Construction, contractor will submit with each pay application:

**UNC Chapel Hill Appendix E**

Any specific questions regarding HUB guidelines or forms, please contact Tanya Vogel at tjvogel@fac.unc.edu, 919-843-1424.
A-13 - PROJECT PROCESS & PROCEDURES

A-13.1 – UNC Facilities Services - Design Reviews

UNC Chapel Hill requires that all project drawings, documents, and reports for capital projects are reviewed by Facilities Services personnel. Design Teams shall provide adequate time in their project design schedules to account for design reviews by Facilities which typically run parallel with State Construction Office reviews for drawing package submittals. The following guidance is recommended to Design Teams

Design Submittal Format
Hardcopies & Digital Format
All drawing sets more than 15 sheets shall be submitted as hardcopies; basically, any capital project. Design teams may request a reduced quantity of hardcopies from those shown below, at the discretion of the Facilities Planning project Manager.

1. A total of six (6) sets (drawings and specifications) shall be provided by the designer:
   - 1 set: User – half size
   - 1 set: Project Manager – half size
   - 1 set: Facilities Planning - half size, place in designated flat file
   - 1 set: Engineering Services – half size, place at Engineering Table
   - 1 set: Construction Manager – full size
   - 1 set: Plan Review Room – full size, place in downstairs Plan Room

2. PDF's of drawings and specifications shall be uploaded onto Dr. Checks upon successful intake.

3. The Project review time starts when Hardcopies have been received at Facilities and distributed.

Design Submittal Intake
For Design Development (DD) and Construction Document (CD) stage submittals only, UNC Facilities requires an intake review of the submittal package to determine that it meets the minimum content requirements for its specific submittal stage.

The FPD project manager will hold a meeting with a representative from Engineering and Construction to review the content of the design submittal. The PM shall catalog the deficiencies of the design submittal, as applicable. At the conclusion of the meeting the PM advises the design team of the following:

a. Acceptance
   i. The PDF of the Design Submittal is posted to ProjNet and the clock starts on the previously specified review duration. The submitted Hardcopies are distributed around Facilities for review.

b. Rejection
   i. The list of deficiencies is transmitted to the Design team lead. An in-person meeting is recommended to review the deficiencies in detail.
   ii. A schedule for Re-Submittal shall be established.
   iii. The submitted Hardcopies shall be recycled.
**Project Design Process**

This section outlines the procedures that are unique to capital projects at The University of North Carolina at Chapel Hill. These requirements supplement the planning procedures required by North Carolina’s Division of Administration, North Carolina State Construction Office, as outlined in the North Carolina State Construction Manual or NCSCO Manual.


**Project Design Sequence**

**Overview**
The Designer submits a proposed Project Development Schedule to the University’s Project Manager for approval. This schedule will incorporate the end-of-phase milestone dates stipulated in the Design Contract. In addition, this schedule will show:

- The start dates and duration of each major design phase
- The duration and completion dates of each design review period, which are required to maintain the project schedule
- The project duration and completion dates and other project-related activities, such as funding decisions, surveys, sub-surface investigations, and zoning approvals
- The estimated duration of the construction contract award process and the construction process

The Project Development Schedule is updated and resubmitted with each end-of-phase submittal described below.

**Project Design Phases – Required Documentation**
The Designer is expected to conduct project design and coordination meetings to verify the project program and review the design as it develops. The Designer is expected to take minutes of all meetings and distribute them to all participants through the FPD Project Manager.

The Designer is required to make submittals of design documents at the conclusion of each design phase to the State Construction Office, the University Facilities Planning Department, and any other pertinent review agency. The requirements for each project development phase are outlined in Chapter 300 of the SCO Manual.

1. **Schematic Design Phase (SD)**
The Designer shall confer with the University’s Project Manager, the future occupants, and the owner representatives at the beginning of the schematic design phase to review the program and establish the project requirements.

   a. *Existing Conditions* - The University attempts to provide accurate, as-built drawings for the use of the Designer. However, due to the age of many of the University’s buildings and the many renovations some buildings have endured, as-built drawings are not always available. It is the responsibility of the Designer to notify the Project Manager when any information regarding the existing conditions of a project is inaccurate or inadequate.
b. **Site Utilities Information** - Additional information is available on the conditions of existing structures, maintenance items that need to be addressed, and hazardous materials in existing structures. This information should not be considered complete or accurate. The Designer is responsible to review record documents of existing facilities to determine all utility and subsurface tie-ins to adjacent buildings, or building being renovated, including storm and foundation drains, and to determine all utilities located within the project limits, including areas impacted by work of the project. Project impact limits include improvements may be off the main project site, but are part of the project, such as utility extensions, driveways, and roadways.

c. **Geotechnical Information** - As part of the Designer’s services to the University, the Designer shall recommend a qualified, licensed geotechnical services firm that will provide all project required geotechnical information for the project. The geotechnical consultant shall contract directly with the University, but still be obligated to coordinate its services with the lead designer.

d. **Schematic Design Submittal** - The Schematic Design Submittal to the University consists of a minimum of seven (7) complete sets of documents, plus an electronic file in pdf format or as determined by the Project Manager. The University will review the documents for completion prior to submission to State Construction Office.
   
   i. In addition to the requirements outlined in the North Carolina State Construction Manual, these documents should include the following information:
      1. Proposed walk and bikeways, disability, vehicular, fire and service access shown on site plans
      2. Net square feet for each space and comparison to program
      3. A LEED Checklist
      4. A Conceptual Landscape Plan
      5. A Tree Protection Plan (at this stage the plan may be interpreted as an evaluation of the impact to the existing landscape)
      6. An initial inventory of valuable and reusable building materials available for reuse in this project, other projects, in general or to be recycled
      7. Owner’s Project Requirements (OPR) document, as facilitated by the University’s commissioning (Cx) agent
      8. A Stormwater Concept Plan (See the University’s Stormwater Design Guidelines for specific components, which include an existing conditions analysis, an estimate of proposed impervious cover, and estimated size and location of proposed stormwater infrastructure and best management practices.)
      9. A preliminary energy model that evaluates orientation, day lighting opportunities, and HVAC strategies

2. **Design Development Phase (DD)**
   
   Based on the approved schematic submittal, the Designer shall prepare the design development documents.
   
   a. **Design Development Submittal** - The Design Development Submittal to the University consists of a minimum of five (5) complete sets of documents, plus an electronic file in pdf format or as determined by the Project Manager. The University will review the documents for completion prior to submission to State Construction Office. In addition to the requirements outlined in the SCO Manual, these documents are to include the following:
i. Site and space planning information for waste and recycling collection
ii. Equipment and furniture layouts for all rooms.
   1. Note: If the architectural contract includes the moveable equipment portion of the work, the Designer shall provide the moveable furniture and equipment layouts. If the moveable equipment is not in the contract, the Designer will provide floor plans to the University.
iii. Outline specification for the Energy Management Control System
iv. An updated Owner’s Project Requirement (OPR) document and a Basis of Design document with input from each designer
v. An updated project development schedule
vi. Stormwater Management report (See the University’s Stormwater Design Guidelines for specific components.)
vii. An updated LEED checklist including supporting documentation for projected energy and water savings
viii. A fully developed energy model including all files required to allow UNC to rerun the energy model
ix. Site Utility Plans
x. Prior to the Construction Document submittal, submit a response to the substantive Design Development Review Comments in Dr. Checks.

3. **Construction Documents Phase (CD)**

Based upon the approved design development submittal, the Designer shall prepare construction documents and other materials required for the receipt of bids on the project. The Designer will prepare these documents as described in the North Carolina State Construction Manual Section 205.

The University fully supports and encourages minority business participation in campus projects. The Designer shall make every effort to ensure that the latest requirements from the State Construction Office are followed during the preparation of documents for bidding.

The Designer and the University are responsible for determining the fees applicable to the project. The Designer and the University shall agree upon what fees are paid by the University, and what fees are listed in the specification for payment by the construction contract.

a. **Construction Documents Submittal** - The Construction Document Submittal to the University consists of a minimum of five (5) complete sets of documents, plus an electronic file in pdf format or as determined by the Project Manager. The University will review the documents for completion prior to submission to State Construction Office. In addition to the requirements outlined in the North Carolina State Construction Manual, these documents are to include the following:

   i. Drawings, containing:
      1. Stormwater management plans and details
      2. Tree protection plan
      3. Erosion Control plans
      4. Annual water and sewage volume
      5. Annual usage volume of non-potable water. Detailed plan sheets showing outdoor service enclosure(s) including screen wall details, electrical

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requirements, lighting drainage, a note listing the buildings that the site(s) are intended to serve
6. Plans showing clearly marked locations of the walkway recycling sites and installation details
7. Clearly marked locations of all indoor recycling locations -AND- detail sheets showing the plans for any recycling cabinets to be built by the project
8. Drawings are to have noted the locations of all items which Contractor is to salvage

ii. Project Manual, shall include:
1. An updated Owner's Project Requirements (OPR) and Basis of Design documents
2. CSI Master Format Specifications Sections
3. A utility Load Summary Sheet identifying estimated utility loads
4. A Statement of Special Inspections that lists all required inspections and identifies the Special Inspector
5. Recycling and waste management requirements
6. An updated LEED checklist, including supporting documentation for projected energy and water savings
7. Integrated functional testing protocols and equipment testing checklist
8. Sequence of operations for HVAC controls
9. Updated Stormwater Management Report (See: University’s Stormwater Design Guidelines for specific components)
10. Utility plans and profiles of all utilities up to the building perimeter
11. An updated energy model including all files required to allow UNC to rerun the energy model

iii. Project Specific Guidance
1. Specifications & Front End Documents (refer to Design Guidelines Section A-14)
   a. UNC-CH General Requirements - The Designer is responsible for procuring the most current version of the University's General Requirements and incorporating them into the contract documents. The Project Manager will provide a copy upon request.
   b. General Conditions - The Designer is responsible for procuring the most current version of the State of North Carolina's General Conditions. Copies may be found at the State Construction Office’s website, http://www.nc-sco.com/Forms/Alpha_All_Forms.htm
2. Pedestrian Safety Plans
   a. The Designer is responsible for coordinating with FPD and creating a site plan to maintain an accessible pathway around the building and immediately adjacent site during construction. This plan shall include locations for temporary signage to illustrate the accessible pathway to campus users.
3. Construction Logistics Plans
   a. The Designer is responsible for coordinating with FPD and creating a site construction logistics plan to include locations for: (1) haul route; (2) construction fencing; (3) project limits; (4) temporary parking; (5) plans for access to the building (if occupied) and adjacent buildings such that deliveries and recycling/waste collection services can be maintained.

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iv. Cost Estimate

1. At the CD phase, a third-party, Construction Cost Estimate shall be provided with a minimum sixteen division breakdown. The estimate shall include general contractor fees, overhead & profit in percentages aligned with the current SCO guidance for construction contract efforts.

Design Response

The University uses an online Design Review and Checking System call “Dr Checks”, administered by ProjNet for logging and tracking design review comments throughout the entire design process. The Project Manager will provide instructions for accessing and using the Dr. Checks system.

The designer shall provide responses on Dr. Checks to review comments generated by University personnel following the initial submittal for the schematic design phase, the design development phase and the construction document phase.

Fixture, Furniture & Equipment (FFE) Inventory

The project shall provide the final inventory for Moveable Fixtures, Furniture & Equipment which includes detailed info and quantities on fixture, furniture and equipment (Brand, year, etc.). The FFE Inventory schedule shall indicate: whose equipment it is, who will be getting it, and how it will be transferred, delivered, or moved.

Bidding Phase

The Designer’s bidding phase responsibilities, related to advertising for bids, opening of bids, disposition of bids, and award of the construction contract(s), are outlined in the SCO Manual. They shall conform to the applicable North Carolina General Statutes.

1. Prerequisites to Advertisement for Bids

   The Designer is to furnish two sets of revised copies of the construction documents to the University’s Project Manager. The Designer shall provide additional sets, as required by the SCO Manual, to the State Construction Office and other regulatory agencies having jurisdiction.

   Upon final approval of the construction documents, the Designer provides the University with a minimum of five (5) copies of the “As-Bid” construction documents. The Designer is to establish the date for receipt of bids in consultation with the University’s Project Manager and the State Construction Office. The Project Manager is responsible for notifying the University’s Historically Underutilized Businesses (HUB) office.

2. Bid Date

   The Designer must coordinate with the Project Manager in setting the date and time of the bid opening.

3. Pre-bid conferences

   Pre-bid conferences are arranged at the convenience of the Designer and the University’s Project Manager. Preferred alternate meeting must be scheduled at the same timeframe of pre-bid meeting.

4. Bid Openings
It is the Designer’s or – for a project with a Construction Manager at risk (CM-R) – the CM-R’s responsibility to accept and open bids.

5. **Certified Bid Tabulation**

It is the Designer’s or for a project with a CM-R – the CM-R’s responsibility to provide Certified Bid Tabulation to the University within 48 hours after the bid opening, together with MBE appendices required under the “Guidelines for Recruitment and Selection of Minority Businesses for Participation in State Construction Contracts” to the University’s Design Manager. The Design Manager will forward these documents to the State Construction Office.

**Construction Phase**

The construction phase for the project begins when the Designer receives a fully executed copy of the construction contract(s).

The Designer’s responsibilities during the construction phase are outlined in Sections 205 and 206 of the SCO Manual.
Submittal Review Types & Durations

Feasibility Studies
Preliminary drafts of a feasibility study will be submitted at the discretion of the PM. The final draft of a feasibility studies will be submitted for review. List of reviewers shall be limited to people that were involved in the study.

Study Review Phases:
- Preliminary Drafts (optional)
  1. Open for Comment: Minimum 2 – 4 weeks depending on project.
  2. Open for Evaluation: PM to determine deadline based on comments.
- Final Draft
  1. Open for Comment: Minimum 2 – 4 weeks depending project.
  2. Open for Evaluation: PM to determine deadline based on comments.
  3. Open for Backcheck: Upload Final Document. Backcheck is for record only and Designer not expected to respond.

Design Drawing & Specification Submittals
It is recommended that the Design Submittal packages are delivered to SCO and Facilities simultaneously to assist with shortening a project’s overall design duration.

Review Phases:
- Schematic Design
  1. Open for Comments: Minimum 4-week review
  2. Close Comments and open for Evaluation: Evaluation remains open until all comments are resolved.
  3. Open for Backcheck: Open no later than Design Development submittal.
- Schematic / Design Development Combined - option for smaller projects
  1. Open for Comments: Minimum 4-week review.
  2. Close Comment and open for Evaluation: Evaluation remains open until all comments are resolved.
  3. Open for Backcheck: Open no later than Design Development submittal.
- Design Development
  1. Open for Comments: Minimum 4-week review.
  2. Close Comments and open for Evaluation: Evaluation remains open until all comments are resolved.
  3. Open for Backcheck: Open no later than 75% or Construction Documents submittal.
- 75% Construction Documents – an option for larger/complex project
  1. Open for Comments: Minimum 4-week review.
  2. Close for Comments and open for Evaluation: Evaluation remains open until all comments are resolved.
  3. Open for Backcheck: Open no later than Construction Documents submittal.
- Construction Documents
  1. Open for Comments: Minimum 4-week review.
2. Close for Comments and open for Evaluation: Evaluation remains open until all comments are resolved.
3. Open for Backcheck: Open no later than Final Construction / Bid Set is submitted. Minimum 2 weeks for comments to be resolved.

Addendums and Value Engineering
Any addendums issued during the bid phase of the project shall be submitted as PDF’s on Dr. Checks.
*Review time shall be 3-5 working days.*

Any design elements removed from, or changes made to the project due to Value Engineering shall be submitted as PDF’s on Dr. Checks.
*Review time shall be 3-5 working days.*

A-13.2 – UNC Committee Approvals

Capital Improvements Project will require review by several entities at multiple stages through the course of the design effort. The Facilities Planning Project Manager will coordinate presentation materials with the design team for the following groups:

1. **Design Review Committee**
   a. Guides the Architectural & Landscape Design aesthetic. Meetings are led by the University Architect.

2. **Chancellor’s Buildings & Grounds Committee**
   a. Reviews Site Selection for all new buildings and additions as well as any site improvement projects. Also reviews designer selections.

3. **Board of Governors**
   a. Approves initial Authority request, as well as requests for Authority Increases.

4. **Board of Trustees**
   a. Approves design of new exterior projects, typically in two steps:
      i. (1) For Information Only (FIO)
      ii. (2) Final Review
A-13.3 – Site Development & Regulatory Approvals

General Information

The following guidelines and parameters are provided by UNC to assist design teams in their development of the project program and design extents, with a mind towards promoting eco-friendly and sustainable development while conscious of both project budget and project schedule impacts. This list is not exhaustive and is not meant to detail every conceivable constraint. It is incumbent upon the design team to perform due diligence with respect to local, State, and Federal requirements for sites on campus and proposed improvements.

For University projects, permitting typically includes both local and state agencies. The permitting requirements for a specific project will be determined by Facilities Planning during the pre-design phase of each project.

The Designer is responsible for coordinating with the Facilities Planning Project Manager on all submittals to Outside Agencies. The Designer is responsible for ensuring that all documents meet Agency Standards and for soliciting and responding to review comments at each phase.

Regulatory Reviews & Approvals

Jordan Lake Rules
As a State entity, the University is required to meet the requirements of 15A NCAC 02B .0271 Jordan Water Supply Nutrient Strategy: Stormwater Requirements for State and Federal Entities. The University is responsible to the North Carolina Division of Water Quality for these requirements. For individual development sites, the University’s Stormwater Engineer and the Environment, Health, and Safety Department will review the plans for compliance. Details can be found in the Stormwater Design Guidelines.

Environmental Reviews
The University is subject to state and federal approvals of construction activities on State owned property with land disturbance and/or air quality impacts.

1. Environmental Assessment (EA) or Finding of No Significant Impact (FONSI)
   The ES or FONSI is required of all new buildings or significant additions. The Facilities Planning Project Manager submits the EA/FONSI with information supplied by the designer, at the end of the Design Development phase of the design process.

2. Air Pollution Permits
   If a generator is to be used in the project, the University must obtain a modification to its air permit. The Designer must notify the Environmental Affairs Manager of the UNC Environment, Health and Safety Office when the generator’s make and model have been determined.

3. Erosion & Sedimentation Control (ESC) Plan
   An ESC Plan is required to be submitted to the NC DLQ for all projects one (1) acre or larger. The ESC plan must be reviewed by UNC Environment, Health and Safety before the plan is submitted to DLQ. These projects will receive a NC General Permit and are required to follow all the conditions of the permit.
4. **State Natural Heritage Area**  
   Construction adjacent to the Heritage Areas shall be avoided to the greatest extent possible. Design teams may download a map from the DEQ website.

5. **Wetlands, Streams, & Buffers**  
   For each project, review its proximity to existing wetlands. It is the goal of the University that new construction and grading shall not impact wetlands whatsoever. Impacts to wetlands will require federal and state permitting, with significant construction costs, submittal requirements and extended durations for review. Design teams shall demonstrate Avoidance and Minimization of design around wetland areas.

6. **Floodplain**  
   Currently a preference, UNC is working towards developing a requirement for a “True Zero-Foot Rise in the Floodplain” to preserve the future development of University land. The design team shall provide a Floodplain Study for all proposed construction work adjacent to or within the floodplain.

7. **Forests & Trees**  
   The Design team shall survey and document the number of specimen trees within the project limits, the size of the trees to be surveyed shall be not less than 12” in diameter. UNC requests a Tree survey of all areas of proposed clearing. Use this survey to avoid construction where high-quality stands of trees are located.

8. **Air Quality Permits**  
   If a generator is to be used in the project, the University must obtain a modification to its air quality permit. The Designer must notify the Environmental Affairs Manager of the UNC Environment, Health and Safety (EHS) Office with the generator’s manufacturer-make and model as soon as they have been determined.

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**Town Of Chapel Hill Approvals**

Buildings on campus are subject to Town zoning and require the appropriate permit (Town’s Land Use Management Ordinance). The designer shall coordinate with the FPD Project Manager to determine which zoning district applies and which permit(s) is (are) required.

The Facilities Planning Project Manager submits the permit application with information supplied by the designer, at the end of the Design Development phase of the design process.

1. **Site Development Permit (SDP)**  
   Typically, for buildings within the OI-4 zoning district (main campus) or U-1 zoning district (Carolina North), a Site Development Permit is the only Town zoning application required.

   SDP Applications to the Town of Chapel Hill are not complete for the purposes of review or approval without final approval from OWASA.
2. Special Use Permit
   The University operates several facilities on parcels outside of main campus. Properties within the Town of Chapel Hill’s Planning jurisdiction have Land Use entitlements approvals via “Special Use Permits.” The design team shall coordinate the need for an SUP modification with the Facilities Planning project manager. If needed, the project manager will coordinate the required documentation form the design team. The FPD project manager will submit the Application, supporting documentation, and fees to the Town of Chapel Hill.

3. Zoning Compliance Permit
   The Town of Chapel Hill requires an approved site plan to locate occupiable buildings, site features, BMP’s, as well as other land improvements via a “Zoning Compliance Permit.” The design team shall coordinate the need for a new ZCP, or modification to an existing ZCP, with the Facilities Planning project manager. If needed, the project manager will coordinate the required documentation form the design team. The FPD project manager will submit the Application, supporting documentation, and fees to the Town of Chapel Hill.

Submittal Coordination & Responsibilities
Responsibilities for preparing the various permit applications and other submittals required by the local, state, or federal agencies having jurisdiction over aspects of the project are as follows:

The University’s Project Manager shall coordinate, prepare, and file on behalf of the University the submittals required by:

1. The Town of Chapel Hill, and the Town of Carrboro, on all matters
2. The North Carolina Department of Administration, to demonstrate compliance with the Environmental Policy Act
3. The North Carolina Department of Transportation (NCDOT), for encroachment agreements, driveways, and traffic control.
4. The North Carolina Division of Water Quality, for utilization of reclaimed water
5. Orange Water and Sewer Authority (OWASA) for water, reclaimed water, and sewer extensions and connections
6. Any work in area of streams or environmental areas will require appropriate environmental permits

The Designer will provide the background and technical materials necessary to support these submittals. Materials include, but not limited to:

1. Site Development Permit Summary Sheets
2. Stormwater management plan including storm water calculations
3. Erosion and Sediment control plan
4. Traffic control plan
5. Exterior lighting plan

The Designer shall attend public hearings related to these submittals, as required.

The Designer will file all other applicable permit applications, plans, specifications, and other documents required by any local, state or federal agencies having jurisdiction over any part of the project. Including NCDOT (See Section 203 of the SCO Manual.)

A-14.1 – Front End Documents

Capital Projects at UNC Chapel Hill are required to meet documentation standards as defined by the State Construction Office (SCO). Contract Documents issued by the designer for Bidding and Construction shall include standard forms from SCO for: General Conditions, Advertisement, Bidding, Delivery Methods, and Construction Contracts, etc. In addition, UNC Chapel Hill requires the incorporation of Supplementary General Conditions to illustrate University and project specific requirements.

Sections List
The following documents, organized by section, shall be included in the Project Manual:

00 10 10 - Advertisement for Bids

00 20 10 - Notice to Bidders

00 30 10 - General Conditions
a. Projects >500K - <$2M
i. UNC General Administration (2015 – Fifth Edition)
ii. “Instructions to Bidders and General Conditions of the Contract” – Form OC-15
b. Projects >$2M
v. “Instructions to Bidders and General Conditions of the Contract” – Form OC-15

00 40 10 - Supplemental General Conditions
a. UNC-Chapel Hill General Requirements
b. http://old.northcarolina.edu/info/vendors/Division_1_Supplemental_Conditions_1-2011.doc

00 50 10 - Form of Proposal
a. Use SCO Form and edit for University use

00 60 10 - Form of Bid Bond

00 70 10 - Guidelines for Recruitment and Selection of Minority Businesses for Participation in University of North Carolina Construction Contracts
b. Identification of HUB Certified/Minority Business Participant

c. UNC Affidavit A – Listing of Good Faith Efforts

d. UNC Affidavit B – Intent to Perform Contract with Own Workforce

e. UNC Affidavit C – Portion of the Work to be Performed by HUB Certified/Minority Businesses

f. UNC Affidavit D – Good Faith Efforts

g. Appendix E – MBE Documentation for Contract Payments

00 80 10 - Form of Construction Contract

a. For University use; name, campus legal counsel in lieu of Attorney General, OSBM not applicable

b. https://www.northcarolina.edu/sites/default/files/uncconstructioncontractformsbonds.doc

c. Form of Performance Bond

d. Form of Payment Bond

e. Sheet for Attaching Power of Attorney

f. Sheet for Attaching Insurance Certificates

g. Approval of the UNC Attorney

A-14.2 – Project Specifications

General
For capital projects Specifications Sections shall follow the CSI MASTERSPEC Format.

The Project Manual shall also include as an appendix, project specific reports, including, but not limited to:

1. Advance Planning Studies
2. Construction Cost Estimates
3. Hazardous Materials Reports: asbestos (ACM), lead (LBP), etc.
4. Geotechnical or other Subsurface (SUE) Reports
5. Acoustical, Wind, or Vibration Studies
A-16 - PROJECT CLOSE-OUT PROCEDURE

Record Document Requirements
The Designer shall provide the following project services toward completion of the project. These requirements are in addition to the deliverable requirements described in the North Carolina–State Construction Manual (NC-SCM). Final payment will not be approved until all deliverables are received in good order. All items are expected to be delivered within sixty days of project acceptance.

At project close-out
The Designer shall provide the following documents to the University Construction project manager. All the following items shall be updated to accurately reflect as-built conditions:

1. One Archival Drawing Set printed. As follows:
   1. This set shall be imaged on Mylar stock
   2. This set shall be made up of loose sheets, NOT bound.
   3. This set includes ALL drawings and illustrations that describe any demolition and construction completed as part of the project.
   4. The drawing set’s Table of Contents or Sheet List shall be updated to reflect the final drawing collection.
   5. Formatted per section D below.

2. One set of CAD Drawing Files used to produce the printed drawings.
   1. Delivered per section E below.

3. One Drawings Index in electronic format.
   1. One line per record document sheet: giving the document sheet number, sheet name and corresponding electronic file name used to produce the record drawing.
   2. Described in section E below.

4. Specifications Manual set including Addenda following NC-SCM guidelines:
   1. One Printed set per section D below.
   2. One Electronic set per section E below.

5. Final Report following NC-SCM guidelines
   1. One Printed copy per section D below.
   1. Include a copy of all warranties.
   2. Include a copy of all close-out required affidavits.
   2. One Electronic file(s) set per section E below.
   1. Original content only, forms and scans are not required.

Printed materials
1. Shall follow the following standards unless specified otherwise above:
   1. For As-built drawings, document pages must be imaged on Mylar.
   2. All other materials should be imaged on acid-free, white, 18 to 30-pound white paper of bond or rag base with contrasting print.
   3. Covers must be acid-free cover paper, card stock, art board or Mylar.
   4. Plastic (polyvinyl) covers and/or comb binding are NOT permitted.
   5. All text (margins) must be at least ¾ inches from document edge.
   6. Document sets over 1 inch thick shall be split into multiple volumes.
   7. The cover of each item, and each drawing sheet, shall include, as applicable:
1. Phase indication or “Record Document” clearly visible.
2. Architect and/or engineer’s name and State IDs.
3. Architect and/or engineer’s Seal and Signature.
   Note: PE must Seal and Sign As-Built drawings.
4. State Project Code-Item and State Project ID.
5. Revision history with revision dates.
6. A volume identifier, such as “Volume 1 of 3”.
8. Materials produced by a reprographics firm shall include a statement of the materials used by the reprographics firm (or receipt) to assure compliance with these UNC standards.

Electronic documents
1. May be delivered on: Compact Disk, DVD or Flash Drive media and follow the standards below:
   1. All electronic files shall be named according to their printed sheet name.
   2. File names shall not include space or punctuation characters other than hyphens, periods and underscores.
3. Text files shall be:
   1. Delivered in Rich Text Format, RTF, or Microsoft Word 2000 or later format.
   2. Acrobat PDFs are also acceptable for textual material as long as content are text searchable and selectable.
   3. All documents in printed form must include seal and signature.
4. Spreadsheets shall be:
   1. Delivered in Comma Separated Values, CSV format or Microsoft Excel 2000 or later format.
5. Drawing Files shall be:
   2. Each CAD file shall be bound with no external references (XREFs) and purged of unreferenced objects.
   3. Include any non-bindable attachments, custom font (SHX file) and the CTB file used in project.
   4. In editable condition, not protected or locked.

Notes
1. Documents will be reviewed by UNC Construction staff for completeness and accuracy before being accepted by the Plan Room.
2. Documents not meeting these requirements when received by the Plan Room Archive will be need to be corrected and resubmitted at the expense of the designer.
A-20 - ENVIRONMENT, HEALTH, AND SAFETY

The Environment Health and Safety Department has established and implemented procedures for designers to follow for new construction and major renovation projects.

1. Decommissioning

2. Demolition and Hazardous Material Abatement
   
   [Links to documents]

3. Hazardous Material Management and Waste Disposal (hazardous and universal waste)


   [Links to documents]

   Management of fuel and oil in containers, at construction sites, 55 gallons or greater in size must be conducted in accordance with the Spill Prevention Control and Countermeasure (SPCC) Plan. Specific requirements are located in the UNC SPCC Plan Design Guidelines and Construction Site Guidelines located at: [EHS website link]

4. Construction in or near occupied buildings-occupant protection

   Refer to [EHS website link]

5. Design for indoor environmental quality

   Refer to [EHS website link]

6. Emergency Generators

   Refer to [EHS website link]

7. Fire safety equipment

   [EHS website link]
8. Laboratory buildings


9. Ergonomics

Refer to http://facilities.unc.edu/files/2016/03/Ergonomic.pdf.

10. Machine Guarding and Electrical Safety for New Equipment

Currently under development. The EHS website has significant additional information. The EHS home page is http://ehs.unc.edu/.

The campus Environment, Health and Safety Manual is located at: http://ehs.unc.edu/manuals/ehsmanual/

Designers are to contact EHS during design for input and information on user requirements. Contact information for EHS is at http://ehs.unc.edu/staff/
A-20 - ENVIRONMENT, HEALTH, AND SAFETY

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I. INTRODUCTION

If more than one hazardous material abatement is required, the following plan must be completed prior to demolition:

Demolition Plan for Renovation of facilities containing multiple hazardous materials: This document outlines the demolition process by which hazardous materials will be removed from the facility prior to and during the renovation work starting ____________.

General demolition work will be considered and integrated into this hazardous materials demolition plan.

In order of authority the following will supervise and legally monitor the hazardous materials removal.

1. UNC Environmental, Health and Safety Department.
2. Professional Monitors (Certified Industrial Hygienist) _____________ (asbestos, lead, and mercury wastes)
3. Professional Monitor (Certified Industrial Hygienist) _____________ (radioactive contaminated materials.)
4. Designer ____________________________.

Four hazardous materials, requiring special approvals and techniques, will be removed (abated):

Asbestos, Lead, Mercury, radioactive contaminated equipment and ductwork.

The following contractors will be employed to remove the respective hazardous materials.

Asbestos ______________________________

Lead ________________________________

Mercury ______________________________

Radioactive Contaminated materials _____________________________

UNC Environmental, Health and Safety will oversight and document the activities of all hazmat (hazardous material) contractors, consultants, and the location and legal disposal of a hazmat materials. At the conclusion of the project demolition phase, EHS will also issue a final clearance document for each of the hazmat types in order for further demolition / construction work to be performed.

The first hazardous material type to be removed is asbestos. This material removal is expected to begin starting ________________.

The second hazmat type to be removed is lead. This material removal is expected to begin starting ________________.

The third hazmat type to be removed is mercury. This material removal is expected to begin ________________.
The fourth hazmat type to be removed is radioactive materials. This material removal is expected to begin
_______________________.

The consultant monitoring professionals will provide documentation for the monitoring of hazmat presence, contractor qualification, removal procedures, and worker protection and exposure. In addition all other legally required abatement documents will be the responsibility of the contracted monitoring professional. Copies of all document issued by the monitoring professionals during the course of abatement will be delivered to EHS for their review.

As each material type is fully abated, the monitoring professional will certify to that fact and EHS will confirm by noting EHS review of the documents and EHS concurrence.

EHS will issue a final report document that summarizes the location, type, amounts, and final disposal of the listed hazardous materials. EHS will all note its concurrence with the opinion of the monitoring professionals that the hazardous materials have been safely removed and legally disposed. The architect will include this document with the final report.

This outline plan and the supporting procedural methodologies for each type of hazardous material is the sum of the Hazardous Materials Demolition Plan. Each concurring party agrees with the elements and requirements of this plan.

Concur:

________________________________________
Environmental Health and Safety

________________________________________
Monitoring Professional

________________________________________
Monitoring Professional

________________________________________
Asbestos Abatement Contractor

________________________________________
Lead Abatement Contractor

________________________________________
Mercury Abatement Contractor
Radioactive Materials Abatement Contractor

A. ASBESTOS CONTAINING BUILDING MATERIALS

1. Asbestos Regulations and Standards

The architects and contractors are responsible to comply with all applicable regulations and obtain the required permits for removal and disposal.

Applicable regulations and standards are listed below:

a) 29CFR 1926.1101 (OSHA Construction Industry Asbestos Standard)
c) Asbestos Hazard Management Program, 10 NCAC 19C section .0600
d) EPA Publication 600/4-85-049, Nov 1985, Measuring Airborne Asbestos
e) Following an Abatement Action
f) NIOSH Method 7400 “fibers” 3rd revision, 2nd issue
g) EPA 340/1-90-007 NESHAP, Demolition and Renovation Inspection Procedures
h) Asbestos Abatement Guidelines and Policies, 1996, State of North Carolina, Department of Administration, State Construction Office

2. Design of Asbestos Removal Projects

The EPA NESHAP regulation covers the demolition asbestos containing building materials (ACBM). An architect or designer for a project must inspect the facility to identify all ACBM for the project. If asbestos will be disturbed during the project then this material must be removed. The architectural firm must hire an environmental firm to conduct a survey for ACBM. The survey is to be comprehensive and is to include all ACBM.

Based upon building history, drawings and construction, the asbestos building assessment must include an estimate of “hidden” asbestos content. If walls, chases and ceilings will be breached or demolished during the planned renovation project, these areas must be evaluated, documented and included in the abatement project plans. An accredited asbestos designer uses the asbestos survey to develop plans for the asbestos removal aspects of the project. EHS is to be provided with both a copy of the ACBM survey results and the design for the asbestos removal project in the building.

3. Asbestos Removal

The industrial hygiene oversight firm hired to monitor the project must be hired by the University, rather than the contractor. EHS must be notified of pre-construction meetings that involve the asbestos removal and of the scheduling as to when the removal will be conducted. Industrial Hygiene firm should coordinate their oversight activities with EHS. The oversight firm will conduct inspections and air monitoring to protect the public from exposure to asbestos. The oversight firm will verify demolition and renovation operations are in accordance to the design specification and with all applicable regulations. Any evidence of violations of the regulations will be reported immediately to EHS. The final IH report is to confirm or revise the designer’s statements as to what ACBM has been removed and what ACBM has remains in the building. A copy of the final IH report of the project will be sent to EHS.
4. Final Documentation of Removal-Building Drawings

The architect must clearly mark the final as-built drawings for the project to illustrate where ACBM remains in the building. The drawings should clearly differentiate between areas where asbestos is known to be present based upon visual observation and those areas where it is suspected to remain but was never confirmed because the area was untouched by the renovation project.

B. EHS GENERAL PROCEDURES FOR PAINT FILM STABILIZATION

1. Definition:

Paint film stabilization is the systematic repair and restore of damaged paint. This is a process of wet scraping, priming, and repainting surfaces that are coated with deteriorated lead-based paint.

2. Objective:

To guide the workers in the safe management of lead-based paint (LBP) commonly encountered during the paint film stabilization of University buildings. The procedures will help the workers to:

a) Control the creation of lead-contaminated dust.
b) Effectively clean up lead-contaminated dust and debris created by the work being done.
c) Protect workers, and occupant’s health and safety.

3. Performance:

A moderate amount of lead-contaminated dust and debris will be generated or disturbed during paint film stabilization work at University buildings. A moderate amount is clearly visible and may contain debris and paint chips. These quantities of paint chips may be regulated as hazardous waste.

a) Four important rules to follow when chipping loose paint:
b) Mist the work area to minimize airborne dust.
c) Using a putty knife or scraper, carefully scrape loose paint flakes and deteriorated surface.
d) Collect all debris and paint chips created on 6-mil plastic sheeting and place in waste drum.
e) Vacuum the entire work area thoroughly using a HEPA vacuum.

4. Personal Protective Equipments:

Personal protective equipment includes protective clothing and respirators are to be used in all projects. Protective clothing is worn to prevent lead from coming into contact with the body. Protective clothing includes coveralls, head covering, foot covering, and gloves. Respirators should always be used; typically a half face HEPA filter air-purifying respirator is to be used in all paint film stabilization. Powered air purifying respirators (PAPR) should be provided if requested by an employee for use where respirators are required.

5. Personal Hygiene:

All workers should wash their hands and face immediately after every project. Eating, drinking, smoking, and applying cosmetics should not be permitted in any work area.
6. Equipment:

- a) Cleaning supplies, such as cloths, mop and bucket.
- b) Misting or spray bottles.
- c) Tape and plastic drop cloths and 6-mil plastic sheeting
- d) High Efficiency Particulate Air (HEPA) filter-equipped vacuum cleaners.
- e) Putty knives or scrapers.
- f) Personal Protective Equipment (PPE), such as; full Tyvek suite, disposable Gloves, respirators with HEPA cartridges, and safety glasses.

7. Preparation:

- a) For Exterior Surfaces:
  - i. Cover ground under work area with polyethylene sheeting.
  - ii. Attach edge of ground polyethylene sheeting to building.
  - iii. The polyethylene sheeting should extend ten feet beyond the perimeter of the working surfaces.
  - iv. Mist the work surfaces; use a putty knife or scraper to remove all loose paint.
  - v. Maintain good housekeeping duties throughout the work.
  - vi. Remove debris and paint chips at frequent intervals, place in waste drums.
  - vii. Limit access through the work area, a tape “barricade” may be placed to help control traffic.

- b) For Interior Surfaces:
  - i. Move furnishings and equipment away from area of work.
  - ii. Place plastic drop cloth over fixed in place equipment or furnishings.
  - iii. Place 6-mil plastic sheeting on the floor under area of work extending five (5) feet.
  - iv. Mist the work surfaces; use a putty knife of scraper to remove all loose paint.
  - v. Maintain good housekeeping duties throughout the work.
  - vi. Remove debris and paint chips at frequent intervals, place in waste drum.
  - vii. Limit access through the work area, a tape “barricade” may be placed to help control traffic.

- c) Cleaning Work Area:
  - i. After completing the work, remove polyethylene sheeting contaminated with lead paint chips and place it in a 55-gallon drum provided by the Department of Environment, Health & Safety.
  - ii. Plastic sheeting should be rolled inward and placed in disposable bags with other waste.
  - iii. Waste generated during repair & restore of deteriorated lead-based paint work may be regulated as hazardous waste.
  - iv. Call the Department of Environment, Health & Safety to arrange for waste pick-up.

C. INDUSTRIAL HYGIENE DESIGN GUIDELINES

Duct work is to be insulated on the exterior of the ducts. No interior lined insulation is to be used.

For heat recovery systems from remote maintenance where feasible. If not feasible, provide supplied air for respiratory protection for buildings with heat recovery, for protection of maintenance workers who must enter contaminated air flow plenums.
Do not provide building humidification, unless required for special equipment or materials. Only direct steam injection systems are permitted with downstream condensate detection in the duct work.

D. LEAD BASED PAINT MANAGEMENT FOR RENOVATIONS/DEMOLITION OF EXISTING BUILDINGS

All renovation projects must be reviewed by the Department of Environment, Health & Safety (EHS) prior to starting them.

For large capital projects, EHS can provide information on preliminary building lead assessments. However, a complete lead assessment must be completed as part of the building renovation by a contractor certified to perform lead assessments.

For small projects, the EHS Office can test surface finishes for lead content. Facilities Services should complete the form “Request for Lead-Based Paint Inspection”, when requesting a survey for Lead-based Paint (LBP).

A copy of the completed assessment reports shall be sent to EHS.

Contractors hired to remove LBP from university buildings shall submit a written abatement plan that must be reviewed and approved by the Department of EHS prior to beginning paint removal.

1. The plan should address the following:

   a) An overall time table
   b) Specifications of abatement methods
   c) Containment of lead dust & debris
   d) Protection of workers
   e) Clean up during and after abatement
   f) Waste management and disposal

The Department of Environment, Health & Safety (EHS) must inspect and approve the containment area before abatement work begin, and, may inspect and perform air monitoring during and after the completion (final clearance) of the abatement project.

If an outside IH firm is hired to perform air monitoring, a copy of all monitoring activities must be submitted to the Department of Environment, Health & Safety.

Lead contaminated waste generated during the abatement projects must be disposed of as hazardous waste through the Department of EHS.

E. PREVENTION OF MOISTURE AND MOLD GROWTH PROBLEMS

1. Introduction

As part of the campus priority for sustainable buildings, energy conservation and indoor air quality are critically important. In the past, building designs have facilitated one or the other criteria but rarely have both aspects been achieved simultaneously.

For renovations and new construction projects, during the schematic design phase, the Designer shall evaluate quantitatively the potential for moisture and vapor intrusion within and through the building
envelope. The control of indoor relative humidity, surface temperatures, and moisture migration are the primary means of minimizing microbial growth in buildings. Generally, room air and near surface relative humidity levels less than 60% will preclude mold growth. When excess moisture does enter the building, a design which allows rapid moisture/vapor removal is essential for long term mold prevention within the structure. In addition to the potential to degrade indoor air quality, moisture/mold problems present significant impact on building deterioration and lifespan.

While the University is not located in the geographic region defined by ASHRAE as hot-humid climate, it is located in the part of the country where moisture related indoor air quality problems frequently occur in buildings. Thus it is imperative that the design considerations presented in this document and references be considered for all major building projects.

2. **Requirements for moisture control**

   a) **Proper Building Pressurization:**

   The movement of unconditioned moist air into a structure is one of leading problems that causes moisture and mold growth in buildings. To address this issue, buildings should be designed to operate under net positive pressure with respect to the outdoors. Building layout, mechanical systems (HVAC, exhaust), and air infiltration are the key elements that must be considered in building pressurization.

   b) **Minimization of Air Infiltration:**

   Incorporate the use of air barriers and seals to deter infiltration. The design must specify the maximum infiltration rate to which the building will be constructed.

   c) **Control of Moisture:**

   i. Reduce the potential for moisture accumulation, including condensation, and provide for the egress of water that may accidentally enter the envelope and have an effective drainage plane within the wall assemblies to drain rain water.

   ii. Prevent penetration of both surface water and groundwater, including capillary water movement through materials.

   d) **Control of Vapor Diffusion:**

   While the materials ordinarily used in the building envelope may perform as an adequate vapor retarder, certain buildings may require colder-than-normal interior temperatures that may warrant a special vapor retarder. If vapor diffusion material is required, careful consideration must be given to the permeance rating and location of the vapor retarder. The use of materials with very low permeance rating, such as polyethylene, aluminum foil, and vinyl wallpaper should be avoided.

   e) **Provide Dehumidification:**

   It is important to properly size the HVAC systems. Over sizing of HVAC systems can result in short-cycling which reduces the sensible heat but not the latent heat which holds the moisture in the space. Also, energy management control systems must be programmed such that HVAC set backs do not result in an increase in building humidity above allowable limits (generally 60%)
HVAC controls shall include humidity sensors as well as temperature and differential CO2 sensors (indoor/outdoor). Variable fan speed controls tied to the humidistats allow for dynamic control of humidity as well as temperature and outside air requirements (CO2). These 3 parameters are most critical for offices, auditoriums, classrooms and residential spaces where exhaust air is not the predominant feature.

In laboratories spaces with large quantities of fresh air supplied continuously for chemical hood makeup. Temperature and humidity controls and research chemicals containment are the greater challenges without the need for special attention to CO2 concentrations.

f) Materials of Construction:

In general, inorganic construction materials do not support mold growth and are the preferred products wherever practicable. In shower rooms and other areas subject to high moisture levels, products such as dens board (Georgia Pacific) have been used successfully. Interior insulation in duct systems must not be used. Also, carpeting and wall gypsum board extending to a concrete slab below grade are discouraged due to moisture and accidental flooding issues.

g) Site Selections, Grading, and Landscaping Issues:

Grading and Landscaping should be designed to shed water away from the foundation. Sprinkler spray patterns must be directed away from the façade and foundation areas.

h) Scheduling Construction to Minimize Moisture/Mold:

Specifications should be written to require that building materials subject to mold growth are kept dry throughout construction including sheetrock, thermal insulation, wood products, carpets, ceiling tiles etc. Any wetted materials must be replaced at the contractor’s expense.

HVAC duct systems must be protected from the collection of dust and debris within the ducts during construction. However, once the dusty operations are concluded, operating the HVAC to remove trapped humidity within the building would be advantageous assuming that the windows and doors are kept closed.

i) Special Considerations for Historic and Old Buildings:

An engineering assessment is required to determine the projected impacts of renovation activities on moisture control within the structure. This assessment should include considerations of below grade, at grade and above grade differences, the tightness of the envelope and the deterioration of or lack of moisture and vapor barriers and retarders.

j) Commissioning:

The building envelope including the roof and windows and wall structures should be tested for water leakage by using pressure hoses on the outside and inspectors on the inside of the building.

The final building structure should be tested for air leaks by pressurizing the building and measuring the leakage rate. The observed air leakage shall not exceed the design infiltration rate used in sizing the HVAC and humidity control systems.
3. **Suggested References for Guidance on Design Considerations**

   a) Preventing Indoor Air Quality Problems in Educational Facilities:


   b) Mold, Moisture, & Indoor Air Quality:


   c) Hold the Line:


   d) ASTM:


   e) Ventilation for Acceptable Indoor Air Quality:


   f) Control of Moisture Problems Affecting Biological Indoor Air Quality,

   TFI—1996, International Society of Indoor Air Quality and Climate, Ottawa, Ontario, Canada, 1996

   g) ASHRAE:

   Humidity Control Design Guide for Commercial and Institutional Buildings, Harriman, Brundrett & Kittler, Atlanta, GA 2002

   h) ACGIH:

   Bioaerosols: Assessment and Control: Editor: Janet Macher, American Conference of Governmental Industrial Hygienists, Cincinnati, OH 1999.

F. **HAZARDOUS AND UNIVERSAL WASTE ISSUES**

All Hazardous and Universal Waste (H/U) issues shall be presented to the UNC Environment, Health and Safety Department (EHS).

Contacts are:
Mike Long  919-962-5723
Steve Parker  919-962-5509
All H/U waste shall be handled using applicable Federal and State laws, including EPA regulations codified in the 40 CFR. For assistance, contact EHS.

Contact EHS for a list of University approved disposal vendors, or visit our website at www.ehs.unc.edu for more information.

EHS requires a written plan to be submitted for approval at the beginning of the project that outlines which H/U wastes have been identified and the proposed disposal venues to be utilized.

Bills of Lading, Manifests and LDR’S must be signed by a representative of EHS for all shipments of hazardous or universal waste, excluding asbestos.

If you are unsure if you have a hazardous waste, contact EHS.

1. **Bulbs**

   The following procedure is to be used for 4 and 8-foot fluorescent bulbs, High Intensity Discharge Bulbs (mercury bulbs), and U-Tubes.

   a) Bulbs should be placed in manufactured boxes.
   b) When you put the first bulb in the box, a Universal Waste label shall be placed on the outside of the box. Fill in contents and date.
   c) When not actively putting bulbs in the box, the lid shall be closed and sealed.
   d) Keep box inside, and away from any water.
   e) EHS does not approve of the use of a fluorescent bulb crusher.

2. **Mercury Contaminated Materials**

   a) All mercury contamination must be treated as hazardous waste and disposed of according to State and Federal regulations. All sink traps located within research buildings are suspected to be contaminated with some mercury. Immediately contact the UNC Environment, Health and Safety Department if and/or when these items are discovered for a copy of the University’s Mercury Plumbing Removal procedure.
   b) Contractor shall contact a reputable hazardous waste disposal firm for removal, shipping, and disposal needs. Mercury items shall be sent to a facility within the U.S. for retort. This includes mercury containing switches, devices, and sink traps.

3. **Ballasts: PCB and Non-PCB Ballast**

   a) PCB Ballasts shall be placed into UN approved 55-gallon drums for disposal, and shipped on a Hazardous Waste Manifest. Also, the lid on the drum shall be secured unless actively adding to the drum. There is a one-year time limit to dispose of the drum from when the first ballast went into it. A ballast is considered to be a PCB ballast if the label says it is, or the label does not say at all.
   b) Non-PCB Ballasts will have “Non-PCB Ballasts” written on the ballasts. These should be placed in a separate drum, (UN Approved), for recycling. For larger quantities, use a 20y3, covered roll-off that you can send to the recycler.
   c) When planning storage, keep in mind that a full ballast drum weighs approx. 700 pounds.
4. Broken Fluorescent Tubes

Fluorescent bulbs, HID’s, or U-tubes that are unintentionally broken, shall be placed into a UN approved poly drum. These are considered Hazardous Waste and should be treated as such due to the possible release of mercury vapors. When not actively adding to the drum, the lid shall be on, and secure. Also, the drum needs to have a label that says Broken Fluorescent Bulbs, and the date the first item was placed inside the drum. The one-year time limit for disposal applies to this waste as well.

5. Asbestos

See the construction specifications on Asbestos Abatement.

6. Lead Paint

a) Lead Paint waste from scraping, grinding, or peeling is considered hazardous waste and shall be stored in a UN approved drum with the lid securely fastened. This drum must be labeled as Lead Paint Chips and locked in an area away from public access.

b) Core samples from suspected Lead Based Paint containing materials such as walls, windows, doors, and door casings shall be taken prior to demolition and sent for TCLP analysis. An EHS representative shall be present for any sampling activities.

c) All sampling results shall be sent to EHS for proper waste disposal determination.

7. Miscellaneous chemicals

Any chemicals found during demolition shall be handled as hazardous waste. Examples include: cylinders, bottles, cans with liquid, spill clean-ups etc.

** When in doubt, contact EHS at 919-962-5507 or Mike Long at 919-962-5723.
** Do not ship any Hazardous/Universal Wastes without EHS notification and approval.

8. Hazardous and Universal Waste Process – Chart
Hazardous and Universal Construction Waste Process

Contaminated Debris: - including casework, piping, P-traps, etc.

Lead Paint Chips

Mercury Containing Articles

PCB Ballasts

Non-PCB Ballasts

Fluorescent Bulbs

Drum, Label, Date, and Recycle as Scrap Metal

Store in boxes, Label, Date, and Keep Closed

Store in a locked area

Waste Determination by TCLP

Pass TCLP

Fail TCLP

>55 Gallons of Hazardous Waste

Create 90 Day Storage Area - Requires Approval of EHS Director.

EHS must validate ultimate disposal site to protect UNC from future liabilities.

EHS should be notified to help generate and sign waste profiles.

EHS MUST Be Present for and Sign Any Manifest for Any Universal or Hazardous Waste Shipment.

Disposal in CBD Landfill

Develop Contingency Plan

Notify Local Authorities

Record Weekly Inspections

Training Records - Keep on site

Adequate Aisle Space

Post Evacuation Plans

Spill Kits and Emergency Equipment

Contractor

EHS

Shared

Responsibilities

Contact Michael Long at 962-5729 or mlong@ehs.unc.edu with questions.

(END OF SECTION)
A-21 - SUSTAINABILITY

Design and construction of capital projects play a role in moving towards the University’s sustainability goals. As of February 2020, these long-term goals are summarized as the “Three Zeros,” which are:

- Net Zero Water
- Zero Waste to Landfills
- Net Zero Greenhouse Gases

1. **Net Zero Water**
   To move towards net zero water, the University has defined two sub-goals:
   - Reduce potable water use, calculated as both total water use and building water use intensity.
   - Reduce the amount of untreated stormwater discharged to downstream creeks.

   1.1 **Potable water use reduction**
   The following metrics should be used to measure the building and site progress towards net zero water:
   - Water use is subject to North Carolina General Statute 143 135.37. “Energy and water use standards for public major facility construction and renovation projects; verification and reporting of energy and water use.”
   - LEED v.4

   Potable water conservation should be achieved through a combination of the following strategies:
   - Use of water efficient plumbing fixtures. Detailed design guidance should be sought in the Plumbing section of this document. [LINK TO BE ADDED]
   - Use of chilled water for process cooling water. See the Chilled Water guidelines in this document for further information. [LINK TO BE ADDED]
   - Use of non-potable water for toilet flushing and irrigation. The University is served by reclaimed water and by harvested rainwater from cisterns. Buildings will be dual plumbed for use of non-potable water for toilet flushing. Non-potable irrigation is expected for all sites. See the Non-Potable Water design guidance in this document for further information. B-22 – Non-Potable Water

   1.2 **Stormwater**
   As a State entity within the Jordan Lake watershed, the University is subject to stringent stormwater requirements. See the Stormwater section of this document for details. B-27 - Stormwater

2. **Zero Waste to Landfills**
   The University seeks to reduce waste from demolition and construction activities as well as from routine operations. Consult the Waste Sections of this document. A-25 – Waste Management & Recycling

3. **Net Zero Greenhouse Gases**
   The University is subject to both voluntary and mandated metrics related to energy use and greenhouse gases.
   - As a signatory of the American College and University Presidents’ Climate Commitment, the University has pledged to be greenhouse gas neutral in the next 15 years. The Climate Action Plan presents the strategies to achieve this goal.

Energy models developed for NC GS 143-135 must comply with state construction office guidance (http://www.nc-sco.com/documents/guidelines/EnergyBldg.pdf) and with UNC Chapel Hill’s Energy Policy (https://policies.unc.edu/files/2013/04/Energy-Use-Policy.pdf) for occupied hours, temperatures and relative humidity. Designers should contact UNC Chapel Hill’s Energy Management department (http://facilities.unc.edu/engineering/energy-management/) for the current utility rates to use in modeling. The designer must provide month by month energy consumption figures for each utility in the model. This will allow UNC Chapel Hill to compare actual and predicted performance of the building. In addition, the designer must provide complete revised/updated energy model files in electronic format so that UNC Chapel Hill can re-run the energy model.

Greenhouse gas reduction or minimization should be achieved through a combination of the following strategies:

- During advance planning, building orientation should be analyzed with the goal of minimizing solar heat gain and glare, and optimizing opportunities for day lighting.
- Programming should adhere to campus space standards and seek opportunities for multiple-use spaces.
- Lighting must comply with UNC Chapel Hill’s Lighting Policy (http://policies.unc.edu/files/2013/05/Energy-Efficient-Lighting.pdf) prohibiting the use of incandescent lighting except in special circumstances.
- All new buildings and additions that affect the HVAC system shall incorporate commissioning of the MEP systems.
- Building envelope commissioning should be undertaken when appropriate.
- Buildings are required to have metering for performance verification of energy and water use to comply with NC GS 143-135 (http://www.nc-sco.com/documents/guidelines/Bldg_Perf_Verification.pdf).
- Building projects are encouraged to incorporate renewable energy systems when possible and appropriate. Consult the Solar Electric Generation Policy in the Electric Distribution Systems section of these guidelines. B-23 – Electrical Distribution Systems

4. Other Sustainability Areas
We recognize the USGBC’s LEED rating system as the most widely accepted standard for evaluating sustainability of the built environment. Individual building projects are encouraged but not required to seek LEED certification. However, each project is expected to incorporate measures that would enable it to be certified at a minimum silver level whether or not it is applying for certification.

5. Design Process
Design teams are expected to conduct a charrette early in the design process to involve stakeholders in planning for energy efficiency, water efficiency, solid waste reduction, land preservation and other aspects of sustainable development. Ideas will be evaluated by the project team for feasibility within the constraints of project program, budget and schedule.

A LEED checklist is to be included with each design submittal indicating current performance objectives. Supporting documentation outlining the strategies that will be employed to achieve energy and water efficiency should also be included. A campus-specific checklist, showing which points are attainable through adherence to the Design Guidelines, may be found in the Appendix.
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<td>Project information Form</td>
<td>UNC/Arch</td>
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<td>UNC</td>
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<td>2 LTc3 High Priority Site (Ex Perf combine option 1 with either Option 2 or 3)</td>
<td>UNC</td>
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<td>3 LTc4 Surrounding Density and Diverse Uses</td>
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<td>4 c5 Access to Quality Transit (Ex Perf double transit services)</td>
<td>UNC</td>
<td>Chapel Hill Transit routes</td>
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<td>1 LTc6 Bicycle Facilities (showers, 2.5% of visitors bike rack &amp; 5% of FTE bike storage)</td>
<td>UNC</td>
<td>Emphasis around bicycle storage under overhang of building</td>
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<tr>
<td>1 c7 Reduced Parking Footprint</td>
<td>UNC</td>
<td>Parking only for service vehicles</td>
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<tr>
<td>1 c8 Electric Vehicles</td>
<td>UNC</td>
<td>Level 2 EV charging stations for at least 2 spaces; EV ready raceway/conduit</td>
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<th>Sustainable Sites</th>
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<tr>
<td>1 SSc1 Site Assessment (site assessment, vegetation, climate, and soils)</td>
<td>UNC</td>
<td>Work this credit with Integrative process</td>
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<tr>
<td>2 Protect or Restore Habitat</td>
<td>UNC</td>
<td>Preference for native/adaptive/pollinator friendly/edible plants</td>
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<tr>
<td>3 SSc5 Heat Island Reduction</td>
<td>UNC</td>
<td>Avoid asphalt. Utilize high SI materials, vegetated roofs, PV canopies</td>
</tr>
<tr>
<td>1 SSc6 Light Pollution Reduction</td>
<td>UNC</td>
<td>Projects to have a B-U-G rating of at least = 4-2-2</td>
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<td>Q</td>
<td>Critical Path: Get the CM at risk and CxA onboard ASAP; min MEP and RE</td>
</tr>
<tr>
<td>2 EAp2 Minimum Energy Performance</td>
<td>O</td>
<td>Based on ASHRAE 90.1-2016; Recommend using IESVE software for modeling purposes (UIF) (UNC)</td>
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<td>3 EAp3 Building-Level Energy Metering</td>
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<td>Consider embodied Carbon and ODP in Construction Calculator and either retrofit or IMO C3; See UCLCF for embodied carbon data EC3</td>
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<td>CM/Arch</td>
<td>Encourage CM to utilize Green Badger for documentation purpose</td>
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<td>Encourage CM to utilize Green Badger for documentation purpose</td>
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<td>1 IEQp1 Minimum Indoor Air Quality Performance</td>
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**Notes:**
- GOAL: Min 40% reduction, CW for equipment cooling, double plumb, water sense products; Energy* certified ice machines; water bottle refill stations
- Projects to have a B-U-G rating of at least = 4-2-2
- Grid Harmonization
- Renewable Energy
- Enhanced Refrigerant Management
- Energy and Atmosphere
- Materials and Resources
- Indoor Environmental Quality

**Sustainability Meeting Occurred On:**
- Date:
- Project Name: UNC-###
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<td>20% (by contract fees) of team achieved JUST certification or other social responsibility recognition</td>
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<td>Pipes, solder, flashing, wire, paints</td>
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<td>Innovation - Fume hood Cx - ex perf</td>
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</table>
A-22 - ACCESSIBILITY

General
The University of North Carolina at Chapel Hill is committed to making all buildings and areas of the campus physically accessible to all faculty, staff, students, and visitors. A universal design principle that provides the same access to all is encouraged. The Designer is expected to provide a design that will comply with the current versions of the North Carolina State Building Code and the Americans with Disabilities Act Accessibility Guidelines (ADAAG). [http://www.ada.gov/publicat.htm](http://www.ada.gov/publicat.htm). The University requires some elements that exceed these codes and standards.

Designers Shall Refer to the following Design Guideline Sections for additional information:
- B-40 – Site Hardscape
- C-01 – Architecture
- C-11 – Interior Design Elements
- C-30 – Vertical Transportation

Typical Accessibility Concerns in Renovation & New Construction
1. Path of Travel/Curb Cuts/Ramps
   a. Exterior walkways should not exceed a slope of 1:20 in the direction of travel. If this cannot be achieved because of site topography, then a ramp may be used. Use of ramps should be kept to a minimum. Construction tolerances shall be considered in the design of sloped surfaces to ensure they do not exceed the maximum allowed.
   b. Curb Cuts shall be concrete contrasting in color to the adjacent walkway and shall have detectable warnings in the lower 2’-0” for the width of the ramp portion. All curb cuts shall be in the direction of travel. Diagonal curb cuts at intersections should not be used.
   c. Exterior stairs shall be kept to a minimum. They shall be concrete or approved material of contrasting color from the adjacent walkway. A step with a single riser shall not be used. All stairs shall have handrails on both sides.

2. Doors and Hardware
   a. All lever hardware shall have an end return.
   b. Automatic door opener shall be hardwired. The location of activators (push plates) and stub outs for the automatic door openers shall be shown and dimensioned on the architectural drawings. Activators shall be mounted 36” above the adjacent grade or floor and be 48” minimum from any portion of the door in the open position. The push plate shall be 4-1/2” diameter minimum. Door activator shall be provided at the following locations:
      i. Main Entrance doors into the building. Where the building has main entrances on different levels, they shall be provided at each level. These locations shall also be stub out for a proximity reader.
      ii. Entrance doors into the primary multi-fixture toilet rooms on levels served by the main entrances mentioned above
      iii. Additional locations may be requested on a project by project basis no later than the Design Development Phase
      iv. Where vestibules are provided, the opener shall activate the doors on each side of the vestibule. An activator shall be located in the vestibule.
   c. In addition, stub outs for future automatic door openers (conduit supplied to ceiling above and...
to boxes at future activator locations) shall be provided in the following locations:

i. Entrance doors to all other multi-fixture toilet rooms on all floors
ii. Entrance doors of common use bathrooms in dormitories, accessible dorm room
   entrance doors and toilet room doors in an accessible suite

3. Toilet Rooms, Bathrooms and Accessories
   a. Toilet rooms shall not have vestibules.
   b. Toilet rooms with more than 10 fixtures (water closets and urinals) should have a cased
      opening entrance without doors into the toilet room unless it is off an area where a door is
      desired (i.e. a waiting, reception or seating area).
   c. Accessible toilet stalls should have a turning space within the stall as defined by the NCBC, (a
      60” clear diameter circle).
   d. The accessible paper towel dispenser shall be adjacent to the accessible lavatories.
   e. If only one urinal is provided, it shall be accessible.

Equal Access Toilet Rooms
In new buildings and major building renovations that include toilet rooms at least one Equal Access Toilet Room
shall be provided. This shall be a single use toilet room with a lockable door that includes the following
features:

1. Compliant with the current ADAAG and NCBC for a single accessible toilet room
2. Signage shall read “Toilet Room” or “Unisex Toilet Room”

Provide diaper changing and lactation areas within these restrooms in buildings such as libraries, museums,
performing arts buildings and other location where they are most likely to be in demand. Verify with the
Facilities Planning Project Manager if this is to be included in the project. In addition to the above also provide:

1. A fixed built-in diaper changing table / countertop separate from the lavatory.
2. An electrical outlet adjacent to the diaper changing table between 32” and 42” AFF. It shall be out
   of reach of a child on the table but within 36” of the surface
3. An area for a large chair for nursing mothers
4. Provide signage indicating additional uses
5. Drinking Fountains located along a path of travel should be recessed when possible.
6. Elevators shall be provided with a grab bar on at least one wall of the elevator cab.
7. Platform Wheelchair Lift shall not require a key to operate.
8. Interior and exterior signs identifying permanent rooms and spaces shall have both the name and
   number inraised letters and Braille that complies with the current accessibility codes.
9. In classrooms and auditoriums where a tablet arm is provided for fixed seating, a fixed table or
   tablet armon a pedestal shall be provided at all wheelchair seat locations.
10. Stair handrails shall have a bottom extension that extends 12” plus one tread width from the bottom
    nosing.
A-24 – Parking & Transportation

General
The University traditionally follows the Town of Chapel Hill design standards for roadway lane widths, asphalt section details, and parking space dimensions. Designers may refer to the Town’s design standards manual for reference as a starting point only. The University reserves the right to deviate from any and all, past or current standards that the Town of Chapel Hill has published.

Given that each project on campus is unique, designers shall coordinate all design standards, details, and layouts with the Facilities Planning Project Manager and coordinate with UNC stakeholders including Transportation & Parking, a unit of the Department of Public Safety.

Referenced Sections
Information regarding UNC’s Parking and Transportation unique Design Standards and Guidelines can be found in the following sections of this document:

A-30.4 - Construction Parking Process
B-06 - Pavement
B-07 - Roadway, Driveway, and Fire Lane Design
B-08 - Parking Standards
B-09 - Pedestrian Safety and Traffic Control Plans
A-25 – WASTE MANAGEMENT & RECYCLING (OWRR)

Introduction

Designers are to work with the University Office of Waste Reduction and Recycling to develop spaces for waste handling containers and service access, construction and demolition waste management plans and practices, and to ensure that access is maintained to active buildings during the construction process. The University is mandated by the “North Carolina Solid Waste Management Act of 1989” and North Carolina Executive Order 156 on State Government Environmental Sustainability, Reduction of Solid Waste, and Procurement of Environmentally Preferable Products, Section 4.b. (signed July 20, 2000) to establish recycling programs and meet waste reduction goals.

“As set forth in North Carolina General Statute 130A-309.14, all state agencies shall ensure that employees have access to containers for recycling (at a minimum) aluminum cans, high-grade office paper, and corrugated cardboard. All state employees are required to separate identified recyclables materials generated in the course of agency operations and place them in the appropriate recycling containers.

State agency facilities that routinely house the general public, such as highway rest areas, state parks and recreation areas, employment security offices, state historic sites, etc., shall implement programs for the collection of recyclable materials discarded by the public at all such locations (e.g., aluminum cans, glass, and plastic beverage containers) when feasible and practicable. State agencies that operate or contract for the operation of food service establishments, such as snack bards, cafeterias, dining halls, etc., are encouraged to implement programs to recover and recycle leftover food when practicable and feasible."

Executive Order 156 also calls on all state agencies to:

"...seek opportunities to reduce environmental impacts associated with capital improvements throughout project planning, site and building design, and construction. Agencies shall, to the extent feasible and practicable, implement project initiatives or modifications that result in energy efficiency, water conservation, pollution prevention, solid waste reduction, and land preservation during the construction and operation of agency facilities."
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Section Page: 4
I. SITE AND SPACE PLANNING

Design considerations for waste and recycling containers must be based on the building’s usage and occupancy. In addition to indoor recycling, a building must, at a minimum, have access to a dumpster for trash, one for cardboard and outdoor recycling carts.

When the building contains food service operations, containers and exterior space must be allocated for grease collection and food waste recycling. Animal labs and quarters require exterior space for the collection of animal bedding for composting. Theatres, art studios, and maintenance shops often produce bulky waste that cannot be collected in front load dumpsters. Any building containing offices will generate some quantity of high grade waste paper (all purpose printer paper from computer labs, copiers, printers, and routine administrative business) and must have loading dock or service area access for paper collection. Residence Halls require extra refuse and recycling containers.

UNC-Chapel Hill collects the following materials for recycling:

- Animal Bedding—Collected on the interior by the animal lab staff, and then stored outside for pickup
- Bottles & Cans—Collected throughout the building on a space usage basis and in outdoor carts (especially in high volume areas like residence halls, catering areas, dining halls, etc.)
- Cardboard—Housekeeping brings flattened boxes out of the building to dumpsters outside
- Food Waste—Collected at kitchen areas inside and then stored outside for pick up
- Grease—Collected at dining facilities and picked up by outside contractors
- Newspaper & Magazines—Collected throughout the building on a space usage basis and in outdoor carts (especially in high volume areas such as residence halls, libraries, etc.)
- Office Paper—Collected throughout the building on a space usage basis
- Scrap Metal—Collected at shops and taken to county or in-house facilities
- Clean Wood Waste—Collected at shops and taken to county or in-house facilities

A. OUTDOOR SERVICES AREAS

Each building is to have an outdoor recycling collection site (cardboard dumpsters and recycling carts). The designer must, for projects in which this requirement cannot be met, specify what cannot be sited at the building and the recommended location that will serve as an alternate site for these services. This is to be submitted to the Office of Waste Reduction and Recycling and to Housekeeping Services for approval.

Design considerations for waste and recycling containers must be based on the building's usage and occupancy. All containers shall be located on an accessible path of travel per the ADA and State Building Code.

Ideally, the recycling carts and dumpsters will be on the same pad and enclosure. However, in some cases it is necessary for the dumpsters (or compactors) to be located on separate pads from the carts. This page gives a variety of configurations and basic requirements. The standard design for an outdoor service area is for a recycling and trash site that can accommodate:

- 3-6 recycling carts (residence halls require more)
- cardboard dumpster
- at least one trash dumpster (residence halls and high volume areas may require more than one)

A variety of programs can utilize the outdoor service areas. Along with this a variety of containers and vehicles are used to service the program. A brief list is given below.

- Dumpsters (Trash and Cardboard)
- Outdoor Recycling Carts (Bottles/Cans, Newspapers/Magazines)
- Compactors (Trash and Cardboard)
- Rolloff Containers
• Animal Bedding
• Food Waste Carts
• Grease Collection

Dumpsters are serviced by front load trucks. The standard size for a cardboard dumpster is 8 cubic yards. As of April 2006, the standard trash dumpster 8 cubic yards with access via closable sliding side doors. The concrete pad for the dumpsters can be designed in a variety of configurations as long as the pad and site meet the University’s service requirements. Pads should be sloped away from rear wall and towards planned drainage routes to avoid pooling around dumpsters and carts. The quantity, size, and type of dumpsters needed is dependent on the building use and size. When volume or special needs dictate a larger dumpster, horizontal compactors are recommended. Contact the Office of Waste Reduction and Recycling for assistance determining the size and type of container needed.

More information about the specific containers and their dimensions is listed on the Waste Handling Containers & Equipment

Also see: Needs Based on Building Use

B. INDOOR RECYCLING SITES

Interior space for recycling collection must be allocated based on where and how much material is generated. There must always be a trash can adjacent to or as part of the indoor recycling site. Office paper, newspaper/magazine, and bottle/can recycling locations should be located on each floor.

In non-public areas, standard OWRR-provided bins are sufficient. In public areas, recycling cabinets may be used instead of OWRR’s standard bins.

All containers shall be located on an accessible path of travel per the ADA and State Building Code. Care should be given to locate containers away from exit doors, elevators, or in areas that may impede movement in the event of an emergency. In accordance with applicable codes, recycling containers should be placed away from fire alarms, extinguishers and automatic door openers. Recycling containers shall not be placed in stairwells.

Whenever possible, departments should share recycling areas. When this is not possible, each department should have its own recycling areas. If there is only one department for the whole building, there should be a recycling center for office paper, newspaper/magazine, and bottle/can collection on each floor.

Click here for photos of recycling cabinets installed in various campus buildings.

Also see: Needs Based on Building Use

1. General:

Indoor recycling must be provided in the following areas:

- work rooms*
- copy rooms*
- break rooms**
- computer labs*
- lounges**
- outside classrooms and auditoriums**
- other areas where people will congregate or generate recyclables**

* Copier, mail and work rooms must have a trash can and two recycling bins (one for office fiber and one for newspapers/magazines).
**Public areas** must have a trash can, bottle/can bin, and newspaper/magazine bin. In some situations, office fiber bins are also needed in public areas. Buildings such as residence halls, dining halls, athletic facilities, theatres, conference centers, shipping and receiving areas, animal quarters, etc. may have special needs. Consult the Office of Waste Reduction and Recycling (apreble@fac.unc.edu) for assistance with planning space for indoor recycling in these areas. OWRR will work with designers and building occupants to determine location, the number and type of bins needed.

2. **Footprint:**
   While there are several different styles of indoor recycling bins, planning for a footprint of 24" W x 24" D per container is adequate.

3. **Service Vehicles:**
   The Waste Handling Vehicles (http://www.fac.unc.edu/OWRRGuidelines/?Topic=Vehicle) page gives complete dimensions for all of the vehicles used to service indoor recycling.

4. **Abbreviations:** (update 6/18/07)
   - BC = Bottles/Cans
   - OF = Office Fiber
   - NM = Newspapers/Magazines
   - MP = Mixed Paper

C. **WALKWAY SITES**
   1. **General:** (updated 4/6/05)
      Place receptacles at the intersections of major pedestrian corridors, plaza areas, and entries to major student areas such as the Student Union and snack bars. Coordinate placement of “walkway” recycling receptacles with the Office of Waste Reduction and Recycling and the Grounds Department to ensure that the site can be serviced adequately. All containers shall be located on an accessible path of travel per the ADA and State Building Code. Recycling sites must have three containers. One for trash, one for bottles/cans, and one for newspapers. They must be located adjacent to one another as pictured. They should be placed with the trash container closest to the area highest in traffic. The bottle/can bin should be the middle bin and the newspaper bin should be next. The containers should be level, firmly secured to the ground contiguous to walks, and on a brick-surfaced area extending outward from the walk. Also see: Needs Based on Building Use (http://www.fac.unc.edu/OWRRGuidelines/?Topic=BuildingUseTable)

   2. **Pad Requirements:** (6/15/07)
      Walkway sites are to be placed on brick pads. Dimensions: The pad area for three containers side-by-side is approximately 9'8" in length and 3'10" in width. Containers are centered on the pad, 2'8" apart on center. The containers should be installed in this order from left to right: Trash, Bottles/Cans, Newspapers.
Locations of walkway sites and detailed drawings must be shown on the plans.

3. **Containers and Equipment:**
   See the Waste Handling Containers & Equipment (http://www.fac.unc.edu/OWRRGuidelines/?Topic=Walkway) page
   - make sure that **funds** are reserved for equipment
   - make sure equipment is **ordered** in time for occupancy
   - **coordinate** with OWRR to make arrangements for any special needs or assistance with ordering equipment

4. **Installation:** *(moved and highlighted 3/2/05 and 4/6/05)*
   Containers ordered as part of a capital project are to be installed by the project. Note that containers placed above membranes for rooftop gardens and other stormwater retention projects may require special installation.
   Containers purchased outside of a capital project, contact OWRR to coordinate installation.
   Installation requires coordination with the following shops: Grounds, Mason, Carpentry, OWRR.

5. **Services Vehicle:**
   The Waste Handling Vehicles (http://www.fac.unc.edu/OWRRGuidelines/?Topic=Vehicle) page gives complete dimensions for all of the vehicles used to service outdoor (and indoor) sites. The Gator is used to transport materials from these sites to outdoor recycling cart sites.
D. NEEDS BASED ON BUILDING USE

1. Academic

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Special Considerations</th>
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<td>Trash</td>
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<tr>
<td>Cardboard</td>
<td>dumpster</td>
</tr>
<tr>
<td>Outdoor sites</td>
<td>carts</td>
</tr>
<tr>
<td></td>
<td>With OWRR approval carts may be optional in this setting if indoor recycling is adequate.</td>
</tr>
<tr>
<td>Walkway sites</td>
<td>Victor Stanley Receptacles</td>
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<tr>
<td></td>
<td>Recycling Areas: Hallways outside classrooms, lecture halls and auditoriums; vending areas and lounges; break rooms; computer labs; and office work/copy areas.</td>
</tr>
</tbody>
</table>

2. Administrative

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Special Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trash</td>
<td>dumpster</td>
</tr>
<tr>
<td>Cardboard</td>
<td>dumpster</td>
</tr>
<tr>
<td>Outdoor sites</td>
<td>carts</td>
</tr>
<tr>
<td></td>
<td>With OWRR approval carts may be optional in this setting if indoor recycling is adequate.</td>
</tr>
<tr>
<td>Walkway sites</td>
<td>Victor Stanley Receptacles</td>
</tr>
<tr>
<td>Indoor Recycling</td>
<td>bin enclosures and standard bins</td>
</tr>
<tr>
<td></td>
<td>Recycling Areas: Hallways outside classrooms, lecture halls and auditoriums; vending areas and lounges; break rooms; computer labs; and office work/copy areas.</td>
</tr>
</tbody>
</table>

3. Athletics

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Special Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Category</td>
<td>Receptacles</td>
</tr>
<tr>
<td>-------------------</td>
<td>----------------------------------------------</td>
</tr>
<tr>
<td>Trash</td>
<td>dumpster or compactor</td>
</tr>
<tr>
<td>Cardboard</td>
<td>dumpster or compactor</td>
</tr>
<tr>
<td>Outdoor sites</td>
<td>carts or other container</td>
</tr>
<tr>
<td>Walkway sites</td>
<td>Victor Stanley Receptacles</td>
</tr>
<tr>
<td>Indoor Recycling</td>
<td>bin enclosures and standard bins</td>
</tr>
</tbody>
</table>
4. Clinical

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Special Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trash</td>
<td>dumpster</td>
</tr>
<tr>
<td>Cardboard</td>
<td>dumpster</td>
</tr>
<tr>
<td>Outdoor sites</td>
<td>carts</td>
</tr>
<tr>
<td>Walkway sites</td>
<td>Victor Stanley Receptacles</td>
</tr>
<tr>
<td>Indoor Recycling</td>
<td>bin enclosures and standard bins</td>
</tr>
<tr>
<td>Confidential Paper Shredding</td>
<td>Shredders, locked containers, etc.</td>
</tr>
</tbody>
</table>

5. Food Service Areas

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Special Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trash</td>
<td>dumpster or compactor</td>
</tr>
<tr>
<td>Cardboard</td>
<td>dumpster or compactor</td>
</tr>
<tr>
<td>Outdoor sites</td>
<td>carts or other container</td>
</tr>
<tr>
<td>Grease</td>
<td>Carts or other container</td>
</tr>
<tr>
<td>Food Waste</td>
<td>Carts</td>
</tr>
<tr>
<td>Walkway sites</td>
<td>Victor Stanley Receptacles</td>
</tr>
<tr>
<td>Indoor Recycling</td>
<td>bin enclosures and standard bins</td>
</tr>
</tbody>
</table>

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1. Any facilities that will host large events or have catering kitchens should plan to have recycling bins inside for use during functions. In addition, outdoor recycling carts must be available for service and catering personnel to use during or after the event.
6. **Historic Campus**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Special Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trash Cardboard and Carts</strong></td>
<td>If the service area and dumpster pad are not located at the building, as is sometimes necessary for main campus buildings, the project <strong>must state</strong> which existing dumpster/service area will be used once the building is complete.</td>
</tr>
<tr>
<td><strong>Walkway sites</strong></td>
<td><strong>Victor Stanley Receptacles</strong></td>
</tr>
<tr>
<td></td>
<td>Recommended in high traffic pedestrian areas or other outside gathering places.</td>
</tr>
</tbody>
</table>

7. **Institutes, Conference Centers, Student Union**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Special Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trash</strong></td>
<td>dumpster or compactor</td>
</tr>
<tr>
<td></td>
<td>Horizontal compactors may be required by the health department or due to volume.</td>
</tr>
<tr>
<td><strong>Cardboard</strong></td>
<td>dumpster or compactor</td>
</tr>
<tr>
<td></td>
<td>High volumes of cardboard may dictate use of an horizontal compactor.</td>
</tr>
<tr>
<td><strong>Outdoor sites</strong></td>
<td>carts</td>
</tr>
<tr>
<td></td>
<td>Food prep areas generate #10 steel cans, glass and plastic bottles. Also, carts are used to store recyclables collected from high volume events or seating areas.</td>
</tr>
<tr>
<td><strong>Walkway sites</strong></td>
<td><strong>Victor Stanley Receptacles</strong></td>
</tr>
<tr>
<td></td>
<td>Recommended in high traffic pedestrian areas or other outside gathering places.</td>
</tr>
<tr>
<td><strong>Indoor Recycling</strong></td>
<td>bin enclosures and standard bins</td>
</tr>
<tr>
<td></td>
<td>Hallways outside conference rooms, classrooms, lecture halls and auditoriums; vending areas, break rooms and lounges; computer labs; and each department's copy area. Any facilities that will host large events or have catering kitchens should plan to have recycling bins inside for use during functions. In addition, outdoor recycling carts must be available for service and catering personnel to use during or after the event.</td>
</tr>
</tbody>
</table>

8. **Maintenance Shops, Art Studios, Performing Arts**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Special Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trash</td>
<td>dumpster or roll-off</td>
</tr>
<tr>
<td>-----------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Cardboard</td>
<td>dumpster</td>
</tr>
<tr>
<td>Outdoor sites</td>
<td>carts</td>
</tr>
<tr>
<td>Compostable</td>
<td>Carts or other</td>
</tr>
<tr>
<td>Plant</td>
<td>container</td>
</tr>
<tr>
<td>Walkway sites</td>
<td>Victor Stanley</td>
</tr>
<tr>
<td>Indoor Recycling</td>
<td>bin enclosures and</td>
</tr>
<tr>
<td></td>
<td>standard bins</td>
</tr>
</tbody>
</table>

9. Parking Decks and High Volume Parking Lots

<table>
<thead>
<tr>
<th>Trash</th>
<th>dumpster</th>
<th>High volume parking lots and decks may need a 4-6 cubic yard slant front dumpster into which the street sweeping equipment can be emptied.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walkway sites</td>
<td>Victor Stanley</td>
<td>Recommended at park and ride lots next to the bus stop.</td>
</tr>
<tr>
<td>Outdoor sites</td>
<td>carts</td>
<td>Carts may be optional in this setting if indoor recycling is adequate.</td>
</tr>
</tbody>
</table>

10. Printing Operations

| Trash           | dumpster             | High volumes of cardboard may dictate use of an horizontal compactor.                                                |
| Cardboard       | dumpster or compactor|                                                                                                                     |
| Outdoor sites   | carts                | Carts may be optional in this setting if indoor recycling is adequate.                                               |
| Walkway sites   | Victor Stanley       | Recommended in high traffic pedestrian areas or other outside gathering places.                                     |
| Indoor Recycling| bin enclosures and   | Hallways outside conference rooms, vending areas, break rooms and lounges, and each department’s copy area. In addition to the routine areas for paper recycling, print operations will generate large volumes of office paper for recycling. This is usually stored in large, palletized boxes at the loading dock area. |
|                 | standard bins        |                                                                                                                     |

11. Retail, Bookstores, Etc.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Special Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indoor Recycling</td>
<td>Hallways outside conference rooms, vending areas, break rooms and lounges, and each department’s copy area. In addition to the routine areas for paper recycling, print operations will generate large volumes of office paper for recycling. This is usually stored in large, palletized boxes at the loading dock area.</td>
</tr>
<tr>
<td>Category</td>
<td>Type</td>
</tr>
<tr>
<td>-------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Trash</td>
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</tr>
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</tr>
<tr>
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<td>bin enclosures and standard bins</td>
</tr>
</tbody>
</table>
### 12. Research Labs

<table>
<thead>
<tr>
<th><strong>Equipment</strong></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Trash</td>
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<tr>
<td>Cardboard</td>
<td>dumpster</td>
</tr>
<tr>
<td>Outdoor sites</td>
<td>carts</td>
</tr>
<tr>
<td>Animal Bedding</td>
<td>carts or other container</td>
</tr>
<tr>
<td>Compostable Plant</td>
<td>Carts or other container</td>
</tr>
<tr>
<td>Walkway sites</td>
<td>Victor Stanley Receptacles</td>
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<tr>
<td>Indoor Recycling</td>
<td>bin enclosures and standard bins</td>
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<tr>
<td>Confidential Paper Shredding</td>
<td>Shredders, locked containers, etc.</td>
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### 13. Retail, Bookstores, Etc.

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Trash</td>
<td>dumpster or compactor</td>
</tr>
<tr>
<td>Cardboard</td>
<td>dumpster or compactor</td>
</tr>
<tr>
<td>Outdoor sites</td>
<td>carts</td>
</tr>
<tr>
<td>Food Waste or Compostable Plant Material</td>
<td>carts or other container</td>
</tr>
<tr>
<td>Walkway sites</td>
<td>Victor Stanley Receptacles</td>
</tr>
<tr>
<td>Indoor Recycling</td>
<td>bin enclosures and standard bins</td>
</tr>
</tbody>
</table>
E. CONTAINERS & EQUIPMENT OVERVIEW

It is the responsibility of the project to budget or reserve funds for the equipment and work with OWRR to ensure that the equipment is ordered, shipped and installed prior to occupancy. Trash and cardboard dumpsters, rolloff containers, and walkway containers (Section 02870 Site Furnishings) are examples of the type of equipment for which this needs to happen. Horizontal compactors are considered part of the building systems. Compactors are to be included in the project budget, planning, design and requirements (Section 11170 Waste Handling Equipment).

Indoor cabinets may be built by the project or ordered by the project (Section 12300 Custom Millwork and Cabinets). Funding for the cabinets must either be part of the project budget or reserves. It is the project's responsibility to design, order, receive and install the cabinets. Some equipment such as standard indoor recycling bins and outdoor carts will be provided by OWRR at no charge.

F. WASTE HANDLING SERVICE VEHICLES

This page gives dimensions for all of the vehicles used OWRR and its contractors. Please contact OWRR to verify which vehicles will need access to the service area being designed.

Items which need extra attention include:
- vehicle width (with mirrors) and length;
- turning radius;
- approach*; and
- overhead clearance.

* Dumpster and rolloff trucks must be able to make direct contact with the containers; thus please take into consideration the truck's angle of approach when designing pads. Due to the high amount of pedestrian traffic, care should be taken to minimize the distance that drivers of waste handling vehicles (and others delivery and service vehicles) have to drive in reverse. Care should also be taken to avoid having service vehicles back across walkways or into traffic. A reference is the Town of Chapel Hill Design Manual (http://townhall.townofchapelhill.org/agendas/ca040126/5b-design%20manual.pdf):

> 8.2.4 Dumpster Placement and Access
> “The essential element in locating a dumpster is the ability of the refuse collection vehicle to safely and efficiently service the container... A turning radii template should be used to assure that access can be provided without unnecessary backing maneuvers... Where refuse collection vehicles will need to turn around to exit a development site, the site plan should be designed so that backing movements do not exceed 100' in length. In these cases the turn around area should be dimensioned using a turning radii template of the appropriate scale. In all cases, the proposed site plan should be designed so that refuse collection vehicles do not need to back onto or off of any public street or over any public sidewalk.”

The location of air intakes should be remote from sources of pollutants and the building air intake and exhaust outlets shall be remotely located from each other to prevent supply air contamination. Take special care to ensure that exhaust from hoods, emergency generators, loading docks, idling trucks, etc., is not pulled into the building through make-up or fresh air intakes.

1. Vehicles: Outdoor Service Areas
   a) Equipment: Front-end Loader: (updated11/19/04 and 8/9/05)
      Special Considerations:
Used for trash and cardboard dumpsters

- Height: 12.5'
- Wheel Base: 237" (19.5')
- Width: 97" (8' 1'"
- Overhead clearance with can in raised position: 18.5'
- Turning radius: 46'
- Turning diameter: 97'
- Track: 78.6" (approx. 6'6")
- Total length with boom overhang and arms extended: 41'
- Total overall length of truck (with boom overhang): 37'
- Truck length without boom: 35'
- Front overhang: 50" (4'2'"
- Fork length: 4'
- Boom arms front of bumper overhang: 24"

Empty scale weight: 40,400 pounds
Total gross vehicle weight: 75,020 pounds (the maximum without being over weight limits)
Front axle weight: 18,000 pounds
Empty trash dumpster estimated weight: 700 pounds
Full trash dumpster estimated weight: 1,600 pounds

See the Site and Space Planning (http://www.fac.unc.edu/OWRRGuidelines/?Topic=OutdoorSpace) or Containers and Equipment (http://www.fac.unc.edu/OWRRGuidelines/?topic=Equipment) pages for more information.

b) Equipment: Roll-off Truck: (update 5/15/09)

Special Considerations:

Used for rolloff containers and horizontal compactors

- Truck length: 34’9”
- Truck wheelbase: 27’
- Turning radius: 65’
- Front overhang: 3’
- Rear overhang: 5’3”
- Typical distance from ground to top of hoist rail = 40-44"
- Width: 11’ with mirrors
- Height: 12’ with exhaust pipe
- Overhead clearance needed = 18-24’
- Container length: 21-23’
- Total length when being picked up: “~52’

See the Site and Space Planning (http://www.fac.unc.edu/OWRRGuidelines/?Topic=OutdoorSpace) or Containers and Equipment (http://www.fac.unc.edu/OWRRGuidelines/?topic=Equipment) pages for more information.

For more information, contact truck manufacturer or service provider. Marathon Equipment has detailed information on rolloff hoist trucks.
c) Equipment: Outdoor Recycling Truck: (update 6/18/07)

**Special Considerations:**

*Used for collection of carts from outdoor service areas*

- Length: 35'
- Width: 10'
- Height: 10'2"
- Turning radius: 38-40°
- Overhead Clearance: 15’ with bucket and container

See the Site and Space Planning (http://www.fac.unc.edu/OWRRGuidelines/?Topic=OutdoorSpace) or Containers and Equipment (http://www.fac.unc.edu/OWRRGuidelines/?topic=Equipment) pages for more information.

d) Equipment: Food Waste and Animal Bedding Collection: (updated 6/18/07)

**Special Considerations:**

*Used for collection of food waste and animal bedding carts*

- Tri-Axle Width: 8', 10' including mirrors; 12' minimum clearance, ideal is 16' for straight back-in approach
- Length: 28'
- Height: 12'
- Overhead Clearance: 22.5' with dump extended

See the Site and Space Planning (http://www.fac.unc.edu/OWRRGuidelines/?Topic=OutdoorSpace) or Containers and Equipment (http://www.fac.unc.edu/OWRRGuidelines/?topic=Equipment) pages for more information.

e) Equipment: Grease Collection:

**Special Considerations:**

*Used for collection of cooking grease*

- Truck used to collect drums:
  - General: Similar to a small dump truck
  - Weight: 30,000 lbs. (empty)
  - Height: 13'
- Truck used to collect from small dumpster type containers:
  - General: Tractor trailer
  - Height: 12'
- Turning radius:
  - Overhead clearance: 25' (12-13' boom)

See the Site and Space Planning (http://www.fac.unc.edu/OWRRGuidelines/?Topic=OutdoorSpace) or Containers and Equipment (http://www.fac.unc.edu/OWRRGuidelines/?topic=Equipment) pages for more information.

f) Equipment: OWRR collection vehicle: (updated)

**Special Considerations:**
20 cubic yard (was used by OWRR for animal bedding and is now used for collection of other materials as needed)
Length: 26'
Width: 11' with mirrors
Height: 12.5'
Empty Weight: 27,000 pounds
Gross Vehicle Weight: 40,000 pounds
See the Site and Space Planning (http://www.fac.unc.edu/OWRGGuidelines/?Topic=OutdoorSpace) or Containers and Equipment (http://www.fac.unc.edu/OWRGGuidelines/?topic=Equipment) pages for more information.

2. Vehicles: Indoor Recycling
   a) Equipment: Indoor Recycling Truck:
      Special Considerations: Used for indoor recycling collection
      Length: 26' (28.5' with lift gate extended)
      Width: 11' with mirrors (8' wheel base)
      Height: 13.5'
      Turning radius: 75' (cab over truck: 35-40')
      See the Site and Space Planning (http://www.fac.unc.edu/OWRGGuidelines/?Topic=OutdoorSpace) or Containers and Equipment (http://www.fac.unc.edu/OWRGGuidelines/?topic=Equipment) pages for more information.
   b) Equipment: Box Van:
      Special Considerations: Used for confidential paper collection
      Length: 14' body
      Width: 11' with mirrors

3. Vehicles: Walkway Recycling
   a) Equipment: John Deere Gator:
      Special Considerations: Used by OWRR for collection of materials from walkway
      Length: 102" (8.83')
      Height: 43.6' (3.63')
      Turning clearance: 24.8'
      See the Site and Space Planning (http://www.fac.unc.edu/OWRGGuidelines/?Topic=OutdoorSpace) or Containers and Equipment (http://www.fac.unc.edu/OWRGGuidelines/?topic=Equipment) pages for more information.
II. CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT

The University, State, Orange County and Chapel Hill are committed to reducing waste and the use of landfills. Waste reduction and recycling practices aren't limited to routine day-to-day functions and events on campus; they also apply to construction and renovation activities. Construction waste management practices include deconstruction, reuse, salvage, recycling and disposal.

Executive Order 156 calls on all state agencies to: "seek opportunities to reduce environmental impacts associated with capital improvements throughout project planning, site and building design, and construction. Agencies shall, to the extent feasible and practicable, implement project initiatives or modifications that result in energy efficiency, water conservation, pollution prevention, solid waste reduction, and land preservation during the construction and operation of agency facilities."

Proper waste management and waste avoidance are to be considered in decisions made during all stages of the capital project planning and construction process. Those involved with the design and construction of buildings on campus are to have the knowledge and resources needed to avoid waste and manage the resulting waste in a manner that allows for the least environmental impact.

A construction and demolition waste plan is required for all projects. Contractors are required to develop their waste management plan jointly with the University Office of Waste Reduction and Recycling. OWRR can direct contractors to local markets for recyclable materials. The Orange County Regulated Recyclable Materials Ordinance bans cardboard, metals, clean wood waste, and pallets from county landfills. Waste haulers must obtain a license from the Orange County Solid Waste Office.

A. CONSTRUCTION WASTE MANAGEMENT HIERARCHY

<table>
<thead>
<tr>
<th>Building Materials and Components</th>
<th>Fixtures, Furniture and Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reuse in project</td>
<td>Reuse by department</td>
</tr>
<tr>
<td>Reuse on campus</td>
<td>Reuse on campus</td>
</tr>
<tr>
<td>Recycle (grinding wood for mulch, metal shelves recycled)</td>
<td>Sell through Surplus (on-site if appropriate)</td>
</tr>
<tr>
<td>Disposal (in accordance with state regulations)</td>
<td>Disposal in accordance with state regulations</td>
</tr>
<tr>
<td>Marble bathroom partitions, slate roofing, mechanical equipment, stone, carpet, fixed furniture, auditorium seats, wall cabinets</td>
<td>Bulletin boards, clocks, pencil sharpeners, desks, chairs, lab equipment, a/v equipment, capital assets</td>
</tr>
</tbody>
</table>

B. REQUIREMENTS

This information must be included in the spec book for each project. Any changes must be approved by OWRR.

1. 01060 Regulatory Requirements

   The Contractor shall be responsible for knowing and complying with regulatory requirements - Federal, State and Local - pertaining to legal disposal of all construction and demolition waste materials, including but not limited to the following:
   a) N.C. General Statute 130A
      i. Whole Tires as of March 1, 1990 banned in landfills.
      ii. Used Oil as of October 1, 1990, banned in landfills.
iv. Aluminum Cans as of July 1, 1994, banned in landfills or incinerators.


b) Orange County Regulated Recyclable Materials Ordinance requires cardboard, clean wood, scrap metal and pallets to be either source separated or taken in mixed loads to a permitted facility (contact OWRR or Orange County Solid Waste (http://www.co.orange.nc.us/recycling/candd.asp) at 919/968-2788 for a list of facilities). It also requires that anyone hauling these wastes in a vehicle that is 9,000 lb. or greater within Orange County must have a license. Contact Orange County Solid Waste to obtain a license. All containers (dumpsters, rolloffs, compactors) for regulated materials must display a unique identifying number at least 3” high, along with the name of the owner or hauler.


2. 01505 Construction Waste Management

   a) WASTE MANAGEMENT DEFINITIONS

   Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.

   Commingling: Mixing recyclable C/D material in one waste container. Materials Recovery Facilities (MRF) exist to sort and recycle commingled materials off-site.

   Construction and Demolition Waste: Includes all non-hazardous solid wastes resulting from construction, renovations, alterations, repair, and demolition.

   Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitability, corrosiveness, toxicity or reactivity.

   Material Recovery Facility (MRF): A processing facility designed to sort and separate recyclables based on market needs and material components.

   Non-hazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitability, corrosiveness, toxicity, or reactivity.

   Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.

   Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.

   Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste. Can be conducted on-site (as in the grinding of concrete and reuse on-site).

   Return: To give back reusable items or unused products to vendors for credit.

   Reuse: To reuse a construction waste material without altering its form on the Project site or elsewhere.
Salvage: To remove a waste material from the Project site to another site for resale or reuse by others.

Sediment: Soil and other debris that has been eroded and transported by storm or well production runoff water.

Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste in order to reuse or recycle them.

Toxic: Poisonous to humans either immediately or after a period of exposure.

Trash: Any product or material unable to be reused, returned, recycled, or salvaged.

Volatile Organic Compounds (VOCs): Chemical compounds common in and emitted by many building products over time through offgassing: solvents in paints and other coatings; wood preservatives; strippers and household cleaners; adhesives in particleboard, fiberboard, and some plywood; and foam insulation. When released, VOCs can contribute to the formation of smog and can cause respiratory tract problems, headaches, eye irritations, nausea, damage to the liver, kidneys, and central nervous system, and possibly cancer.

Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

Waste Management Plan: A Project-related plan for the collection, transportation, and disposal of the waste generated at the construction site. The purpose of the plan is to ultimately prolong the useable life of waste materials and reduce the amount of material being landfilled.

b) WASTE MANAGEMENT GOALS

Within the limits of the construction schedule, contract sum, and available materials, equipment, products and services, the Owner has established that this Project shall generate the least amount of waste possible and employ processes that ensure the generation of as little waste as possible. This expectation is consistent with:

i. The 1997 “Statement on Voluntary Measures to Reduce, Recover, and Reuse Building Construction Site Waste” released by the American Institute of Architects and the Associated General Contractors of America

ii. Federal Executive Order 13101

iii. EPA Comprehensive Procurement Guidelines (CPG)


The Contractor shall develop, for the Architect’s and owner’s review, a Waste Management Plan (http://www.fac.unc.edu/OWRRGuidelines/?Topic=cdSpec01505#DRAFT%20WASTE%20MANAGEMENT%20PLAN) for this Project consistent with these goals.

i. Minimize the amount of C/D (construction and demolition) waste initially generated by such methods as efficient use of materials, appropriate planning, proper storage, prevention of breakage and damage to materials, avoidance of excess packaging and source separation of waste.

ii. Of the inevitable waste that is generated, as many of the waste materials as economically feasible shall be reused, salvaged, or recycled. Waste disposal in landfills shall be minimized. Consistent with LEED criteria, the project goal is to reuse, salvage, or recycle a minimum of 50% of the wastes generated by weight on demolition/renovation projects and 75% on new construction.
iii. Use recycled, salvaged, renewable and recyclable building materials.

c) DRAFT WASTE MANAGEMENT PLAN
The Contractor shall provide, to the Owner and Architect, a Draft Waste Management Plan within 5 business days after receipt of Notice to Proceed or prior to any waste removal, whichever occurs sooner. Consistent with Orange County ordinances and in order to achieve the waste diversion goals listed above, the Contractor may choose to separate waste and recyclables on-site or use a combination of source separation and a C/D sorting facility permitted by Orange County. The Contractor will submit the draft and final plans electronically on forms provided by OWRR. See www.fac.unc.edu/OWRRGuidelines (C/D Forms and Printed Materials).

The Draft Waste Management Plan shall contain the following:

i. Waste assessment:
   An analysis of the proposed jobsite wastes to be generated, including types and estimated quantities. This includes salvageable materials as well as recyclables and trash.

1. Materials for reuse in project: (Designer modifies list as appropriate.)
   a. Slate roof
   b. Wood flooring
   c. Brick pavers
   d. Stone walls
   e. Architectural details
   f. Building equipment
   g. Program equipment

2. Materials for reuse on campus:
   Contractor delivers to Owner. (Designer lists materials here)

3. Materials which must be recycled by law (also see Section 01060 Regulatory Requirements):
   a. Beverage containers
   b. Cardboard
   c. Clean dimensional wood and pallets
   d. Scrap metal, including but not limited to metals from banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized sheet steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze
   e. White goods

4. Materials to be recycled (project specific):
   Designer lists materials here.

5. Suggested salvageable materials: Designer lists materials here.
   a. Slate roof
   b. Wood flooring
   c. Brick pavers
   d. Stone walls
   e. Architectural details
f. Building equipment  
g. Program equipment

6. Other recyclable materials to be considered include (but are not limited to):
   a. Asphalt  
b. Bricks  
c. Ceiling tile  
d. Concrete  
e. Concrete Masonry Units (CMU)  
f. Drywall  
g. Paint  
h. Plastic buckets

ii. Landfill options:
   The name of the landfill(s) where trash will be disposed of, the applicable landfill tipping fee(s), and the estimated cost of disposing of all Project waste in the landfill(s). This estimate will be used as a baseline for recycling/salvage cost comparison.

iii. Waste Diversion Economic Analysis:
   A list of each material proposed to be salvaged, reused, or recycled during the course of the Project, the proposed local market for each material, and the estimated net cost savings or additional costs resulting from separating and recycling (versus landfills) each material. "Net" means that the following have been subtracted from the cost of separating and recycling:
   1. revenue from the sale of recycled or salvaged materials  
   2. landfill tipping fees saved due to diversion of materials from the landfill  
   3. replacement value of materials reused in the project  
   For a list of markets and resources, see [www.fac.unc.edu/OWRRGuidelines](http://www.fac.unc.edu/OWRRGuidelines) (C/D Resources and Links).
   Also see Specification 02070 Selective Demolition for information regarding items to be salvaged.

d) FINAL WASTE MANAGEMENT PLAN

Once the Owner has determined which of the recycling options addressed in the Draft Waste Management Plan are acceptable, the Contractor shall provide a Final Waste Management Plan within 5 business days.

The Final Waste Management Plan shall contain the following:
   i. Contact information:
      The name and contact information of who will be responsible for implementing the Solid Waste Management Plan.
   ii. Meetings/instruction:
      A description of the regular meetings to be held to address waste management.
   iii. Waste assessment:
      An analysis of the proposed jobsite wastes to be generated, including types and estimated quantities.
   iv. Alternatives to landfills:
A list of each material proposed to be salvaged, reused, or recycled during the course of the Project.

v. Landfilling information:
The name of the landfill(s) where trash will be disposed of, the applicable landfill tipping fee(s), and the estimated quantity of waste to be landfilled.

vi. Materials Handling Procedures:
A description of the means by which any waste materials identified in items 4 and 5 above will be protected from contamination, and a description of the means to be employed in handling the above materials consistent with requirements for acceptance by designated facilities.

vii. Transportation:
A description of the means of transportation of recyclable materials and waste (whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site) and destination of materials.

viii. Cost estimate summary:
The estimated cost of implementing the final solid waste management plan, broken down by material.

ix. Copy of Orange County RRMO hauling license:
This license is required for any vehicle over 9000 lbs GVW hauling RRMO materials (see 01060). It must be renewed annually. Contact Orange County Solid Waste Management at 968-2800 ext. 163 for more info.

e) IMPLEMENTATION AND DOCUMENTATION OF WASTE MANAGEMENT PLAN

i. Manager:
The Contractor shall designate an on-site party (or parties) responsible for instructing workers and overseeing and documenting results of the Waste Management Plan for the Project. This contact will notify OWRR immediately should any deviance from the Final Waste Management plan be necessary.

ii. Distribution:
The Contractor shall distribute copies of the Waste Management Plan to the Job Site Foremen, Subcontractors, the Owner, and the Architect.

iii. Instruction:
The Contractor shall provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the Project.

iv. Separation facilities:
The Contractor shall designate and label a specific area to facilitate separation of materials for potential recycling, salvage, reuse, and return. Recycling and waste bin areas are to be kept neat and clean and clearly marked in order to avoid contamination of materials.

v. Hazardous wastes:
Hazardous wastes shall be separated, stored, and disposed of according to local regulations.

vi. Documentation:
The Contractor shall submit with each Application for Progress Payment a Summary of Waste Generated by the Project. Failure to submit this information shall render the Application for Payment incomplete and shall delay Progress Payment. The Summary shall be submitted on a form acceptable to the Owner and shall contain the following information. For electronic forms see http://www.fac.unc.edu/OWRRGuidelines/ (C/D Forms and Printed Materials).

1. Disposal information:
   a. amount (in tons or cubic yards) of material landfilled from the Project
   b. identity of the landfill
   c. total amount of tipping fees paid at the landfill
   d. total disposal cost (including transportation and container rental)
   e. weight tickets, manifests, receipts, and invoices (attach copies)

2. Recycling information:
   a. amount (in tons or cubic yards)
   b. date removed from the jobsite
   c. receiving party
   d. transportation cost
   e. amount of any money paid or received for the recycled or salvaged material
   f. net total cost or savings of salvage or recycling each material
   g. manifests, weight tickets, receipts, and invoices (attach copies)

3. Reuse and salvage information:
   a. list of items salvaged for reuse on project or campus
   b. amount (in tons or cubic yards)
   c. receiving party or storage location
   d. net savings (avoided tip fee and cost difference of item purchased new)

   vii. Revenues:
       Revenues or other savings obtained from recycled, reused, or salvaged materials shall accrue to contractor unless otherwise noted in the contract documents

3. 02070 Selective Demolition
   a) Demolition
      Proper coordination for the shut-off of utility services and control measures for dust and noise must occur prior to commencement of any demolition work. Considerations must be given to on-going University activities in adjacent areas. In confined areas of selective demolition, install and maintain dust and noise control barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove these protection measures after demolition operations are completed.
      Maintain and protect existing building services which transit the area affected by selective demolition.
      Completely remove all equipment noted for removal including all associated devices, controls, conduit, wiring, etc. Remove all exposed conduit and wiring back to the panel from which it is served. Mark all disassociated breakers "spare". Unless otherwise noted, the Contractor shall fill and patch all wall, floor, and ceiling openings resulting from this demolition work with materials and finishes identical to adjacent materials and finished. Unless otherwise noted, remove all wiring devices, fixtures, controls, circuitry (conduit and wiring), etc., made obsolete by the demolition within or around the building.
The Contractor shall relocate all existing piping, circuitry (conduit and wiring), ductwork, etc., which impedes the installation of new materials and equipment, unless otherwise noted.

Demolish, remove, demount, and disconnect the following:

i. Inactive and obsolete piping, fitting and specialties, equipment, ductwork, controls, fixtures, and insulation.

ii. Piping and ducts embedded in floors, wall, and ceiling may remain if such materials do not interfere with new installation. Remove materials above accessible ceilings. Drain and cap piping and ducts allowed to remain.

All demolition which involves the removal or disturbance of Asbestos Containing fireproofing, finish material, insulation or other asbestos containing material shall be performed in strict accordance with the Division of State Construction "Specifications for Asbestos Abatement" and must be approved by the University’s Department of Environment, Health and Safety.

Notify the Department of Environment, Health and Safety (919) 962-5507 if any underground tanks are removed from the ground on the construction site.

Demolition activities that affect parking, vehicle or pedestrian traffic must be approved by UNC Department of Public Safety at (919) 962-8100 prior to work commencing.

Notify the Department of Environment, Health and Safety at (919) 962-9752 for information on proper disposal of ballasts and fluorescent light bulbs.

Prior to building demolition, the Department of Environment, Health and Safety should be contacted at (919) 962-5507 to review the project for potential mercury containing equipment such as piping in dental and scientific buildings, thermostats, and switches.

b) Disposal of Equipment and Materials

The Contractor shall remove all generated trash, recyclables and debris (including, for example, old carpeting) at his or her expense. The Contractor may not place this trash and debris in University dumpsters. The Owner, acting through the Designer, shall retain the right to direct the disposal of salvageable equipment and materials (such as metals, cardboard, plastics, paper, glass, and blueprints). The Contractor will comply with all requirements as outlined in 01505 (Construction Waste Management) and 01060 (Regulatory Requirements). After selective demolition is complete, submit a list of items that have been removed and salvaged.

The University, as a State institution, is accountable for controlled property and equipment including electrical, mechanical, and plumbing equipment. No equipment is given to the Contractor unless specifically listed in the job specifications prior to contract award. The Contractor shall deliver any surplus equipment to the Surplus Property Warehouse and return a receipt for the equipment to the Facilities Services Data Control Office.

For equipment retained by the Contractor under the contract, the Contractor shall remove the equipment control decals and return them to the Facilities Services preventive maintenance shop or the University's Asset Manager. Do not disturb equipment or fixtures bearing a hazardous, biological or radiological warning sign in any way until authorized by the University Department of Environment, Health and Safety Office who will remove or obliterate the warning sign.

c) Definitions

Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.
Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

d) Execution
i. Removed and Salvaged Items:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning. Identify contents of containers.
   3. Store items in a secure area until delivery to Owner.
   4. Transport items to storage area designated by Owner, Contractor or other authorized party.
   5. Protect items from damage during transport and storage.

ii. Removed and Reinstalled Items:
   1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
   2. Pack or crate items after cleaning and repairing. Identify contents of containers.
   3. Protect items from damage during transport and storage.
   4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

iii. Existing Items to Remain:
   Protect construction indicated to remain against damage and soiling during selective demolition.
   When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

C. DESIGN REQUIREMENTS
   1. Building Material Salvage
      a) General:
         This section refers to the building components such as slate roofing, brick pavers, stone, marble bathroom partitions, doors, windows, architectural elements.
      b) Hierarchy:
         i. Reuse in project
         ii. Reuse on campus
         iii. Recycle (grinding wood for mulch, metal shelves sent to scrap yard)
         iv. Disposal (in accordance with state regulations)
      c) Building Material Walkthrough and Inventory of Valuable & Reusable Materials:
         To identify existing materials that can be reused in the project, the designer (with UNC Design Manager, OWRR and customer) perform an initial walkthrough of the building in the schematic design phase.
         The project creates an initial inventory of valuable and reusable materials.
They evaluate the reuse of these materials back into the project. The inventory of materials to be reused in the project, salvaged for use in other projects, or to be recycled is to be included in Section 01505.

d) Reuse in Project:
For materials to be reused in the project, the Designer will create a detailed plan for removal, refurbishment, storage, and reinstallation of said materials to be included in Section 02070.

e) Reuse in Other Projects:
Information about any valuable materials not being reused (i.e. slate roofing) should be shared with other UNC Planning Managers and Building Services Supervisors. For materials to be reused in other projects on campus, the UNC Planning Managers or Building Services Supervisors will work together to create a salvage plan.

f) Recycle and Off-Campus Salvage:
The designers should use the inventory of remaining materials in coordination with OWRR to create a list of project specific materials required and suggested to be recycled to assist the Contractor in the creation of a Solid Waste Management Plan. This list should be developed in coordination with OWRR and included in Section 01505, Section C, Draft Solid Waste Management Plan.

g) Disposal:
Disposal is in accordance with state and local regulations. See Section 01060 for more information.

2. **Fixtures, Furniture and Equipment Salvage**

a) General:
This refers to bulletin boards, clocks, pencil sharpeners, desks, chairs, lab equipment, kitchen equipment, audio visual equipment, capital assets, etc. Making sure that everything in the building is removed from the building and relocated or properly disposed of is very important. For this to happen smoothly and efficiently, communication and coordination between the Designer, the owning department, the move coordinator, the UNC design and construction managers, Surplus Property, the movers, and OWRR is required.

b) Hierarchy:
   i. Reuse by department
   ii. Reuse on campus
   iii. Sell through Surplus (on-site if appropriate)
   iv. Disposal in accordance with state regulations

c) Fixtures, Furniture and Equipment Walkthrough and Inventory
The Designer (with the help of UNC Design Manager) organizes a walkthrough of building with maintenance shops, Surplus, and OWRR during the Design Development phase to provide adequate time for prioritizing and planning salvage. The purpose of this walkthrough is to evaluate a list of fixtures, furniture and equipment to be managed in accordance with the FF&E salvage hierarchy: reuse by the department, reuse on campus, sell through surplus (on-site, if appropriate) and disposal in accordance with state regulations.

d) Salvage List:
A list is generated detailing items to be salvaged and who will be responsible for removing, transporting, and storing said items. This list is to be distributed to the UNC Planning Manager, shops, Surplus, OWRR, and department representatives.

e) Surplus Property:
An inventory of any moveable furniture and equipment not being reused needs to be provided to Surplus. Options for handling excess furniture may include:

i. transfer to other departments (Business Managers may be contacted and notified of available equipment

ii. sell onsite using a Surplus framework, or

iii. transport to the UNC Surplus Warehouse to be sold

f) Departmental Responsibilities:
It is the owning department's responsible to make sure that the proper asset management and surplus property forms have been completed. The owning department must also arrange for the transportation of any surplus moveable furniture and equipment to the surplus warehouse. For more guidance, please refer to the UNC-Chapel Hill Design Guidelines Chapter IV: Moving Procedures for Bond Projects.

g) Shop Follow Up:
The shops will report back to the UNC Planning Manager and OWRR when they have completed their salvage. This work will take place before the Contractor takes possession of the building, if possible. Any other arrangement must be detailed on the plans.

h) Cost Estimate:
The Designer will also, as part of their cost estimate, break out the cost and any benefit of any salvage and reuse compared to purchasing new building materials or fixtures, furniture and equipment. This will be used to prioritize salvage and recycling options, and should be completed during the Design Development phase.

i) Scheduling:
Time for salvage and moving furniture must be considered when creating the project schedule. It is important to think about the appropriate condition of a building at the time of transfer to the Contractor. Asbestos abatement often requires that all furniture and trash be removed prior to beginning work.

j) Construction Documents:
Any salvage involving the Contractor is to be clearly designated on the Construction Document set of plans.
As appropriate, any equipment or fixtures of interest that will be left as part of the project should be included in Section 01505 to assist the contractor with the preparation of a solid waste management plan. They may be included in the project specific salvage and recycling requirements or in the list optional materials for which salvage and recycling options are to be evaluated by the contractor.
All moveable furniture and equipment should be removed prior to the contractor taking possession of the building.

D. CONSTRUCTION REQUIREMENTS

1. Meetings
   a) Pre-Bid:
OWRR must be placed on the pre-bid meeting agenda to discuss regulatory requirements, the required solid waste management plan, and distribute resource lists to the bidders.
b) Pre-Construction:
OWRR must be placed on the pre-construction meeting agenda to review the above topics, meet or get the contact info for the project contact, and discuss monthly reporting requirements.

c) Solid Waste Management Planning Meeting:

Prior to the creation of the Final Solid Waste Management Plan, a meeting is needed to review the Draft Plan and discuss monthly reporting requirements. This meeting is to include the Contractor, the UNC Construction Manager, and OWRR’s Construction and Demolition Waste Specialist. Subcontractors may also be included in this meeting or subsequent follow up meetings, as necessary.

d) Progress and Follow Up:
Throughout the construction process and prior to project completion, OWRR, the Construction Manager, or the Contractor may request periodic meetings to discuss progress or difficulties encountered with the development, implementation or reporting of plan requirements.

2. Planning and Implementation
   a) Draft Plan:
The Contractor is required to submit a Draft Solid Waste Management Plan (Section 01505) five days from Notice to Proceed OR prior to removal of ANY waste from job site, whichever occurs first. The draft should be completed and submitted electronically. To expedite the plan review, it is to be submitted simultaneously to the Designer and OWRR in order to expedite plan review.

   b) Final Plan:
Once OWRR has communicated requested changes, the Contractor has five business days to submit a Final Solid Waste Management Plan (Section 01505). Any deviance from the final SWMP must be approved by OWRR.

3. Documentation
   c) Monthly Solid Waste Management Plan Reporting:
In accordance with Section 01505, each month the Contractor must submit documentation (weight tickets, manifests, etc.) of the disposal, recycling, reuse, and salvage of all materials and a summary with each Payment Application. Failure to do so may delay payment. This submittal must be in an OWRR approved format and the summary must be filled out electronically.

   d) Selective Demolition Reporting:
In accordance with Section 02070, items or materials identified during the design process for salvage or reuse must be identified on the plans and in construction documents. Also, the University, as a State institution, is accountable for controlled property and equipment including electrical, mechanical, and plumbing equipment. The Contractor shall deliver any surplus equipment to the Surplus Property Warehouse and return a receipt for the equipment to the Facilities Services Data Control Office.

   e) Project Close-Out Reporting:
At the completion of the project, the design team is to provide OWRR and the UNC Construction Manager with a summary of recycling, reuse and salvage activities for the project. This is to include, but is not limited to:

i. quantities landfilled, recycled, reused, and salvaged;

ii. a break down of the types of materials recycled, reused and salvaged; the percent of total waste of each of the categories listed;

iii. the destinations of these materials;

iv. the economic impact of these activities on the project; and

v. any success stories or challenges incurred.

E. FORMS AND PRINTED MATERIALS

If the project is outside the University's Development Plan a solid waste management plan may be required by Chapel Hill before the SUP and ZCP will be issued. Contact the Facilities Planning Office for more information on this requirement.

1. **Solid Waste Management Plan Forms**

<table>
<thead>
<tr>
<th>Worksheet and Solid Waste Management Plan (SWMP) Forms: updated 6/18/07</th>
<th>Blank Forms: Excel form this excel spreadsheet contains multiple tabs updated 6/18/07</th>
<th>Requirements: The Draft SWMP is due 5 business days from notice to proceed and before any waste is removed from the job site. The Final SWMP is due 5 business days from receipt of comments from OWRR review of the DRAFT SWMP and before any waste is removed from the job site.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Monthly Reporting:</th>
<th>Blank Forms: Excel form updated 6/18/07</th>
<th>Requirements: Weight tickets and monthly reports are due with payout materials at the end of each month.</th>
</tr>
</thead>
</table>

2. **Inventory and Salvage Forms**

<table>
<thead>
<tr>
<th>Building materials and equipment Furniture and fixtures Who to contact for salvage</th>
<th>Blank Forms: Excel form this excel spreadsheet contains multiple abs updated 6/18/07</th>
<th>Requirements:</th>
</tr>
</thead>
</table>

3. **Regulated Recyclable Material Ordinance (RRMO) Form Info**

<table>
<thead>
<tr>
<th>RRMO Summary:</th>
<th>Forms: Printable PDF (Prepared by Orange County)</th>
<th>Requirements:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>RRMO Flyer:</th>
<th>Forms: Printable PDF (Prepared by OWRR.)</th>
<th>Requirements: This handout provides a brief summary of the RRMO for contractors and their employees.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>RRMO Hauling Application</th>
<th>Forms: License Application PDF</th>
<th>Requirements: Any truck hauling regulated materials in Orange County with a</th>
</tr>
</thead>
</table>
RRMO Recyclable Material Permit:

<table>
<thead>
<tr>
<th>Company</th>
<th>Material</th>
<th>Contact</th>
<th>Phone Number</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armstrong</td>
<td>ceiling tile</td>
<td>Janine Onufrak Rydin</td>
<td>(888) 234-5464 x8083</td>
<td>will visit building to assess tile [<a href="http://www.armstrong.com/commceilings">www.armstrong.com/commceilings</a> na/environmental.html](<a href="http://www.armstrong.com/commceilings">http://www.armstrong.com/commceilings</a> na/environmental.html)</td>
</tr>
<tr>
<td>B&amp;B Topsoil</td>
<td>clean (unpainted) drywall scrap</td>
<td>George Andrews</td>
<td>919-477-6328</td>
<td>no minimum quantity - call before coming</td>
</tr>
<tr>
<td>Habitat for Humanity (Wake)</td>
<td>strips out, deconstruction</td>
<td>Joel Lubell</td>
<td>(919) 833-1999 x231</td>
<td>[<a href="http://www.habitatwake.org/Reuse">http://www.habitatwake.org/Reuse</a> donate.htm](<a href="http://www.habitatwake.org/Reuse">http://www.habitatwake.org/Reuse</a> donate.htm)</td>
</tr>
<tr>
<td>Interface</td>
<td>carpet</td>
<td>Michel Belland</td>
<td>(800) 336-0225 x1334</td>
<td>will visit building to assess carpet (wants vinyl-backed)</td>
</tr>
<tr>
<td>International Aggregate</td>
<td>plumbing fixtures, bricks, concrete blocks (no plastic tile), asphalt</td>
<td>Derwin Charles</td>
<td>(336) 364-1436 (updated 2/9/07)</td>
<td>dump yard is located at Hwy 70 and I85 in Durham</td>
</tr>
<tr>
<td>Mellott Contractors &amp; Supply Company, Inc</td>
<td>top soil, concrete w/ metal (if thick enough), rock, and trees for mulch</td>
<td>Calvin Mellott</td>
<td>(919) 967-2441</td>
<td></td>
</tr>
<tr>
<td>OK Sales</td>
<td>big electrical switches, scrap metal</td>
<td>Tim Griggs</td>
<td>(336) 227-1938</td>
<td>will visit building to bid</td>
</tr>
</tbody>
</table>

F. REPORTS, PRESENTATIONS, AND ARTICLES

1. Visit the link below for more information:

G. RESOURCES AND LINKS

1. Recycling and Salvage Resources [Updated on 9/27/05, 6/18/07]
Orange County Landfill | scrap metal, clean wood waste, white goods (refrigerants removed) | Rob Taylor | (919) 932-2989 | must be separated, no or reduced tip fee

Peters Design Works | Sales, restoration and re-creation of antique and architectural materials. | Steve Peters | (919)599-0124 | interested in architectural features

Strategic Materials | They accept plate glass and will spot a rolloff. They also accept borosilicate glass. | Dan Grassi, Plant Manager | (919) 596-9883 | The fee depends on the quality and quantity. They will come and evaluate glass. strategicmaterials.com

Sustainable Living | whole buildings | Brad Lessler | (919) 260-6647 | moves houses www.sustainableliving.com

2. Approved Mixed Load Facilities— Permitted by Orange County (RRMO)
   [Updated on: 9/27/05, 7/23/08]
   Coble Sandrock
   5833 Foster Store Road
   Liberty, NC 27298
   (336) 565-4750
   WCA
   421 Raleigh View Rd.
   Raleigh, NC 27610
   (919) 866-1211
   This facility’s recycling rate for 2008 was 34.2%.

3. Results: [Under construction!]
   a) Project Summaries:
      Under construction.
   b) News/Articles:
      To be added: examples include Gazette articles, the one for Orange County, sustainability report—all press releases
   c) Presentations:
      OWRR Guidelines: Summary, Changes Highlighted, and Requirements by Phase
      (http://www.fac.unc.edu/OWRRGuidelines/Presentations/owrrguidelines_fp_edits.pdf)
      This presentation is a review of the OWRR webpage features and highlights recent changes to the requirements. (added 6/13/06)
      UNC-CH Construction and Demolition Waste Management and Site & Space Planning
      (http://www.fac.unc.edu/OWRRGuidelines/Presentations/UNC_CDWaste.pdf)
      This presentation highlights construction and demolition waste planning issues and various
project results. It also gives a brief overview of the site and space planning section of this webpage (i.e. indoor, outdoor and walkway recycling in completed projects). CD2004.pdf (http://www.fac.unc.edu/OWRRGuidelines/Presentations/CD2004.pdf)  
Note: The Murphey project used a combination of source separation and a mixed load processor.

4. Deconstruction, Reuse, Salvage, Recycling and Demolition Links
[Updated on: 9/27/05]
   a) North Carolina
      • Deconstruction Institute - www.deconstructioninstitute.com
         This site provides "educational materials, tools and techniques, networking, case studies, articles, facts about the environmental impacts of deconstructing, and many other downloadable and interactive modules."
      • Durham Deconstruction Links - www.ci.durham.nc.us/departments/solid/deconstruction.cfm
      • Durham A-Z Recyclery - www.ci.durham.nc.us/departments/solid/recycle_index.cfm
         Search by Construction and Demolition Materials. Sponsored by the North Carolina Division of Pollution Prevention and Environmental Assistance (DPPEA).
      • North Carolina Waste Trader - www.ncwastetrader.org/home.aspx
         Post or find surplus materials or items.
      • Orange Community Recycling - www.co.orange.nc.us/recycling/
      • Orange County Regulated Recyclable Material Ordinance - www.co.orange.nc.us/recycling/ordinance.asp
      • Orange County Solid Waste Management - www.co.orange.nc.us/recycling/
      • Triangle-J Council of Governments Waste Spec - www.tjcog.dst.nc.us/cdwaste.htm
         This is a comprehensive guide to requirements and information regarding C&D recycling.
   b) National
      • Building Materials Reuse Association- www.ubma.org/
         The members of this non-profit are involved in the deconstruction of buildings and reuse of salvaged materials.
      • Institution Recycling Network - www.wastemiser.com
         "We provide a single point of contact to handle everything related to recycling: planning, training, on-site management, hauling, and marketing the recycled materials. We assure that waste management fits seamlessly into the project. Recycling does not need to get in the way, slow the job down, or take up extra space. On the contrary, recycling makes for a safer and more productive work site."
      • Green Goat - www.greengoat.org (moved from NC to nat'l)
         "Green Goat, a non-profit, works with architects, contractors, and manufacturers to put used building materials back into other structures and even other industries. We save companies disposal costs through salvage and recycling, help them stay in compliance with regulations, and help them win new clients!
      • California Integrated Waste Management Board (CIWMB) C&D Home Page - www.ciwmb.ca.gov/ConDemo/
- National Association of Home Builders (NAHB): C&D Toolbase Technote -
  www.nahbrc.org/g/
  This is a good overview of C&D issues and resources.
- New York City’s Department of Design and Construction -
  Information about C&D debris recycling NYC Dept. of Design and Construction
- Oakland Recycles C&D Waste Management Forms -
  www.oaklandpw.com/oakrecycles/construction/forms.htm
- WasteCap Wisconsin C&D Recycling Facts and Worksheet -
  http://www.wastecapwi.org/candd.htm
  This site provides specifications, case studies an easy to read fact sheet and sample forms for calculating the percent of recyclable material from a project. (link updated 3/31/06)

c) University Programs
- University of Oregon, Eugene - http://www.uoregon.edu/~recycle/cd.htm
- Washington State University Construction Recycling -
  www.wsu.edu/recycle/construction.html

d) International
- BRE SmartWaste - www.bre.co.uk/services/smartwaste.html
  "The BRE SMARTWaste System is a set of computer-based tools to help your company apply the concept of sustainable waste management. The system monitors construction and demolition wastes, monitors segregation targets, and calculates Environmental Performance Indicators (EPIs). Through close links with SalvoMIE and BREMAP, the system also identifies opportunities for reuse and recycling and the location of suitable facilities for this."
- CIRIA (Formerly known as The Construction Industry Research and Information Association - www.ciria.org/cwr/index.html
  "The intention of this web-site is to encourage waste reduction and improved resource productivity in the building and civil engineering sectors."

e) Recycled Content Building Materials and Products:
- Architectural Salvage News - www.architecturalsalvagenews.com
  "Architectural Salvage News provides readers with valuable sourcing information to help locate suppliers of specialty products, both salvaged and reproduction, and introduces readers in the industry to new tools that help them run their business."
- Products with Recycled Content - www.epa.gov/cpg/products.htm
- Recycled Content Tile - www.terragreenceramics.com/index.html
- Used Building Material Exchange - www.build.recycle.net/index.html

III. ACCESS TO BUILDINGS DURING CONSTRUCTION
In order to maintain services to buildings under construction and adjacent buildings, OWRR and its contractors must be able to access dumpsters and loading docks during all phases of construction and renovation.1 Contact Ray Lanier (919) 962-7175.
The questions and considerations given in this section are designed to ensure continued and efficient solid waste services to campus buildings.
These issues must be addressed and discussed with OWRR throughout the design process.
A. Maintaining Services to Buildings In or Near Construction Areas

1. Will the building be occupied during construction?
   Yes:
The phasing and staging plans must take into consideration the continuation of services throughout the project. (See Staging Plans and Container Removal information pages.)
   No:
Multiple buildings may share a service area. Therefore, it is vital that this be taken into consideration before assuming that dumpsters or carts can be removed or blocked during construction. (See the section below.)
All non-essential containers (dumpster, indoor bins, and carts) must be removed prior to any site work or construction fencing being installed.

2. Will staging, phasing, or fencing impede services to any buildings?
   (See the Site and Space Planning page for a list of services.)
   Yes:
Site drawings must reflect current conditions and plans must reflect temporary changes (See Staging Plans.)
OWRR, Housekeeping, and Parking & Transportation must be consulted and problems resolved satisfactorily for all involved. Vehicular and pedestrian access via walks and ramps must be maintained to dumpsters and buildings.
   No:
Great! If, at any time, unexpected conditions cause access to be temporarily blocked, OWRR must be notified immediately.

B. Staging Plans

1. Existing Conditions:
The existing condition drawings must show the current location of all dumpsters and carts that will be impacted by construction, fencing or traffic pattern shifts.

2. During Construction:
Phasing, staging, and site limit plans must show the temporary location and traffic patterns (vehicular and pedestrian) for all dumpsters and carts temporarily relocated as a result of the project.
All non-essential containers or those to be moved (and the new location), must be denoted on the plans as such. See Container Removal below.

C. Container Removal

1. Outdoor Containers:
The contractor or construction manager must contact OWRR to remove all non-essential containers (dumpster, indoor bins, and carts) prior to beginning any site work or installing any construction fencing.
The site, staging and demolition plans are to read: "Notify the Office of Waste Reduction and Recycling at 962-1442 to remove these containers prior to beginning any construction activities."
Ray Lanier, 962-7175, is the current contact for issues related to outdoor containers and building access.

2. Indoor Containers:
Offices and departments are to clean out files and recyclables prior to evacuating spaces to be renovated.
All indoor recycling bins must be removed prior to construction. If any remaining recycling bins remain in the building, the contractor is to contact OWRR (962-5169) for their removal. Amy Preble (962-5169) is the current contact for issues related to indoor recycling and file purges.

D. Campus Dumpster Use

1. Construction Waste:
   Campus dumpsters and recycling bins are not to be used by contractors and their employees. A Solid Waste Management Plan is required for all campus projects. In the plan, the contractor provides his or her plans for construction and demolition waste management throughout the project.

2. Blocking Dumpsters:
   Dumpsters and service areas are to remain accessible throughout the project and are not to be blocked by construction activity, gates or vehicles at any time. If, at any time, unexpected conditions cause access to be temporarily blocked, OWRR must be notified immediately.

IV. REQUIREMENTS BY PHASE

These pages outline OWRR's expectations and requirements at each phase of the design and construction process. For more information about the designer’s relationship to the University, the project development sequence, design review process, and submittal requirements, see Chapter II of the UNC-Chapel Hill Design Guidelines.

A. Schematic Design (SD)

3. Outdoor Service Area
   List existing recycling and dumpster locations on the existing condition site plans.

4. Indoor
   Amy Preble provides feedback about where recycling locations need to be and gives an overview of indoor recycling requirements.

5. Walkway
   Ray Lanier and Sarah Myers provide feedback about locations.

6. Building Material Assessment and Salvage
   Building Material Walkthrough
   Initial walkthrough by the design team TO DETERMINE what valuable and reusable materials are available for:
   • Reuse in this project,
   • Reuse in other campus projects,
   • Reuse by the general public,
   • Recycled (required and suggested).
   • SD submittal requirement: Valuable & Reusable Building Material Inventory [Initial list at this time]

7. Fixtures, Furniture and Equipment Assessment and Salvage
   Designers and customers begin thinking about what will and will not be reused in the finished project and during temporary housing.
B. Design Development (DD)

1. **Outdoor Service Area**
   Before DD documents are prepared, the design team and the Office of Waste Reduction and Recycling meet to discuss outdoor service area requirements and equipment to be used. Include section 02475 with any relevant site or space planning requirements for this project. Include section 11170 listing requirements, installation information, and suppliers for solid waste handling equipment to be purchased BY the project—at a minimum, this will include compactors.

   Detailed plan sheets showing outdoor service area enclosures, including:
   - screen wall details
   - electrical requirements
   - lighting
   - drainage
   - a list of buildings that the site(s) are intended to serve

   An initial summary sheet listing all the outdoor service area equipment to be used. This will include:
   - the type of equipment (example: 8 yd. cardboard dumpster),
   - the estimated cost,
   - whether the project, FP&C or the customer is purchasing them, and
   - the locations (if there’s more than one building in the project).

2. **Indoor**
   Before DD documents are prepared, the design team and the Office of Waste Reduction and Recycling meet to discuss indoor recycling locations and any special situations. Include section 02475 with any relevant site or space planning requirements for this project. Include Section 12300 Manufactured Casework listing requirements for recycling cabinets.

   Clearly marked locations of all indoor recycling locations -AND- detail sheets showing the plans for any recycling cabinets to be built by the project.

   An initial summary sheet listing all the indoor recycling sites. This will include the:
   - indoor recycling locations,
   - which locations will use cabinets,
   - whether the project, FP&C or the customer is purchasing them, and
   - the amount reserved for cabinets that are not being built by the project.

3. **Walkway**
   Before DD documents are prepared, the design team and the Office of Waste Reduction and Recycling meet to discuss walkway recycling locations and any special situations. Include Section 02870 listing the walkway recycling containers to be used and their placement.

   Clearly marked plans showing the locations of all walkway recycling locations.

   An initial summary sheet listing all the walkway recycling sites. This will include the:
   - walkway recycling locations,
   - whether the project or FP&C is purchasing them, and
   - the amount reserved for walkway bins (assuming that FP&C will be purchasing them).

4. **Access**
   DD Staging plans and site drawings should include plans for access to the building (if occupied) and adjacent buildings such that deliveries and recycling/waste collection services can be maintained.
DD Demo plans shall note the requirement of contacting the Office of Waste Reduction and Recycling to remove indoor and outdoor containers (including dumpsters) as the project phasing affects different areas.

5. **Building Material Assessment and Salvage**

   **Based on Valuable & Reusable Building Material Inventory**

   Reuse in project based on inventory:
   - Discussion and initial decisions by design team and construction manager at risk
   - DD Submittal requirement: Decisions are to be integrated into specs and drawings: 01505, 02070, and appropriate information and drawings.

   Reuse in other projects:
   - Design team and construction manager at risk circulate list to Facilities Planning and other design teams.
   - DD Submittal requirement: Salvage to be listed in 01505, 02070 and appropriate information and drawings.

   Outside salvage/recycle:
   - Market research by design team and construction manager at risk, with assistance from Office of Waste Reduction and Recycling
   - DD Submittal requirement: Any potential recyclables are to be listed in 01505 as a rough list of required and suggested materials. Any salvage is to be listed in 02070 and appropriate information and drawings.

6. **Fixtures, Furniture and Equipment Assessment and Salvage**

   **Fixture, Furniture & Equipment Walkthrough**

   DD Submittal requirement: Fixture, Furniture & Equipment Inventory

   Initial walkthrough by the design team TO DETERMINE what valuable and reusable materials are available.
   - initial list at this time
   - detailed information and quantities on FF&E (Brand, year, etc.).
   - movable items
   - fixed items (list in 01505, 02070, add language to appropriate information and show details on plans (demo and others as needed)

   Reuse in project:
   - Based on inventory--discussion and initial decisions
   - UNC Design Manager, Design Team, consultants (move coordination, interior design, etc.), UNC Interior Design Services, Office of Waste Reduction and Recycling

   Reuse elsewhere on campus:
   - UNC Design Manager, Design Team, Facilities Services Shops, Office of Waste Reduction and Recycling (assists)
   - Circulate inventory to departmental business managers

   Surplus:
   - UNC Design Manager, Design Team, Construction Manager at Risk, Surplus, Office of Waste Reduction and Recycling (assists)
   - Discuss presale or warehouse.
   - Research markets.

7. **01060**

   Standard wording at DD phase
8. 01505
At DD phase, INITIAL lists for building materials and non-moveable FFE of:
- Reuse in this project,
- Reuse in other campus projects,
- Reuse by the general public,
- Recycled (required and suggested).

9. 02070
At DD phase, INITIAL plan for building materials and non-moveable FFE:
- Storage for reuse in Project
- Transfer for reuse on campus
- Delivery to Owner (Surplus and Shops)

C. Construction Documents (CD)
1. Outdoor Service Area
Before CDs are prepared, the design team and the Office of Waste Reduction and Recycling meet to confirm outdoor service area requirements and equipment to be used.
Include section 02475 with any relevant site or space planning requirements for this project.
Include section 11170 listing requirements, installation information, and suppliers for solid waste handling equipment to be purchased BY the project—at a minimum, this will include compactors.
Detailed plan sheets showing outdoor service area enclosures, including:
- screen wall details
- electrical requirements
- lighting
- drainage
- a list of buildings that the site(s) are intended to serve
An FINAL summary sheet listing all the outdoor service area equipment to be used. This will include:
- the type of equipment (example: 8 yd. cardboard dumpster),
- the estimated cost,
- whether the project, FP&C or the customer is purchasing them, and
- the locations (if there’s more than one building in the project).

2. Indoor
Before CDs are prepared, the design team and the Office of Waste Reduction and Recycling meet to confirm indoor recycling locations and any special situations.
Include section 02475 with any relevant site or space planning requirements for this project.
Include Section 12300 Manufactured Casework listing requirements for recycling cabinets
Clearly marked locations of all indoor recycling locations -AND- detail sheets showing the plans for any recycling cabinets to be built by the project
An FINAL summary sheet listing all the indoor recycling sites. This will include the:
- indoor recycling locations,
- which locations will use cabinets,
- whether the project, FP&C or the customer is purchasing them, and
- the amount reserved for cabinets that are not being built by the project.
3. **Walkway**

Before CDs are prepared, the design team and the Office of Waste Reduction and Recycling meet to confirm walkway recycling locations and any special situations. Include Section 02870 listing the walkway recycling containers to be used and their placement. Clearly marked plans showing the locations of all walkway recycling locations.

An **FINAL** summary sheet listing all the walkway recycling sites. This will include the:
- walkway recycling locations,
- whether the project or FP&C is purchasing them, and
- the amount reserved for walkway bins (assuming that FP&C will be purchasing them).

4. **Access**

CD staging plans and site drawings should include plans for access to the building (if occupied) and adjacent buildings such that deliveries and recycling/waste collection services can be maintained.

CD demo plans shall note the requirement of contacting the Office of Waste Reduction and Recycling to remove indoor and outdoor containers (including dumpsters) as the project phasing affects different areas.

5. **Building Material Assessment and Salvage**

**Based on Valuable & Reusable Building Material Inventory**

Reuse in project based on inventory:
- Discussion and **FINAL** decisions by design team and construction manager at risk.
- Create a plan for storage of materials.
- CD submittal requirement: Decisions are to be integrated into specs and drawings: 01505, 02070, and appropriate infomation and drawings.

Reuse in other projects:
- Design team and construction manager at risk circulate **FINAL** list to Facilities Planning and other design teams.
- Create a plan for transfer and storage of items.
- CD submittal requirement: Salvage to be listed in 01505, 02070 and appropriate section and drawings.

Outside salvage/recycle:
- **FINAL** list
- Market research by design team and construction manager at risk, with assistance from Office of Waste Reduction and Recycling
- CD submittal requirement: Any potential recyclables are to be listed in 01505 as a **FINAL** list of required and suggested materials. Any salvage is to be listed in 02070 and appropriate section and drawings.

6. **Fixtures, Furniture and Equipment Assessment and Salvage**

**Fixture, Furniture & Equipment Walkthrough**

CD submittal requirement: Fixture, Furniture & Equipment Inventory

Walkthrough by the design team **TO DETERMINE** what valuable and reusable materials are available.
- **FINAL** list at this time
- detailed information and quantities on FF&E (Brand, year, etc.).
- movable items
- fixed items
• list in 01505 and 02070 with construction language to appropriate section and show details on plans (demo and others as needed)

Reuse in project:
• Based on inventory--discussion and FINAL decisions
• Create a plan for transfer and storage
• UNC Design Manager, Design Team, consultants (move coordination, interior design, etc.), UNC Interior Design Services, Office of Waste Reduction and Recycling

Reuse elsewhere on campus:
• UNC Design Manager, Design Team, Facilities Services Shops, Office of Waste Reduction and Recycling (assists)
• FINAL list of who's getting what (re-circulate inventory to departmental business managers, if necessary)
• Create a plan for transfer and storage.

Surplus:
• UNC Design Manager, Design Team, Construction Manager at Risk, Surplus, Office of Waste Reduction and Recycling (assists)
• Decision on presale or warehouse.
• Research markets.
• Create a plan for transfer and storage.

7. 01060
   Standard wording at CD phase

8. 01505
   At CD phase, FINAL lists for building materials and non-moveable FFE of:
   • Reuse in this project,
   • Reuse in other campus projects,
   • Reuse by the general public,
   • Recycled (required and suggested).

9. 02070
   At CD phase, FINAL plan for building materials and non-moveable FFE:
   • Storage for reuse in Project
   • Transfer for reuse on campus
   • Delivery to Owner (Surplus and Shops)

D. Pre Bid
   1. Outdoor Service Area
      Not applicable
   2. Indoor
      Not applicable
   3. Walkway
      Not applicable
   4. Access
      Not applicable
   5. Building Material Assessment and Salvage
      Invite the Office of Waste Reduction and Recycling to Pre-bid meeting.
      Review requirements and list of required and supplemental recycling with bidders.
      Design team, Construction Manager at Risk, Office of Waste Reduction and Recycling
6. **Fixtures, Furniture and Equipment Assessment and Salvage**
   Department fills out surplus forms and arranges for moving (move consultant and contractor). Shops salvage and report back to design team and the Office of Waste Reduction and Recycling. Move is well underway and departments are sending goods to surplus. Surplus receives goods and or provides special pick ups if prearranged.

7. **01060**
   Explain process and requirements (include meeting requirement before project starts).

8. **01505**
   Explain process and requirements (include meeting requirement before project starts).

9. **02070**
   Explain process and requirements (include meeting requirement before project starts).

**E. Pre Construction**

1. **Outdoor Service Area**
   Notify the Office of Waste Reduction and Recycling Contact to remove the following from areas affected by construction:
   - dumpsters and carts
   - indoor containers
   - walkway bins
   This is to happen at the start of each segment of phased construction.

2. **Indoor**
   Notify the Office of Waste Reduction and Recycling Contact to remove the following from areas affected by construction:
   - dumpsters and carts
   - indoor containers
   - walkway bins
   This is to happen at the start of each segment of phased construction.

3. **Walkway**
   Notify the Office of Waste Reduction and Recycling Contact to remove the following from areas affected by construction:
   - dumpsters and carts
   - indoor containers
   - walkway bins
   This is to happen at the start of each segment of phased construction.

4. **Access**
   Work with the Office of Waste Reduction and Recycling to ensure that traffic plans do not impede access to dumpsters or other waste removal services for occupied buildings.

5. **Building Material Assessment and Salvage**
   Invite the Office of Waste Reduction and Recycling to Pre-bid meeting. Review requirements and list of required and supplemental recycling with bidders. Design team, Construction Manager at Risk, Office of Waste Reduction and Recycling

6. **Fixtures, Furniture and Equipment Assessment and Salvage**
   Department fills out surplus forms and arranges for moving (move consultant and contractor). Shops salvage and report back to design team and the Office of Waste Reduction and Recycling. Surplus receives goods and or provides special pick ups if prearranged.
Departments are moved and building is left clean and empty of all furnishings, recyclables and trash.

7. 01060
   Hold separate meeting to review these sections and discuss the draft solid waste management plan.

8. 01505
   Hold separate meeting to review these sections and discuss the draft solid waste management plan.

9. 02070
   Hold separate meeting to review these sections and discuss the draft solid waste management plan.

F. Construction
   1. Outdoor Service Area
      Immediately notify the Office of Waste Reduction and Recycling of any deviations from plans or requirements and provide a copy of the appropriate change order.

   2. Indoor
      Immediately notify the Office of Waste Reduction and Recycling of any deviations from plans or requirements and provide a copy of the appropriate change order.

   3. Walkway
      Immediately notify the Office of Waste Reduction and Recycling of any deviations from plans or requirements and provide a copy of the appropriate change order.

   4. Access
      Immediately notify the Office of Waste Reduction and Recycling of any changes that will affect service to occupied buildings or dumpsters.

   5. Building Material Assessment and Salvage
      Implementation and documentation
      • Draft and Final Solid Waste Management Plan
      • Monthly reports and weight tickets (receipts)
      • Meetings as necessary to discuss reports or practices

   6. Fixtures, Furniture and Equipment Assessment and Salvage
      Implementation and documentation
      • Draft and Final Solid Waste Management Plan
      • Monthly reports and weight tickets (receipts)
      • Meetings as necessary to discuss reports or practices

G. Project Completion
   1. Outdoor Service Area
      Order all recycling/solid waste equipment for the project. The final list should have been part of the CD phase.
      Arrange for installation of the recycling/solid waste equipment per drawings and requirements in the Construction Documents.
      Coordinate installations with the Office of Waste Reduction and Recycling.
      Office of Waste Reduction and Recycling provides any equipment not purchased as part of the project, labels equipment, coordinates a collection schedule with staff and contractors, and provides billing information to the accounting department.
2. **Indoor**
   Order all recycling/solid waste equipment for the project. The final list should have been part of the CD phase.
   Arrange for installation of the recycling/solid waste equipment per drawings and requirements in the Construction Documents.
   Coordinate installations with the Office of Waste Reduction and Recycling.
   Office of Waste Reduction and Recycling provides any equipment not purchased as part of the project, labels equipment, coordinates a collection schedule with staff and contractors, and provides billing information to the accounting department.

3. **Walkway**
   Order all recycling/solid waste equipment for the project. The final list should have been part of the CD phase.
   Arrange for installation of the recycling/solid waste equipment per drawings and requirements in the Construction Documents.
   Coordinate installations with the Office of Waste Reduction and Recycling.
   Office of Waste Reduction and Recycling provides any equipment not purchased as part of the project, labels equipment, coordinates a collection schedule with staff and contractors, and provides billing information to the accounting department.

4. **Access**
   Resume normal access to buildings.

5. **Building Material Assessment and Salvage**
   Provide the Office of Waste Reduction and Recycling with a summary of ACTUAL recycling, reuse and salvage activities for the project. This is to include, but is not limited to:
   • quantities landfilled, recycled, reused, and salvaged;
   • a break down of the types of materials recycled, reused and salvaged; the percent of total waste of each of the categories listed;
   • the destinations of these materials;
   • the economic impact of these activities on the project; and any success stories or challenges incurred.

6. **Fixtures, Furniture and Equipment Assessment and Salvage**
   Provide the Office of Waste Reduction and Recycling with a summary of ACTUAL recycling, reuse and salvage activities for the project. This is to include, but is not limited to:
   • quantities landfilled, recycled, reused, and salvaged;
   • a break down of the types of materials recycled, reused and salvaged; the percent of total waste of each of the categories listed;
   • the destinations of these materials;
   • the economic impact of these activities on the project; and any success stories or challenges incurred.
A.30 - CONSTRUCTION SITE MANAGEMENT

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A30.1 - GENERAL PRINCIPLES

A. BACKGROUND

Campus construction projects impact many people in diverse ways. The people affected include students, visitors, faculty and staff, nearby community neighbors, the City and the State of North Carolina. Once a construction project is underway, Environment, Health and Safety is primarily concerned with potential soil and water contamination in and around the site and the health and safety risks for personnel outside the construction zone. The health and safety activities and practices within the construction area are the sole responsibility of the contractor until they affect personnel outside.

The architects are responsible for anticipating and planning for the EHS aspects of the construction project. They incorporate these controls as part of the construction documents with special notes and specification requirements. However, not every contingency has been anticipated and addressed. Consequently, any unspecified activities, which could result in environment, health or safety impacts outside the construction area, must be communicated to and through the Construction Manager. The EHS Department is available for consultation on these issues. Any imminent threats or occurrences that impact the environment (spills, leaks, releases to the soil, stream, storm system, or sewer) or the health or safety of personnel outside of the construction area must be communicated immediately to EHS (962-5507). If someone is not available, a phone message directs the caller to an alternate number, 24 hours per day. It is expected that the Contractor will take quick action to address the problem. However, the EHS Office needs to be notified quickly when these situations arise to ensure University resources are brought to bear when appropriate.

In summary: In an emergency, take prudent action immediately and call EHS (962-5507).

1. General Requirements for Contractors on all construction projects (critical issue recap):

   a) Establish a list of building representative contacts for buildings that will be impacted by the construction project.
   b) Keep the fire lanes, hydrants and fire department connections clear at all times. (Should be specified on the drawings)
   c) Provide and maintain directional signs around construction fences, barricades and at blocked exits.
   d) Maintain pedestrian walkway protection near the project. (From overhead falling objects, projectiles and construction material which may protrude through the fence)
   e) Maintain erosion control devices. Dust, mud and silt are not to escape from the site during a rainstorm. The Contractor must inspect the run-off at the beginning and during a storm event to ensure compliance. Corrective action must be put in place immediately when a deficiency is discovered.
   f) Provide covered chemical secondary containment and spill response equipment.
   g) Protect streams, storm drains, sanitary sewer-no chemicals, dirt or construction chemicals or debris.
   h) Exposures to:
      i. Noise: Maintain construction noise within acceptable levels (see section 3). Noise control techniques include proper equipment placement, mufflers, and/or constructing noise dampening enclosures.
ii. Dust: Ensure dust control techniques are used routinely including wet cleaning methods such as wet drilling/cutting of masonry materials.

iii. Fumes: Locate welding/cutting, heated tar pots etc. away from building air intakes

iv. Engine exhausts: Turn off vehicles, or equipment when not in use. Idling creates a great deal of pollution. Keep IC engines away from air intakes.

v. Lay down areas must occur in designated areas only to prevent pedestrian slips, trips and falls and to keep fire lanes open.

vi. Maintain MSD sheets on site for rapid access in the event of an emergency.

vii. Repair vehicle and equipment leaks immediately to prevent fuel, coolants, and oils (hydraulics and gear box) spills.

viii. Maintain access and clearance for service vehicles, including trash and recycling collection vehicles.

2. Protecting Adjacent Building

Protect building air intakes from vehicle and construction equipment exhaust. Consider feasibility of the following:

a) Blocking potentially contaminated intakes and provide building makeup air from other clean air intakes (may not be possible to maintain any building balance.)

b) Filter intake air for dust and exhaust.

c) Provide physical barriers to restrict traffic and deflect exhaust.

d) Use low emission equipment-electrically powered in most circumstances.

e) Position portable IC generators/compressors away from building intakes.

f) Locate hot tar units away from windows, doors air intakes.

g) Keep road and drive accesses clear at all times as per the construction drawings. Fire lanes must never be blocked.

h) Disruption of utility services must be coordinated in advance with building representatives with contingencies provided for fire alarms, security and critical equipment operations.

3. Protection in Occupied Building under Construction

Wherever possible, occupants will be moved out of the buildings during renovation projects. Construction in an occupied building requires more planning and the development of contingency plans to deal with construction inconveniences as well as health and safety risks. When buildings must be occupied during construction, the architect is responsible for incorporating theoccupancy mitigation features into the design specifications for the construction project. After construction begins, unforeseen issues must be resolved between the architect, construction manager and the general contractor. These issues and their resolution are to be added to the construction logbook. It is expected that occupant concerns will be addressed rapidly (within 24 hours preferably but no longer than 1 week).

a) Communication

i. Issue:

Once construction begins, occupants feel that their work environment is out of their control. They are subject to risks and inconveniences that occur often without warning for an undetermined amount of time. Preplanned weekly meetings should forewarn occupants of what to expect as well as allow them to provide feedback and suggestions on how to improve their work environment.
ii. Controls:
   1. Identify the primary and secondary building contact person for contractors and occupants.
   2. Schedule weekly meetings with the building occupants led by the building liaison with the construction manager in attendance.
   3. Record minutes for the meeting.
   4. Minutes should indicate what the construction plans are for the coming week and any changes to building access and services.
   5. Minutes should reflect employee concerns and resolution completed.
   6. Copies of the minutes should be sent to EHS for review.
   7. Any unresolved issues after 1 week need to be raised to Ed Willis

b) Life/Fire Safety
i. Issue:
   During construction, exits may be blocked for days or months at a time. Nevertheless, in an emergency, occupants must have access to emergency evacuation routes so they can safely leave the building in the event of a fire or other emergency. Also, when electrical systems are shut off, the fire alarm systems may be lost. Similarly, when plumbing lines are disconnected, the sprinkler system may be disabled as well. If the fire alarm system requires re-programming to accommodate extensive renovations to an occupied facility or major additions to an occupied facility, that constitutes a 10% or greater change to the system database, the fire alarm vendor and/or contractor will assume all and full responsibility and liability of the entire system. Upon completion of the project a 100% inspection by the Owner will be scheduled and performed. Assumption of responsibility and liability for the system will return to the Owner after the system inspection items have been satisfactorily addressed.

ii. Controls:
   1. Maintain life safety features
   2. Means of egress
   3. Alternate means of egress
   4. Clear directional signs to alternate exits
   5. Sprinklers/Fire alarm systems/fire watch provisions
   6. Additional fire extinguishers where required
   7. Emergency communication method

c) Interior Building Separation of Construction Traffic/Work Areas:
   i. Issue:
      Construction traffic carrying demolition debris and new construction materials (pipes, studs, wire etc.) could injure the occupants of a building due to lack of protective equipment or lack of awareness of construction hazards.

ii. Controls: Physical Barriers
   1. Each project phase shall be designated on the drawings.
   2. Temporary wall locations and sound insulation requirements- sealed air tight.
   3. Locations to seal off wall and floor penetrations to be dust tight
   4. Designated construction worker travel paths in the building separate from occupants
5. Designated building occupant paths with barriers at the construction zone.
6. Areas around floor and walls to be penetrated to be blocked with barricades to keep occupants out when the penetrations are made.
7. All floor penetrations to be covered with steel plate, fixed in place to prevent objects from falling through to the floors below.
8. Which occupied areas must be secured and vacated before wiring, pipes and conduit are run overhead through walls or ceilings.
9. Which occupied areas are below unprotected openings in the ceiling which must be vacated and barricaded to prevent falling objects from the construction area hitting occupants. Physical barriers are to be inspected and repaired and repaired at least daily.

d) Warning and Directional Signs
Warning and directional signs shall be specified in the construction documents to indicate the paths of safe egress through the building. The architects will specify the appropriate number and location of these exit paths for the entire construction project according to building code requirements. Signs must comply with OSHA standards. The contractor must maintain these signs at all times throughout the project.

e) Indoor Air Quality
i. Issues:
   1. Every construction project generates dust and odors at various points throughout the project that may include:
      a. Masonry dust (cutting, jack hammering, blasting)
      b. Sheet rock and spackle dust – sanding
      c. Solvents- adhesives, caulks, finishes, sealants, resins
      d. Metal fumes/dust (welding and cutting)
      e. Fungi (mold and mildew) (vii) Asphalt fumes
ii. Controls:
   1. Block and seal off any ductwork shared with occupied areas.
   2. Protect all active building air intakes from external contaminants (dust, exhaust, chemicals etc.).
   3. Maintain a continuous negative air pressure in the construction zone.
   4. Use exhaust fans (include filters for dust).
   5. Pressurize the occupied areas with excess clean outside air.
   6. Demonstrate negative pressure in the construction zone with smoke tests at low and high openings (watch for thermal gradients) or through the use of a pressure differential meter.
   7. Use wet methods for masonry cutting.
   8. Use wet methods or HEPA vacuum for cleaning (no compressed air or dry sweeping).
   9. Stop work if exposures exceed specified limits outside of the construction area (see the monitoring section).
   10. Use low or no VOC content in paints, adhesives and finishes.
   11. Avoid the use of isocyanates and urea formaldehyde resin containing materials.
   12. Perform certain tasks when the building is unoccupied including extremely loud activity, overhead crane work etc.
   13. Use covered chutes to drop materials from upper levels to the ground
14. Use of propane heaters or IC engine powered equipment shall not be used in the building without multiple CO monitors within and outside of the construction zone.

15. Facilities services must check HVAC filters more frequently to avoid plugging with dust and debris.

f) Noise
   i. Issue:
      Noise levels within an office environment directly affect one’s ability to use the telephone. The average sound levels for the speech frequencies (500, 1000, 2000 and 4000 Hz) constitute the speech interference level (SIL). SILs greater 80 dB make telephone use impossible. SILs down to 60 dB make phone conversation difficult. Below 60 dB, telephone conversation is acceptable.
      Construction zones may be located near non-University communities. Noise generated in the construction zones must meet any applicable local noise ordinances.
   ii. Controls:
      1. Restrict high noise operations to unoccupied periods.
      2. Provide suitable mufflers for air operated tools and engine powered equipment.
      3. Provide acoustical enclosures for noisy fixed equipment.
      4. Prefab building components outside or offsite.
      5. Incorporate sound insulation in construction barriers.

g) Maintenance of Building Mechanical Systems
   i. Issues:
      The building occupants need access to restroom facilities, and the regular utilities. Disruption of these services can be a hardship particularly for individuals with significant personal health issues or disabilities.
   ii. Controls:
      The architect will provide alternate plans in the specifications to address scheduled disruptions in the following services:
      1. HVAC
      2. Plumbing
      3. Electrical/lighting
      4. Telephone
      5. Data lines

h) Inclement Weather
   i. Issues:
      Roof work and the creation of openings in the building envelope can result in water intrusion into the occupied areas resulting in water damage to the building and equipment. In addition, slip hazards and electrical shock hazards could be introduced.
   ii. Controls:
      Provide barriers and water diverters to control water in the building. These devices must be checked carefully at the beginning and periodically throughout a rain event to ensure they function properly.

i) Housekeeping
   i. Issues:
      Areas in and around construction sites are often characterized by the accumulation of dust and dirt, trash and debris.
ii. Controls:
The Contractor is responsible for keeping his work area clean. If the dust barriers and negative air units are performing properly, little dust will migrate outside the construction zone. Even so, the University is responsible for keeping the occupied areas clean as well. Contractors should be working and traveling only within the confines of the construction zone. Restricting contract employee access to owner occupied areas should reduce the amount of trash and debris accumulating outside the construction zone. Wet cleaning and/or HEPA vacuuming should be used within and outside of the construction zone. Contractors are responsible for their work areas. University housekeeping maintains the occupied areas. Compressed air must not be used for cleaning purposes.

j) Exposure Monitoring

i. Issue:
Building occupants tend to have a low tolerance for exposures to dust and chemicals because they do not control the exposures and often do not know what the exposures are.

ii. Control:
The Contractor is responsible for monitoring exposures outside the construction zone. He/she must have a trained and qualified individual on site at all time with the capability to monitor for noise, dust and vapor emissions escaping from the project. The Contractor will ensure that the instrumentation is properly calibrated and zeroed in a clean air environment prior to use, using the manufacturer’s instructions. Calibration procedures must be documented in an equipment logbook.

At least weekly, the Contractor shall select random times to monitor these exposures for a minimum of 4 hours using direct reading instrumentation. Average and peak readings, sample times, locations and instrumentation shall be recorded in the construction logbook. When a building occupant registers an exposure complaint with the University Construction Manager, all the exposure parameters will be checked at the complainant’s workstation and documented in the construction logbook. The University Construction Manager will notify the EHS Office of this concern whether the exposures register above the specified limits or not. If exposures exceed the limits, work must stop until the source of the problem is found and fixed. The following list contains the exposure guidelines for building occupants outside of the construction zone:

1. Total dust: 1 mg/M3
2. Carbon monoxide: 10 PPM
3. Noise: < 60 dB averaging the speech frequencies (500, 1000, 2000, 4000 Hz) and < 80 dB using the A weighted scale.
4. Total Hydrocarbon: 10 PPM
5. 25% of the TLV for other specific compounds. These levels are more stringent than industrial standards in order to provide a greater safety margin for the general public. If these levels are exceeded over a 4-hour averaging period, work must stop and corrective action must be taken. Sampling frequencies must be increased if the exposure limits are exceeded based upon consultation with the EHS Department.
6. The EHS Department will review the construction logbook data and will perform additional assessments as needed.
A-30.2 - CONSTRUCTION FENCING
  a. The construction area should be enclosed by a six-foot-high (minimum) chain link fence with top rail and screening to obscure construction activities from view. At completion of the project, the Contractor must remove the construction fence completely, including all portions of belowground footings. Fence posts must be removed, not sawn off flush with the soil line.

A-30.3 - DECOMMISSIONING
  a. Building Removal
     i. The removal of any building requires the approval of the UNC Board of Trustees.
     ii. Reuse of building materials in the new project must be considered. Recycling and salvage of materials must be coordinated through the project manager, OWRR, and Surplus Property.

A-30.4 - CONSTRUCTION PARKING
  a. Construction Contractors
     i. Contractors and subcontractors working on campus should communicate directly with the UNC Facilities Services Project Manager regarding project staging and parking access. Project Managers will communicate directly with Transportation & Parking regarding the project needs. Parking, staging areas and storage needs are normally coordinated through project and construction managers for all campus construction. Transportation & Parking assigns and approves all campus construction parking access needs. Valid permits must be displayed at all times and a license plate must be registered to allow virtual permitting by construction contractors or vendors.
     ii. Construction contractors and their employees are not typically eligible for Vendor Permits. Parking is limited on UNC’s campus, so construction contractors and vendors are encouraged to use transit services. Personal vehicles may be parked at the Town of Chapel Hill Park & Ride lots, served by free Chapel Hill Transit. Go-Triangle also offers free regional Park & Ride lots with routes serving UNC. Bus passes may be purchased online.

b. Vendors
   i. Companies providing services to the UNC campus whose employees are not affiliated as a student, temporary or permanent employee and who do not have permanent work sites on campus are eligible for vendor permits. Companies that have a contractual relationship with the University to deliver goods or services may apply for a vendor service permit. Approved Vendors may also purchase temporary (daily/weekly) permits from UNC Transportation & Parking that are valid in service spaces located throughout campus. Faculty, staff, and students are not eligible to display or purchase Vendor Service Permits.
   ii. Large delivery vehicles prominently displaying the vendor’s name or logo, performing routine deliveries and pick-ups from university buildings, and requiring less than 15 minutes are exempt from any permit requirement.
A-31 – CONSTRUCTION SITE WASTE MANAGEMENT

A-31.1 – CONSTRUCTION WASTE

Construction and Demolition Debris
The University, State, Orange County and Chapel Hill are committed to reducing waste and the use of landfills. Waste reduction and recycling practices are not limited to routine day-to-day functions and events on campus; they also apply to construction and renovation activities. Construction waste management practices include deconstruction, reuse, salvage, recycling, and disposal.

Executive Order 156 calls on all state agencies to:
"...seek opportunities to reduce environmental impacts associated with capital improvements throughout project planning, site and building design, and construction. Agencies shall, to the extent feasible and practicable, implement project initiatives or modifications that result in energy efficiency, water conservation, pollution prevention, solid waste reduction, and land preservation during the construction and operation of agency facilities."

Resources and more information are available on the Construction and Demolition Waste Management section of the OWRR design guidelines: http://facilities.unc.edu/design-guidelines/waste-reduction/

Recycling Office of Waste Reduction and Recycling Services to Buildings During Construction
In order to maintain services to buildings under construction and adjacent buildings, OWRR and its contractors must be able to access dumpsters and loading docks during all phases of construction and renovation.

Also see Construction Staging Areas, Walkways, and Driveways in Chapter IV of these guidelines. Important information relevant to maintaining solid waste services is on the “Services to Buildings During Construction” section of the OWRR design guidelines: http://facilities.unc.edu/design-guidelines/waste-reduction/
A-31.2 - HAZARDOUS MATERIAL MANAGEMENT AND WASTE DISPOSAL

All Hazardous and Universal Waste (H/U) issues shall be presented to the UNC Environment, Health and Safety Department (EHS).

Contacts:  Mike Long  919-962-5723  
Steve Parker  919-962-5509  
EHS Dept.  919-962-5507

All H/U waste shall be handled using applicable Federal and State laws, including EPA regulations codified in the 40 CFR. For assistance, contact EHS.

Contact EHS for a list of University approved disposal vendors, or visit our website at www.ehs.unc.edu for more information.

EHS requires a written plan to be submitted for approval at the beginning of the project that outlines which H/U wastes have been identified and the proposed disposal venues to be utilized.

Bills of Lading, Manifests and LDR’S must be signed by a representative of EHS for all shipments of hazardous or universal waste, excluding asbestos.

If you are unsure if you have a hazardous waste, contact EHS.

1. Bulbs
   a. The following procedure is to be used for 4 and 8-foot fluorescent bulbs, High Intensity Discharge Bulbs (mercury bulbs), and U-Tubes:
   b. Bulbs should be placed in manufactured boxes.
   c. When you put the first bulb in the box, a Universal Waste label shall be placed on the outside of the box. Fill in contents and date.
   d. When not actively putting bulbs in the box, the lid shall be closed and sealed.
   e. Keep box inside, and away from any water.
   f. EHS does not approve of the use of a fluorescent bulb crusher.

2. Mercury Contaminated Materials
   a. All mercury contamination must be treated as hazardous waste and disposed of according to State and Federal regulations. All sink traps located within research buildings are suspected to be contaminated with some mercury. Immediately contact the UNC Environment, Health and Safety Department if and/or when these items are discovered for a copy of the University’s Mercury Plumbing Removal procedure.
   b. Contractor shall contact a reputable hazardous waste disposal firm for removal, shipping, and disposal needs. Mercury items shall be sent to a facility within the U.S. for retort. This includes mercury containing switches, devices, and sink traps.

2. Ballasts: PCB and Non-PCB Ballast
   a. PCB Ballasts shall be placed into UN approved 55-gallon drums for disposal, and shipped on a Hazardous Waste Manifest. Also, the lid on the drum shall be secured unless actively adding to the drum. There is a one-year time limit to dispose of the drum from when the first ballast went into it. A ballast is considered to be a PCB ballast if the label says it is, or the label does not say at all.
b. Non-PCB Ballasts will have “Non-PCB Ballasts” written on the ballasts. These should be placed in a separate drum, (UN Approved), for recycling. For larger quantities, use a 20y3, covered roll-off that you can send to the recycler.

c. When planning storage, keep in mind that a full ballast drum weighs approx. 700 pounds

3. Broken Fluorescent Tubes

Fluorescent bulbs, HID’s, or U-tubes that are unintentionally broken, shall be placed into a UN approved poly drum. These are considered Hazardous Waste and should be treated as such due to the possible release of mercury vapors. When not actively adding to the drum, the lid shall be on, and secure. Also, the drum needs to have a label that says Broken Fluorescent Bulbs, and the date the first item was placed inside the drum. The one-year time limit for disposal applies to this waste as well.

3. Asbestos

a. See the construction specifications on Asbestos Abatement.

4. Lead Paint

a. Lead Paint waste from scraping, grinding, or peeling is considered hazardous waste and shall be stored in a UN approved drum with the lid securely fastened. This drum must be labeled as Lead Paint Chips and locked in an area away from public access.

b. Core samples from suspected Lead Based Paint containing materials such as walls, windows, doors, and door casings shall be taken prior to demolition and sent for TCLP analysis. An EHS representative shall be present for any sampling activities.

c. All sampling results shall be sent to EHS for proper waste disposal determination.

5. Miscellaneous chemicals

a. Any chemicals found during demolition shall be handled as hazardous waste. Examples include: cylinders, bottles, cans with liquid, spill clean-ups etc.

** When in doubt, contact EHS at 919-962-5507 or Mike Long at 919-962-5723.

** Do not ship any Hazardous/Universal Wastes without EHS notification and approval.
Hazardous and Universal Construction Waste Process

- **Lead-Based Paint Debris and PPE**
- **Mercury Contaminated Debris** (including casework, piping, printups, etc.)
- **Lead Paint Chips**
- **Mercury-Containing Articles**
- **PCB Ballasts**
- **Non-PCB Ballasts**
- **Fluorescent Bulbs**

**Waste Determination by TCLP**
- **Pass TCLP**
- **Fail TCLP**

**Containerize in Drums, Label, Date, and Keep Closed. Store in a locked area.**

**>55 Gallons of Hazardous Waste**
- **Create 90 Day Storage Area – Requires Approval of EHS Director.**

**Drum, Label, Date, and Recycle as Scrap Metal**

**Shipment of Waste through EHS**

**Disposal in C&D Landfill**

**Develop Contingency Plan**

**Notify Local Authorities**

**Document Weekly Inspections**

**Training Records – Keep on-site**

**Adequate Aisle Space**

**Post Evacuation Plans**

**Spill Kits and Emergency Equipment**

**EHS must validate ultimate disposal site to protect UNC from future liabilities.**

**EHS should be notified to help generate and sign waste profiles.**

**EHS MUST Be Present for and Sign Any Manifest for Any Universal or Hazardous Waste Shipment.**

**Responsibilities**
- Contractor
- EHS
- Shared

Contact Michael Long at 962-5728 or mldlong@ehs.unc.edu with questions.
LEAD BASED PAINT MANAGEMENT FOR RENOVATIONS/DEMOLITION OF EXISTING BUILDINGS

All renovation projects must be reviewed by the Department of Environment, Health & Safety (EHS) prior to starting them.

For large capital projects, EHS can provide information on preliminary building lead assessments. However, a complete lead assessment must be completed as part of the building renovation by a contractor certified to perform lead assessments.

For small projects, the EHS Office can test surface finishes for lead content. Facilities Services should complete the form “Request for Lead-Based Paint Inspection”, when requesting a survey for Lead-based Paint (LBP).

A copy of the completed assessment reports shall be sent to EHS.

Contractors hired to remove LBP from university buildings shall submit a written abatement plan that must be reviewed and approved by the Department of EHS prior to beginning paint removal. The plan should address the following:

a) An overall time table
b) Specifications of abatement methods
c) Containment of lead dust & debris
d) Protection of workers
e) Clean up during and after abatement
f) Waste management and disposal

The Department of Environment, Health & Safety (EHS) must inspect and approve the containment area before abatement work begin, and, may inspect and perform air monitoring during and after the completion (final clearance) of the abatement project.

If an outside IH firm is hired to perform air monitoring, a copy of all monitoring activities must be submitted to the Department of Environment, Health & Safety.

Lead contaminated waste generated during the abatement projects must be disposed of as hazardous waste through the Department of EHS.
MOVING PROCEDURES FOR BOND PROJECTS

g) Organizing a Move

To ensure a smooth transition to a new location, every aspect of the move should be planned in order to eliminate confusion for the movers, new occupants, and neighboring departments. This requires close attention to details such as building access, parking, elevators, keying, communications, mail service, hazardous materials, surplus property and the ordering of new furniture. The following is a brief summary of the procedures required to perform a departmental move in an organized and coordinated manner.

(1) Appoint Department Move Coordinator for all moves:

This person will ensure the many details affecting the move are handled. For small moves this job can be managed on a part-time basis, but for large “whole building” moves a person that can devote full time to the process would be preferred. In either case the coordinator must have the full support of the Dean or Department Head.

(2) Create Move Plan:

The Facilities Planning and Construction Project Manager will create documents that will list all of the tasks involved in the move and create a plan and timetable for accomplishing each task. For complex moves these items can be put on a Gantt chart to help the Coordinator visually check the progress of each facet in relation to the total move (See Attachment C). Facilities Planning and Construction will prepare this since it is imperative that the move schedule be coordinated with remodeling and building schedules.

(3) Establish scope of the move and select a moving company:

Once all of the requirements of the move are determined, they should be sent to Purchasing on a requisition form. Upon receipt of the requisition, Purchasing will start the bid process. This process takes a minimum of 30 days and consists of the following steps:

(a) Notification of prospective bidders.
(b) Pre-bid conference and walk-through with prospective bidders.
(c) Request for bids.
(d) Bid opening.
(e) Appraisal of the successful bid.
(f) Approval of the successful bid.
(g) Issuance of Purchase Order

The Department Move Coordinator will schedule a Pre-bid conference and walk-through with prospective movers. Purchasing will furnish the names of movers who are on the University’s bidder list. Movers will conduct every aspect of the move if this is specified; however, a department is expected to do its own packing.
Note: The vacated space must be entirely devoid of furnishings, equipment, recyclables, chemicals, and trash by a date agreed upon by the Move Coordinator and the Facilities Planning project manager.

h) Coordination:

Any relocation within the University will require close coordination between the different departments involved in the move. The following is a list of those departments, a brief description of their involvement in the moving process and how they impact the move. It is the responsibility of the Move Coordinator to contact the appropriate departments with ample time to insure adherence to the move schedule.

(1) Asset Management

The Capital Assets Accounting Office can furnish a printout of all for the departmental capital assets. Prior to the move, changes should be made to the printout giving the new locations of each asset. The move is a good time to conduct an asset inventory.

(2) Auxiliary Services

(a) Carolina Copy

All university copiers are handled by Carolina Copy. Movers are not allowed to relocate any copy equipment unless it owned by the department and is being sent to Surplus. In order to relocate copiers the department coordinator must contact Carolina Copy at least 2 weeks before the move. Prior to the move, any changes in department stationary and employee business cards should be handled. This needs to be done at least 2 weeks before the move.

(b) Vending Machines

In order to relocate existing vending machines or order new ones, the department Move Coordinator is required to contact auxiliary services at least one month before the move.

(3) Environmental Health and Safety (EHS)

EHS must be advised of any move within the university. This is of particular importance when it comes to the relocation laboratories and or laboratory equipment. EH&S has prepared very specific guidelines to assure the proper disposal and relocation of hazardous materials in laboratories, shops and other areas. See Attachment E or visit the EHS website for more information: http://www.ehs.unc.edu/ In order to be ready for a move EHS will require notification 60 days before the move date. Some examples of EHS areas of concern include:
(a) Hazardous Waste
(b) Biosafety
(c) Radiation Safety
(d) Process Hazard
(e) Ergonomics
(f) Universal Waste

(4) Facilities Services Customer Service and Work Request Center

The Facilities Services Customer Service Center receives and assigns all requests for Building Maintenance, Signage, Lock Shop, and Elevators. All building Liaisons have been provided with the BUILDING LIAISON GUIDE TO FACILITIES SERVICES. The Move Coordinator should consult and coordinate with the Building Liaison in the preparation of work requests for Facilities Services at least three months before the move.

(a) Elevators

Facilities Services is responsible for maintaining the campus elevators. They can also furnish keys to allow elevator cars to be stopped on floors while the movers load or unload. This is important because jamming the doors open can damage the elevators. Whenever elevators are used, movers must provide adequate padding and take care to protect the walls, floors, and doors.

(b) Key Systems

One of the most important aspects of the move is the establishment of an effective keying system. While it may be possible to duplicate the system used at the old location in small moves, moving to a larger or more complex location may require a significant amount of planning. This process should take place at least three months before the move to allow Facilities Services Lock Shop adequate time to order locks, cut keys, and install the system. It should be noted that large hardware systems might require several months to receive.

The first step in organizing a new key system is to carefully study the new location and to identify the doors to be keyed. Next a decision should be made regarding who will need access to each door. At this point the Facilities Services Lock Shop should be contacted. They can furnish a Keying Diagram that provides a hierarchic assignment of keys from masters down to individual door keys. Once there is a clear idea of what will be required, the requirements along with a floor plan of the new location indicating each door should be taken to the Hardware Shop for review. When the review is complete the Shop should be given a copy of the key plan, floor plan, and a Key Request Form indicating how many keys of each code will be needed. The Lock Shop must be kept abreast of any changes in the key requirement until the system is installed.
(c) Signage

Information to be supplied at a later time.

(d) Housekeeping

At least 6 weeks before, contact the housekeeping zone manager to get extra trash containers. This should be done concurrently with requesting additional recycling bins from the Office of Waste Reduction and Recycling. One week before the move the moving coordinator should contact University Housekeeping to insure that new space is cleaned before the relocation and that the vacated space is cleaned and all remaining trash is removed after the move is complete.

Housekeeping’s Moving Crew provides moving services for moves that can be completed in one day or less. They also can provide loaner tables and chairs. See Attachment D for more information.

(5) Information Technology Services

Information to be supplied at a later time.

(6) Academic Technology and Networks

ATN should be contacted 60-90 days in advance regarding telephone service and data network connectivity requirements. Department moving should send notification email to and an analyst from ATN will meet with the department to plan relocation of their services and assist them on any new services they may desire. The analyst will give technical assistance and training to help provide for a smooth transition. It is important to note that academic units typically have their own LAN coordinators who provide computer desktop support. Administrative units get similar support centrally from AIS. The Move Coordinator must involve their LAN desktop support group early in the process to insure all network requirements are properly coordinated.

(7) Insurance and Risk Management

Supplemental insurance for moves

(8) Interior Design and Workspace Planning

(a) 12 Months before Move Date:

(i) Contact Work Management to initiate relocation and new furniture purchases.
(ii) Determine the internal budget allotted for furniture and design time. Budget Estimates can be provided to assist the department.
(iii) Complete the necessary funding document From Work Management to begin the design process for relocating ext’g furniture or planning new furniture and interior finishes and return the Documents to Work Management.
(iv) Engage in meetings with Design to discuss work space layouts and furniture specifications.

(b) 6 Months before Move Date:

(i) Make sure all layouts, furnishings, fabrics, etc are finalized with the Design Department.
(ii) Complete the necessary funding document From Work Management to begin the ordering of new furniture, carpet, artwork, etc. and return the documents to Work Management.
(iii) Meet with Project Lead to discuss the scope of the project including time lines, move phases and dates and any special needs the department may have in relation to furnishings or office layouts.

(c) 4-6 Months before the Move Date:

(i) The Department Coordinator and the Project Lead will maintain close communication to keep each other informed of the move plan, timeline and any changes that may occur such as unexpected delays or changes to the move plan.
(ii) At this time, the Project Lead will work with purchasing to conduct the bidding of furniture and create all the necessary purchase orders to put the new furniture on order and oversee the installation of the product.

(d) Consequences:

If the Department doesn’t follow the outlined time line the consequences may include but are not limited to the following;

(i) Funding may not be in place with Work Management to begin the design process
(ii) Funding may not be in place with Work Management to begin the ordering of goods
(iii) The furniture may show up too early accruing storage fees from the contractor
(iv) The furniture may show up too late delaying the move

(9) Interior/Room Signage

Room signage for new buildings is usually included in the construction cost and will be coordinated through the project manager or architect. For changes necessary when moving to existing buildings, Facilities Services should be
consulted. They can supply a variety of signage in accordance with the University’s signage standards. Once the signs are selected, Facilities Services will require a work order and adequate lead-time to fabricate and install the signs, at least three months.

(10) Work station planning and furniture layout

Information to be supplied at a later time.

(11) Mail Services

Even though campus box numbers remain the same when a department moves, the campus mail services section should be notified so they can change the route. They should be notified when to stop delivery at the old location and when to start it at the new location. A new pick-up and delivery point will also need to be established.

(12) Office of Waste Reduction And Recycling (OWRR)

(a) Indoor recycling, confidential paper, trash and construction and demolition waste

Most people who have been at the same desk for a long time have a great collection of paper and obsolete information and this a good time to clean up. Move Coordinators should encourage their staff to PURGE BEFORE THEY PACK.

At least 6 weeks before packing starts, contact OWRR to coordinate collection of confidential paper and arrange to have extra recycling bins delivered. The Move Coordinator and an OWRR representative will conduct a walk through to evaluate the scope and type of recyclables to be discarded. Every effort should be made to supply enough bins at an early enough date to maintain the regular recycling schedule for the building. If the volume is such that additional pick ups are needed, this must be coordinated thru OWRR.

Materials that can be recycled in the extra bins include

(i) office paper
(ii) newspapers/magazines
(iii) soft back books
(iv) hardback books
(v) office supplies

It is important to schedule final removal of the recycling bins once the department is completely moved. In some cases it is also necessary to arrange to have the trash dumpsters at the building emptied more frequently. Make sure to take desk side recycling bins with you when you
move. See Attachment G for more information about planning for recycling during the move.

(13) Property Office (Leased Space)

Information to be supplied at a later time.

(14) Purchasing

See: I. ORGANIZING A MOVE, Section C. Establish scope of the move and select a moving company.

(15) Surplus Property

Moving presents an excellent opportunity to dispose of equipment and furniture that will not be needed at the new destination. Surplus property can be sold in place to other state agencies, non-profits or the public; taken to University or State Surplus Property Offices; transferred to other university departments; or scrapped. Whichever method is employed, care should be taken to keep from moving it to the new destination before disposal. To coordinate this effectively, the Move Coordinator should request a capital asset listing from the Asset Manager at least 6 months before the move or during the Design Development phase of the renovation project planning phase. At this time, a walkthrough with the Surplus Property manager and OWRR’s construction waste reduction coordinator should be conducted to coordinate the advance sale of items and delivery of remaining items to the Surplus warehouse by the contracted movers. Furniture and equipment to be disposed off must be identified, flagged, and listed on an UNC-CH Surplus Disposal Form (P-110). For more information about these procedures, see Attachment F or http://www.unc.edu/mds/sp/index.htm.

(16) Telephones

Information to be supplied at a later time.

(17) Transportation

The Move Coordinator must contact the Transportation Division at least 1 week in advance for assistance in controlling traffic around both locations during the move. Transportation can block off parking and enable the movers free access for their trucks and equipment. Transportation can be helpful in identifying periods of peak traffic that would adversely affect the move.

(18) University Archives

http://www.lib.unc.edu/mss/uars/uinv.html
In accordance with the provisions in Chapters 121 and 132 of the General Statues of North Carolina, the University Archives serves as the administrative memory of University of North Carolina Chapel Hill. Its function is to preserve records with continuing administrative, legal, and historical value to the University and make them available to departments, scholars, and all interested researchers. By centralizing these materials, the Archives promotes greater and more efficient use of such records, relieves individual offices of the responsibility of servicing them, releases considerable filing equipment and space, and reduces the fire hazard created by storing records in inaccessible areas. Moving presents an excellent opportunity to archive documents of historical importance that will not be needed at the destination. University Archives will require at least 6 months notification.

i) Relocating Heavy Equipment

Occasionally there are large pieces of equipment, which must be moved by heavy equipment riggers. These items should be identified during the programming phase of the future space and listed by the architect. Large items usually require the special skills of a rigger to safely relocate them to the destination. Some of the things that need to be considered when relocating heavy equipment are as follows:

1. Measure doorways, passageways, and elevators through which equipment must move.
2. Allow lead-time when renovations are required at the destination to accommodate the equipment.
3. Be sure that power, water, air, or steam lines have been disconnected before attempting to move the equipment.
4. Be sure that the proper services for power, water, steam, or air are available at the new location.
5. Arrange in advance for the removal of doors or windows to facilitate the removal of equipment.
6. Arrange in advance with the Transportation Department to provide a clear operating area for the riggers and their equipment.
7. Protect floors, walls, elevators, walks, and grounds from damage during the rigging operation.
8. Provide insurance coverage for the relocation of expensive scientific equipment.

It is important to remember that the employment of riggers will require a separate bidding process and involve close coordination between the movers and riggers. Since the relocation of heavy equipment often involves the disconnecting and connecting of utility services that may require design work, advance planning for the rigging and reinstallation operations should begin and end well before the move takes place. The mover will identify any item that they cannot move during the initial walk-through.

j) Packing and Labeling

1. Moving Labels
Moving labels are furnished by the mover and are applied to each piece to be moved to enable the movers to quickly assemble items for the destination. The Move Coordinator will distribute these and provide the necessary instructions to staff for tagging and labeling procedures (the mover will assist in this process). This process should include coordination of items to be moved to the new location, transferred to other departments, sold in place (thru Surplus), taken to surplus, etc. The Facilities Planning and Construction will provide drawings of the new space to facilitate the tagging process. All labels should be uniformly placed on each piece of furniture and equipment and boxes to eliminate confusion for the movers (a tagging diagram will be provided by the mover).

(2) Desks

Pack all contents in and on top of desks. The desks will be upended during the move. The mover will not be responsible for personal items such as money, plaques, plants, or glass items. Please move these items privately. Put all loose items such as paper clips, pens, and pencils in envelopes and pack them in a moving carton. Be sure to label both pieces of furniture such as “L” shaped desks, which will be disassembled before moving.

(3) Cubicles

Pack all contents in and on top of cubicles including overhead storage cabinets and tack boards. In most cases cubicles will be reconfigured and people will move into a different cubicle. Any items that are not packed and flagged for moving should be disposed of. Cubicles should be left completely empty and any keys should be left at the cubicle. In some cases, it may be necessary to have cubicles dismantled before the move. The Move Coordinator should determine if this needs to happen and who will be responsible for this.

(4) Boxes

The most common and economical carton is the 1.5 cu. Ft. “book box”. They come “knocked down” and must be assembled. They will hold either letter or legal-size files, and can easily be picked up when full of books. These boxes can be easily assembled using 2” plastic packing tape. Be sure to properly assemble all boxes to prevent them from coming apart. Place label on EITHER END (near handle) NOT TOP! Cartons are stacked when moved; please DO NOT over pack.

(5) Bookcases

Remove all books and put them into cartons. Take loose shelves out and tape them together. Brackets, clips, and pins that shelves sit on should be sealed in an envelope and then taped to the shelves or packed in a carton. Do not forget to label both the bookcase and the shelves. Discarded books and magazines should be recycled using the extra bins that are available from OWRR. In addition to the benefits of waste reduction, recycling these materials lightens the burden on housekeeping and those who empty the trash barrels.
(6) Filing Cabinets

(a) Vertical Filing Cabinets - Place label on top drawer. Be sure all pressure plates are moved forward so contents will be secured. Tape (Duct Tape) or lock drawers closed. BE SURE TO KEEP THE KEYS!
(b) Lateral Filing Cabinets - Place label on top drawer. If the cabinet has 2 or 3 drawers, contents can remain. With 4 or 5 drawer cabinets all contents must be removed and packed in cartons (except for the bottom two drawers). If the contents are packed, label both the cartons and file drawers so the contents can be easily identified for unpacking.

(7) Storage, Supply Cabinets, and Metal Shelves

Pack all of the contents in cartons. Cabinet doors should then be locked. BE SURE TO KEEP THE KEYS! If metal shelving units are connected in tandem they should be disconnected to facilitate moving. Place label on front near upper right-hand corner. Secure shelves or bundle them to be moved separately. (If moved separately, please label).

(8) Personal Computers

Label any separate piece. Do not apply labels to the glass screen. Disconnect all cables and pack all small loose items such as cables, speakers and the control “mouse”.

(9) Office Machines

Disconnect all small office machines and do not pack. Typewriters should be disconnected and carriages must be centered. Pads, covers, and loose cords for the machines should be packed in a carton. Contact Carolina Copy regarding the relocation of copy machines.

(10) Telephone Equipment

Arrangements for the move of telephone equipment will be under the direction and control of ATN.

(11) Pictures and Lamps

The owner should remove all personal pictures and lamps prior to the move date. Most movers charge extra to move lamps and pictures.

(12) Recycling Bins

Individual desk side recycling bins should be flagged and moved to the new location. Centralized recycling bins should be left at the building being vacated and collected by OWRR at the end of the move as coordinated by the Move
Coordinator. In situations where someone else is moving into the vacated space, the centralized recycling bins will be left in place for the new tenants. OWRR will work with the Move Coordinator to set up recycling bins and dumpsters at the new location. Moving customized and specialty recycling bins should be coordinated with OWRR.

(13) Miscellaneous

Tag chair seats and pad, carpet protector, wastebaskets, etc. The labels are designed to come off easily when the move is completed. Because of this, the stickers will not adhere to some surfaces, such as upholstered chairs and sofas. If necessary, place a piece of scotch tape over label or place label on wooden or metal leg or arm.

REMEMBER... IF IT IS NOT FLAGGED, IT WILL NOT BE MOVED. BE SURE TO DOUBLE CHECK ALL ARTICLES. PLEASE TAKE HOME ALL PERSONAL OR PRECIOUS ITEMS BEFORE THE MOVE AND RETURN THEM AFTER THE MOVE.

k) Activities at the Destination

(1) The Move Coordinator should verify that all offices and cubicles at the new location are labeled.
(2) Instruct your employees by e-mail or memo to unpack as soon as possible.
(3) As soon as unpacking is complete, break the cartons down and place them in a central area for removal.
(4) COORDINATE THE RETURN, REUSE OR RECYCLING OF THESE WITH YOUR MOVER OR HOUSEKEEPING. Have the mover, one of your employees, or housekeeping remove them from the space for return, reuse, or recycling.
(5) Walk the space and visit with each employee to adjust chair heights, work surface heights and make sure that everything is working make record of any moving damage or missing items.
(6) Inspect every lateral file cabinet to ensure that it’s not unbalanced, top heavy or about to fall over. If it’s dangerous, have the mover level, balance, bolt and gang it.
(7) Set up and test your computers as soon as possible including the ones in offices and at workstations where the employees are traveling or on vacation.
(8) File Damage Claims in writing as soon as possible with your mover on his Damage Claim Form. Follow-up and confirm that he has received the completed forms.
(9) Instruct your employees to place any item or carton that’s not theirs in the “Lost & Found” room.
(10) Coordinate with OWRR to set up centralized recycling bins and dumpsters for the new location.

l) ATTACHMENTS

(1) Move Contact List
(2) Move Check List
(3) Move Responsibility and timeline matrix— Information to be supplied at a later time.
(4) Housekeeping Move Check List
(5) Environment Health and Safety Lab Closeout Procedures
(6) Surplus Property Procedures
(7) Office of Waste Reduction and Recycling Move and Office Cleanout Check List
Attachment A

Move Contact List

Overall estimated move timeframe:

<table>
<thead>
<tr>
<th>Department</th>
<th>Contact Name</th>
<th>Telephone</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facilities Planning and Construction Project Manager</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Project Manager</td>
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<tr>
<td>Construction Manager</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Contact Name/ Email/Phone:</td>
<td>Department(s):</td>
<td>From:</td>
<td>To:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Department</td>
<td>Contact Name</td>
<td>Telephone</td>
<td>Email</td>
</tr>
<tr>
<td>Asset Management</td>
<td>Candi Woody</td>
<td>962-6267</td>
<td></td>
</tr>
<tr>
<td>Auxiliary Services (Carolina Copy, Vending and Laundry)</td>
<td>Alvin Garner</td>
<td>962-2799</td>
<td></td>
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<tr>
<td>Vending Machines</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copiers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environment Health and Safety</td>
<td>Peter Reinhart</td>
<td>843-5913</td>
<td></td>
</tr>
<tr>
<td>Hazardous Waste Manager</td>
<td></td>
<td></td>
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<tr>
<td>Biosafety Officer</td>
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<tr>
<td>Radiation Safety Officer</td>
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<tr>
<td>Process Hazard Review</td>
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<tr>
<td>Ergonomics</td>
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<tr>
<td>Etc.....</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Facilities Services Customer Service and Work Request Center</td>
<td>Steve Copeland, Steve Stoddard</td>
<td>962-4633, 962-1565</td>
<td></td>
</tr>
<tr>
<td>Sign Shop</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Lock Shop</td>
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<tr>
<td>Elevators</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Housekeeping Services</td>
<td>Bill Burston</td>
<td>962-1440</td>
<td></td>
</tr>
<tr>
<td>Insurance and Risk Management</td>
<td>Janet Hoernke</td>
<td>962-6681</td>
<td></td>
</tr>
<tr>
<td>Supplemental insurance for moves</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interior Design and Workspace Planning</td>
<td>Cheryl Leguillow</td>
<td>962-9037</td>
<td></td>
</tr>
<tr>
<td>Mail Services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Office of Waste Reduction and Recycling</td>
<td>Tommy Brickhouse</td>
<td>962-4699</td>
<td></td>
</tr>
<tr>
<td>Indoor recycling and confidential paper</td>
<td>Sarah Myers</td>
<td>962-4699</td>
<td></td>
</tr>
<tr>
<td>Extra service of trash dumpsters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction and Demolition Waste (and other unique things)</td>
<td>Stephen Condrin</td>
<td>962-9063</td>
<td></td>
</tr>
<tr>
<td>Property Office (Leased Space)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Department</td>
<td>Contact Person</td>
<td>Phone</td>
<td></td>
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<tr>
<td>-----------------------------------</td>
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<td></td>
</tr>
<tr>
<td>Purchasing Contract Movers</td>
<td>Mark Sillman</td>
<td>962-9463</td>
<td></td>
</tr>
<tr>
<td>Surplus Property</td>
<td>Al Jeter</td>
<td>962-2160</td>
<td></td>
</tr>
<tr>
<td>Telephones</td>
<td>Steve Harward</td>
<td>962-0004</td>
<td></td>
</tr>
<tr>
<td>Transportation and Parking</td>
<td>Deborah Hawkins</td>
<td>962-5026</td>
<td></td>
</tr>
<tr>
<td>University Archives and Records</td>
<td>Janis Holder</td>
<td>962-0043</td>
<td></td>
</tr>
</tbody>
</table>
Move Check List

6-12 MONTHS BEFORE MOVING DAY
Department/College Moving coordinator
- Assign Department moving coordinator
- Assign office space
- Coordinate with Environmental Health & Safety (EHS)
- Review EH&S Lab Move Procedures check list
- Coordinate with University Archives
Facilities Division
- Prepare move Schedule and choose the move day
- Coordinate inventory of existing furniture
- Coordinate furniture purchase if required
- Send Purchasing request for moving services
- Schedule pre bid walk through with moving vendors
- Coordinate selection of moving vendor with Purchasing

3-6 MONTHS BEFORE MOVING DAY
Department/College Moving coordinator
- Submit life safety plans for new facility to EH&S
- Review EHS lab startup requirements
- Arrange for additional trash/recycling disposal
- Set-up cleaning service
- Arrange for copier move or buy new equipment
- Order keys, access cards
- Coordinate with surplus property (Sell old equipment, furniture etc.)
Facilities Division
- Coordinate furniture delivery
- Coordinate furniture installation with power and data requirements

1-2 MONTH BEFORE MOVING DAY
Department/College Moving coordinator
- Create new office layout map (to be done by individual user)
- Create new office extension directory
- Order new stationery
- Order new business cards
- Order new business forms
- Purge old, obsolete materials
- Create new office extension directory
- Obtain moving crates/cartons
- Update Web site with new information as required
- Notify Mail Services of Change of Address
- Back-up computers
- Store property that will not be moved
- Tag furniture to be moved
- Tag items for surplus storage
- Inventory existing computers
- Contact University Dining for Vending machine requirements
Facilities Division
- Verify phone line installation schedule
- Code new office space on a map for movers

1-3 WEEKS BEFORE MOVING DAY
Department/College Moving coordinator
- Pack up desks, personal spaces
- Pack up common areas
- Distribute new keys, cards
- Collect old keys, cards
- Empty, defrost and clean refrigerator
- Order dry ice and coolers for items that may require continued refrigeration

Facilities Division
- Coordinate move of systems furniture
- Coordinate truck access with transportation
- Coordinate protection of main moving paths and elevators

MOVING DAY
Department/College Moving coordinator
- Assign room to be used as lost and found
- Post coded signs in new office for movers
- Move plants and personal items

Facilities Division
- Final inspection of former location
Attachment C

Move Timeline Matrix

Information to be supplied at a later time.

Attachment D

Housekeeping Moving Procedures For Moves That Will Take 1 Day or Less:

- Contact Moving Office 3-4 weeks before date you want items moved
- If boxes are needed, contact moving office, give an account #, and boxes can be purchased and delivered, (but this too must be scheduled too)
- Let other staff know what needs to be moved or what they want moved. It is best to label items with destination so there is no mistake.
- Inform everyone that everything (desks, file cabinets, bookcases, etc.) must be emptied before the date of the move
- Complete move request form, return form to moving office
- If needed, contact parking and transportation to have 2-3 parking spaces at bldg. blocked off for move trucks for the day of the move
- For modular furniture, contact physical plant for break-down, dismantling
- If moving centrifuges or hoods, contact Health & Safety office to have these items flagged, (movers will not touch without a clearance form). Have Freon removed by the HVAC shop first.
- Housekeeping Services Moving Crew does not move computers, copiers, printers, etc. unless going to surplus.
- Items That Will Be Moved to Surplus (also see Attachment F):
  - Send completed surplus form to Surplus Dept. (CB#1070)
  - If you want the surplus picked up before the movers get to it, you must call and request a pick up date
- NOTE: Surplus is worked into the schedule unless a request for pick-up is made
- Tables & Chairs Loan:
  - Call at least 3-4 weeks in advance
  - If loan is for Friday, (and pick up is not until Monday), tables & chairs can not be left outside, they have to be stored in a bldg. (you must let the moving office know where they will be stored in advance)
  - We do not have podiums or round tables
  - Someone will have to meet the movers to sign for the table and chairs
  - No loans are to go to a personal residence
Environment, Health and Safety

Laboratory Closeout Procedure

This form is to guide laboratory personnel when laboratory operations are moved or discontinued. Other requirements may apply.

Be sure to clean out and decontaminate freezers, coldrooms, other storage areas outside of the lab and common storage areas. If these areas will no longer be used, remove all materials, including chemicals and biologicals.

Contact the Department of Environment, Health and Safety (EHS) 60 days prior to vacating the laboratory, room or area. For more information, see ehs.unc.edu or call EHS at 262-5507.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Date Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chemicals</strong></td>
<td></td>
</tr>
<tr>
<td>For questions, call Hazardous Materials Manager 2-5509 or see <a href="http://www.ehs.unc.edu">www.ehs.unc.edu</a></td>
<td></td>
</tr>
<tr>
<td>Evaluate all chemicals and label all containers</td>
<td></td>
</tr>
<tr>
<td>Are there any unknown chemicals? Identify if possible.</td>
<td></td>
</tr>
<tr>
<td>Submit waste forms, either online, (<a href="http://www.ehs.unc.edu">www.ehs.unc.edu</a> ), or by hard copy.</td>
<td></td>
</tr>
<tr>
<td>Clean Laboratory surfaces</td>
<td></td>
</tr>
<tr>
<td>Confirm Hazardous Waste has been removed</td>
<td></td>
</tr>
<tr>
<td><strong>Controlled Substances</strong></td>
<td></td>
</tr>
<tr>
<td>If you have your permit, DEA agents can be sewer ed with a witness signature. Keep records for at least 3 years. If no permit, call Hazardous Materials Manager, 2-5509.</td>
<td></td>
</tr>
<tr>
<td>Have Controlled Substances permit available</td>
<td></td>
</tr>
<tr>
<td><strong>Gas Cylinders</strong></td>
<td></td>
</tr>
<tr>
<td>Return to supplier</td>
<td></td>
</tr>
<tr>
<td>For non-returnables, send in HMTF</td>
<td></td>
</tr>
<tr>
<td>Contact Scientific Storeroom: 6-5671</td>
<td></td>
</tr>
<tr>
<td>*Make sure cylinder is disconnected, valve off, cap on</td>
<td></td>
</tr>
<tr>
<td><strong>Animal and Human Tissue</strong></td>
<td></td>
</tr>
<tr>
<td>Dispose of tissue. Describe method:</td>
<td></td>
</tr>
<tr>
<td>Dispose of Preservative. Describe method:</td>
<td></td>
</tr>
<tr>
<td>Clean refrigerators/ freezers</td>
<td></td>
</tr>
<tr>
<td>Transfer responsibility of samples to:</td>
<td></td>
</tr>
<tr>
<td><strong>Microorganisms and Cultures</strong></td>
<td></td>
</tr>
<tr>
<td>For questions, call Biological Safety Officer 2-5726 or see ehs.unc.edu</td>
<td></td>
</tr>
<tr>
<td>Autoclave waste (see procedure at ehs.unc.edu)</td>
<td></td>
</tr>
<tr>
<td><strong>Radioactive Materials</strong></td>
<td></td>
</tr>
<tr>
<td>For questions or waste pickup, call 2-5507 or see Radiation Safety FAQ, “Moving Your Laboratory” at ehs.unc.edu</td>
<td></td>
</tr>
<tr>
<td>Procedure</td>
<td>Date Completed</td>
</tr>
<tr>
<td>-----------</td>
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</tr>
<tr>
<td>Prepare Radioactive waste for pick-up and call 2-5507</td>
<td></td>
</tr>
<tr>
<td>Lead bricks, lead pigs, shielding, source containers. Do wipe tests, attach to 102 form, and call 2-5507 for removal.</td>
<td></td>
</tr>
<tr>
<td>Exit survey of rooms and equipment is required!</td>
<td></td>
</tr>
</tbody>
</table>

**Recyclables**

To schedule pick-up, contact Office of Waste Reduction/Recycling; 2-1442. Also see [www.fac.unc.edu/WasteReduction](http://www.fac.unc.edu/WasteReduction).

<table>
<thead>
<tr>
<th>Large quantities, overflows, or confidential paper pick-ups</th>
<th></th>
</tr>
</thead>
</table>

**Laboratory Equipment/Surplus Property**

Units that may contain refrigerants must be evaluated by Facilities Services Refrigeration Shop (2-1087) to determine if refrigerant needs to be removed. If refrigerant needs to be removed, submit a work order to Facilities Services Customer Service (2-3456). The Department or owner must pays for removal.

For equipment that may be contaminated with radioactive material, decontaminate, remove warning stickers, and complete a Safety Clearance Form and attach it to the unit prior to calling. For information, call 2-5507 or see Radiation Safety FAQ, at ehs.unc.edu.

For equipment that may be contaminated with chemicals or biological material, decontaminate, remove warning stickers, and complete a Safety Clearance Form and attach it to the equipment.

For other discarded lab equipment, notify your Department manager; call Surplus Property (2-2134) and complete forms. Call the University Moving Crew (2-0662) to arrange for transportation of equipment to Surplus Property. (If Surplus Property determines that the equipment should be scrapped, it will be taken to the Orange County Recycling Facility at no charge.)

**Sharps**

| Chemically contaminated sharps, use metal can- then trash | |
| Biologically contaminated sharps, use metal can, autoclave- then trash | |
| Radioactive sharps, plastic container, call in, 2-5507, 102 form | |
| Metal can for sharps, (item# SP-28700), call 6-5671 | |

**Glassware**

| Brown, empty bottles, de-face then trash | |
| Other glassware that is empty, use plastic-lined cardboard glass box, then trash | |
Attachment F

Surplus Property Procedures

ASSET MANAGER: 962-6267

SURPLUS PROPERTY MANAGER: Al Jeter 962-2134

Timeline:

- Three to Six Months out
  - Request a Capital Asset listing from Asset Manager.
  - Department Coordinator and Surplus Manager do a walk through to determine what items surplus wants and to see what items should be scrapped as opposed to bringing these items to surplus and surplus will have to send them to a landfill.
  - Review Surplus procedures (see Section C below)

- One month out the Department Coordinator and Surplus Manager should meet to discuss.
  - Who the Private contractor is
  - Number of deliveries per day
  - Number of days needed for move
  - Surplus will not accept a move after 3:30 pm
  - To insure surplus forms are completed
  - Insure ES 102 Forms are completed
  - Insure that white goods are taken directly to county’s recycling program unless cleared previously by Surplus manager
  - Insure that all equipment delivered to surplus has the Safety Clearance form
  - Insure the outside contractor know Surplus’ hours of operation
  - No equipment with hospital decal numbers will be accepted by surplus

- One week out let Surplus know when the first delivery will be made.
  - If the Department Coordinator complies with the time line above than nothing else is needed by Surplus

- Consequences: If the Department doesn’t keep surplus informed according to the time line consequences may include:
  - Surplus would not be able to receive of the property when it is delivered by the contractor.
  - The private contractor would charge the Department additional money
  - The moving process would be backed up, possibly for days.
  - The Surplus Property Manager would have to bring in additional people to support the unexpected delivery. The cost would be $10.00 per hour for each of the two employees for as long as required.

- Surplus Property Procedures:
  - Request a capital asset listing from Asset Management
  - Determine what items on the capital asset listing will no longer be needed by the Department
  - Items no longer needed should be flagged. Items can be flagged by using plain white paper, colored dots, labels, etc.
For items that appear on your equipment inventory listing, prepare an E/S-102 Form, Notice of Disposal or Change in Location for these items going to surplus or being transferred, sold, or given to another Department.

- Do not remove decals when turning in equipment to surplus.
- Equipment owned and/or controlled by the University may not be given away or sold, either to an individual or to another institution, without prior approval from the Director of Asset Management.
- No tool, instrument, vessel, storage cabinet, refrigerator, etc. used with radioactive material may be moved to another department or to surplus until it has been fully decontaminated and cleaned by Environment, Health, and Safety.
- Units that contain refrigerants other than R12, R22 or 134A must be evaluated by Facilities Services Refrigeration Shop. If refrigerant needs to be removed, submit a work order to Facilities Services.
- Property that is surplus to one department may be transferred directly to another department (omitting transfer to surplus). This allows the department to recover some cost for equipment that is no longer needed.
- Surplus forms P-110’s can be requested from the Surplus Office. Thirteen separate individual lines may be placed on this form. The surplus form P-110 listed on the web site only six separate individual lines may be listed.
- Moves requiring less than eight hours can be requested through the Housekeeping Services moving supervisor (962-6586).
- Larger moves requiring eight hours or more, Housekeeping Services will provide the requesting departments with a list of contract moving companies.
- The Facilities Services Division moving crew makes small moves free of charge.
- The Surplus Property Receipt form should contain, at a minimum, the following:
  - Department Name and number
  - POC and phone number
  - Location of property (room number and building)
  - Description of property
  - Serial number
  - UNC Decal number
  - Signature of persons authorizing the transfer
- The Surplus Property Receipt form P-110 must match the truckload of items being delivered to surplus.
- It is not the responsibility of surplus personnel to prepare surplus forms for items received from departments, nor to notify Asset Management.
- Department Coordinators should be aware of the following:
  - The fact that an item costs less than $100 and is not required to be inventoried, does not relieve fiscal agents or staff members of the responsibility for the prudent use, care and safeguarding of the item.
  - An item costing $100.01 or greater but less than $500.00 and has a useful life of one year or longer is considered equipment. It is the responsibility of the fiscal agent to identify. Each item is to be identified by an identification tag (blue) to be affixed to the item. The Business Office will provide an identification tag (blue) along with a copy of the purchase order.
  - Equipment items costing $500.00 or greater and equipment with a value of less than $500.00 but considered a high theft item is maintained in the University’s fixed assets system. These items are added to the fixed asset system (a) after the Business Office has made payment or (b) following transfer from another location or agency.
Office of Waste Reduction and Recycling

Check List for Indoor Recycling

Related to Moves and File Clean-outs

- Walk through to determine bin needs (recycling, surplus, EHS, move coordinator, housekeeping...)
- Move coordinator notifies Office of Recycling with temporary indoor bin needs at least six weeks in advance
- ORS or OWRR will deliver temporary bins with instructions on different recyclables and how they should be separated
- When departments are purging, they should be sure to place recyclable materials in appropriate bins and do not contaminate! Information on materials recycled and proper sorting is available at www.fac.unc.edu/wastereduction.
- Try to have the bins picked up and delivered on scheduled pick-up days if possible (nor more than once a week)
- If more bins are necessary, please notify recycling office
- After purge is over, please notify the recycling office so these bins can be removed, again preferably on the regular route schedule
- At least one week prior to vacating the building, please contact recycling office for final walk-through and material assessment

NB: If recyclables are left in the building after the final recycling pick-up, it will be the responsibility of the move coordinator along with housekeeping to remove the additional materials

- Relocation and Move-In
- For new building set-up during/ after move- indoor recycling sites will be set up according to plans arranged during design review
- If the sites were not arranged during planning stages, then there will be a walk through and assessment of the building with a bin installation after the move.
# A-32 – ENVIRONMENTAL DEMOLITION & REMEDIATION

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Applicability
The design specifications for the environmental demolition and remediation are to be used without regard to
the anticipated bidding process and contractual agreements for all existing University owned buildings. Certain
hazardous materials are found in all construction sites both for renovations and new building construction. It is
expected that the contractors and subcontractors are cognizant of these hazards and are taking the necessary
measures to protect their employees, University personnel and the environment. Consequently, special
attention is not directed to these common materials. These materials include intact lead containing paint, silica
in concrete, wood dust, metal fumes (cutting/welding), adhesives, solvents etc.

Building Specific Hazards
While the specifications cover the common hazardous materials in detail, handling of other hazardous materials
may need to be added to individual job specifications depending on the prior uses of the building to be
renovated or demolished. Many items covered in the specification include the hazards expected in laboratory
renovations. References to laboratory specific items should be removed from the specifications for buildings
which were never used as laboratory and/or medical facilities. It is important to recognize that the older
buildings have served multiple functions and departments through the years and hazards may be hidden in
abandoned piping and duct work that have not been used for decades.

Bidding Preference
Preferably, environmental demolition will be bid as a separate project under the control of an environmental
demolition contractor who understands and has experience with hazardous materials that are often hidden
within a building and do not appear until extensive demolition work is accomplished. All participating
environmental demolition contractors must go through a prequalification process conducted by the University
or by the General Contractor or CM at Risk.

Work Sequence
The environmental demolition work will precede all subsequent work on a designated project site. All
demolition work required to remove all hazardous materials shall be performed by the environmental
demolition contractor. If a subsequent contractor will begin work at the site while the environmental
demolition contractor is also active at the site, separate work areas must be clearly bounded by rigid walls,
ceilings and floors with no opportunity for cross contamination from the environmental demolition work and
the other contractors at the site. The minimum area to be devoted to the environmental demolition work is an
entire floor of the building at a time.

Once an environmental demolition contractor leaves a defined work-space, the hazmat work is to be complete
to the extent of the entire renovation project scope. The intent shall not be for the next contractor to perform
further demolition to expose more hazardous material requiring the return of the environmental demolition
contractor. Any exceptions to this approach will require further detailed specifications including a clear
delineation of tasks and a detailed description of the hazardous material which remains.

Preface
The expectation of the environmental demolition work is to perform all hazardous material removal from each
designated, clearly bounded area. The environmental demolition contractor is to control all demolition and
hazmat removal according to regulatory requirements in such a manner as to control contract worker exposures
below permissible exposure limits and to prevent the release of hazardous materials into adjacent areas or into
the environment (soil, air, water and sewer). Any hazardous material that will remain after abatement will be
clearly defined in the specifications and will be secured in a way that subsequent contractors or building occupants will not be exposed to releases of the remaining material. Other than what is clearly excluded, all hazardous material is considered within the abatement scope of this contract.

SECTION 1 – PROJECT INFORMATION

1.01 OVERVIEW

This section shall specify the purpose for the renovation or demolition project. Specific details concerning the project shall include the phasing and scheduling details including start and completion dates. The overview shall outline any phasing required during the project and identify the materials associated with each phase, the location, and the amount of material. The scope of work shall be specific to include any specialty requirements for each area or phase, and any demolition activities required by the abatement contractor. Please Note: The designer shall incorporate all items included in the abatement specification itemized on the bid document on a per square foot basis, per linear footage or items on a per item basis and a cost associated with re-mobilization to the site.

The work schedule shall reflect any anticipated shift work, number of shifts scheduled and the time associated with each shift. The work schedule shall state that the University of North Carolina and/or Project Designer shall approve deviations of the work schedule listed below:

- Project Start Date: Insert Date
- Daily Work Schedule: AM thru PM
- Project Completion Date: Insert Date, by PM

The University of North Carolina has the right to adjust the schedule and the contractor shall adhere to those revisions provided the total number of days allotted for the project is not altered.

Project Information: The contractor shall post at the job site on a designated display board within 10 square feet of the decontamination unit, the Health Hazard Control Unit (HHCU) notification and all other pertinent licenses. The Point of Contacts for the project shall be posted and include the name, pager number or cell phone number of the following entities:

- The Project Designer
- The Site Superintendent/Supervisor for the Abatement Contractor
- The General Contractor or Site Superintendent
- The Onsite Industrial Hygienist Air Monitor
- The Building Owner Representative
- The Supervising Air Monitor

1.02 BUILDING HISTORY

This section shall include the current function of the building, the location and the age of the building. The history shall include any previous building functions. Incorporate the number of floors, the number of mechanical rooms, a description of the exterior construction, type of roof, windows, and HVAC system. A description of the interior construction shall include the basic flooring, ceiling, walls and plumbing systems. Any previously abated areas shall be identified including the type of material, location and approximate date of
abatement and a description of the replacement material. The description of the replacement materials shall specify if the materials are non-asbestos.

1.03 CODES AND REGULATIONS

The contractor shall assume full responsibility and liability for compliance with applicable federal, state and local regulations pertaining to work practices, waste handling, protection of workers, visitors to the site and persons occupying areas adjacent to the site. Work shall also be completed according to all UNC guidelines including the UNC Design and Construction Guidelines. A copy of these and other UNC guidelines may be downloaded, saved and printed from the UNC Facilities Planning and Construction website. We have directly referenced some of the more pertinent sections of the UNC Design and Construction Guidelines, the UNC Hazardous and Universal Waste Guidelines, the UNC Construction and Demolition Waste Management Guidelines (http://surface.facilities.unc.edu/OWRRGuidelines/) and the UNC Waste Reduction Guidelines (http://www.wastereduction.unc.edu/) throughout the plan. It is the responsibility of the contractor to read and understand these guidelines and other federal, state and local codes and regulation pertinent to completing the work prior to preparing and submitting the bid package.

Unless modified by this project specification, specifications for work including cutting, remediation, stripping, removal, repair and disposal work shall conform to the updated versions of the following guidelines and standards, as they become available:

The following regulations and guidance published by the Environmental Protection Agency (EPA):

1. Resource Conservation and Recovery Act (RCRA)
2. 40 CFR Parts 260-272, Solid and Hazardous Waste (RCRA)
5. 40 CFR, Subchapter J, Parts 300-373: Superfund Emergency Planning and Community Right-to-Know Programs
6. Comprehensive Environmental Response Compensation and Liability Act

The following regulations published by the Department of Transportation (DOT):

1. Hazardous Materials Transportation Act as amended
2. 49 CFR Parts 171 through 177

The following regulations published by the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA):

5. “Specifications for Accident Prevention Signs and Tags,” Title 29, Part 1910, Section 145 of the Code of Federal Regulations
11. Federal Standard 313A: Material Safety Data Sheets, Preparation and Submission of

The following regulations published by North Carolina State, county or town agencies:

1. Orange Water and Sewer Use Ordinance, Orange County, North Carolina
2. Orange County Regulated Recyclable Materials Ordinance
4. North Carolina General Statutes, including Chapters 95, 97, 130
5. Town of Chapel Hill Noise Ordinance-Ordinance Number 2001-09-24/O-8
6. The State Building Code
7. North Carolina Construction Manual, Division of State Construction, Department of Administration, Section 112.4 Electrical
8. North Carolina Administrative Code, Title 15A, Chapter 13 Solid Waste Management
9. Wastewater Permit discharge requirements for UNC Chapel Hill
10. Occupational Safety and Health Act of North Carolina (OSHANC)

The following documents published by the American National Standards Institute:


Documents published by the following professional electrical engineering, fire or other associations:

1. Underwriters’ Laboratories (UL)
2. National Electrical Manufacturers’ Association (NEMA)
3. National Fire Protection Association (NFPA)
6. Electrical Testing Laboratory
7. American National Standards Institute (ANSI)
8. Institute of Electrical and Electronic Engineers (IEEE)

The following documents published by UNC:
1. UNC Hazardous and Universal Waste Guidelines
2. UNC Design and Construction Guidelines
3. UNC Construction and Demolition Waste Management Guidelines

Please note where these or other referenced guidelines conflict with this specification or each other, the more stringent of the guidelines shall prevail.

1.04 CONTRACTOR QUALIFICATIONS INCLUDING LICENSES, ACCREDITATIONS AND TRAINING

The contractor shall maintain current company licenses and accreditation, and licenses and accreditations for workers and supervisors as required by applicable federal, state and local jurisdictions for removal of materials and for other regulated activity relative to the work of this contract. The contractor is also responsible for payment of all permit fees required for this project.

A. The asbestos/hazardous materials abatement contractor will be a licensed general contractor in the specialty interior, building, unclassified or asbestos categories by the North Carolina Licensing Board of General Contractors.

B. All supervisors shall be accredited by the NC Department of Health and Human Services (NC DHHS)/Division of Public Health/Health Hazards Control Unit (HHCU). All supervisors on the project shall have experience in the administration and supervision of asbestos abatement projects including work practices, protective measures for building and personnel, disposal procedures, etc. Experience and Training: The General Superintendent must be accredited as an Asbestos Abatement Supervisor in accordance with the AHERA regulation 40 CFR Part 763, Subpart E, Appendix C and as amended February 3, 1994 (ASHARA) and be accredited as NCDHHS Supervisors. All supervisors on the project must have had a minimum of Three (3) years on-the-job training in asbestos abatement procedures and have worked at least five (5) projects, three (3) of which are comparable in complexity and size to this project.

C. All workers performing any asbestos-related shall be accredited by the NC DHHS.

D. Provide an adequate number of qualified personnel to meet the schedule requirements of the project. Submit to the Owner's Representative a request for approval for any person intended to be employed in the project with said employees' name, social security number, qualifications, "Certificate of Workers' Acknowledgment", and "Affidavit of Medical Surveillance and Respiratory Protection".

E. A minimum of one supervisor working in the project shall have attended a 24-hour respiratory protection course.
F. One supervisor shall be provided for every 10 workers inside the containment. A minimum of one supervisor shall be provided per project per work area.

G. Provide a General Superintendent with experience in administration, environmental remediation, demolition, and of asbestos abatement projects including work practices, protective measures for building and personnel, disposal procedures, etc. This person is responsible for compliance with all applicable federal, state and local regulations, particularly those relating to asbestos-containing materials as outlined in OSHA 29 CFR 1926.1101, and including 1926.20 through 1926.32. The Superintendent needs to be knowledgeable of the North Carolina Asbestos Hazard Management Program Rules as adopted by 10A NCAC 41C .0600. Provide full time Supervisor(s) for inside the work area with experience in asbestos abatement projects including work practices, protective measures for building and personnel, disposal procedures, etc. One of these two supervisors must be able to communicate in the language of the workers and be able to communicate in English to the Building Owner’s Representative(s). These persons are responsible for compliance with all applicable federal, state and local regulations, particularly those relating to asbestos-containing materials as outlined in OSHA 29 CFR 1926.1101, and including 1926.20 through 1926.32. The Superintendent needs to be knowledgeable of the North Carolina Asbestos Hazard Management Program Rules as adopted by 10A NCAC 41C .0600.

H. Competent Person: As required by OSHA in 29 CFR 1926.1101 and 29 CFR 1926.20 through 32. This will generally be the General Superintendent if on-site on a full time basis. If the Superintendent is not on-site full time then the Supervisor(s) will be considered the Competent Person and be so trained. Trained supervisor(s) will be required to be inside the work area during all abatement activities.

I. Submit to the University of North Carolina’s Representative a request for approval for any person intended to be employed in the project with said employees' name, social security, qualifications, "Certificate of Workers' Acknowledgment" and "Affidavit of Medical Surveillance and Respiratory Protection". The building owner’s representative and/or IH firm reserves the privilege of approving all General Superintendents and/or Supervisor(s) named for said project. The building owner’s representative and/or IH firm also reserves the privilege of requesting that any General Superintendent, Supervisory and/or workers that do not perform in an acceptable professional manner will be asked to leave the worksite either on a temporary or permanent basis.

J. Medical: Include individually signed and notarized forms by each worker to be utilized on the project documenting that each is actively involved in a company employee medical surveillance program.

K. Respiratory and other personal protective equipment: Copies of the most recent fit-testing and training records, individually signed for each worker shall be utilized on the project. Demolition personnel must be certified to wear personal protective equipment (PPE), including respiratory protection to complete demolition.

L. Initial Exposure Assessment: As required by the OSHA construction asbestos standard 29 CFR 1926.1101.

M. Abatement activities of other environmental hazardous materials will be completed only by contractor personnel that are 40-hour trained as specified in 29 CFR 1910.120 (OSHA Hazardous Waste Operations Training) and who have previous project experience with each contaminant included within the scope of work.
N. Mercury abatement activities will be completed only by contractor personnel that are 40-hour trained as specified in 29 CFR 1910.120 (OSHA Hazardous Waste Operations Training) and who have previous project experience decontaminating mercury. The contractor’s employees shall receive mercury awareness training at the outset of the project that includes the identification of mercury spills, the hazards associated with mercury and its compounds and the proper personal protective equipment to use on the jobsite where mercury has been discovered. The contractor’s employees will also be informed that elemental mercury and mercury containing materials, such as organomercuries and inorganic mercuric salts, are inhalation and contact toxins that require special handling and disposal precautions. Mercury compounds are regulated by numerous statutes and regulations, particularly regarding workplace exposure avoidance and prevention of releases to the environment.

O. Construction activities disturbing lead-containing paint requires adherence to 29 CFR 1926.62 (Lead in Construction Standard). The contractor is responsible for conducting employee airborne exposure monitoring, providing personal protective equipment, and using appropriate exposure control measures as defined by the standard. The contractor’s employees shall receive lead awareness, hazard communication, and respiratory training prior to construction work.

P. Contractor will be responsible for ensuring that General Superintendents, Supervisor(s) and/or non supervisory (worker level) personnel are trained to address other identified environmental concerns in accordance with OSHA and EPA standards.

1.05 NOTICES

The contractor shall notify the following offices in writing within the time frame specified by the National Emission Standard for Hazardous Air Pollutants (NESHAP) regulations prior to beginning any asbestos removal operations.

State Agencies

Health Hazards Control Unit
Occupational & Environmental Epidemiology Section
N.C. DEHNR
(Regular Mail) (UPS, Fed Ex, etc.)
P.O. Box 27687 2728 Capital Blvd
Raleigh, N.C. 27611-7687 Parker Lincoln Bldg.
Telephone: (919) 733-0820 Second Floor / 2A210
Fax: (919) 733-8493 Raleigh, N.C. 27604

1.06 WORK AREA BOUNDARIES

The contractor will provide and install permanent, six-foot tall, chain link fencing around the building and the staging area prior to completing other work on-site. The chain link fencing will be covered with landscape fabric on one side to reduce noise, dust and visual impact. A lockable access gate to the work and staging area will be installed.
The contractor shall establish work area boundaries that will:

1. Establish a decontamination zone to allow only authorized access to the work areas including personnel decontamination area and staging area.
2. Ensure that unauthorized people do not enter the work area.
3. Protect people in the vicinity of the work area from potential dangers that may exist in the work areas.
4. Ensure contaminants are contained within the work areas.

The contractor should notify the local emergency medical services, police and fire departments in writing of the type and scope of work being performed and request that these departments make an inspection prior to beginning the work.

1.07 STAGING AREA AND PARKING

The contractor is responsible for supplying temporary storage required for storage of equipment and materials for duration of project. As identified in the UNC Planning and Construction Design Guidelines, the contractor’s temporary facilities, including trailer and storage dumpsters, will be maintained in the areas designated by UNC Chapel Hill Parking Services in the Department of Public Safety (919.962.7135). Parking will be allowed in areas designated by Mr. Roy Cox.

Universal and hazardous materials and waste may be accumulated and temporarily stored on UNC property, but storage should not exceed 30 days except for extremely hazardous materials, for which arrangements should be made to remove the material from the premises as soon as is practicable. The contractor will provide locked storage for hazardous materials and waste with a clearly marked and labeled section specifically devoted to hazardous waste. Satellite Accumulation Rules should be followed until a total of 55 gallons of waste is accumulated. Once that threshold has been crossed, less than 90 day storage requirements must be implemented. The contractor will clearly identify the storage areas with proper signage and secure the area.

The hazardous and universal waste accumulation area will be pre-approved by UNC and the designer before wastes are stored there. The areas will be open for inspection by the UNC Environment Health and Safety (UNC EHS) or designer upon request. Hazardous waste accumulation area shall be locked when not in use.

The contractor is responsible for keeping the staging area secure. Waste materials will be protected from the weather and stored off the ground. The contractor will complete inspections of the waste storage area on a weekly basis and complete a daily inspection log. The contractor will keep the inspection forms in a project logbook on-site and provide copies to UNC EHS and/or the designer upon request. The contractor shall confirm that containers are secure and not leaking, and wastes are segregated into compatible groups and is properly labeled.

The contractor shall maintain an adequate quantity of spill response supplies to contain, at a minimum, 115% of accumulated waste. If a spill or leak is detected, the contractor shall immediately contact UNC-EHS. The spill or leak should be contained as soon as it is safe to contain. The contractor should clean the spilled material and contain it according to federal, state and local regulations and guidelines. UNC-EHS will assist the contractor in completing the required paperwork, including reporting and regulatory agency notification, as required.

1.08 TEMPORARY FACILITIES
1.08.1 First Aid

A minimum of one first aid kit shall be located in the clean room. Additional first aid kits as the contractor determines as necessary or are required by law shall be located throughout the work area.

1.08.2 Fire Extinguisher

The contractor shall comply with the applicable recommendations of the National Fire Protection Agency (NFPA) Standard 10 - "Standard for Portable Fire Extinguishers." The contractor shall locate fire extinguishers where they are most convenient and effective for their intended purpose, but provide not less than one extinguisher in each work area equipment room and one in the clean room of the personnel decontamination unit.

1.08.3 Toilet Facilities

If required, provide temporary toilet facilities to be used by contractor’s employees. Use of the owner’s existing toilet facilities will be at owner’s discretion and these privileges may be revoked at any time.

1.08.4 Water Services

A. The contractor shall lock and tag out water equipment in the work area. The contractor shall confirm water supplies have been locked and tagged out prior to beginning work. The owner will provide water for the project. The contractor is responsible for connection to the water source and providing water to the work areas. Contractor bears the expense of getting water to the work and decontamination areas and heating that water.

B. The contractor shall provide temporary connection to existing building utilities or provide temporary facilities as required herein or as necessary to carry out the work.

C. The contractor shall employ qualified tradesmen for installation of temporary services and facilities. The contractor shall work with UNC to locate, modify and/or extend temporary services and facilities where they will serve the project adequately and result in minimum interference with the performance of the work.

D. The contractor shall supply hot and cold water to the decontamination units. Hot water shall be supplied at a minimum temperature of 100 degrees Fahrenheit.

E. After completion of use, connections and fittings initially installed by the contractor shall be removed by the contractor without damage or alteration to existing water piping and equipment.

Refer to the UNC Design and Construction Guidelines for further information including Chapter V - Technical Design and Performance Standards – Division 15, Mechanical Systems.

1.08.5 Electrical Services

A. General: The contractor shall comply with applicable National Electrical Manufacturers’ Association (NEMA), National Electric Code (NEC), and Underwriter’s Laboratory, Inc. (UL) standards and governing state and local regulations for materials and layout of temporary electrical service.
B. The contractor shall lock and tag out electrical and Heating, Ventilation, and Air Conditioning (HVAC) equipment in the work area. The contractor shall verify that the power and HVAC have been locked and tagged out prior to beginning work. The owner will provide electricity for the project. The contractor is responsible for connection of power panels and providing temporary electrical services to the work areas.

C. The contractor shall provide temporary facilities as required herein or as necessary to carry out the work. The contractor shall contact UNC Electric Systems for the location of the temporary service equipment, the appropriate size of any CT cabinets (if required), and associated costs for the service. Temporary service is generally provided just inside the construction site fence at an agreed point of delivery as approved by UNC Electric Systems.

D. Standard temporary service is typically overhead but may be installed underground depending on the construction site. UNC Electric Systems’ preferred temporary service is single-phase 120/240 volt furnished from an overhead transformer. Overhead or underground three-phase 120/208 volt, 120/240 volt and 480 volt services can be made available. UNC discourages the use of single-phase 120/240 volt service due to the associated cost.

E. Temporary services of 200 amperes and under are metered with self contained meters and require a standard meter base supplied by UNC Electric Systems. Temporary services over 200 amperes require current transformers for metering and require a CT cabinet supplied by the contractor.

F. The contractor is responsible for coordinating and acquiring all local inspections and filing an application for services with the Energy Services Business Office. The filing date must allow adequate time for UNC Electric Systems to provide the desired service.

G. The contractor shall provide a structure sufficient in strength and height to accept the appropriate overhead or underground supply conductors and to comply with appropriate local and NEC codes for height, voltage, clearance and utilization of power.

H. The contractor shall employ qualified tradesmen for installation of temporary services and facilities. The contractor shall locate, modify and extend temporary services and facilities where they will serve the project adequately and result in minimum interference with the performance of the work.

I. Ground Fault Protection: The contractor shall provide receptacle outlets equipped with ground fault circuit interrupters (GFCI), reset button and pilot light, for plug-in connection of power tools and equipment. All GFCIs shall be located outside the containment area. All powered equipment shall be connected to a GFCI.

J. The contractor shall provide a weatherproof, grounded temporary electric power service and distribution system of sufficient size, capacity and power characteristics to accommodate performance of work during the construction period.

K. The contractor shall install temporary lighting adequate to provide sufficient illumination for safe work and traffic conditions in every area of work. The contractor will not be allowed to utilize the existing lighting at the site during abatement of asbestos containing materials. All light fixtures shall be cleaned and removed.
under the containment or wrapped with two layers of six mil polyethylene sheeting. Maintain a level of at least 75 foot candles in all construction areas. During the final visual inspection, the temporary lighting shall be maintained at level of at least 150 candle foot. Any deviations in the lighting requirements must be approved by UNC EHS and/or the Project Designer. If adequate lighting is not provided during the work process, during visual inspection by UNC EHS, project designer or IH firm, in and/or during air monitoring, the project will be shut down at the contractor’s expense until lighting is provided. There will be no additional time allotted to the contractor for the project in the event these circumstances arise. Reference OSHA 29 CFR 1926.56(b).

L. The contractor shall provide services of an electrician, on a standby basis, to service electrical needs during the abatement process.

M. The contractor shall provide additional power service and distribution service, consisting of individual, dedicated 15 amp 120 volt circuits to electrical drops with receptacle outlets equipped with ground fault circuit interrupt protection, color coded for the exclusive use of the industrial hygiene firm. A minimum of 5 drops per work area is required.


1.08.6 Security

A. The contractor is responsible for constructing and maintaining secure containment areas including the entry/exit areas. The regulated area shall be restricted to authorized, trained, and protected personnel including the contractor’s employees, employees of subcontractors, state representatives and other designated individuals. The contractor shall establish a list of authorized personnel prior to job start and post this list in the clean room of the decontamination facility. Abatement, remediation and demolition locations will be appropriately identified utilizing warning signs as required by OSHA and city, state, and federal regulations. The contractor is responsible for creating and maintaining a secure work area during the entire project.

B. The contractor is responsible for maintaining secure entry/exit locations at the facility while work is being completed.

C. The contractor shall maintain a logbook in the clean room area of the decontamination system. Anyone who enters the regulated area must record name, affiliation, time in, and time out for each entry.

D. Access to the regulated area shall be through a single decontamination system. Other means of access (doors, windows, hallways, etc.) shall be blocked or locked so as to prevent entry to or exit from the regulated area. The only exceptions to this rule are the waste pass-out air lock that shall be sealed except during the removal of containerized waste from the regulated area, and emergency exits in case of fire or accident. Emergency exits shall **not** be locked from the inside; however, they shall be sealed with polyethylene sheeting and tape.

1.09 LOCKOUT/TAGOUT
The contractor shall have a company lockout/tagout program. A coordination meeting may be required with UNC Facilities where locks are required from both the University and the contractor on the same switch gear. The contractor shall lock and tag out electrical equipment, including HVAC equipment and water in the work areas. The contractor shall verify that power and water in the work areas have been locked and tagged out prior to beginning work. The owner will provide electricity and water for the project. The contractor is responsible for temporary connection to power panels and the temporary water lines and routing electricity and water to the work areas.

1.10 HOT WORK

The contractor is responsible for having a hot work permit program, training the workers and utilizing hot work permits. Written documentation shall be kept for each hot work permit provided on a daily log. Each permit shall be cancelled when work is completed or on a daily basis, whichever time is shorter. Cancelled permits shall be maintained by the contractor. A copy of each initial permit authorization and the cancelled permit shall be kept on-site by the contractor in a binder and provided to UNC and/or the designer upon request.

1.11 RADIOACTIVE, BIOLOGICAL AND CHEMICAL HAZARDS

The occupants may be required by UNC-EHS to remove radioactive, biological and chemical materials and obtain clearance from UNC-EHS prior to vacating their location(s). Documentation of these clearances may be obtained from UNC-EHS. UNC-EHS keeps documentation on a variety of environmental health and safety data including, but not limited to the following:

A. The Hazardous Materials Management Program maintains UNC’s chemical inventory system and hazardous materials use permits. Chemical inventory reports can be generated and sorted by location and chemical-specific parameters such as hazard class, toxicity and physical state. This information may be used by the contractor to evaluate recent potential sources of contamination within a lab.

B. Hazardous waste generated on campus is processed through the UNC-EHS’ Chemical Waste Program. A representative of UNC-EHS must observe waste sampling, review all testing data and waste determinations and must sign all manifests. The waste shall be accepted, transported and disposed by one of the pre-qualified waste disposal contractors listed in Section 1, 1.14 - Hazardous and Universal Waste Disposal. The contractor is responsible for fees associated with transportation and disposal of hazardous and universal waste materials.

C. The contractor is responsible for certifying, by documentation, items which are decontaminated and disposed are clean and free of hazardous materials. If such decontamination is completed to remove only a certain amount of hazardous materials to a level appropriate for a specific disposal option, this must also be documented by a proper waste determination.

D. The UNC-EHS also tracks the use of radioactive materials and equipment on campus. A health physicist is assigned to every research project that uses isotopes and assists the researcher in moving materials between locations. The health physicist also coordinates terminal radiation surveys.

E. The Biosafety Program tracks the use of biohazardous materials and assists the professors with relocation of such materials.
F. Radioactive materials currently stored in the building will be relocated by UNC-EHS prior to the contractor beginning work. UNC-EHS will complete testing to confirm a radiation hazard does not exist in the known storage locations of radioactive material. The contractor shall utilize a radiation meter during the completion of the work to protect workers from potential radioactive materials that may be discovered during completion of the work. UNC-EHS must be notified immediately of any positive findings.

1.12 BIOLOGICAL HAZARD REMEDIATION

Standard laboratory decontamination methods will be adequate for the majority of the surfaces that may contain biological hazards. The contractor shall utilize NSF International/ANSI 49 methodology for decontamination of areas that may contain biological hazards. Biological waste will be placed into appropriate storage containers immediately following generation of the waste. The container shall be sealed, labeled with appropriate shipping label and stored in appropriate staging location. The contractor is responsible for coordinating biological material disposal with the pre-qualified waste disposal contractors listed in Section 1, 1.14- Hazardous and Universal Waste Disposal.

Decontamination of Potential Biological/Pathogenic Materials (optional)
The contractor will disinfect all biosafety laboratory suites and biosafety cabinets (e.g., biosafety cabinet work surfaces, etc.) wiping them thoroughly with a 10% bleach solution. Arrangements should be made for more rigorous disinfecting procedures for Biosafety Level II and III suites involving paraformaldehyde vapor procedures or other equivalent methods pre-approved by the UNC-EHS Biological Safety Office.

1.13 MERCURY SPILLS AND CONTAMINATION

1.13.1 Related Documents

A mercury survey will be performed by UNC, the results of which will be provided to the contractor and will be the basis for determining which labs and areas require decontamination. This initial survey will indicate areas of greater probability of finding mercury, but all areas must be tested during the removal of plumbing and case work. Although this survey will serve as the initial scoping document for mercury abatement activities, the contractor must be aware that during the performance of the contract, particularly during demolition activities, other areas of mercury contamination may be identified, which will be the responsibility of the contractor to properly decontaminate.

1.13.2 Summary

A. This section covers the demolition, use, handling, storage, transport, accumulation, and disposal of mercury spills and mercury-contaminated building and laboratory materials. The contractor should be aware that elemental mercury, and its compounds- e.g., organic and inorganic mercuric salts, are inhalation and contact toxins that require special handling and disposal precautions. Mercury compounds are regulated by numerous statutes and regulations, particularly regarding workplace exposure avoidance and prevention of releases to the environment.

B. The contractor is advised that mercury spills may contaminate asbestos-containing building materials that may be removed by the contractor. The presence of mercury above hazardous waste action levels

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on asbestos-containing materials requires that the material be managed as a hazardous waste. The contractor is responsible for properly accumulating, storing, and disposing of mercury-characteristic and other hazardous wastes at an EPA permitted and UNC approved Treatment, Storage, and Disposal Facility (TSDF). The contractor is required to subcontract an approved UNC-Chapel Hill hazardous waste disposal contractor for disposal of hazardous waste generated under this contract. The contractor shall notify UNC and designer when UNC owned hazardous materials, not specifically identified in this contract, are discovered. Methodologies for removal and/or decontamination of the newly identified hazards will be presented to the owner and designer for approval prior to the initiation of mercury abatement activities.

C. Worker protection: Personal protective equipment for workers should be clearly specified in the site specific health and safety plan for the project. A minimum of Level C protection is recommended. Most of the protective measures detailed in Section 6.00 of the Asbestos Abatement Specification have general application to decontamination of mercury spills and demolition activities in the presence of mercury. Exceptions are the use of respirators fitted with mercury vapor cartridges and chemically impermeable gloves (nitrile or rubber) to prevent mercury compounds from contacting the skin.

D. Removal of mercury-containing intrinsic items: Manufactured or intrinsic items containing elemental mercury will be identified by the inspector and reconfirmed and removed by the contractor. Examples of intrinsic items containing mercury include: manometers and pressure gauges (e.g., Stokes McCleod gages), thermometers (laboratory and duct insertion), pumps, switches (e.g., MERCOID switches, etc.), thermostats, and fluorescent tubes (see Section 13.0A). The contractor will segregate these items from other mercury-containing waste and manage them as hazardous and/or universal after they are removed. The contractor will arrange to have intrinsic items shipped to a recycler for recovery of mercury by retort. All shipping paperwork must be signed by an UNC-EHS representative.

E. UNC “Controlled Materials” are defined as any material that poses a human health threat or damage to the environment. Disposal options should be thoroughly investigated for these materials and may involve recycling or reuse or disposal. Irresponsible discharges to the environment or improperly managing waste should be avoided. It is imperative that the use, handling, storage, transportation, and disposal of hazardous and recyclable materials and waste from UNC facilities and the UNC campus are consistently managed following the guidelines outlined in federal, state, local, and UNC regulations. This ensures the safety of UNC personnel and visitors and averts liability or penalties to UNC from the reckless or improper disposal or management of waste generated during the performance of the contract or during transport off campus.

F. The contractor shall have a mercury spill kit, mercury vacuum or other appropriate equipment on-site in the immediate location of work activities. The contractor shall clean visible mercury discovered or accidentally spilled while completing work. If mercury is detected visually or with mercury vapor detection equipment, the contractor shall immediately notify UNC-EHS and initiate cleanup activities.

1.13.3 Mercury action levels and regulatory exposure limits

A. Air Survey Action Level (ASAL): 250 ng/m³ (0.000250 mg/m³) - the concentration of mercury in the initial air survey above which action must be initiated to both identify the source and to remove or decontaminate it. Areas below the ASAL during the initial survey must also be tested during the removal of plumbing and case work. The ASAL is established at 1/100 the TLV (defined below) to provide a substantial margin of protection for building occupants and workers and to ensure that all sources of
mercury are discovered. Please note that the ASAL is 4 times less than the concentration of mercury vapor allowed after decontamination is attempted to offset the limited ability to detect less volatile mercury compounds (i.e., inorganic mercuric salts) that may be present at concentrations also requiring decontamination. The contractor should include methodologies for removing these inorganic compounds in proposed decontamination procedures.

B. OSHA Permissible Exposure Limit (PEL) for mercury: 100,000 ng/m³ (0.1 mg/m³) - Maximum allowed worker exposure over an 8-hour time weighted average.

C. NIOSH 8-Hour Time Weighted Average (TWA): 50,000 ng/m³ (0.05 mg/m³) - Maximum recommended worker exposure over an 8-hour period.

D. OSHA Permissible Exposure Limit for Methylmercury- 10,000 ng/m³ (0.01 mg/m³) - Maximum allowed worker exposure to this toxic organomercury over a 8-hour TWA. Methymercury is the metabolic product of mercury and is typically accumulated in bacterial sludge in wet sink traps.

E. Threshold Limit Value (TLV): 25,000 ng/m³ (0.025 mg/m³) - Established by the American Conference of Governmental Industrial Hygienists (ACGIH) this is the time-weighted average concentration of mercury in the air for a normal 8-hour work day and 40-hour work week. Workers may repeatedly be exposed to this concentration without experiencing adverse health effects.

F. Agency for Toxic Substances & Disease Registry (ATSDR) Indoor Air Quality: 1,000 ng/m³ [0.001 mg/m³]- This is the recently established maximum concentration for residential indoor air quality published by an agency of the Center for Disease Control and Prevention (CDC).

G. Post Decontamination Air Clearance Level (PDCL): 1,000 ng/m³ (0.001 mg/m³) - This is the concentration of mercury vapor at the surface of a item or area, which has been decontaminated, below which the item or surface requires no further decontamination and, therefore may be disposed as a non-regulated solid waste for recycling or reuse.

H. Toxicity Characteristic Leaching Procedure (TCLP): 0.2 mg/L- Mercury concentration in a TCLP extract (EPA Method SW 1311) of a solid waste equal to or above which the material must be managed as a mercury-characteristic hazardous waste.

I. Total Mercury Concentration Clearance Level: 4.0 mg/kg [4 ppm]- the total concentration of mercury in a digest of a solid waste equal to or above which the material must be managed as a hazardous waste. The level was established to afford an estimate of the TCLP extraction efficiency and is 20 times the TCLP action level. Typically this test is run in lieu of TCLP, when limited sample is available.

J. North Carolina Wastewater Discharge Limit: 0.0002 µg/L - The concentration of mercury in wastewater below which it may be safely and compliantly discharged to the sewer. Wastewater with concentrations equal to or greater than 0.0002 µg/L will be disposed of as hazardous. It may not be discharged to storm drains, the municipal sewer, sanitary drains in the building, or dumpsters, nor may it be poured on the ground or directly released to the environment in an uncontrolled fashion. Demonstrated decontamination procedures have not generated significant quantities of hazardous wastewater, however, if large quantities are produced, the contractor will investigate wastewater treatment options to remove or extract specific contaminants preventing it from being discharged to the sewer.

K. Reportable Spill Quantity- EPA’s reportable spill quantity for mercury is approximately 33.6 milliliters (approximately 2-3 tablespoons of liquid). Any quantity equal to or greater than this must be reported to the EPA and state authorities as an uncontrolled release of mercury to the environment. Reporting of any spill to the EPA and state authorities must be coordinated through UNC-EHS. Notify UNC-EHS as
soon as possible after a spill has occurred. Reported releases subsequently require formal planning procedures or remedial site investigation and formal clean-up activities, which includes removal, remediation, and/or disposal of contaminated material, i.e. soil, etc.

1.14 HAZARDOUS AND UNIVERSAL WASTE DISPOSAL

UNC defines hazardous and universal wastes as any waste material that poses a human health threat or may cause damage to the environment. Disposal options should be thoroughly investigated for these materials and may involve recycling, reuse, or disposal. Irresponsible discharges to the environment or improperly managing waste should be avoided. It is imperative that the use, handling, storage, transportation and disposal of hazardous and recyclable materials and waste from UNC facilities and the UNC campus are consistently managed following the guidelines outlined in federal, state, local and UNC regulations and other hazardous waste regulations. Items contaminated with Hazardous material must be decontaminated and sampled to confirm the hazardous materials were removed or shall be disposed of as hazardous waste. All hazardous and universal waste disposal must be cleared through UNC-EHS. Contacts include Mike Long, Safety Officer – 919.962.5723 and Steve Parker, Hazardous Material Manager – 919.962.5509. Containers used to store hazardous waste must be approved by the United States Department of Transportation (DOT). The contractor shall supply necessary containers. The containers shall remain closed except when material is being placed into them. Each container shall be labeled with a properly completed hazardous waste label as soon as any quantity of waste is placed into it. UNC-EHS must observe waste sampling, review all testing data, evaluate waste determinations and must sign all manifests.

A. The contractor will comply with all regulations and conditions of UNC permits and licenses applicable to the project. Included are wastewater discharge permits and satellite accumulation requirements for hazardous waste, etc.

B. The contractor assumes responsibility and liability for compliance with all applicable regulations especially those affecting the health and safety of contractor employees, subcontractors, and all others at UNC during the performance of the work. This responsibility includes the protection of UNC employees and visitors located near the worksite. Prevention of damage to UNC property, supplies, and equipment from accidents, improper storage or misuse of hazardous materials shall also be avoided.

C. Hazardous materials and waste may be accumulated and temporarily stored on UNC property per the provision of UNC’s hazardous waste permit, but should not exceed 30 days, except for extremely hazardous materials, for which arrangements should be made to remove the material for the premises as soon as is practicable. The following conditions should be met to ensure that hazardous substances are properly managed:

1. Hazardous waste containers should be in good condition, compatible with the material being stored in it, properly labeled at all times, and free of leaks.
2. Adequate secondary containment should be provided for those wastes where accidental discharges or leaks could cause an environmental release.
3. Hazardous waste accumulation areas will be pre-approved by the owner and designer before wastes are stored there. The areas will be open for inspection by the owner or designer upon request. Hazardous waste accumulation areas shall also be inspected at least daily by the contractor or its environmental oversight subcontractor and shall be locked when not in use.

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Wastes in containers that are leaking will be immediately transferred to a reliable container and any spilled material properly cleaned up.

The contractor should coordinate waste disposals with one or more of the UNC approved vendors listed below (as listed on the UNC website). The contractor is responsible for the disposal fees of hazardous and universal waste disposal.

Do not ship any Hazardous or Universal Wastes without EHS notification and approval. EHS must be notified to ensure that the proper paperwork, with the correct EPA ID number, addresses, and emergency contact information is used. An EHS representative MUST sign all paperwork for recycling or disposal shipments Universal or Hazardous Waste, including Bulbs.

Approved Waste Vendors as of 4/01/10:

Clean Harbors
208 Watlington Industrial Drive
Reidsville, NC 27320
336-361-3110
Clinton Atkinson
3910-280-8108
Atkinson.clinton@cleanharbors.com

Ecoflo
2750 Patterson Street
Greensboro, NC 27407
336-855-7925
Fernando Cruz
336-587-4634
fcruz@ecoflo.com

EEI
4650 Spring Grove Avenue
Cincinnati, OH 45232
800-850-3587
513-853-3587

Heritage
4132 Pompano Road
Charlotte, NC 28216
704-564-9802

PSC
1201 Exchange Street
Charlotte, NC 28208
704-399-1744
Alternatives:

Lee Iron and Metal Co., Inc
P.O. Box 778
2219 S. Horner Blvd.
Sanford, N.C. 27331
919-775-7951
(For metal scrap, brass, Non-PCB Ballasts, lead)

NSB- Battery recycler
437 Ward Blvd
Wilson, N.C. 27893
252-237-3938
1-800-682-6896
Contact- Nancy

Veolia
Creedmoor,NC
919-528-3996

1.15 **RECYCLING OF NON-HAZARDOUS DEMOLITION DEBRIS**

The contractor should segregate and recycle demolition debris to the extent possible. The contractor is responsible for coordinating recycling and waste disposal. The contractor should discuss and understand the segregation requirements, the maximum acceptable material size and types/sizes of transport containers with the solid waste disposal contractors. Materials to be recycled include, but are not limited to metal pipes, ductwork, fume hoods and sinks. The contractor is responsible for coordinating construction and demolition debris disposal.

The contractor is required to submit a Draft Solid Waste Management Plan fourteen days prior to beginning work activities. The draft should be submitted simultaneously to the designer and the UNC Office of Waste Reduction and Recycling (OWRR) in order to expedite plan review. Once OWRR has communicated requested changes, the contractor has five business days to submit a Final Solid Waste Management Plan (SWMP) (UNC Specification 01505). Any deviance from the final SWMP must be approved by OWRR. In accordance with Specification 01505, each month the contractor must submit documentation (weight tickets, manifests, etc.) of the disposal, recycling, re-use, and salvage of all materials and a summary with each Payment Application. Failure to do so may delay payment. See UNC Design and Construction Guidelines for additional information concerning recycling of non-hazardous materials.
1.16 PROJECT TESTING SUMMARY REPORTS

The contractor shall maintain a log that details the testing performed during the completion of this project including pH, perchlorates, peroxides/oxidizers, acids, metals, salts and other substances. A report shall be completed for each test location and, at a minimum, each report shall include the following information:

1. Cover Sheet entitled “Project Testing Summary Report,” stating the project name, contractor project number and UNC project number
2. Date
3. Test Completed
4. Location of Test Including Room Name and Number
5. Test Results
6. Date Samples Sent to Laboratory (if applicable)
7. Date Sample Results Were Received From Laboratory (if applicable)
8. Copy of the Laboratory Results (if applicable)

The contractor shall provide 3 typewritten copies of each report to UNC-EHS and the designer within one week of the test date.

1.17 CONTRACTOR CERTIFICATION OF CLEAN AND QUALITY CONTROL

The contractor shall complete the required work and certify that each area is clean and free of hazardous materials based on applicable federal, state and local regulations. Work areas and other areas should be clean and free of debris, dirt and dust following remediation activities. The contractor will not be responsible for collecting final clearance samples. A UNC representative will collect samples in certain locations to document the condition of the areas sampled. The contractor’s environmental health and safety manager shall keep a written log of areas where work was completed, the type of work, the dates work were completed in the area, the quantity of materials removed from the area and any laboratory testing completed. This information should be updated daily, kept in a binder onsite and provided to UNC-EHS and/or the designer upon request. For additional information refer to the AIA Specifications included in Section III – AIA Specifications - Section 01450 – Quality Control. Quality control documentation forms are included in this section.

At the conclusion of each phase of environmental demolition, the following individuals will walk the site together to review the completed work and check for deficiencies:

Architect
Environmental Abatement designer
Environmental demolition contractor
Construction manager
EHS representative
General contractor/CM responsible for subsequent renovation work

The architect and the environmental abatement designer will attest in writing that all hazardous material has been abated or secured according to the specifications and no remaining hazardous material will be disturbed in this space by subsequent construction activity in this space.
If all hazmat has not been addressed, the architect will prepare a punch list of deficiencies to be corrected at the contractor’s expense. While fixing the punch list items, the contractor is expected to use the required protective measures necessary to complete the work as outlined by the abatement designer.

If the construction manager or the EHS representative disagrees with the clearance assessment of the architect and consultant, additional testing may be required. If this testing reveals residual contamination, the cost of this testing and additional testing shall be born by the architect and the consultant. Additional abatement expense shall be absorbed by the environmental demolition contractor.

The next phase of construction can begin in the designated work space after all parties agree on the clearance and the architect and consultant sign a document to release the space.

1.18 ENVIRONMENTAL HEALTH AND SAFETY MANAGER

The contractor shall retain the fulltime services of a firm with a Certified Industrial Hygienist or a similarly qualified expert (this person may be employed by the contractor as long as they have the required expertise) having experience managing hazardous substances and a background in chemical toxicology and/or mercury abatement techniques. This person will serve as the project Environmental Health and Safety Manager (EHSM). The EHSM will ensure compliance with all OSHA and EPA regulations. Duties of the EHSM shall include but are not limited to:

A. Monitoring the contractor’s work involving the identification and decontamination of mercury for compliance with the federal, state and local regulations and the provisions of this specification. Included shall be the oversight of activities for properly characterizing, handling, storing, and transporting wastes.

B. Monitoring air quality of the worksite and contiguous occupied spaces of the building for hazardous vapors, fire and explosion hazards, fumes, dust, aerosols, and odors, etc. The EHSM will assist in the identification and resolution of complaints from contractors, UNC employees and visitors regarding same.

C. Provide the Construction Manager and his technical authorities with documentation of monitoring and test results impacting the progress of the work and the quality of the workplace environment, as well as test results intended for hazardous waste characterization.

D. The EHSM will be physically present for the following activities/ phases of the project related to mercury (similar specifications may be required for other hazardous materials besides mercury and asbestos):

   1. Air Monitoring during mercury abatement procedures including surface decontamination and sanitary pipe removal described below.

   2. Mercury testing and surveying to delineate the extent of previously identified mercury spills during the initial survey and/or newly discovered mercury spills that are uncovered during the demolition and removal of laboratory casework, etc. Testing must be performed during the dismantling and removal of laboratory plumbing and casework off of floor at all times.
3. Characterization of mercury-containing hazardous wastes using the project surface vapor concentrations outlined in Section 1.12 – Mercury Safety, specifically those in that exceed the PDCL.

4. Mercury exposure monitoring involving the evaluation of the breathing zone air during all decontamination and demolition activities.

5. Air-monitoring and sampling during all other work activities, i.e. nuisance dust sampling, fume hood sampling, etc.

SECTION 2 – CONTRACTOR SUBMITTALS

2.01 REQUIRED CONTRACTOR PRE-SELECTION SUBMITTALS

The contractor shall submit to UNC a written plan describing the means and methods and the materials that will be utilized to complete the project. This submittal shall be used by UNC to select the contractor to complete the work. The following information is required in the submittal:

A. Written procedures for completing testing for perchlorates, peroxides/oxidizers, acids, metals, salts and other substances that may impact the fume hoods and exhaust systems.

B. Written procedures for completing testing for chemical and biological contaminants that may be contained in the sanitary sewer piping.

C. Written procedures for cleaning the fume hoods, fume hood cabinets, fume hood exhaust piping/duct work including exhaust fans and sewer piping including procedures utilizing absorbents, neutralizing agents, solvents and solutions.

D. Written procedures for decontaminating, dismantling, cutting and moving, to staging area, the fume hoods, fume hood cabinets, fume hood exhaust piping/duct work including exhaust fans, sink drain traps, sewer piping, chemical cabinets and case work.

E. Written procedures for cleaning and decontaminating floor drains.

F. Written procedure describing work practices and environmental controls that will be instituted to ensure that mercury and its vapors are properly identified, monitored, contained and deactivated.

G. A written procedure for roof penetration repair.

H. A written fluorescent lamp removal and disposal plan.

I. A written Lockout/Tagout Plan.

J. A list of subcontractors the contractor will utilize to complete this project.

2.02 REQUIRED CONTRACTOR PRE-AWARD SUBMITTALS
The apparent low bidder shall submit the following items to the Project Designer within twenty-four hours after the bid opening. **Failure to submit the following documentation within the specified timeframe will render the Contractor non-responsive.**

A. Contractor shall include with the package a list of projects similar in size and scope to the work of this project that has been successfully completed by Contractor. Representative jobs thus cited shall span a period of not less than five years preceding commencement of this project. Include names and telephone numbers of references for verification of completion and quality of work.

B. Contractor shall include with the package a listing of all closed and/or pending citations issued by regulatory agencies and/or judgments against the Bidder from a court of law in North Carolina and South Carolina and within the last three (3) years. If no citations and/or judgments have been issued then a letter to this effect shall be submitted. Serious violations issued from regulatory agency may render the Contractor disqualified.

C. Contractor shall include with the package a listing of all assessed or pending penalties or liquidated damages, and the project in which it occurred within the last three (3) years. If no assessed penalties or liquidated damages have been incurred or is pending within the past three (3) years than a letter to this effect shall be submitted. Assessed or pending penalties or liquidated damages may render the Contractor disqualified.

D. Contractor shall include with Bid a listing of any contract terminations or pending termination by the building owner or contractor within the last three (3) years. If no such contract terminations have occurred than a letter to this effect shall be submitted.

E. Contractor shall include a work schedule for the project that includes the number of workers that will be scheduled for the project, work days and hours expected to be scheduled.

F. Contractor must submit a list of all subcontractors that will be utilized during the project. The Contractor should plan on this list being a constant, unless prior notification has been given to the contract administrator and building owner representative. UNC has the right to deny the change of subcontractor.

G. Contractor must submit a list with an explanation for any legal technical problems or pending problems that have yet to be settled that has occurred on completed or current projects over the past three (3) years. If no such legal problem is occurring or pending than a letter to this effect shall be submitted.

### 2.03 REQUIRED CONTRACTOR PRE-JOB SUBMITTALS

#### 2.03.1 General

The contractor shall submit three complete, bound sets of pre-job submittals to UNC and one copy to EHS at least fourteen work days prior to start of work. Work is prohibited until the submittal package has been reviewed and approved by UNC. UNC does not assume any responsibility or liability for errors and omissions in the contractor’s submittals. A copy of the submittals shall be kept in a three-ring binder (project log) by the contractor at the project site.
A. Draft Solid Waste Management Plan (to be reviewed by designer and UNC). Written procedures for minimization of waste outlining the methodologies that will be instituted to ensure that maximum quantities of waste generated are recycled, recovered, or reused, as well as methodologies for minimizing hazardous wastes generated from contaminated construction/demolition debris.

B. Final Solid Waste Management Plan – (Revised to include comments from designer and UNC). The final plan must be received 5 business days prior to beginning work.


D. Notifications: Provide notification letters to local EMS, fire and police departments and any other required notifications.

E. Employee List: Provide copies of lists of supervisors and workers, along with their accreditation and Social Security numbers, to be utilized on the project.

F. Permits: Provide copies of required permits.

G. Medical: Include individually signed and notarized forms by each worker to be utilized on the project documenting that each is actively involved in a company employee medical surveillance program.

H. Respirator Training: Copies of most recent fit testing records, individually signed for each worker to be utilized on the project.


J. Initial Exposure Assessment (Lead): As required by the OSHA Lead in Construction Standard 1926.62, provide documentation of all monitoring and other data used in conducting employee exposure assessments relevant to the project.

K. Project Schedule: Time schedule for the project, outlining the proposed start, setup, clearances, etc. for the various phases of the project. List holidays expected to work in advance. The contractor will be required to pay for any additional holidays worked due to slippage in schedule.

L. Contingency Plan: The contractor shall prepare a site-specific contingency plan for emergencies including fire, accident, power failure, negative pressure system failure, supplied air system failure (if applicable), evacuation of persons for both life threatening and non-life threatening injuries, or any other event that may require modification or abridgment of decontamination or work area isolation procedures. Include in plan specific procedures for decontamination or work area isolation. Note that nothing in this specification should impede safe exiting or providing of adequate medical attention in the event of an emergency.

M. Any other programs or training as outlined by the OSHA and EPA standards.

2.03.2 Asbestos Abatement
Submit three complete, bound sets of pre-job submittals to the designer and one copy to EHS, in an expedited manner, at least fourteen work days prior to start of work. Work is prohibited until submittal package has been reviewed and approved by designer. A copy of the approved submittals shall be kept in a three-ring binder (project log) by the contractor at the project site in the clean room or in the on-site office of the contractor.

A. Notifications: Provide copies of Asbestos Permit Application and Notification for Demolition/Renovation (NC DHHS Form), which provide written notice to all required agencies, including North Carolina HHCU. Provide notification letters to local EMS, fire, and police departments.

B. Employee List: Provide copies of lists of supervisors and workers, along with their accreditation and Social Security numbers, to be utilized on the project.

C. Permits: Provide copies of approval of a waste disposal site in compliance with 40 CFR 61.154. Identification of both asbestos and hazardous waste landfills is required.

D. Medical: Include individually signed and notarized forms by each worker to be utilized on the project documenting that each is actively involved in a company employee medical surveillance program.

E. Respirator Training: Copies of most recent fit-testing records, individually signed for each worker to be utilized on the project.

F. Initial Exposure Assessment: As required by the OSHA construction asbestos standard 29 CFR 1926.1101.

G. Any other programs or training as outlined by the OSHA and EPA standards.

2.03.3 Mercury Abatement

Submit three complete, bound sets of pre-job submittals to the designer and one copy to EHS, in an expedited manner, at least fourteen work days prior to start of work.

1. Mercury Action Plan describing the procedures, work practices, and environmental controls that will be used to ensure that mercury and its vapors are properly identified, monitored, contained, and deactivated.

2. Site Specific Health and Safety Plan delineating the hazards associated with mercury and its compounds that may be encountered during the project; personal protective equipment that will used by all workers working with mercury: and contain MSDSs of contaminants and commercial reagents that the contractor will use and store onsite for performance of the contract.

3. Waste Minimization Plan outlining the methodologies used to ensure that maximum quantities of waste generated are recycled, recovered, or reused, as well as methodologies for minimizing hazardous wastes generated from contaminated construction/demolition debris.

4. The Mercury Action Plan should include provisions for waste test results to be formally documented and submitted to the owner as they are received from an EPA accredited testing or analytical laboratory. Appropriate QC samples will be collected and/or run by the laboratory. The contractor will fully evaluate the implications of the results on waste handling, and/or workplace health & safety and report unusual or extremely hazardous findings to the owner immediately.
5. Resumes and qualifications of Project Safety Officers and the EHSM and/or firm.

2.04 REQUIRED CONTRACTOR ACTIVE PROJECT SUBMITTALS
AND POST-JOB SUBMITTALS

2.04.1 General

The contractor shall submit three complete, bound sets of post-job submittals to UNC following the final completion of the work.

A. Monthly documentation (weight tickets, manifests, etc.) of the disposal, recycling, re-use, and salvage of all materials and a summary with each Payment Application. (Coordinate with Waste Disposal contractors.)

B. Affidavits: Contractor’s affidavit of payment of debts and claims, affidavit of release of liens, and consent of the surety company to final payment.

C. Manifest: UNC-EHS must sign all outgoing hazardous waste manifests and receive copies of the return waste manifests after disposal.

D. Daily Supervisor Log: A notarized copy of all daily logs showing the following: name, date, entering and leaving time, company or agency represented, reason for entry for persons entering the work area, employee’s daily air monitoring data as required by the OSHA standard and written comments by inspectors, UNC, and visitors.

E. Medical: Copies of worker release forms, asbestos training certification forms and respirator training documentation of all new employees hired during the project.

F. Project Testing Summary Reports as discussed in Section 1, 1.15 - Project Testing Summary Reports.

G. Contractor Daily Work Log as discussed in Section 1, 1.16 - Contractor Certification of Clean and Quality Control.

H. Quality Control Documentation Forms.

2.04.2 Asbestos Abatement Specific Submittals

A. Post-Job Submittals

Submit three complete, bound sets of post-job submittals to the designer following the final completion of the work.
1. Manifest: North Carolina Asbestos Waste Shipment Record (DEHNR 3787) receipt from landfill operator which acknowledges the contractor's delivery(s) of waste material. Include date, quantity of material delivered and signature of authorized representative of landfill. Also, include name of waste transporter.

2. Daily Log: A notarized copy of all daily logs showing the following: name, date, entering and leaving time, company or agency represented, reason for entry for all persons entering the work area, employee's daily air monitoring data as required by the OSHA standard and written comments by inspectors, industrial hygienists, designers and visitors.

3. Medical: Copies of medical surveillance program forms, worker release forms, asbestos training certification forms and respirator training documentation of all new employees hired during the project.

4. Special Reports: All documents generated under Section 1.06.

5. Daily manometer readings: All strip chart recordings or manual documentation (manual readings 3 times per eight hour work shift) shall be included in the post submittal package

B. Special Reports

1. General: Except as otherwise indicated, submit special reports to designer within one day of occurrence requiring special report, with copies to others affected by occurrence. Also keep a copy in the project logbook.

2. Reporting Unusual Events: When an event of unusual and significant nature occurs at site (examples: failure of negative pressure system, rupture of temporary enclosures), prepare and submit a special report to the designer immediately, listing chain of events, persons participating, response by contractor's personnel, evaluation of results or effects, and similar pertinent information. When such events are known or predictable in advance, advise designer in advance at earliest possible date.

3. Reporting Accidents: Prepare and submit reports of significant accidents, at site and anywhere else work is in progress. Record and document date and actions; comply with industry standards for reporting accidents. For this purpose, a significant accident is defined to include events where personal injury is sustained, or property loss of substance is sustained, or where the event posed a significant threat of loss or personal injury.

C. Contingency Plan

Prepare a site-specific contingency plan for emergencies including fire, accident, power failure, negative pressure system failure, supplied air system failure (if applicable), evacuation of injured persons for both life threatening and non-life threatening, or any other event that may require modification or abridgment of decontamination or work area isolation procedures. Include in plan specific procedures for decontamination or work area isolation.
Note that nothing in this specification should impede safe exiting or providing of adequate medical attention in the event of an emergency. Keep these plans in the on-site office.

Post outside/in clean room of Personnel Decontamination Unit:

1. Telephone numbers and locations of emergency services including but not limited to, fire, ambulance, doctor, hospital, police, power company, telephone company, and the North Carolina HHCU.

2. A copy of Material Safety Data Sheets (MSDS) for any chemicals used during the asbestos project.

The contractor shall post asbestos signs in each appropriate language as per the OSHA 29 CFR 1926.1101 standard.

2.04.3 Mercury Abatement Specific Submittals

Post-job Submittals:

Submit three complete, bound sets of post-job submittals to the designer following the final completion of the work.

1. Field and Lab Test Results involving air and personal exposure monitoring, should the latter be necessary. This data will be compiled and reported to the owner and its representatives as soon as they are received by the contractor, but also incorporated in the draft and final reports. Air monitoring will be performed not only in the project worksite, but also in areas of the building that are still occupied and being used for administrative and research or instructional purposes.

   a. Copies of hazardous waste manifests and bills of lading from hazardous or universal waste shipments.

   b. A Draft and Final Report detailing the areas of contamination, the results of initial air monitoring, procedures used for decontamination and removal of mercury, quantities and types of waste generated, and the results of final clearance air surveys performed to determine the effectiveness of the procedures employed.

Note: Requests for final payment will not be approved until the submittal package has been reviewed and approved by the general contractor.

SECTION 3 – ITEM SPECIFIC ENVIRONMENTAL REMEDIATION

3.01 FLUORESCENT TUBE, HIGH INTENSITY DISCHARGE BULBS AND U-TUBE REMOVAL AND DISPOSAL

Many fluorescent tubes, high intensity discharge bulbs and U-Tubes contain the element mercury, a material regulated by federal, state and local environmental laws. Thus, the contractor shall remove the fluorescent tubes, high intensity discharge bulbs and U-Tubes and they shall be handled as regulated waste. The contractor shall complete the removal of fluorescent tubes, high intensity discharge bulbs and U-Tubes prior to completing other work identified in this section of the plan (Section 3 – Scope of Work).
The contractor shall remove and handle fluorescent tubes, high intensity discharge bulbs and U-Tubes in a manner which will minimize occurrences of lamp breakage. The use of a device for the crushing and disposal of fluorescent light bulbs is prohibited. Unbroken bulbs are much easier and safer to manage than broken bulbs. The lamps shall be placed in the manufacturers’ box or other suitable containers (sturdy cardboard box with cushioning material) appropriate for shipment to the recycling facility. When not actively putting bulbs into the box, the contractor shall close and seal the box. Boxes shall be stored in a dry location and shall remain dry. A Universal Waste label shall be placed on each box as soon as one bulb is placed into the box. If a bulb does break it shall be handled as hazardous waste and the materials should be properly contained in a UN polyethylene drum and disposed of properly, and in a timely manner. The container must be capped with a lid that ensures no material will be spilled from the container during storage or transport and labeled appropriately, including a class 8 corrosive sticker.

The contractor is responsible for coordinating fluorescent lamp disposal with the pre-qualified waste disposal contractors listed in Section 1, 1.14 - Hazardous and Universal Waste Disposal. An EHS representative is required by law to sign any paperwork associated with bulbs shipments.

Refer to Section 1, 1.13 – Mercury Spills and Contamination for additional information. Also refer to the UNC Design and Construction Guidelines for further information including Chapter IV – Supplemental Guidelines – Section B – Hazardous Material Guidelines – Sub-Section 6 – Hazardous and Universal Waste Issues.

3.02 PCB AND NON-PCB BALLASTS

The contractor shall safely remove ballasts and observe the written information on the ballast. Ballasts that contain PCBs shall be placed into a UN approved 55-gallon drum for disposal and shall be shipped on a Hazardous Waste Manifest. The lid on the drum shall be secured unless the contractor is actively placing ballasts into the drum. A Class 9 label should be placed on the drum as soon as the first ballast is placed into it. The contractor will consider a ballast as containing PCBs if the written information of the ballast indicates it contains PCBs or does not clearly indicate it does not contain PCBs.

Non-PCB ballasts will have “No PCB’s” written on them. The contractor shall place non-PCB ballasts in a different UN-approved 55-gallon drum. Only non-PCB ballasts shall be placed in the drum. The lid on the drum shall be secured unless the contractor is actively placing ballasts into the drum. The drum should be labeled as soon as the first ballast is added.

The contractor shall coordinate disposal of the materials with the appropriate pre-qualified waste disposal contractor listed in Section 1, 1.14 - Hazardous and Universal Waste Disposal. An EHS representative is required by law to sign any paperwork associated with bulbs shipments.


3.03 CHEMICAL STORAGE CABINETS, CASEWORK AND SURFACES

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3.03.1 Chemical Storage Cabinets

The contractor shall thoroughly clean the interior of each chemical storage cabinet and accessible exterior portions of the chemical storage cabinet before moving the cabinet. Next, the contractor will carefully move the cabinet to access the exterior portions of the cabinet that may have been inaccessible where it was originally situated (i.e., the back of the cabinet, the side of the cabinet, the top of the cabinet and/or the bottom of the cabinet). The contractor will use extreme care when moving the cabinet and be aware of potential hazards associated with moving the cabinet. Such hazards include asbestos exposure from dislodging asbestos-containing floor tile from the floor or baseboards applied to walls with asbestos-containing mastics/adhesives that have bonded to the cabinet over the years of use, biological hazards and chemical hazards including chemicals that may have leaked in the cabinet and are present under the cabinet. The contractor should be prepared to discover chemicals under the cabinet from chemical leaks which may have previously occurred within the cabinet. The contractor shall minimize impact and shock when moving the cabinet. The contractor shall thoroughly clean the inside and outside of the cabinet.

Decontamination of the cabinets should be completed in a controlled area. The contractor shall implement a decontamination plan to address multiple compounds. Absorbents, buffering compounds, neutralizing agents and/or solvents or other items may be used at the contractor’s discretion for the decontamination procedure along with atomizers, sprayers, washers and wipes. Decontamination fluids will be contained in 1H1 55-gallon drums and decontamination solids will be contained in 1A2 55-gallon drums. The contractor will complete appropriate testing on the cabinet to confirm decontamination procedures were successful and the cabinet does not contain hazardous materials. The cabinet will be decontaminated until test results confirm hazardous materials are not contained on the cabinet.

3.03.2 Casework and Surfaces

The contractor shall thoroughly clean casework and surfaces. The contractor will use extreme care when moving casework and other items and be aware of potential hazards associated with moving the casework or other items. Such hazards include asbestos exposure from dislodging asbestos-containing materials, biological hazards and chemical hazards including chemicals that may have leaked and are present in unexposed and/or hidden locations. The contractor should be prepared to discover chemicals under these items from chemical leaks which may have previously occurred. The contractor shall minimize impact and shock when moving these items. The contractor shall thoroughly clean and decontaminate casework and other items such as countertops and cabinets which may need to be removed to access sanitary sewer piping locations.

Decontamination of these items should be completed in a controlled area. The contractor shall implement a decontamination plan to address multiple compounds. Absorbents, buffering compounds, neutralizing agents and/or solvents or other items may be used at the contractor’s discretion for the decontamination procedure along with atomizers, sprayers, washers and wipes. Decontamination fluids will be contained in 1H1 55-gallon drums and decontamination solids will be contained in 1A2 55-gallon drums. The contractor will complete appropriate testing on these items to confirm decontamination procedures were successful and these items do not contain hazardous materials. These items will be decontaminated until test results confirm hazardous materials are not contained on the items.
The results of chemical testing will be documented by the contractor (refer to Section 1, 1.16 - Project Testing Summary Reports).

The contractor will store the 55-gallon drums in the staging area approved by UNC-EHS and coordinate disposal with the appropriate pre-qualified waste disposal contractor, if the waste fails TCLP, listed in Section 1, 1.14 - Hazardous and Universal Waste Disposal. Please refer to Section 1, 1.10 through 1.17 for further information.

3.04 ASBESTOS ABATEMENT

3.04.1 General

A. The asbestos/hazardous materials abatement contractor will be a licensed general contractor in the specialty of interior, building, unclassified or asbestos categories by the North Carolina Licensing Board of General Contractors.

B. The contractor shall be responsible for inspecting the site prior to bidding to confirm the scope of the work. Any quantities listed by the designer in the plans, specifications or survey are done so as approximations. The actual quantities of asbestos-containing materials – hazardous materials to be encountered are the responsibility of the contractor.

C. The contractor shall furnish and is responsible for all costs including, but not limited to: permit fees, containment preparation, labor, materials, services, insurance, bonding, and equipment necessary to carry out the abatement and hazardous materials operations including disposal of all asbestos and hazardous materials in accordance with the plans and specifications, EPA and OSHA regulations, and any applicable state and local government regulations. Contractor is required to subcontract an approved UNC-Chapel Hill hazardous waste disposal contractor for disposal of hazardous waste generated under this contract.

D. The contractor/employer has and assumes the responsibility of proceeding in such a manner that he offers his employees a workplace free of recognized hazards causing or likely to cause death or serious injury. The contractor shall be responsible for performing this abatement and disposal so that airborne asbestos fiber levels do not exceed established levels. Workers shall not be exposed to any hazardous substance above the OSHA PEL without appropriate personal protective equipment.

E. The contractor will be responsible for all costs associated with employee monitoring to meet the OSHA requirements.

F. The contractor is responsible for all costs, including additional visits, should the designer and/or the industrial hygiene firm determine that the contractor failed a final inspection. Notification and scheduling of the final inspection during the project is the responsibility of the contractor. The contractor will allow a minimum notice of 48 hours unless a different time frame is agreed upon by the designer and the contractor.

G. UNC will pay for a total of ______ days of air monitoring at a rate of __________________________ per eight-hour shift/per man during a continuous week of Monday through Friday. A weekend rate of __________________________ per eight-man hour day on weekends and
3.04.2 Personnel

A. A competent person, as defined in the OSHA asbestos standard 29 CFR 1926.1101, employed by the contractor must be outside the work area at all times to monitor activity, ensure containment security, provide information to visitors, and provide access to the work area.

B. The contractor is responsible for the behavior of workers within his employment. If at any time during the contracted work, any of his employees are judged to exhibit behavior unfitting for the area or judged to be a nuisance by the owner or designer, the contractor shall remove them immediately from the project. The contractor shall be responsible for compliance with the following concerning employee behavior:

1. Under no circumstances are firearms, alcohol, drugs or any other type of controlled substances permitted on university property.

2. All workers are restricted to the construction project site only.

3. All vehicles must be parked in areas prearranged with the owner.

4. All workers must conform to the following basic dress code when in public areas of the project confines: long pants, shirts, no tank tops, no shorts, no bare backs.

5. The contractor is responsible for disposal of all trash brought on state property by his employees, including drink cans, bottles or other food containers and wrappers.

6. The Industrial Hygiene Firm, retained by UNC, shall maintain the same air monitor throughout the project. Any deviations in the onsite air monitor must be approved by EHS. If an alternate air monitor is approved during the project, the Project Designer will conduct a site visit and review the specification, the schedule and other pertinent information with the alternate air monitor.

3.04.3 Site Investigation

A. By submitting a bid, the Contractor acknowledges that he/she has investigated and satisfied himself/herself as to:

1. The conditions affecting the work, including, but not limited to, physical conditions of the site which may bear upon site access, handling and storage of tools and materials, access to water, electric or other utilities or otherwise affect performance of required activities;
2. The character and quantity of all surfaces and subsurface materials or obstacles to be encountered in so far as this information is reasonably ascertainable from an inspection of the site, exploratory work done by the Owner or designated consultants, and information presented in specification included with this contract;

3. The environmental condition, including the presence, location, and condition of asbestos-containing materials and other hazardous materials at the site.

B. Any failure by the Contractor to acquaint himself/herself with available information will not relieve him/her from the responsibility for estimating properly the difficulty or cost of successfully performing the work. The Owner is not responsible for any conclusions or interpretations made by the Contractor on the basis of the information made available by the Owner.

C. Under no circumstances shall the Contractor rely on the material quantities indicated in this document as the total basis for the proposal price. All quantities indicated herein are approximate and intended to alert the Contractor to the general scope of the project. Scheduled quantities refer only to asbestos-containing materials (ACM) the contractor may expect to encounter. No increase in contract cost will be considered due to the Contractor's failure to physically verify all quantities of the ACM specified by this document for removal.

D. The Contractor shall include in their proposal price the total estimated square footage of ACM anticipated. No proposal will be accepted from the Contractor who has not inspected the job site either in person or through a qualified designated representative.

3.04.4 Air Monitoring – Industrial Hygiene

A. General

1. UNC shall be responsible for the coordination and contracting of an industrial hygiene firm. UNC will pay for services rendered by the industrial hygiene firm.

2. Air monitoring shall be done under the direct supervision of a North Carolina accredited supervising air monitor (SAM), retained by the University, except for sampling performed by the contractor to satisfy OSHA requirements.

3. SAM shall be accredited per the Asbestos Hazard Management Program rules.

4. Air monitor shall be accredited as per the Asbestos Hazard Management Program rules and work under the direct supervision of a SAM.

5. The SAM representing each firm shall have taken a 24-hour respiratory protection course that is either National Institute for Occupational Safety and Health (NIOSH), AIHA (American Industrial Hygienists Association) or HHCU recognized.
6. If specific project activities are assigned to an air monitor, the SAM is expected to be responsible for industrial hygiene work completed on the project.

7. Employees of the HHCU shall have right of entry into the project. The HHCU's SAM shall have final authority over the industrial hygiene firm on the project.

8. The designer, architect, SAM, construction manager and EHS shall be responsible for all final decisions relative to the project including the final visual inspection. The project designer and/or EHS shall conduct all visual inspections with the air monitor. The project designer and EHS shall be provided with a minimum of 24 hours notice prior the visual inspection.

9. The Project Designer will conduct a site visit once per week and review the manometer readings, air monitoring data and perform an inspection within the work area.

10. The SAM will be responsible for all air monitoring data collected during the project and shall sign each field sheet upon review.

11. The industrial hygiene firm shall immediately report any deficiencies in the work of the contractor including failure to comply with all applicable regulations to the project designer and EHS.

12. The industrial hygiene firm shall notify the designer, EHS and the contractor, in writing, of any failed clearance visits.

13. The SAM shall submit a written project monitoring plan to the designer and EHS and a copy will be provided to the onsite air monitor.

B. Scope of Work

1. The industrial hygiene air monitoring firm hired by the University shall offer expertise to the designer and contractor, but is not directly responsible for the performance of the job. The air monitoring firm shall maintain an onsite representative during the abatement of asbestos-containing materials.

2. At the job site, the industrial hygiene air monitoring firm is expected to observe, be aware, and comment on general work site conditions and activities as they relate to the specifications and profession of industrial hygiene, and make recommendations in writing to the designer and contractor.

3. The industrial hygiene air monitoring firm shall furnish the contractor a copy of the filed reports if requested. Copies of field notes and reports of observations shall be kept in project logbook.

4. The industrial hygiene air monitoring firm is to conform to the contractor’s schedule and shall respond to necessary changes, provided an advance notice is given as outlined in Section 1.00.

5. The industrial hygiene air monitoring firm’s project monitor shall furnish designer and contractor with a pager or mobile phone number where he can be reached quickly at all times.

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6. The industrial hygiene air monitoring firm shall notify the designer and contractor immediately via phone and within twenty-four (24) hours, in writing of any failed clearance visits.

7. At the completion of the project, the industrial hygiene firm shall prepare a report describing the assessment of the project, all air monitoring data, acceptance letters, calibration records, and a description of the project as it proceeded to completion and submit four copies of the report to the designer.

C. Air Monitoring

1. Ambient Air Monitoring: The purpose of ambient air monitoring by the industrial hygiene firm will be to detect discrepancies in the work area isolation such as: Elevated counts outside the asbestos control area
2. The air sampling plan shall require the air monitor to collect a minimum of five air samples per 10 hour shift.
3. Contamination of the building outside of the work area with airborne asbestos fibers.
4. Failure of filtration or rupture in the negative pressure system.
5. Confirm the work practices established by the contractor and respiratory protection provided for employees are adequate.
6. Work Area Airborne Fiber Levels: The owner's industrial hygiene firm will monitor airborne fiber levels in the work area. The purpose of this air monitoring will be to detect airborne fiber levels, which may challenge the ability of the work area isolation procedures to protect the balance of the building or outside of the building from contamination by airborne fibers.
7. The Industrial Hygiene Firm shall conduct onsite PCM analysis on a daily basis. Analytical results shall be available for review with 12 hours of collection.
8. Work Area Clearance: To determine if the elevated airborne fiber levels encountered during abatement operations have been reduced to an acceptable level, the industrial hygiene firm will sample and analyze air per Section 10.02.
9. In accordance with AHMB Program Rules, the SAM shall develop an Abatement Project Monitoring Plan that complies with EPA and OSHA analytical criteria and will provide a valid representation of airborne fiber concentrations both inside and outside the work area. This program is not intended to satisfy the contractor’s requirement for sampling under the OSHA regulation. All personnel and area sampling conducted by the industrial hygiene firm shall be personally observed. Air sampling pumps shall not be left unattended for extended periods of time.
10. All personal air samples will be collected in such a manner as to comply with OSHA collection and analytical regulations, and to provide a valid representation of airborne fiber levels. The samples collected by the industrial hygiene firm on personnel do not satisfy the contractor’s responsibility under OSHA.
11. All final area air sampling will comply with all State and Federal requirements in measuring airborne asbestos following an abatement action.

12. Air samples will be analyzed and results made available as per the AHMB Program Rules.

13. If TWA samples are being collected by the contractor for the purpose of reducing respiratory protection requirements, the industrial hygiene firm shall directly observe the conditions and work practices represented by each sample and make appropriate notes in the bound book on site.

14. Supplemental air monitoring may be conducted inside and outside the work area by the HHCU. This supplemental sampling does not fulfill air-monitoring responsibilities required by OSHA, EPA, or this contract.

15. If stop work action levels occur, Contractor is responsible for completing corrective work with no change in the Contract Sum or time requirements, if high airborne fiber counts were caused by Contractor's activities. The Contract Sum and schedule will be adjusted for additional work caused by high airborne fiber counts beyond the Contractor's control. If visual inspection is unsatisfactory or Air Clearance Levels are not met, the Contractor must complete corrective work with no change in the Contract sum or time requirements. The period for all work, including final clearance and clean-up of the site following final results, shall be no later than 5:00 PM on the specified completion date. Contractor shall be responsible for Project Administration and/or Owner's IH costs on an hourly basis should work continue beyond this time if the delay is the result of the Contractor's activities.

3.04.5 Negative Pressure System

A. General

1. Before any work begins on the containment barriers, shutdown and seal off all heating, cooling, ventilating or other air handling systems serving the work area. The environment of the work area shall be completely isolated from all other air flows in the building.

2. High efficiency particulate air (HEPA) filter exhaust systems equipped with new HEPA filters for each project shall be used. Exhaust equipment and systems shall comply with ANSI Z9.2-79 and used according to manufacturer's recommendations.

3. A continuous chart-recorded manometer shall be used to confirm this condition or manual readings three times per eight hour work shift and maintained onsite throughout the duration of the project. On a weekly basis (if applicable): Submit to the IH onsite a printout from pressure differential monitoring equipment. Mark printout twice daily with date, time, and initials. Use printout paper that indicates elapsed time in intervals no greater than hours. Indicate on each day’s record, times of starting and stopping remediation/demolition work, type of work in progress, breaks for lunch or other purposes, periods of stop work, and filter changes. Cut printout into segments by day, attach to 8 1/2" by 11" paper. Label with project name, contractors name, and date. These readings shall be included in the Post Submittal Documents.

4. The contractor shall demonstrate operation and testing of pressure differential system to Owner and/or the onsite IH before start of work/isolation by performing smoke test to check for leaks and
breaches as outlined in OSHA CFR 1926.1101 (j)(B)(1). Smoke tests are to be completed at the beginning of each shift. The onsite IH shall document the results of each smoke test on a daily basis. **The contractor shall use reinforced flexible ducting in occupied areas and/or high traffic areas.**

5. A system of HEPA-equipped air filtration devices shall be configured so that a pressure differential is established between the work area and the surrounding area (-0.02 to -0.04" water column). A continuous chart-recorded manometer shall be used to confirm this condition.

6. Additional air filtration devices shall be provided inside the work area for emergency standby as well as for circulation of dead air spaces.

7. The pressure differential is maintained at all times after preparation is complete and until the final visual inspection and air tests confirm the area is clean and acceptable for occupancy and the designer confirms verbally with written follow-up to discontinue the use of the negative pressure system.

8. Air shall be exhausted outside the building. Any variations must be approved by the HHCU.

9. The contractor shall check daily for leaks and log his checks in the bound logbook. This includes checks internal to air-moving devices.

10. There shall be a minimum of four air changes per hour in any containment. The following formula shall be used to determine the approximate ventilation requirements for each work area using four air changes per hour (one air change every 15 minutes):

    \[
    \text{Total air flow ft}^3/\text{min} = \frac{\text{Volume of work area (in ft}^3)}{15 \text{ min}}
    \]

    \[
    \text{Number of units needed} = \frac{\text{Total air flow (ft}^3/\text{min})}{\text{Per Containment Capacity of unit (ft}^3/\text{min) per Containment}} + (1 \text{ Unit for Safety Factor})
    \]

11. Prepare a contingency plan (as described in Section 02080.1.06) in the event of power failure and loss of negative pressure within the work area. The contingency plan shall be approved by the designer and owner.

### 3.04.6 Work Area Preparation

A diagram identifying the locations of the decontamination unit, the equipment waste loadout, the asbestos waste dumpster and the negative air machines will be incorporated within the specification. If the contractor requests to alter the locations of these items, a revised diagram must be prepared by the contractor and submitted to the Project Designer and the Building Owner’s Representative for approval. The diagram will also identify locations of water connections and sanitary sewer drains. **DISCHARGING INTO THE STORM WATER DRAINS ON UNC’S CAMPUS IS PROHIBITED.**

A. General
1. Before work begins in an area, a decontamination unit must be in operation as outlined in Section 8.00. The locations of decontamination units shall be approved by the designer.

2. Completely isolate the work area from other parts of the building so as to prevent contamination beyond the isolated area.

3. Temporary facilities shall be addressed as outlined in Section 3.00.

4. The contractor shall set up a work area, load out, and decontamination area as shown in the plans and specifications. The designer must pre-approve any variations. The decontamination facility outside of the work area shall consist of a change room, shower room and equipment room as described in Section 8.00.

5. The contractor shall wet clean and/or HEPA vacuum all items and equipment in the work area suspected of being contaminated with asbestos, but not in direct contact with the asbestos material and will either secure these items in place with polyethylene sheeting or have them removed from the work area.

6. Critical Barriers: The contractor shall thoroughly seal the work area for the duration of the work by completely sealing off all individual openings and fixtures in the work area, including, but not limited to, heating and ventilation ducts, doorways, corridors, windows, skylights and lighting, with 2 layers (minimum) of 6-mil polyethylene sheeting taped securely in place. If the contractor is using sealant materials to fill in small holes or cracks, the material shall have appropriate fire ratings.

7. Floors (if required): Apply two or more layers of 6-mil (minimum) polyethylene plastic sheeting with joints overlapped 24 inches and taped securely. Plastic shall be carried up walls a minimum of 12 inches and secured.

8. Walls: Apply two or more layers of 6-mil (minimum) polyethylene plastic sheeting with joints lapped 24 inches and taped securely. Plastic shall be lapped over floor coverings and taped securely.

9. Floors and walls shall be installed in such a manner that they may be removed independently of the critical barriers.

10. Entrances and exits from the work area will have triple barriers of polyethylene plastic sheeting so that the work area is always closed off by one barrier when workers enter or exit.

11. No water may be left standing on the floor at the end of the workday.

12. Floor surfaces, walls, finishes or coverings, etc., that in the contractor’s opinion will likely be damaged by water or that may become contaminated with asbestos, shall have additional protective preparation as the contractor sees appropriate, at his cost, to protect the original condition of the surfaces.

13. Any costs associated with physical damage caused by water or securing polyethylene sheeting to areas inside or outside the abatement area shall be the contractor’s responsibility.
14. The contractor shall establish and mark emergency and fire exits from the work area. Emergency procedures shall have priority over established decontamination entry and exit procedures. Audible and visible fire and emergency evacuation alarms shall be installed so as to be heard and seen throughout the entire work area.

15. Integrity of these seals shall be regularly checked and maintained by the contractor.

16. After work area preparation, the contractor shall notify the designer verbally with written follow-up that he is ready for a pre-work inspection.

17. Allow for viewing ports of plexi-glass for the Building Owner, inspectors and his representatives, measuring 24 inches by 24 inches in an external wall of the contained work area. A viewing port needs to be placed at each end of the containment.

B. Work Area Preparation for Exterior Work

1. Contractor shall isolate each work area with barrier tape and appropriate signage (per 29 CFR 1926.1101) installed at a minimum distance of twenty (20) feet the building.

2. Contractor shall place a 6-mil (minimum) polyethylene drop cloth on ground within the regulated work area. Contractor shall protect trees and shrubs with 6-mil (minimum) polyethylene sheeting. Contractor is responsible for any damage to trees, shrubs, or any other vegetation impacted during this projected. Drop clothes shall be secured neatly in-place to avoid trip hazards.

3. Before work begins in an area, a decontamination unit must be in operation as outlined in Section 8.00. The locations of decontamination units shall be approved by the designer.

4. Temporary facilities shall be addressed as outlined in Section 3.00.

5. Contractor shall locate waste dumpster as close as reasonably possible to the regulated area. Owner and designer shall approve location of waste dumpster.

6. After work area preparation, the contractor shall notify the designer verbally with written follow-up that he is ready for a pre-work inspection.

3.04.7 Worker Protection

A. General

1. Provide worker protection as required by OSHA, state and local standards applicable to the work. Contractor is solely responsible for enforcing worker protection requirements at least equal to those specified in this Section.

2. Each time a work area/regulated area is entered the contractor shall require all persons to put on new sets of disposable coveralls, new foot coverings, new head cover, and a clean respirator.
3. Workers shall not eat, drink, smoke, chew gum or chew tobacco in the work area, the equipment room, the load out area, or the clean room.

B. Worker Training

Train all workers in accordance with 29 CFR 1926 and North Carolina state regulations regarding the dangers inherent in handling asbestos, breathing asbestos dust, proper work procedures and personal and area protective measures.

C. Medical Examinations

Provide medical examinations for all workers. Examination shall as a minimum meet OSHA requirements as set forth in 29 CFR 1926.1101.

D. Protective Clothing

1. Provide disposable full-body coveralls and disposable head covers, and require that they be worn by all workers in the work area. Provide a sufficient number for all required changes, for all workers in the work area.

2. Boots: Provide work boots with non-skid soles and, where required by OSHA, foot protection for all workers.

3. Gloves: Provide work gloves to all workers and require that they be worn at the appropriate times. Do not remove gloves from work area. Dispose of work gloves as asbestos-contaminated waste at the completion of the project.

4. Eyewear: Provide OSHA approved protective eyewear for all workers and require they be worn at the appropriate times.

E. Additional Protective Equipment

Half-face negative pressure respirators with combination HEPA and chemical cartridges, disposable coveralls, head covers, and footwear covers shall be provided by the contractor for the owner, the designer, Industrial hygiene firm and other authorized representatives who may inspect the job site.

3.04.8 Personal Decontamination

A. Require that all workers use the following decontamination procedure as a minimum requirement whenever leaving the work area:

1. Remove disposable coveralls, disposable head covers, and disposable footwear covers or boots in the equipment room.
2. Still wearing respirators, proceed to showers. Showering is mandatory. Care must be taken to follow reasonable procedures in removing the respirator to avoid asbestos fibers while showering. The following procedure is required as a minimum:

   a. Thoroughly wet body including hair and face.
   b. With respirator still in place thoroughly wash body, hair, respirator face piece, and all exterior parts of the respirator.
   c. Take a deep breath, hold it and/or exhale slowly, completely wet hair, face and respirator. While still holding breath, remove respirator and hold it away from face before starting to breathe.
   d. Carefully wash face piece of respirator inside and out.
   e. Shower completely with soap and water; rinse thoroughly.
   f. Rinse shower room walls and floor prior to exit.
   g. Proceed from shower to changing (clean) room and change into street clothes or new disposable work items.

3. After showering, each employee shall inspect, clean and repair his respirator as needed. The respirator shall be dried, placed in a suitable storage bag and properly stored.

3.04.9 Respiratory Protection

A. Description of Work

Instruct and train each worker involved in asbestos abatement in proper respirator use and require that each worker always wear a respirator, properly fitted on the face, in the work area from the start of any operation which may cause airborne asbestos fibers until the work area is completely decontaminated. Use respiratory protection appropriate for the fiber level encountered in the workplace or as required for other toxic or oxygen-deficient situations encountered.

B. General

1. Provide workers with personally issued and marked respiratory equipment approved by NIOSH and MSHA and suitable for the asbestos exposure level in the work areas according to OSHA Standard 29 CFR 1926.1101 and other possible contaminants employees might be exposed to during the project.

2. Provide respiratory protection from the time the first operation involved in the project requires contact with asbestos-containing materials (including construction of decontamination units, construction of airtight barriers/barricades, and placing of plastic sheeting on walls) until acceptance of final air clearance test results by the industrial hygiene firm.
3. The minimum respiratory protection for the project during gross removal operations in interior containments shall be powered air purifying respirators (PAPR) with appropriate filter cartridges. The minimum respiratory protection for the project during gross removal operations for exterior work areas shall be half-faced negative pressure respirators with appropriate filter cartridges.

4. Respirator fit testing shall be performed as a minimum within the last six months or at the beginning of the project, at any change in respiratory protection equipment, and at any time during the project if requested by the employee or SAM. Fit testing is to be performed by one of the methods listed in the 29 CFR 1926.1101, Appendix C.

5. Do not allow the use of single-use, disposable or quarter-face respirators for any purpose.

6. The contractor may submit a new exposure assessment (as per 29 CFR 1926.1101) to the designer with a request to downgrade to less protective respirators. The designer will issue a decision in writing to the contractor approving or denying his request. If the contractor disagrees with the decision, then the representative air sampling data may be reviewed by the HHCU for a final decision.

3.04.10 Decontamination Units

A. General

1. If the building is occupied, the contractor shall construct the decontamination unit to include a locking mechanism on the entrance door to prevent unauthorized entry. The Air Monitor and a Building Representative shall be issued a key to access the area.

2. Prior to beginning of interior or exterior abatement operations a fully operational decontamination unit must be established. The locations of decontamination units shall be approved by the designer.

3. Provide fully functional personnel decontamination unit attached to the containment.
   a. Provide a Personnel Decontamination Unit consisting of a serial arrangement of connected rooms or spaces, changing room, shower room, equipment room. Each shall be separated by a minimum of three curtain doorways.
   b. Provide temporary lighting within decontamination units as necessary to reach an adequate lighting level as required in Section 1.08.5.K.
   c. Maintain floor of changing room dry and clean at all times. Do not allow the overflow water from the shower to escape the shower room.
   d. Damp wipe all surfaces twice after each shift change with a disinfectant solution.
   e. Provide hot and cold water, drainage and standard fixtures including an elevated shower head as necessary for a complete and operable shower. A water hose and bucket is not an acceptable shower.
f. Arrange water shut off and drain pump operation controls so that a single individual can shower without assistance from either inside or outside of the work area.

g. Pump shower wastewater to drain. Provide 20 micron and 5 micron waste water filters in line to drain. Change filters daily or more often if necessary. Filtered wastewater shall be discharged into a sanitary sewer only.

h. Visual Barrier: Where the decontamination area is immediately adjacent to and within view of occupied areas, provide a visual barrier of opaque plastic sheeting so that worker privacy is maintained and work procedures are not visible to building occupants.

B. Equipment Decontamination Units

Provide fully functional equipment decontamination unit attached to the containment.

1. Provide an equipment decontamination unit consisting of a serial arrangement of rooms, clean room, holding area, and washroom, each room separated by a minimum of three curtain doorways, for removal of equipment and material from work area. Do not allow personnel to enter or exit work area through equipment decontamination unit.

2. Washroom: Provide washroom for cleaning of bagged or drummed asbestos-containing waste materials passed from the work area.

3. Holding Area: Provide holding area as a drop location for sealed drums and bagged asbestos-containing materials passed from the washroom.

4. Clean Room: Provide clean room to isolate the holding area from the building exterior or occupied areas.

5. Equipment or Material: Obtain all equipment or material from the work area through the equipment decontamination unit according to the following procedure:

   a. When passing contaminated equipment, sealed plastic bags, drums or containers into the washroom, close all doorways of the equipment decontamination unit, other than the doorway between the work area and the washroom. Keep all outside personnel clear of the equipment decontamination unit.

   b. Once inside the washroom, wet-clean the bags and/or equipment.

   c. When cleaning is complete, insert bagged material into a clean bag/drum during the pass between the washroom and holding area. Close all doorways except the doorway between the washroom and holding area.

   d. Workers from the building exterior enter the clean room then the holding area to remove decontaminated equipment and/or containers for disposal. Require these workers to wear full protective clothing and respiratory protection as described in Sections 6.00 and 7.00.
C. Decontamination Unit Air Quality Requirements

If the air quality in the decontamination unit exceeds 0.01 fibers per cc analyzed by PCM or 70 structures per mm square analyzed by TEM or its integrity is diminished through use as determined by the designer or industrial hygiene firm, no employee shall use the unit until corrective steps are taken and approved by the designer and industrial hygiene firm.

3.04.11 Asbestos Removal

A. General

1. Prior to starting asbestos removal, the contractor’s equipment, work area and decontamination units will be inspected and approved by the designer.

2. All loose asbestos material removed in the work area shall be adequately wet, bagged, sealed and labeled properly before personnel breaks or end of shift.

3. All plastic sheeting, tape, cleaning material, clothing and all other disposable material or items used in the work area shall be packed into sealable plastic bags (6 mil minimum) and treated as contaminated material.

4. All material shall be double-bagged.

5. All excess water (except shower water) shall be combined with removed material or other absorptive material and properly disposed of as per EPA regulations. Contractor shall not place water in storm drains, onto lawns, or into ditches, creeks, streams, rivers or oceans.

B. Scope of Work

1. The scope of work for this project requires asbestos abatement in ________ phases. The project phasing and sequencing of events is shown on asbestos abatement drawings for this project. Asbestos contractor shall coordinate phasing with university and designer.

2. Scope of Work, Define each containment structure in detail with specific requirements for abatement of ACM. Each containment description shall include the materials scheduled to be removed, any special precautions required, the amount of material, the removal methods used and waste bag instructions. The section should reference the asbestos inspection report included as an Attachment. The scope of work should incorporate the intent of the abatement activities. If all of the ACM cannot be removed from the building, a statement shall be incorporated within the specification stating the type and amount of material to remain. If all asbestos debris cannot be removed from the crawlspace or a substrate, include a statement in the specification to describe final visual requirements.

C. ACM Products To Be Removed

In this section, list the ACM products to be removed during the asbestos abatement.
D. Asbestos Removal

Full containment removal of asbestos-containing materials:

1. After work area preparation is complete, contractor shall adequately wet asbestos-containing materials with a fine mist of amended water. Care shall be taken not to over saturate and allow excess dripping to pool on floor.

2. Contractor shall carefully remove manageable sections of asbestos-containing materials and place it directly into bags for disposal. Do not allow asbestos debris to accumulate on floor.

3. Contractor shall continue misting asbestos-containing materials with amended water throughout the removal process.

4. Contractor shall take all precautions necessary not to allow asbestos-containing material to free fall to the floor. Asbestos-containing materials may not free fall more than six feet.

5. Contractor shall clean work area as required by section 01711.

6. Where asbestos-containing pipe insulation extends beyond the containment boundary (i.e. tunnels), contractor shall remove insulation 2 inches into the floor or ceiling penetration and repair ends to remain in place with lag cloth.

7. Contractor shall remove asbestos-containing floor tile mastic using non-friable, non-regulated removal techniques. Asbestos-containing floor tile mastic shall be removed using a low to no odor solvent. Contractor shall use solvent sparingly for odor control.

8. Asbestos containing waste bags shall be transported from the work site to the dumpster after normal business operating hours such as before 8:00 am or after 5:30 pm.

E. Asbestos Containing Floor Tile and Mastic Abatement (Non-friable Removal Techniques)

1. Contractor shall remove asbestos-containing materials using hand tools and wet methods. No mechanical tools will be allowed for removal of asbestos-containing materials.

2. A system of HEPA-equipped air filtration devices shall be placed within the work area to minimize the odor associated with the heat treatment of the floor tiles and the mastic removal odor. The exhaust for the unit(s) shall be discharged outside of the building.

3. Critical Barriers: The contractor shall thoroughly seal the work area for the duration of the work by completely sealing off all individual openings and fixtures in the work area, including, but not limited to, heating and ventilation ducts, doorways, corridors, windows, skylights and lighting, with 2 layers (minimum) of 6-mil polyethylene sheeting taped securely in place. If the contractor is using sealant materials to fill in small holes or cracks, the material shall have appropriate fire ratings

3.04.12 Disposal of Asbestos-Containing Waste Material
A. General

1. All asbestos materials and miscellaneous contaminated debris shall be properly sealed and protected, and the loadout vehicle/dumpster shall be locked, while located on the facility site and then transported to a predesignated disposal site in accordance with 40 CFR 61.150 and DOT 49 CFR Parts 100-399.

2. An enclosed vehicle will be used to haul waste material to the disposal site. No rental vehicles or trailers shall be used. Vehicle selection, vehicle covers and work practices shall assure that no asbestos becomes airborne during the loading, transport and unloading activity, and that material is placed in the waste site without breaking any seals.

3. Waste disposal polyethylene bags (6 mil) and containers, non-porous (steel/plastic) drums or equivalent, with labels, appropriate for storing asbestos waste during transportation to the disposal site shall be used. In addition to the OSHA labeling requirements, all containers shall be labeled with the name of the waste generator and the location at which the waste was generated.

4. The contractor shall transport the containers and bags of waste material to the approved waste disposal site. The sealed plastic bags shall be placed into the burial site unless the bags have been broken or damaged. Upon the landfill's approval damaged bags shall be left in the non-porous containers and the entire contaminated package shall be buried. Uncontaminated containers may be reused.

5. Workers loading and unloading the asbestos will wear respirators and disposable clothing when handling material. Asbestos warning signs shall be posted during loading and unloading of asbestos waste.

6. The contractor shall use the HHCU's Waste Shipment Record for disposal records as per 40 CFR 61.150 and distribute a copy of all waste shipment records to the designer and HHCU after the completion of the project.

3.04.13 Project Decontamination and Work Area Clearance

A. Carry out a first cleaning of all surfaces of the work area, including plastic sheeting and tools, by use of damp-cleaning and mopping and/or a high efficiency particulate air (HEPA) filter vacuum until there is no visible debris from removed materials or residue on plastic sheeting or other surfaces. Do not perform dry dusting or dry sweeping.

B. Equipment shall be cleaned and all contaminated materials removed before removing polyethylene from the walls and floors.

C. The contractor shall replace all prefilters and clean the inside and outside of the HEPA exhaust units.

D. After polyethylene sheets have been removed from walls, but are still remaining on all windows, doors and the critical components, the contractor shall clean all surfaces in the work area, including ducts, electrical conduits, steel beams, roof deck, etc., with amended water and/or HEPA-filtered vacuum.
E. After cleaning the work area, the contractor shall allow the area to thoroughly dry and then wet-clean and/or HEPA vacuum all surfaces in work area again.

F. At the completion of the cleaning operation, the contractor’s supervisor shall perform a complete visual inspection of the work area to ensure that the work area is dust- and fiber-free. If the supervisor believes he is ready for a final project decontamination inspection, he shall notify the designer.

G. The designer shall contact the industrial hygiene firm and advise the firm of the final project decontamination inspection requested by the contractor.

H. Final project decontamination inspection includes the visual inspection and air monitoring clearance.

I. Visual inspection for acceptance shall be performed by the industrial hygiene firm after all areas are dry. The inspection shall be conducted following the guidelines set forth in the American Society for Testing and Materials, Standard Practices for Visual Inspection of Asbestos Abatement Projects, Designation: E1368.90.

J. If the work area is found visibly clean, air samples will be collected by the industrial hygiene firm. Any discrepancies found shall be documented in the form of a punch list.

   1. During the air testing, the accredited air monitor shall cause disruptive air currents as described in the EPA-AHERA regulations (40 CFR Part 763, Subpart E, Appendix A).

   2. For exterior removal operations, no clearance air samples are required. However, contractor must pass final visual inspection prior to removing regulated area. Visual inspection shall be performed by the industrial hygiene firm.

   3. For interior removal operations, clearance air samples are to be analyzed using TEM, the Mandatory Transmission Electron Microscopy Method described in 40 CFR Part 763, Subpart E, Appendix F shall be used. Clearance criteria shall be an arithmetic mean less than or equal to 70 structures per square millimeter.

   4. The industrial hygiene firm shall immediately report the final air sampling clearance results to the designer.

   5. The use of the negative pressure system may be discontinued after the industrial hygiene firm instructs the contractor that he has passed the final project decontamination inspection.

K. If the industrial hygiene firm finds that the work area has not been adequately decontaminated, cleaning and/or air monitoring shall be repeated at the contractor’s expense, including additional industrial hygiene fees, until the work area is in compliance.

L. After the work area is found to be in compliance, all entrances and exits shall be unsealed and the plastic sheeting, tape and any other trash and debris shall be disposed of in sealable plastic bags (6 mil minimum) and disposed of as outlined in Section 02080.13.00.
M. All HEPA unit intakes and exhausts shall be wrapped with six-mil polyethylene before leaving the work area.

N. After the industrial hygiene firm has approved the final project decontamination and the contractor has completed the tear down for occupancy by others, the designer shall perform the project final inspection as outlined in the general conditions.

O. Any residual asbestos that may be present after removing critical barriers, which in the designer’s judgment should have been cleaned during the pre-cleaning phase prior to installing critical barriers, shall be cleaned and cleared at the contractor’s expense.

P. There shall be appropriate seals totally enclosing the inspection area to keep it separate from clean areas or other areas where abatement is or will be in progress. Once an area has been accepted and passed air tests, loss of the critical barrier integrity or escape of asbestos into an already clean area shall void previous acceptance and tests. Additional visual and final air clearance sampling shall be required at the contractor's expense.

3.05 LABORATORY SINK TRAP AND OTHER INTERNAL BUILDING PIPING REMOVAL AND DISPOSAL

Sink traps existing in the building shall be properly removed and disposed. The traps are constructed of various types of materials including plastic and metal.

Prior to removal of the sink drain traps, the contractor shall rinse each drain line with an appropriate, pre-approved solution, such as a hypochlorite solution, that will decontaminate the line and stabilize the pH of the interior of the drain line. The solution shall not be injected into the drain or placed into the drain utilizing methodology that may disturb mercury caught in the sink traps. Next, the hot and cold water faucet handles will be opened fully to confirm the water has been shut off and residual water drains out of the faucet. The contractor will then completely close the faucets. The contractor will then wrap the faucet handles with yellow adhesive caution tape or tape labeled “Do Not Touch.” Next, the sink drain trap will be properly removed such that the fluid and sediment which exists in the trap is contained. The fluid in the sink drain trap will be contained in a 1H1 5-gallon or 55-gallon container appropriately labeled. The sink trap will be appropriately cleaned and rinsed with water. The cleaning solution and the rinse water will also be contained in the same container. The container will be kept sealed after material is placed into it. Refer to Section 1, 1.12 - Mercury Spills and Contamination for monitoring and clearance information.

The contractor will store the 5-gallon buckets or 55-gallon drums in the staging area approved by UNC-EHS and coordinate disposal with the appropriate pre-qualified waste disposal contractor listed in Section 1, 1.14 - Hazardous and Universal Waste Disposal.

Following removal of the drain trap, the contractor will test the pH and mercury content of the drain line where the sink trap connected to the discharge end of the line. The results of the tests will be documented by the contractor (refer to Section 1, 1.15 - Project Testing Summary Reports). Next, the pipe will be plugged with a plastic or wood plug. The plug will be securely installed in such a manner that it will not inadvertently fall off during work on another section of the same pipe. If the pH of the pipe is between 5.5 and 8.5, the pipe will be sprayed with green spray paint in such a manner that the paint will remain on the pipe during removal. If the pH of the pipe is below 5.5
or above 8.5, the pipe will be sprayed with red spray paint (which indicates additional decontamination is required) in such a manner that the paint will remain on the pipe during removal.

3.06 FLOOR DRAIN REMEDIATION AND REMOVAL OF OTHER POTENTIAL MERCURY CONTAINING ITEMS

Floor drains existing in the building shall be properly cleaned by the contractor. The floor drains are generally constructed of metal. Sample sediment located in randomly selected floor drain traps at the subject property. The samples should be analyzed at a laboratory for the presence or absence of mercury.

The existing fluids in the floor drains shall be removed and placed in a 1H1 5-gallon container or 55-gallon drum by the contractor. Next, the sediment in the floor drain will be removed and contained in a 1A2 5-gallon drum or 55-gallon drum. The container(s) will be kept sealed after material is placed into it/them. The contractor will then cap the drain line. The floor drain and trap shall then be appropriately cleaned and rinsed with water. The cleaning solution and the rinse water will also be contained in the same container. The drain line cap will then be removed and the contractor shall rinse each drain line with an appropriate, pre-approved solution, such as a hypochlorite solution, that will decontaminate the line and stabilize the pH of the interior of the drain line. Refer to Section 1, 1.12 - Mercury Spills and Contamination for monitoring and clearance information.

The contractor will store the 5-gallon buckets and/or 55-gallon drums in the staging area approved by UNC-EHS and coordinate disposal with the appropriate pre-qualified waste disposal contractor listed in Section 1, 1.14 - Hazardous and Universal Waste Disposal.

The contractor will test the pH and the mercury content of the drain line. The results of the tests will be documented by the contractor (refer to Section 1, 1.16 - Project Testing Summary Reports). Next, the drain will be temporarily plugged with a plastic or wood plug. The plug will be securely installed in such a manner that it will not inadvertently fall off during work on or around the floor drain.

Manufactured or intrinsic items containing elemental mercury will be identified and removed by the contractor including, but not limited to, manometers and pressure gauges (i.e., Stokes McCleod gages), thermometers (also potentially located in ducts), pumps, switches (i.e., MERCOID switches) and thermostats. The contractor will segregate these items from other mercury-containing waste and manage them as hazardous and universal waste after they are removed. The contractor will arrange to have intrinsic items shipped to a recycler for recovery of mercury. UNC-EHS signature is required on all shipping documents.

3.07 MERCURY ABATEMENT

3.07.1 Delegation of Authority

UNC’s Project Officer, a representative of the Department of Environment, Health & Safety, and asbestos/hazardous material design representative are assigned to be technical authorities to the project by the UNC Contracting Officer. They may seek the services and assistance of a qualified environmental firm for air monitoring, mercury identification and decontamination, waste determination methodologies, and general guidance on lab decommissioning strategies.
3.07.2 Security, Special Equipment, Materials and Reagents

A. The appropriate personal protective equipment (PPE) will be provided by the contractor to all approved visitors to the site. The contractor will keep a log of visitors at the primary entrance to the worksite with the dates and times of their visit to the building.

B. Warning signs and labels shall be posted for the duration of the work, which restrict access to “off limits” areas to authorized personnel only. Warning signs identifying mercury decontamination procedures shall read “Caution: Mercury decontamination in progress. Do not enter!” Doors or entrance ways to areas where decontamination is in progress or final clearance has not been achieved will be sealed with polyethylene sheet plastic, yellow caution tape, and the aforementioned warning sign posted at the entrance.

C. Mercury testing as described herein will be the responsibility of the contractor and will employ an OhioLumex RA-915+ Mercury Analyzer for the determination of mercury vapor concentrations in the air, specifically to ensure that the project and regulatory action levels are accurately measured. The OhioLumex is a portable and highly sensitive atomic absorption unit with Zeeman background correction for the elimination of interferences. The instrument has proven to be reliable and effective for measuring mercury vapor levels in a demolition environment and for assessing the progress and effectiveness of decontamination procedures in an indoor environment. Attachments for performing liquid and solid mercury analyses are available from the manufacturer, but are not required.

D. Materials and reagents used in the execution of the contract shall be used as specified by the manufacturer’s written instructions. All products will comply with UNC’s fire safety requirements for use and storage. Material Safety Data Sheets (MSDSs) will be submitted as part of the contractor’s site specific health and safety and waste minimization plans. In addition, MSDSs will be posted in accessible locations at the worksite including the primary entrance used by visitors to the building. Hazardous material storage areas will be placarded with the appropriate signage, properly ventilated, and locked when not in use.

E. Commercial materials and reagents will be properly transported to the site at the outset of the project and removed from the building and campus, when they are no longer needed. Prolonged storage or maintenance of excessive quantities of hazardous materials shall be strictly avoided. The contractor will be responsible for promptly transporting unused materials away from the UNC campus during the final project demobilization.

F. Containers will be provided by the contractor and shall comply with all transportation requirements provided in 49 CFR (DOT regulations) for the shipment of hazardous substances. Contractor is required to subcontract an approved UNC-Chapel Hill hazardous waste disposal contractor for disposal of hazardous waste generated under this contract.

3.07.3 Execution of Mercury Abatement

A. Preparation of Work Areas- Contaminated and Non-contaminated Labs/Rooms

1. The results of the mercury survey of all spaces to be renovated will determine what areas will be sealed and access restricted to contractor hazardous material (HazMat or mercury abatement) workers.
2. Labs and areas of the building with breathing zone (BZ) or surface mercury vapor concentrations greater than the ASAL will be restricted by sealing the entrance(s) with polyethylene sheet plastic and barrier tape, and by prominently labeling the room contaminated by painting a green or yellow “Hg” on the outside of the room, preferably at the sealed entranceway.

3. Labs and areas where BZ measures are below the ASAL will be considered non-contaminated. These portions of the building will be released for unrestricted contractor access with regards to mercury contamination but may require removal of casework, etc., if the demolition plans call for asbestos abatement and/or an interior gut of that section of the building.

4. Work area delineation will be reviewed and inspected by the Contractor’s Environmental Health and Safety Manager. More specific delineation of the extent of contamination within each lab/room will be a primary function of the EHSM in order to minimize the area that requires treatment, as well as the materials expended in the process.

5. Visible mercury spills, once they are discovered, must be immediately cordoned off. These spills will be assigned the highest priority for clean-up. Contractor workers shall be trained on how to identify mercury spills and shall report them immediately to the EHSM, so the area can be cordoned off and arrangements made for suitable clean-up.

6. Work areas will be isolated by the contractor through the use of plastic sheeting, duct tape, and signage. Critical barriers will be constructed in the contaminated labs and rooms covering ceilings and walls using with sheet plastic. Entrances will also be closed off with plastic. These barriers will be similar to those described in the Asbestos Abatement Specification (Section 02080; subsection 5.01). Since mercury spills are frequently found between and under asbestos floor tile and mastic, laboratories in which vinyl asbestos tile may require removal of the floor tile and mastic before it can be effectively decontaminated.

7. Every effort will be made to ensure that elevated concentrations of mercury vapor, typically encountered when spilled mercury is disturbed, are not allowed to escape into occupied areas of the building. Therefore, all air handling/HVAC units will be shutdown before beginning decontamination. Vents and intakes will be covered with polyethylene plastic sheet. Should the mercury air concentrations approach the TLV, the contractor will immediately install negative air HEPA filter exhaust units to increase the air circulation in the work area, which will be exhausted outside of the building.

8. Before chemical decontamination of labs is begun the area must be cleaned and free of all removable items, equipment, and casework. All items that are not removed or are to be left in place, per the renovation plans, will be covered with sheet plastic.

9. Inspection of the work area for visible mercury requires vigilance and is an ongoing process. It should be an objective of the contractor. Mercury may be found behind or under casework as it is removed, inside sanitary plumbing pipes, and behind metal partitions, and pipe chases. The EHSM will cordon-off spills as they are discovered, record initial mercury vapor concentrations in both the BZ and on the surface containing the spill, and obtain post-decontamination measurements after the spill has been cleaned-up.

B. Wastewater Sanitary Drains and Pipe Contaminated with Mercury

1. The preliminary mercury survey of areas to be renovated will have as one of its objectives the identification of sink drains that have mercury vapor readings above the ASAL. The EHSM will verify readings from suspected sinks using the OhioLumex and mark them for removal.
2. Before removal of any of the sanitary lines, the contractor will ensure that plumbing is not allowed to drain to the sewer or that the sanitary mains leaving the building are isolated from the sewer to avoid accidental discharges of mercury.

3. Laboratory sink traps are common sources of mercury. All sink traps in areas of the building to be renovated will be removed as the initial remediation activity. Refer to Section 3, 3.05 - Laboratory Sink Trap and Pipe Removal and Disposal for additional information. The contractor must exercise caution when removing sink traps, as they may contain significant quantities of mercury that can be spilled spreading contamination. In addition, sink traps are known to form chemical by-products that are established reactive hazards. These heavy metal azides are friction sensitive as dry crystals and have documented cases where they have detonated, usually when dried plumbing was unscrewed at the threaded joints. Heavy metal azides form, when sodium azide, a common preservative used in numerous biochemical preparations, reacts with the metal in the pipe, especially copper and lead. Sink traps should be inspected carefully for the presence of crystalline deposits around the joints and should only be removed by cutting with a saw above and below the threaded joints and only when the trap is wet! It is strongly recommended that copper and lead traps (i.e., bench cup sinks) should be isolated and removed by a qualified explosion hazard expert wearing body arm and a face shield when crystals are found or suspected to exist. Problems are generally not encountered with newer pipe, especially PVC or plastic pipe.

4. Plastic or PVC pipe will be monitored at both cut ends using the OhioLumex. If the vapor readings are less than the ASAL, the pipe may be disposed as no-regulated solid waste in a dumpster.

5. All sanitary pipes, including sink traps, should be cut using a saw and only if the pipe is wet. The use of torches and other hot methods are strictly forbidden. The cutting of lead pipes must adhere to the Lead in Construction Standard 29 CFR 1926.62. The standard requires application of certain health and safety provisions (i.e. biological monitoring, employee training, and exposure control including respiratory protection). The area beneath the cut should be prepared with a plastic pan or with polyethylene sheeting to prevent the contents of the pipe from spilling mercury or mercury-contaminated water on the floor or base of the cabinet. Cut ends will be sealed with polyethylene plastic and duct tape before they are placed in the appropriate disposal container. Pipe stubs that are left in the wall below the sink will be sealed with polyurethane foam to prevent the evolution of mercury vapor should the pipe be contaminated downstream of the cut. All sanitary pipes will be cut to appropriate lengths for placement in the waste containers selected and by the contractor and approved by the owner and designer.

6. Wastewater in sink traps, p-traps, or other sanitary drain lines will be collected by carefully decanting it into a hazardous waste container. Residue in the trap or length of pipe should remain in the pipe as it may contain the greatest amount of mercury. Mercury is known to amalgamate with various metals and is, therefore difficult to remove from metal pipe. Metal traps that are removed, after decanting the water, shall have both open ends sealed before placing them in a hazardous waste drum for shipment to a mercury retort facility. Pipe, especially metal pipe, shall not be power or pressure washed, unless the pipe is to be abandoned-in-place and only after proposed procedures and assurance of water collection is approved by the owner/designer, and their technical representatives.
7. Wastewater collected from sanitary piping will be analyzed for RCRA-8 metals, pH, and other pollutants or physical properties required by UNC’s wastewater discharge permit. The discharge limit for mercury is 0.012 mg/L, although the analytical results of all metals shall be used to determine whether or not the water may be discharged to the sewer without a permit. Wastewater will be stored in the approved satellite accumulation area in labeled DOT drums or portable tanks pending the results of analysis.

8. Sanitary pipe entering the basement slab of the building will be abandoned–in-place after cutting the pipe flush with the slab elevation. The preferred option is to remove the piping. Once cut the sanitary penetrations will be tested for the presence of mercury vapor using the OhioLumex. Pipe that has elevated mercury vapor levels (>ASAL) will be power washed to remove free elemental mercury or contaminated liquid after cutting the pipe at the service point closest to the building to avoid discharging potential slugs of mercury to the sewer. Wash water that is collected will be tested as noted in item 7 above. UNC will determine the need for additional work involving the removal of slab embedded sanitary pipe or pipe exiting the building.

C. Surficial Decontamination

1. Surface areas, floors, and items with mercury vapor surface reading above the ASAL, 250 nanograms per cubic meter (ng/m³) in the initial survey will be cleaned/decontaminated. It is recommended that contaminated sanitary pipe be removed prior to decontamination of floors and cabinets, so as to avoid repeated cleaning of these surfaces.

2. Elemental mercury that is visibly identified will be removed along with potentially contaminated debris using a mercury vacuum cleaner or other free mercury collection apparatus. Mercury vacuums are designed to prevent dispersion of hazardous vapors into the work area during their use. Waste collected by vacuuming will be disposed of by removing the collection bag and placing it in a container for mercury retort waste.

3. No attempt will be made to decontaminate porous materials, such as carpeting, since they are difficult to clean and, therefore will be disposed of in the hazardous waste container as they are removed provided monitoring indicates that the PDCL is exceeded.

4. An effective decontaminating solution will be used by the contractor to wash all nonporous surfaces that monitor with the OhioLumex above the PDCL. Chemical decontaminants should be selected that are not odiferous (e.g., sulfurous reagents) or extremely hazardous to use. Decontaminants or rinse solutions should be selected based on their effectiveness extracting or removing mercury or the products formed from the reaction with the decontaminant from the surface being cleaned. A decontaminant that is easily applied to various surfaces and that possesses vapor suppressant properties is highly recommended. UNC understands that all decontamination approaches are problematic and may require case-by-case selection and validation. Disposal of decontaminant wastewater and wash solutions as hazardous will be determined from the results of aforementioned wastewater analyses.

5. The contractor will complete air clearances in each work area at the completion of remediation activities to document the effectiveness of the remediation and decontamination activities. The contractor shall verify that mercury levels in the building are below the decontamination clearance level of 1,000 ng/m³ utilizing air monitoring equipment. The air monitoring equipment should be able to accurately detect mercury vapor at 2 ng/m³. The clearance tests will be completed by dividing the work area into a grid of 2’x2’ squares. The contractor will collect air
samples approximately two inches above the cleaned surface and in the center of each grid square, documenting the results. A sample location map should be completed indicating sample location, sample time and sample concentration. The contractor shall also complete a Project Testing Summary Report (refer to Section 1, 1.15 - Project Testing Summary Reports) including the air monitoring instrument manufacturer, model number, calibration date and other pertinent information. If each of the clearance air samples is not ≤ 1000 ng/m³, the contractor will re-clean the area and complete a second round of clearance testing, utilizing the same procedures listed above. The contractor will continue this process until successful clearance is obtained.

6. A TCLP or total mercury composite sample may be analyzed in some cases. Materials that analyze below the TCLP or total mercury action levels will be released for disposal as non-regulated construction debris. Representative TCLP or total metal samples will be documented for the purpose of compliance with hazardous waste regulations. Materials that fail TCLP or total mercury will be managed as hazardous waste and disposed of in the proper container.

7. Floor tile and mastic that are found to be contaminated using the project guidelines will be removed by the contractor, placed in sealed polyethylene bags as described in the Asbestos Abatement Section for disposal as low-mercury contaminated waste. It is important to note that mercury spills frequently occur on floors. Mercury breaks up into very tiny droplets or beads that easily lodge between and under tiles, and in cracks and crevices. Therefore, the mercury abatement contractor will also be required to remove vinyl asbestos floor tile, where it exists.

8. Once areas or laboratories are cleared to below the PDCL, the status and date of clearance should be recorded in a field log, along with the mercury vapor readings. Post-decontamination measurements shall also be reported in the final project report along with the pre-decontamination survey vapor concentrations taken from the same area. Decontamination procedures should be thoroughly documented for future project planning purposes at UNC.

D. Air Sampling and Laboratory Analytical Results

1. The contractor will maintain a field/project log of air sampling performed and solid and liquid samples submitted to an EPA accredited analytical laboratory. Results of all tests will be recorded with the samples. At a minimum the log should include:
   a. Sample type
   b. Name of sampler or the Contractor’s Environmental Health and Safety Manager
   c. Date and time of collection
   d. Sampling location
   e. Analytical methods employed
   f. Laboratory results, reports, and pertinent qualifiers, and QC tests
   g. OhioLumex readings should be reported in the appropriate concentration units (ng/m³) along with the instrument recorded % deviation for mean vapor concentrations obtained.

E. Final Survey
1. A final survey will be conducted to determine how clean the building is before renovations are initiated. Mercury vapor air monitoring is to be repeated in all areas at the conclusion of the D&D activities. For those areas that are not to undergo complete interior gut; piping, mechanical systems, laboratory casework, and debris should be cleared from the area before the final survey is conducted. The level of complexity of this survey shall be determined between the contractor and the owner and designer, but at a minimum should clearly define the effectiveness of the decontamination procedures used by measuring average mercury vapor air readings obtained from all cleaned areas and/or floors of the building. In addition, the contractor will be asked to record Time Weighted Averages (TWAs) over an 8-hour period of mercury air concentrations in defined spaces including open floors using the OhioLumex. TWA software is supplied by the manufacturer of the instrument that automates this process.

F. Packaging, Labeling, and Storing Hazardous Materials On-Site

1. Hazardous wastes will be accumulated in full accordance with the regulations and in DOT approved and labeled containers. The accumulation area will be placarded on the outside with the appropriate warning signs and kept locked, when not in use. It will be the responsibility of the Contractor’s Environmental Health and Safety Manager, and ultimately the contractor, to properly manage and inspect the accumulation area. Other provisions guiding hazardous waste protocols are referenced elsewhere in this specification.

G. Shipping Hazardous Waste Off-Site

1. Contractor is required to subcontract an approved UNC-Chapel Hill hazardous waste disposal contractor for disposal of hazardous waste generated under this contract. Hazardous Waste Manifests: Uniform Hazardous Waste Manifests (EPA Form 8700-22 or the latest revision) shall be completed by the contractor for each waste shipment and shall list the waste and transportation containers type. Manifests will contain UNC’s EPA ID Number and must be signed by the representative of UNC’s Department of Environment, Health and Safety (EHS) responsible for hazardous waste on campus. The owner and EHS representative may inspect all shipments before signing manifests. Copies of landfill receipt of shipment will also be provided to EHS.

2. DOT Emergency Response Information Requirements: The contractor and his transporter must comply with applicable DOT Emergency Response Communication Standards for shipments of all hazardous waste.

3. Permitted Treatment, Storage, and Disposal Facilities (TSDF): All treatment, storage, and disposal facilities (TSDF) must be pre-approved by UNC and shall be permitted to receive and handle the waste types shipped to them. All facilities will have a minimum of an EPA and state approved interim status permit showing the EPA hazardous waste numbers for each waste type the facility is permitted to handle as required by the provisions of 40 CFR 261, Subparts C and D. Mere acceptance of the waste by a permitted facility does not meet the contract requirements for final treatment and disposal under this contract. Records of ultimate disposition of the waste are required.

H. Cleanup and Housekeeping

1. An essential aspect of managing hazardous materials and hazardous waste, as well as properly conducting decontamination operations, is good housekeeping. Surfaces must be free of dirt and debris in order to be effectively decontaminated and to prevent dispersion of contaminants.
Workers must be meticulous in cleaning their areas on a regular basis. A thorough cleanup of the work spaces will be conducted before the final survey is performed.

2. Final Cleanup and Site Demobilization: The Contracting Officer and owner’s representatives will inspect the work areas for approval of mercury cleanup. All hazardous materials and waste will be removed or shipped from the facility before the contractor demobilizes.

3.08 REMOVAL AND DISPOSAL OF COMPONENTS PAINTED WITH LEAD-CONTAINING PAINT OR SURFACE COATINGS

3.08.1 Lead Inspection

A lead inspection must be conducted prior to removal of lead-containing components. During the inspection, lead testing should be done for building materials such as ceramic floor and tile, window sashes and components including metal lintels, exterior doors and exterior door components, interior door headers and casings, wood baseboards, wood crown moldings, wood chalk board casings, painted metal stair railings including balusters, railing caps and newel posts, stair treads, stair risers and stair stringers, radiators and the dumb waiter.

3.08.2 Removal of Lead-Containing Components

The contractor/employer shall adhere to the OSHA Lead in Construction Standard 29 CFR 1926.62 during the removal of components containing any detectable amounts of lead.

A. The contractor/employer will be responsible for conducting employee exposure monitoring and training, and providing employees with respirators and other personal protective equipment during exposure monitoring as defined by the standard. Negative exposure data collected within twelve months of the construction work and during similar work conditions, lead-containing material, and lead content may be used to substantiate no exposure to employees and building occupants.

B. The contractor/employer will be responsible for implementing the health and safety measures required by the standard if airborne lead concentrations equal or exceed the Action Level (30 µg/m³).

C. The contractor/employer shall ensure the airborne lead concentrations do not exceed the Permissible Exposure Limit (PEL) of 50 µg/m³. If concentrations exceed the PEL, engineering controls such as local exhaust or mechanical ventilation shall be utilized.

D. In areas of peeling lead-containing paint, wet scraping or an approved alternate control measure shall be used to remove the chips. The remaining surface shall be stabilized with a paint coating approved by the architect.

E. Lead-containing painted steel that must be removed with saws or torches must be abated prior to removal.
F. For work conducted within or near occupied buildings, the contractor/employer shall protect building occupants by sealing shared air supply and exhaust vents, constructing rigid barriers for jobs exceeding 3 days, implementing dust control methods, and creating negative pressure within the work area.

G. The contractor/employee shall prevent waste water containing paint chips from entering storm drains.

3.08.3 Disposal of Lead-Containing Components

TCLP testing must be conducted prior to disposal of lead-containing components. Components that fail TCLP testing will be collected, and stored in a sealed and labeled container. These containers must be stored in a locked area and EHS must be called for a hazardous waste pickup (Mike Long 962-5723).

Also refer to the UNC Design and Construction Guidelines for further information including Chapter IV – Supplemental Guidelines – Section B – Hazardous Material Guidelines – Sub-Section 2 – EHS General Procedures for Paint Film Stabilization.

3.09 DEMOLITION OF SELECT WALLS, CEILINGS AND FLOORS

The contractor shall demolish walls, ceilings, floors and other barriers as necessary to obtain access to sewer piping and fume hood ducts. Demolition of lead-containing materials shall adhere to the Lead in Construction Standard 29 CFR 1926.62 as listed in Section 3, 3.08 - Removal and Disposal of Components Painted With Lead-Containing Paint or Surface Coatings. Demolished materials shall be recycled as applicable. The contractor shall coordinate disposal of material with the appropriate pre-qualified waste disposal contractor listed in Section 1, 1.14 - Hazardous and Universal Waste Disposal. The cutting of walls, floors and ceilings shall be completed in a manner so as to not endanger the stability of any part of the structure. The contractor shall not, in any case, cut or alter the work of another contractor without the approval of, and under the direction of, the designer. The Superintendent of the Contractor shall supervise all repairs resulting from cutting, as necessary.

Wall, ceiling, floor and roof cuts shall be completed neat, straight and square to accommodate future patching and/or repair. Cuts should run in horizontal and vertical directions. No main structural members shall be cut or disturbed without prior authorization by the UNC Engineering Department and the designer.

Plastic sheet barriers shall be installed on the doors of each room where work will be completed to limit the migration of dust. Rigid barriers shall be installed for projects exceeding 3 days. The contractor shall clean work areas using appropriate methods following demolition. The work areas should be clean and free of debris and dust following cleaning activities. The barriers shall be removed when demolition and clean-up is complete.

Refer to the UNC Design and Construction Guidelines for further information including Chapter V - Technical Design and Performance Standards – Division I, General Requirements – Section 01045 – Cutting and Patching and Section 01060 – Regulatory Requirements. Also refer to the AIA Specifications included in Section III – AIA Specifications - Section 01731 – Cutting and Patching and Section 01732 – Selective Demolition for additional information.

3.10 DECONTAMINATION, DISMANTLING AND DISPOSAL OF FUME HOODS AND FUME HOOD EXHAUST PIPING
The contractor will decontaminate, dismantle and dispose of the fume hoods, fume hood cabinets and fume hood exhaust piping/duct work including exhaust fans. UNC does not have reliable data as to the type and concentrations of chemicals used in the fume hoods. Thus, the contractor should use extreme caution during decontamination and dismantling operations. During demolition, it is possible that additional and/or auxiliary fume hood exhaust lines may be encountered. These lines should also be decontaminated, dismantled and disposed as identified in this section.

3.10.1 Disconnection and Termination of Fume Hood Electrical Connections

Electrical connections to the fume hoods and exhaust systems shall be powered down and disconnected according to federal, state and local codes, regulations and statutes. The contractor should follow appropriate lockout/tagout procedures. The power for this equipment shall be terminated at the main power panel utilizing breakers. The electrical wires shall be capped, taped and labeled appropriately.

3.10.2 Sampling of Fume Hoods and Fume Hood Exhaust Systems

The contractor shall test the fume hoods and exhaust system for perchlorates (perchloric acids), peroxides/oxidizers, acids, metals, salts and other substances that may impact the fume hoods and exhaust systems sensitivity to impact, shock or temperature during demolition. The contractor shall conduct the appropriate testing as required by federal, state and local regulations, statutes and guidelines and to the extent necessary, for the contractor to protect the workers. At a minimum, the contractor will complete rinsate testing in the fume hoods, ducts and the exhaust systems using methylene blue to identify the presence or absence of perchlorate. The contractor shall also complete, at a minimum, testing in the fume hood, ducts and the exhaust systems for the presence or absence of peroxides and oxidizers utilizing peroxide test strips. Samples should be obtained from the lowest points in the ductwork where hot perchloric acid vapors are most likely to have crystallized. If a test is positive for the presence of one of these materials, the contractor will complete additional testing to quantify the amount and types of material that are present using the quantitative procedure developed by Brookhaven National Laboratory (Brookhaven National Laboratory, Safety & Health Services Division, Industrial Hygiene Group, Perchloric Acid Sampling and Analysis Procedure, No. IH75200, September 28, 2001.). The results of the tests will be documented by the contractor (refer to Section 1, 1.16 - Project Testing Summary Reports).

3.10.3 Decontamination and Dismantling of Fume Hoods and Fume Hood Exhaust Systems

The contractor will complete dismantling of the fume hoods and duct and exhaust systems utilizing methods appropriate for the materials identified during testing. The contractor shall minimize impact, shock and high temperatures during dismantling of the fume hoods, ducts and exhaust systems.

Fume hoods and duct and exhaust systems which contain elevated levels of chemical compounds shall be decontaminated. The contractor shall implement a decontamination plan to address multiple compounds. Absorbents, buffering compounds, neutralizing agents and or solvents or other items may be used at the contractor’s discretion for the decontamination procedure along with atomizers, sprayers, washers and wipes. Hazardous waste created during decontamination shall be appropriately contained. The contractor shall coordinate disposal of material with the appropriate pre-qualified waste disposal contractor listed in Section 1, 1.14 - Hazardous and Universal Waste Disposal.

3.10.4 Disposal of Fume Hoods and Fume Hood Exhaust Systems

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Materials shall be recycled as applicable. The contractor shall coordinate disposal of material with the appropriate pre-qualified waste disposal contractor listed in Section 1, 1.14 - Hazardous and Universal Waste Disposal.

3.11 COMRESSOR OILS

The contractor will drain and contain compressor oils. The contractor shall coordinate disposal of the compressor oils with the appropriate pre-qualified waste disposal contractor listed in Section 1, 1.14 - Hazardous and Universal Waste Disposal.

Refer to American Institute of Architects (AIA) Specifications included in Section III – AIA Specifications - Section 011110 – Summary of Work, Section 01733 – Demolition and Construction and Section 01770 – Close Out Procedures for additional information.

3.12 MISCELLANEOUS CHEMICALS

Chemicals identified during this work should be handled as hazardous waste and contained and packaged in approved UN waste containers. Some examples may include cylinders, bottles, containers with unidentifiable liquids, spill clean-up residue, etc. The contractor should immediately contact UNC-EHS when a miscellaneous chemical is discovered.

The contractor shall coordinate disposal of the materials with the appropriate pre-qualified waste disposal contractor listed in Section 1, 1.14 - Hazardous and Universal Waste Disposal.

APPENDIX I – ACRONYMS

ACGIH = American Conference of Governmental Industrial Hygienists
ACM = Asbestos-Containing Materials
AHERA = Asbestos Hazard Emergency Response Act
AIA = American Institute of Architects
AIHA = American Industrial Hygiene Association
ANSI = American National Standards Institute
ASAL = Air Survey Action Level
ATSDR = Agency for Toxic Substances and Disease Registry
BZ = Breathing Zone
CDC = Center for Disease Control and Prevention
DOT = Department of Transportation
EHSM = Environmental Health and Safety Manager
EPA = Environmental Protection Agency
GFCI = Ground Fault Circuit Interrupter
HEPA = High Efficiency Particulate Air
HHCU = Health Hazards Control Unit
HVAC = Heating, Ventilation, and Air Conditioning
IEEE = Institute of Electrical and Electronic Engineers
LDR = Land Disposal Restrictions
MSDS = Material Safety Data Sheet
MSHA = Mine Safety and Health Administration
NC DEHNR = NC Department of Environment, Health and Natural Resources
NC DHHS = NC Department of Health and Human Services
NEC = National Electric Code
NEMA = National Electrical Manufacturers’ Association
NESHAP = National Emission Standard for Hazardous Air Pollutants
NFPA = National Fire Protection Association
NIOSH = National Institute for Occupational Safety and Health
NSF = National Science Foundation
OSHA = Occupational Safety and Health Administration
OSHANC = Occupational Safety and Health Act of North Carolina
OWRR = Office of Waste Reduction and Recycling
PAPR = Powered Air Purifying Respirators
PCM = Phase Contrast Microscopy
PDCL = Post Decontamination Air Clearance Level
PEL = Permissible Exposure Limit
PPE = Personal Protective Equipment
RCRA = Resource Conversation and Recovery Act
SAM = Supervising Air Monitor
SWMP = Solid Waste Management Plan
TCLP = Toxicity Characteristic Leaching Procedure
TEM = Transmission Electron Microscopy
TLV = Threshold Limit Value
TSDF = Treatment, Storage, and Disposal Facilities
TWA = Time Weighted Average
UL = Underwriters’ Laboratories
UNC-EHS = University of North Carolina Environment, Health, and Safety
A-33 - Construction Site Spill Prevention Control and Countermeasure (SPCC) Plan Guidelines

Management of all fuel or oil in containers 55 gallons or greater in size shall be conducted in accordance with the Spill Prevention Control and Countermeasure (SPCC) requirements of the Code of Federal Regulations, Title 40, Part 112 (40 CFR 112). These containers of fuel and oil are also subject to the requirements of the UNC SPCC Plan.

General Requirements

- All containers shall be in good shape without significant rusting, pitting, or other evidence of deterioration or damage.
- Berms and/or other barriers shall be used to protect stored fuel and oil containers from damage due to construction activities.
- Adequate secondary containment shall be provided for all containers.
- Containers of fuel and oil shall be located on level and stable ground and not in close proximity to storm sewer inlets.
- Facility lighting shall be sufficient to discover discharges occurring during the hours of darkness and to prevent discharges from occurring through acts of vandalism.
- Fuel and oil delivery and transfer procedures shall be in accordance with the Fuel Transfer Procedures as referenced in the UNC SPCC Plan.
- Signage shall be provided to warn facility personnel of above-ground piping and/or fuel transfer operations.

All fuel and oil tanks shall comply with the following:

- Tanks shall be double walled with at least 110% secondary containment of the primary tank volume.
- Tanks shall be equipped with a direct vision gauge that clearly indicates the liquid level within the primary tank.
- Tanks shall be equipped with overfill prevention equipment consisting of either a high liquid level alarm or high liquid level flow cutoff device set at 95% of the primary tank volume.
- Tank openings shall be securely capped and/or locked when not in use.
- Motor control for fuel dispensing shall be locked in the off position, except when fueling is being conducted and will only be accessible to authorized personnel.
- A method to gauge the interstitial space between the primary and secondary tank walls using an automatic detection device with audible alarm or manual gauging using a probe device shall be available.
- A spill kit with sufficient sorbent, booms, and other cleanup materials shall be located in close proximity to each fuel tank or drum. The spill kits shall be sized to prevent all potential discharges related to the fuel tank or fuel loading activities from reaching storm sewer inlets.

Weekly inspections shall be conducted to inspect containers of fuel and oil that are 55 gallons or greater in size for signs of damage, deterioration, and oil discharges. Deficiencies shall be promptly remedied. Inspections shall be documented in writing, and records of the inspections shall be available.
for review by UNC personnel.

Additional SPCC requirements are contained in 40 CFR 112 and the UNC SPCC Plan. The UNC Department of Environment, Health & Safety can be contacted for more information on the UNC SPCC Plan at 919-962-5507.
B-01 – GENERAL SITE REQUIREMENTS

Site Limits
The Designer shall establish the limits of the construction site in coordination with the University. The Designer should indicate these limits on the design development drawings. Design development drawings should show the location of any site fences, staging areas, tree protection measures, construction access, material storage areas and parking required by the project.

Construction Fencing
The construction area should be enclosed by a six-foot-high (minimum) chain link fence with top rail and screening to obscure construction activities from view. At completion of the project, the Contractor must remove the construction fence completely, including all portions of belowground footings. Fence posts must be removed, not sawn-off flush with the soil line.

Construction Staging Areas
Construction staging should be planned in the Design Development phase of the project and included in the Design Development submittal. Construction staging plans shall be developed in consultation with the following:

i. All Construction activity including contractor parking should be confined in the construction staging area. No parking, staging or storage of materials is permitted in the landscape outside of the construction staging area.

ii. Transportation and Parking Department regulates traffic circulation, and construction parking; pedestrians walkways are coordinated with both Transportation and Facilities Planning & Design.

iii. Office of Waste Reduction and Recycling – regarding maintaining trash/recycling services to ALL buildings in or around the construction area throughout the construction process (see OWRR design guideline webpage on Maintaining Services during Construction: Office of Waste Reduction & Recycling Guidelines.

iv. Grounds Services regarding tree protection.

v. The Disabilities Advisory Design Review Sub-Committee and regarding measures to be incorporated to insure safe travel of pedestrians and vehicles during construction. These measures shall be indicated on the Pedestrian Safety Plan that will be part of the final bid documents for the project.

vi. Environment Health and Safety Fire Marshall regarding potential conflicts with fire lanes. If construction staging is located on an existing parking lot, the project shall pay Transportation for the temporary use of these spaces and restoration after construction.

vii. Environmental Health and Safety regarding erosion control plan.

viii. Off-site trailer storage/areas The Public Safety Department may be contacted for locating an off-site construction storage trailer.

ix. Construction staging areas and construction sites need to include protection of existing utilities and access to surface features as needed for maintenance, fire protection, and meter reading.
**Pesticides and Chemical Fertilizers**
The UNC-CH Grounds Department employs an integrated pest management program for controlling insect pests and weeds. The Designer should consult the Grounds Department before using any chemical means of pest control. Organic soil amendments are preferred over chemical fertilizers.

**Termite Control**
Termite control should be accomplished by use of borax traps and non-wood building materials.
B-02 - SURVEYING

B-02.1 – GENERAL SURVEY GUIDELINES

The Designer shall confer with the University’s Project Manager, the future occupants, and the owner representatives at the beginning of the schematic design phase to review the program and establish the project requirements.

Existing Conditions
The University attempts to provide accurate, as-built drawings for the use of the Designer. However, due to the age of many of the University’s buildings and the many renovations some buildings have endured, as-built drawings are not always available. It is the responsibility of the Designer to notify the Project Manager when any information regarding the existing conditions of a project is inaccurate or inadequate.

Site Utilities Information
Additional information is available on the conditions of existing structures, maintenance items that need to be addressed, and hazardous materials in existing structures. This information should not be considered complete or accurate.

The Designer is responsible to review record documents of existing facilities to determine all utility and subsurface tie-ins to adjacent buildings, or building being renovated, including storm and foundation drains, and to determine all utilities located within the project limits, including areas impacted by work of the project.

Project impact limits include improvements may be off the main project site, but are part of the project, such as utility extensions, driveways, and roadways.

Site and Existing Conditions Information
The Designer should contact Engineering Information Systems and Energy Services to obtain latest information for construction. They will furnish utility drawings and record drawings for remodeling projects. The University cannot warrant the accuracy of this information.

Given the complexity of the utility infrastructure and the importance of the landscape on UNC-Chapel Hill’s three campuses, it is critical that a surface and sub-surface feature conditions survey be completed by the schematic design phase. Review of the surface and sub-surface features survey by all University utilities is also critical.
B-02.2 - SITE SURVEY

Scope of Site Survey
Perform field location surveys of utilities installed during the construction phase. The following outline lists the utilities to be located and the data to be collected. Conventional survey standards are to be utilized during the collection of field data. A mylar copy and digital file of the location surveys are to be provided in AutoCAD 2000 or later format and a DXF file. The surveys will also require an ESRI Shapefile (shp,shx,dbf,xml) file to include the current Metadata Minimum Standards developed by the UNC-CH Engineering Information Services, GIS Team. Prior to awarding of contract, contact Katherine O’Brien at 919-843-1872 or kobrien@fac.unc.edu for the current Metadata requirements.

All locations performed will be tied to the University of North Carolina Campus Control Network, North Carolina State Plane Coordinate System NAD83 (2011), horizontal and NAVD88, vertical. For a map of Campus Control Points contact UNC’s Campus Surveyor at 919-962-3039 or see https://maps.unc.edu/pdf/

A minimum of two (2) survey control points of semi-permanent material such as rebar or iron pipe oriented to this system shall be established at the project location. The bearing and distance from at least one of the project control points to the UNC-CH Control Monuments used shall be labeled.

Utilities
The Construction firm in charge will provide a surveyor on site to locate all newly installed underground utilities to be delivered with the final construction documentation.

1. Steam Tunnel and Lines
   a. Location and elevations of the tunnel slab, top of the cap, condensation lines and manholes.
   b. Location, size and change in elevations on the steam and condensation pipes in the tunnel.
   c. List the construction material for the tunnels.
   d. Elevations are to be within a tenth of a foot (0.10’)

2. Water Lines (Domestic, Chilled & Hot Water other than OWASA mains)
   a. Locations, size and elevations at the top installed water lines.
   b. Locations of valves and a valve type designation.
   c. Elevations are to be within a tenth of a foot (0.10’)

3. Electric and Communication Duct Banks
   a. Location and elevation of the duct bank top and bottom.
   b. Location and elevations of conduit runs in the duct bank.
   c. Elevations are to be within a tenth of a foot (0.10’)

4. Storm Sewer
   a. Locate manholes rims or inlets with invert elevations to a hundredth of a foot (0.01’).
   b. Note if manhole rims are in the center of the structure or measure the offset, pipe sizes, material types and the direction of the flow.

5. Sanitary Sewer
   a. Locations and elevations of manholes with inverts of all pipes entering and leaving the structure.
   b. Elevations are to be within a tenth of a foot (0.10’).
6. **Existing Utilities**
   a. Locate any existing utilities exposed during excavation of trenches for new utilities. Provide the locations and elevations of these utilities along with a digital photograph of the crossing.
   
b. Elevations are to be within a tenth of a foot (0.10’)

7. **Safety Issues**
   Safety is UNC’s number one priority on the job site. On sites with current construction activity, Surveyors must sign in with the Construction Superintendent. The Surveyors are required to wear safety glasses, hard hats and orange vests at all times on a construction job site. The Construction Superintendent will direct all locations being performed in or near open trenches and structures.

8. **Deliverables**
   a. The subsurface location surveys data and platting will be continuous throughout the project. All data and plats are due to UNC-CH within two-weeks of the backfilling of utilities or completion of a construction task.
   
b. The surveys shall be delivered in a DWG electronic format and a PDF format.

**Delivery Format**
A final site survey of newly constructed surface and sub-surface features to include but not limited to hardscape and landscape will be submitted before the project is finalized. Drawing is to include a survey report as outlined in [http://www.maps.unc.edu](http://www.maps.unc.edu) The survey shall include where newly constructed features tie into existing features.
B-02.2 - SURFACE LOCATION AND TOPOGRAPHIC SURVEY STANDARDS

General Requirements

1. The plat or map of such survey shall bear the name, address, telephone number, and signature of the professional land surveyor who made the survey, his or her official seal and registration number, the date the survey was completed and the dates of all revisions.

2. The survey shall be drawn to a convenient scale, with that scale clearly indicated. A graphic scale, shown in feet, shall be included. A north arrow shall be shown. Symbols or abbreviations used shall be identified on the face of the plat or map by use of a legend or other means. If necessary for clarity, supplementary or exaggerated diagrams shall be presented accurately on the plat or map. The plat or map shall be a minimum size of 11 by 17 inches. The Surveyor will provide UNC-Chapel Hill with a sealed mylar copy and digital file of the location surveys in AutoCAD 2000 or later format and a DXF file. The surveys will also require an ESRI Shapefile (shp, shx, dbf, xml) file to include the current Metadata Minimum Standards developed by the UNC-Chapel Hill Engineering Information Services, GIS Team. Prior to awarding of contract, contact Katherine O’Brien at 919-843-1872 or kobrien@fac.unc.edu for the current Metadata requirements.

3. All locations performed will be tied to the University of North Carolina Campus Control Network, North Carolina State Plane Coordinate System NAD83 (2011), horizontal and NAVD88, vertical. For a map of Campus Control Points contact UNC’s Campus Surveyor at 919-962-3039 or see https://maps.unc.edu/pdf/. A minimum of two (2) survey control points of semipermanent material such as rebar or iron pipe oriented to this system shall be established at the project location. The bearing and distance from at least one of the project control points to the UNC-CH Control Monuments used shall be labeled.

4. Measured and record distances from corners of parcels surveyed to the nearest right-of-way lines of streets, together with recovered lot corners and evidence of lot corners, shall be noted. The distances to the nearest intersecting street shall be indicated and verified. Names and widths of streets and highways abutting the property surveyed and widths of rights of way shall be given.

5. The identifying titles of all recorded plats, filed maps, right of ways maps, or similar documents that the survey represents, wholly or in part, shall be shown with their appropriate recording data, map numbers, and the lot, block, and section numbers or letters of the surveyed premises. For non-platted adjoining land, names and recording data identifying adjoining owners as they appear of record shall be shown. For platted adjoining land, the recording data of the subdivision plat shall be shown. The survey shall indicate platted setback or building restriction lines which have been recorded in subdivision plats or which appear in a Record Document.

6. All evidence of monuments shall be shown and noted to indicate which were found and which were placed.

7. The location of all buildings upon the lot or parcel shall be shown and their locations defined by measurements perpendicular to the boundaries. If there are no buildings erected on the property being surveyed, the plat or map shall bear the statement, “No buildings.” Proper street numbers shall be
shown where available. Show the exterior dimensions of all buildings at ground level and square footage of the exterior footprint of all buildings at ground level.

8. Easements of record shall be shown, both those burdening and those benefiting the property surveyed, indicating recording information. If such an easement cannot be located, a note to this effect shall be included. Observable evidence of easements and/or servitudes of all kinds, such as those created by roads; rights-of-way; water courses; drains; telephone, telegraph, or electric lines; water, sewer, oil or gas pipelines on or across the surveyed property and on adjoining properties if they appear to affect the surveyed property, shall be located and noted. If the surveyor has knowledge of any such easements and/or servitudes, not observable at the time the present survey is made; such lack of observable evidence shall be noted. Surface indications, if any, of underground easements and/or servitudes shall also be shown.

9. The character and location of all walls, buildings, fences, and other visible improvements within five feet of each side of the boundary lines shall be noted.

10. Driveways and alleys on or crossing the property must be shown. Where there is evidence of use by other than the occupants of the property, the surveyor must so indicate on the plat or map. Where driveways or alleys on adjoining properties encroach, in whole or in part, on the property being surveyed, the surveyor must so indicate on the plat or map with appropriate measurements.

11. As accurately as the evidence permits, the location of cemeteries and burial grounds disclosed in the process of researching title to the premises or observed in the process of performing the field work for the survey, shall be shown.

12. Ponds, lakes, springs, or rivers bordering on or running through the premises being surveyed shall be shown.

13. Vicinity map showing the property surveyed in reference to nearby highway(s) or major street intersection(s).

14. Flood zone designation with proper annotation based on Federal Flood Insurance Rate Maps or the state or local equivalent, by scaled map location and graphic plotting only.

15. Parking areas and, if striped, the striping and the type (e.g. handicapped, motorcycle, regular, etc.) and number of parking spaces. Indication of access to a public way such as curb cuts and driveways.

16. Location of utilities existing on or serving the surveyed property as determined by: Observed evidence, observed evidence together with plans and markings provided by client, utility companies, and other appropriate sources (with reference as to the source of information), railroad tracks and sidings, manholes, catch basins, valve vaults or other surface indications of subterranean uses, wires and cables (including their function) crossing the surveyed premises, all poles on or within ten feet of the surveyed premises, and the dimensions of overhangs affecting the surveyed premises.

17. Locate/note observable evidence of the site being use as a solid waste dump, sump or sanitary landfill.
18. Elevations for manholes rims, inlets, inverts, curb & gutter and pavement elevations will be to a hundredth of a foot (0.01'). Spot elevation will be at 25' intervals on curb/gutter and pavement.

19. Elevations for ground shots, water lines, steam lines, and duct banks will be to a tenth of a foot (0.10'). Spot elevation will be at 50' intervals for ground shots.

20. For contours, the error shall not exceed one-half contour interval.

Safety Issues

Safety is UNC’s number one priority on the job site. On sites with current construction activity, Surveyors must sign in with the Construction Superintendent. The Surveyors are required to wear safety glasses, hard hats and orange vests at all times on a construction job site. The Construction Superintendent will direct all locations being performed in or near open trenches and structures.

Delivery Format

A final site survey of newly constructed surface and sub-surface features to include but not limited to hardscape and landscape will be submitted before the project is finalized. Drawing is to include a survey report as outlined in http://www.maps.unc.edu The survey shall include where newly constructed features tie into existing features.
B-02.3 - DESIGN AND CONSTRUCTION SURVEYING/GIS GUIDELINES

General
Layer definitions will adhere to National CAD standards for layers collected in the survey.

Survey Datum
All surveys will be tied to the North Carolina State Plane Coordinate System NAD 83 survey feet with the vertical datum of NAVD 88.

Planning & Design Phase
A site survey of surface and sub-surface features tied to the North Carolina State Plane Coordinate System NAD 83 survey feet with the vertical datum of NAVD 88 will be submitted no more than one week after the site survey has been delivered to the project design firm. The site survey shall be delivered in a DWG electronic format. Layer definitions will adhere to National CAD standards for layers collected in the survey. The electronic documents will be delivered to Facilities Services as directed.

Bid Phase
Overall site plan drawings of surface and sub-surface features, rendered in North Carolina State Plane Coordinate System NAD 83 survey feet with the vertical datum of NAVD 88, will be submitted no more than two weeks after awarding the project to a contractor. If appropriate the demo plan is to be included. The site plan shall be delivered in a DWG electronic format. Layer definitions will adhere to National CAD standards.

Separate from the site plan drawing, submit a drawing file that shows and contains only newly designed features.

The electronic documents will be delivered to Facilities Planning and Construction as directed.

During Construction
The Construction firm in charge will provide a surveyor on site to locate all newly installed underground utilities to be delivered with the final construction documentation. All locations performed will be tied to the North Carolina State Plane Coordinate System NAD 83 survey feet with the vertical datum of NAVD 88.

Final Construction Document
A final site survey of newly constructed surface and sub-surface features to include but not limited to hardscape and landscape tied to the North Carolina State Plane Coordinate System NAD 83 survey feet with the vertical datum of NAVD 88 will be submitted before the project is finalized. Drawing is to include a survey report as outlined in www.maps.unc.edu. The survey shall include where newly constructed features tie into existing features. The site survey shall be delivered in a DWG electronic format. Layer definitions will adhere to National CAD standards. The electronic documents will be delivered to Facilities Planning and Construction as directed. Separate from the final site plan drawing, submit a drawing file that shows and contains only newly constructed and installed features.
B-03 – Geotechnical & Subsurface Exploration

General Information
As part of the Designer’s services to the University, the Designer shall recommend a qualified, licensed geotechnical services firm that will provide all project required geotechnical information for the project. The geotechnical consultant shall contract directly with the University, but still be obligated to coordinate its services with the lead designer.

Procurement Process
Depending upon a specific project’s program, scope, and complexity, the University typically direct selects a geotechnical engineer, however the University may require the design team to engage for services.

In the event that a design team is required to procure a geotechnical engineer’s services, the following process shall be utilized:

1. Designer obtains proposal from a firm of the Designer’s choice.
2. Designer submits proposal to University’s Project Manager.
3. Project Manager obtains approval of proposal.
4. Designer schedules work. Designers (architect and engineers) must be on site to coordinate and verify information.
B-03 – EARTHWORK AND GRADING

Site Grading and Drainage
Grade the site, including paved areas, loading dock, service yards, and landscaped areas so that gravity runoff occurs at all points.

Slope all areas away from the building at a minimum gradient of $\frac{1}{4}"$ (2%) per foot for paved areas, 2.5% for unpaved areas. Grade all terrain surrounding the building, in such a manner to prevent water flow into the building.

Refer to Section B-27 -Stormwater Design Guidelines for storm drain and stormwater management design criteria and guidelines.
B-05 - EROSION AND SEDIMENTATION CONTROL - Guidelines for Construction Projects

**Required Permits/Approvals**

All projects one (1) acre or larger are required to submit an ESC plan to the NCDEQ Division of Energy, Mineral and Land Resources (DEMLR), Land Quality Section (LQS). The ESC plan must be reviewed by UNC Environment, Health and Safety before the plan is submitted to DEMLR. These projects will receive an NC General Permit 01000 for Construction Activities and must follow all permit conditions.

All projects greater than 0.8 acres will be scaled up to exceed one (1) acre and will require an ESC Permit.

All projects between 0.1 acres and 0.8 acres must submit a written ESC plan for approval to the UNC Department of Environment, Health and Safety.

Projects less than 0.1 acre (4,345 square feet) must include in the construction documents ESC and stormwater permit compliance measures that meet the specifications outlined in this document.

**References**

3. NC General Permit for Construction Activities, NCG01000 (Updated April 2019): The NC General Permit is issued upon approval of the ESC plan. The NC General Permit and ESC plan are related, but separate, and both must be followed. Section A is a compete checklist of required elements.
4. NCDEQ DEMLR Inspection and Monitoring Form: This 6-page inspection form is completed by the contractor and kept on site. Different sections are required to be filled out daily, weekly, after each 1.0-inch rain event, and/or at the beginning of each construction phase.
5. UNC Spill Prevention Control and Countermeasure (SPCC) Plan, Construction Site Guidelines
6. UNC National Pollutant Discharge Elimination System (NPDES) Permit

**Examples of Land-Disturbing Activities Requiring ESC Plan and/or Permit**

- Typical construction project
- Trenching for utility installation or removal
- Synthetic turf field replacement
- Building demolition
- Removing asphalt and/or concrete
- Grading gravel or dirt roads
- Outdoor staging area for an interior construction project
- Two or more unrelated projects if on same scope of work or same contract
- Other projects as required by UNC EHS

**Design Requirements and ESC Management**

Part II, Section A of the NC General Permit for Construction Activities NCG01 (updated April 2019) contains a complete checklist of items that must be included in the ESC plan. All grading, erosion and sedimentation control practices, and waterway crossings must meet the design criteria set forth in the most recent version of the NC DEQ Erosion and Sediment Control Planning and Design Manual (latest update May 2013). Additional requirements may be added by UNC EHS.
UNC-Specific ESC Measures
The following UNC requirements are either commonly overlooked during ESC plan development or are more stringent than required by the State.

1. Construction Limits (NCGO1, Part II, Section A #3 and Section B #2)
The entire project limit, including all phases added together, is used in determining the size of the project. Project limits must include:
   A. **Construction area.** A reasonable amount of room must be included for maneuvering equipment around the work areas.
   B. **Material storage locations.** Include all vehicle and equipment staging areas, whether located adjacent to the site or anywhere else on UNC property (e.g. Carolina North, Odum Village).
   C. **Access to ESC measures.**
   D. **Access roads and driveways.**
   E. **Utility work that may extend offsite.** This includes utility work completed by any entity (construction contractor, UNC, public utility, etc.) that will be performed as part of the project or because of the project during any phase.
   F. **Borrow and waste areas and soil stockpiles.**

2. Dewatering of Excavations
Rain and pipe breaks can cause excavated areas and low spots to require dewatering. Turbid (muddy) water from excavations must not be pumped directly to the storm drain system. The ESC Plan shall contain Details for a pump system and dirt/filtration bag or comparable filtration system for removing water from excavated areas. Dewatering discharge must be filtered and diffuse before entering the storm drain system.

3. Construction Entrance
Construction entrances must be designed and maintained to prevent sediment from tracking off-site. Soil tracked onto the road must be swept up using a dry method (e.g. no water trucks or hoses). Tire wash stations are recommended for high-traffic sites. Identify the flow direction of stormwater runoff from the site and do not allow turbid (muddy) runoff to enter storm drains or run down the road.

4. Temporary Cover and Surface Stabilization
   A. **Rolled erosion control products (RECP).** Rolled erosion control products (nets, blankets or mats) must be free of plastic or synthetic materials, even if labeled “biodegradable” or “photodegradable”. These products must be made with natural fibers, for example, jute, straw, sisal, cotton, or coir.
   B. **Seeding.** All seeding mixes must be approved by UNC Grounds and UNC EHS. All types of lespedeza are prohibited on campus. The use of straw may be prohibited in some locations, such as in conservation areas.

5. Inlet Protection
Provide several options for inlet protection, including drop-in sediment sacks, hardware wire and gravel, and curb gutter protection. Gravel can be a safety hazard and should not be used on public roads. Inlet protection may be indicated outside of the construction limits to protect storm drains from construction site runoff.
6. Silt Fence/Sediment Fence/Compost Socks
   A. Silt fence design must comply with state-approved design. Indicate silt fence outlets in areas with
      concentrated flow behind the fence. J-hooks can be used on steep slopes to direct flow to outlets.
      Outlets can be made from wattles or gravel and hardware wire.
   B. Compost socks can be used as alternative to silt fence when 6” or less of sediment accumulation is
      anticipated. Compost socks can be an effective alternative to silt fence on brick sidewalks.

7. Fuel and Oil Storage
   Fuel and oil containers 55 gallons or greater are required to be stored and inspected according to the UNC SPCC
   Plan. The SPCC includes requirements for providing secondary containment, conducting inspections, and
   providing spill kits, signage, and spill and overfill prevention.

8. Pressure- and Non-Pressure-Washing Operations
   A. Do not wash sediment or debris into storm drains, either on-site or on public roadways.
   B. If pressure washing or other cleaning operations are required, use only plain water.
   C. If soap (including biodegradable or “green” soap) or other chemicals must be used, block storm drains to
      prevent any water from entering the system and collect wastewater for disposal at an approved water
      treatment facility.
   D. Many projects use pressure washing that is not included in the initial scope, so plan ahead for
      unexpected project additions.
   E. Refer to the UNC guidelines for specific strategies in managing power washing runoff:
      https://stormwater.unc.edu/prevent-pollution/power-washing/

9. Trash/Litter/Spills
   Garbage is to be disposed of properly. Spills generated from equipment are to be cleaned up immediately.

10. Inspection of ESC Measures
   A. All sites 0.1 acres or larger are required to fill out inspection sheets for ESC measures weekly AND within
       24 hours of rain greater than 1.0 inches.
   B. Sites smaller than 0.1 acres are required to inspect ESC measures regularly but are not required to keep
      records of the inspections.
   C. A rain gauge must be kept on site. Write down daily rain amount, even when amount is “zero”.
   D. Inspection sheets are to be kept on site throughout the duration of the project.

11. The (ESC) Plan must include the following statements:
   A. “Contact UNC EHS at (919) 883-7163 or (919) 962-5507 to schedule and hold a pre-construction meeting
      before installation of ESC measures and again once ESC measures are in place.”
   B. “Erosion and sedimentation control devices must be installed prior to the start of clearing, demolition,
      grading, and/or construction.”
   C. “Any land clearing, construction, or development involving the movement of earth shall be in
      accordance with the approved ESC Plan and the superintendent in-charge or contractor shall be on site
      on all days when construction or grading activity takes place.”
B-06 - PAVEMENT

General
The cutting of chases, openings, or similar holes in walls, floors, and ceilings shall be done in a manner so as not to endanger the stability of any part of the structure. The Contractor shall not in any case cut or alter the work of any other contractor without the approval of—and under the direction of—the Designer. Flowable fill will be used as a standard unless noted otherwise to reduce settlement caused by lack of compaction.

Cutting and Patching Pavement
Prior to any pavement cut all necessary NCDOT, Town and UNC-DPS permits, and approvals must be acquired. Where any paving is cut for placing new utility lines, neatly cut the asphalt with straight edges, even if this requires enlarging the size of the trench and remove with an asphalt cutter. Breaking the asphalt out with a backhoe or other means is not acceptable. Place boards or other suitable material under the backhoe out rigging to prevent damage to the asphalt. Thoroughly compact the backfill placed in the opening and immediately replace the pavement after the opening is backfilled. In parking lots, replace pavement with a minimum of six (6) inches of coarse aggregate base course, followed by a minimum of 3 inches of Type I-1 asphalt.

On streets and on parking lot travel lanes which experience frequent transit bus traffic, compact sub-grade, and replace pavement with a minimum of five (5) inches of Type HB asphalt base, two (2) inches of Type H binder, and 2" of Type I-1 asphalt surface course. Where possible, compact each course of asphalt paving material with a steel-wheeled roller. Where patched areas are too small to allow rolling of the base courses, manually compact areas in a manner approved by the University Construction Manager.

Repair any minor settlement which occurs during the 12 months warranty period by removing all failed material and by re-compacting the sub-grade and patching as described above.

Street and Roadway Utility Repairs and Replacements
All utility repairs or replacements requiring cuts into roadways, driveways, or parking lots shall be coordinated with the Department of Public Safety in advance of the start of work. In repairing required cuts to complete utility repairs, contractors shall provide a subbase compaction rate standard of 95% as required by the State Department of Transportation. Testing shall be conducted to ensure that the appropriate compaction rate is met.
B-07 – ROADWAY, DRIVEWAY, and FIRE LANE DESIGN

B-07.1 - Roadways

General
- Main campus roads should have a cross section width of 48 feet and a speed limit of 30 MPH.
- Facility access roads should have a cross section width of 36 feet and a speed limit of 25 MPH.
- Service roads and driveways should have a cross section width of 24 feet and a speed limit of 20 MPH.

The following dimensional standards are recommended for all University-owned roadways and driveways:

<table>
<thead>
<tr>
<th>Roadway Type</th>
<th>Lane Width</th>
<th>Parking</th>
<th>Bicycle-ped Facilities</th>
<th>Operating Speed Limit (MPH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Campus Roads</td>
<td>11' (max); 10'-10.5' where no bus traffic</td>
<td>Parallel: 7’-8’ wide Perpendicular: 8’-9’ x 18’</td>
<td>Refer to UNC Bicycle Master Plan for facility type locations Bike lanes: 6’ of pavement (min) -8’ sidewalks on both sides of street</td>
<td>25 MPH 20 MPH Posted</td>
</tr>
<tr>
<td>Facility Access Roads</td>
<td>10'-10.5’ (max)</td>
<td>Parallel: 7’-8’ wide Perpendicular: 8’-9’ x 18’</td>
<td>Refer to UNC Bicycle Master Plan for facility type locations Bike lanes: 6’ of pavement (min)</td>
<td>20 MPH 15 MPH Posted</td>
</tr>
<tr>
<td>Service Roads and Driveways</td>
<td>10'-10.5’ (max)</td>
<td>Parallel: 7’-8’ wide Perpendicular: 8’-9’ x 18’</td>
<td>n/a</td>
<td>15 MPH 10 MPH</td>
</tr>
</tbody>
</table>
B-07.2 - Driveways

General
All driveways shall follow the design guidelines as set forth in the North Carolina Division of Highways (Engineering Guidelines) as found on the Web site: www.doh.dot.state.nc.us. However, due to the unique situations and circumstances on the UNC campus, it is expected that these guidelines may require modification from site to site based on the needs of the University and other safety considerations as determined by the UNC Department of Public Safety (Transportation Planner). All necessary driveway permits from the Town or DOT shall be the responsibility of the contractor. Also refer to:

Standards
All driveways shall follow the design guidelines as set forth in the North Carolina Division of Highways (Engineering Guidelines) as found on the Web site: www.ncdot.gov/doh. However, due to the unique situations and circumstances on the UNC campus, it is expected that these guidelines may require modification from site to site based on the needs of the University and other safety considerations as determined by the UNC Transportation & Parking (Transportation Planner). All necessary driveway permits from the Town or NCDOT shall be the responsibility of the contractor.

Also refer to: http://www.townofchapelhill.org/town-hall/departments-services/public-works/engineering/permits

Based on estimated vehicle trips, all campus driveways shall conform to the following standards except as modified in writing by the UNC Transportation Planner:

1. Traffic driveways shall be a minimum of 20' from curb to curb

2. The smallest practical actual curb radii should be chosen based on how the effective curb radius accommodates the design vehicle. An actual curb radius of 5 to 10 feet should be used wherever possible. An appropriate effective radius for urban streets with high volumes of pedestrians is 15 to 20 ft. For arterial streets with a substantial volume of turning buses and/or trucks, an appropriate effective curb radius is about 25 to 30 ft. Typically the maximum desired effective curb radius is 35 feet for large vehicles. Tighter turning radii are particularly important where streets intersect at a skew. Corners characterized by an acute angle may require a slightly larger radius to accommodate larger vehicles; corners with an obtuse angle should have the smallest feasible radius to prevent high-speed turns.

3. Concrete is preferred over asphalt for driveways and loading docks and areas that has frequent bus or heavy truck usage. Six inches minimum thickness of 6000-lb. reinforced concrete is required to accommodate heavy service and utility trucks. Sub-base compaction shall be at the DOT standard of 95%. Flowable fill may be used as filler when less adequate fill is not available. This standard compaction rate shall also apply to pavement patching and other roadway cuts.

4. Raised crosswalks or continuous sidewalks should be considered during the construction or reconstruction of streets or sidewalks:
   a. at entrances to alleys.
   b. on local streets, at the intersections of arterial or collector streets.
c. in the vicinity of multi-modal transit stations or other key civic locations.
d. in places where numerous pedestrians cross between two intersections.

Directional curb cuts and marked continental style crossings shall be provided at all other driveways. In all cases, sidewalk tapers and sidewalk curb cuts shall conform to all accessibility codes and standards.

5. Roadside or gutter drainage must be accounted for in driveway design. Drainage may not flow down into the driveway but must be retained on the roadway system to the nearest designed catch basin or out flow. Drainage inlets are preferred in grates.

6. Driveway intersection plans shall include the design and construction of the appropriate pavement markings and stencils, lane indicators, stop signs, yield signs, pedestrian crossing signs, pedestrian crossings, etc. as required by the UNC Transportation & Parking (Transportation Planner). The costs for such amenities shall be included in the project bid estimates and final construction contract documents.

7. All Town of Chapel Hill or Department of Transportation permits for driveways shall be the total responsibility of the contractor. Construction of driveways intersecting with public right-of-ways or other University roads and driving surfaces shall require a traffic control plan to assure the safety of other vehicles and pedestrians during the construction process.

8. Due to the high amount of pedestrian traffic, care should be taken to minimize the distance that drivers of waste handling vehicles (and others delivery and service vehicles) drive in reverse. Care should also be taken to avoid having service vehicles back across walkways or into Traffic.

Additional References
http://www.ncchpp.ca/docs/2017_BuiltEnvBati_Trottoirs_EN.pdf
B-07.3 - FIRE LANES AND ACCESS ROADS

General
Fire department access roads shall extend within 150 feet of all portions of the exterior walls of the first story of the building unless otherwise approved. Exceptions shall be made in accordance with Section 503.1.1 of the North Carolina Fire Prevention Code.

Standards
Installation of any gate or barricade placed in a fire lane or access road that reduces the size of the fire lane or access road below the minimums in II.B above must be approved by the University Fire Marshal.

Minimum horizontal clearance along a fire lane or access road shall be twenty feet.

Minimum vertical clearance along a fire lane or access road shall be thirteen feet and six inches.

Fire lanes and fire access roads must be able to support a minimum fire apparatus weight of 86,000 pounds.

Dead-end fire lanes in excess of 150 feet shall be provided with an approved area for turning around fire apparatus. This turning area shall be no less than 55 feet.

Signs
Signs shall be provided for fire lanes along or with direct access from a public street. Signs shall not be provided for designated fire lanes along pedestrian paths, where the designated fire lane is protected by a barricade as described in section II.C.

Signs shall be at least 12” x 18” in size, with text reading “NO PARKING – FIRE LANE”. These signs shall be placed at 50 foot intervals along the designated fire lane and at the designated turning area described in section II.F.

Pavement markings shall be provided at the access point of a designated fire lane or access road along a pedestrian path, where the designated fire lane is protected by a barricade as described in section II.C. Pavement markings will indicate “NO PARKING– FIRE LANE”, allowing for the entry of fire apparatus from the public right-of-way.

Fire lanes and access roads shall not be obstructed in any manner including the parking of vehicles. The minimum widths and clearances established in II shall be maintained at all times.
B-08 – PARKING STANDARDS

General
The Designer must review all changes to existing parking with UNC Transportation and Parking. Reduction in number of parking spaces on a building site due to project development must be compensated for by payment into the parking replacement fund. Current parking replacement fees are $20,000 per space. These fees will be charged to the project budget.

Parking lots shall be designed to accommodate heavy trucks when trash and recycling containers are located within the lot.

Existing trees should be preserved to the greatest extent possible. Large parking areas should be visually separated into smaller modules.

New construction of and modifications to existing parking shall adhere to current ADA requirements provided by the United States Access Board regarding total number and dimensions of ADA spaces.

Parking Types
Motorcycle/Scooter replacement fees are $10,000 per space. These fees will be charged to the project budget. Parking lots shall be designed to accommodate heavy trucks when trash and recycling containers are located within the lot. Existing trees should be preserved to the greatest extent possible. Large parking areas should be visually separated into smaller modules.

Electric Vehicle (EV) conduit shall be installed with construction of or modification to existing parking facilities in coordination with UNC Transportation & Parking. A minimum of one networked “Chargepoint EV” charging station shall be installed at new publicly accessible parking facilities. UNC Transportation & Parking will assume maintenance upon installation.

Loading and unloading access shall be included in all new construction.

Design & Planning Process
Planning of any utility projects shall be coordinated with UNC campus road and/or parking facility resurfacing. Should a construction project conduct work in a newly paved UNC maintained road or parking lot, the following fees in accordance with Town of Chapel Hill streets fee schedule shall apply:

Fee Assessments:
   a.  $120 per square yard for each of the first ten square yards
   b.  $50 per square yard for each subsequent square yard
   c.  $30 per square yard for work on gravel roads and/or borings/jackings (open trench/pit area) and/or other work outside the roadway, but within the right-of-way

*These fees are doubled if the street has been resurfaced within the previous two years or increased one-and one-half times if the street has been resurfaced within two plus to five years. In addition, on major
For projects for which the road is severely impacted, especially streets recently resurfaced, the Town may require restoration to include street milling and a complete overlay. Fees may be waived when milling and/or a complete overlay are required.

Penalties:

d. $150 for failure to obtain a permit prior to starting the project (not applicable for emergency street cuts).

e. $150 for failure to repair initial street cut within thirty calendar days.

f. $150 for failure to undertake warranty repair within fourteen calendar days.

The University requires a 5-year warranty on all cuts and restoration work performed by the utility company or private contractor.

Additional sub-base and pavement restoration work required (beyond the area of trench repair) as a result of a major failure (i.e., water line main break) will be billed at the stated square yard rates above, or $625 (whichever is the lesser of the two amounts).

The above fees shall be added to the project budget and paid to the parking and/or street maintenance fund.
B-09 – Pedestrian Safety & Traffic Control Plan

Pedestrian Safety Plan
The pedestrian safety plan should address, but not be limited to:
1. the location of sidewalks in relation to crosswalks on streets
2. the impact of the construction on pedestrian traffic patterns

The Designer will develop this plan in consultation with the University’s Project Manager & Construction Manager, the UNC-CH Department of Public Safety, and UNC Disability Services, refer to their website: [http://www.dps.unc.edu/Transit/aroundcampus/pedestrianinfo/pedestrianinfo.cfm](http://www.dps.unc.edu/Transit/aroundcampus/pedestrianinfo/pedestrianinfo.cfm)

These departments will review the plan and approve it or make recommendations for improvement. The Pedestrian Safety Plan is included in the bid documents and must address the following:

1. **Limits of construction**
   A. Staging areas
   B. Entrance to construction site/staging areas
   C. Vehicular circulation to and through site

2. **Pedestrian routes around construction site**
   A. Accessible routes
   B. Disability parking location

3. **Building entrances**
   A. Key building entrances and service areas to be maintained
   B. Accessible building entrances

4. **Resolution of pedestrian/construction traffic conflicts**

5. **Signage plan (prepared by Designer, coordinated with University’s Project Manager)**
   A. Proposed pedestrian signage
   B. Designated pedestrian routes
   C. Signage locations

6. **Details of proposed pedestrian safety improvements**
   A. Temporary sidewalks, ramps, etc.

7. **Phasing**
   A. Separate plans indicating construction phasing and schedule

8. **Public advertisement (by user and UNC)**
   A. Appropriate public advertising of the pedestrian plan

9. **Written approvals (UNC-CH, University’s Project Manager’s responsibility)**
   A. Facilities Planning (University’s Project Manager and staff)
B. Construction Administration (University’s Project Manager)
C. Public Safety (Transportation Planning and Parking)
D. Disabilities Advisory Committee
E. User

Traffic Control Plan
All construction activity impacting roadways (vehicular access), sidewalks (pedestrian access), and cycling facilities (bike lanes, side paths) shall have a written traffic control plan (TCP) and access plan submitted for review and comment by UNC Transportation and Parking prior to the completion of the final construction and bid documents. For Town of Chapel Hill and North Carolina State Department of Transportation (NCDOT) maintained roads, the TCP shall also require approval from the Town of Chapel Hill’s Traffic Engineering Department or the NCDOT. Traffic Control Plans must be included in the project bid documents. The Town of Chapel Hill will monitor adherence to the approved TCP.

The responsibility and implementation costs for any required Traffic Control Plans (TCP) required before, during, or after the project construction activity, shall be the responsibility of the contractor. These costs shall include all labor and equipment necessary to meet the requirements of the TCP including all reimbursement costs to UNC Transportation & Parking and/or UNC Police for special traffic direction, construction parking enforcement, or other personnel utilized to provide and assure the safety of UNC-CH during the construction.

The TCP shall follow the standards found in the Manual for Uniform Traffic Control Devices (MUTCD) issued by the Federal Highway Administration (FHWA) except as modified by the Town of Chapel Hill Traffic Engineering Office or UNC Transportation and Parking (Transportation Planner).
B-20 – SITE UTILITIES INTRODUCTION

Site Utilities
All campus electrical, steam, chilled water, storm drainage and non-potable water systems are owned and operated by UNC Energy Services. The Communications Technology office of UNC’s Information Technology Services is responsible for telephone and computer network connections. Water (potable and reclaimed) and sanitary sewer mains on campus are owned and maintained by the Orange Water and Sewer Authority (OWASA: www.owasa.org), with some segments of the mains owned by the University. Water (potable and non-potable) and sanitary sewer laterals are owned by the University. Gas is provided by PSNC Energy and all gas mains are owned by PSNC Energy. The University generates its own steam at its Cogeneration Facility on West Cameron Avenue. The University generates electricity at the Cogeneration Plant and purchases electricity from Duke Energy Company distributed through the University’s three substations and distribution system. Chilled water is produced at several Chilled Water plants and distributed across campus.

Obtaining site utility information: UNC Facilities Planning or Energy Services will provide the Designer with existing site utility information for construction and renovation projects. This information is schematic only. The Designer is responsible for obtaining more detailed and accurate information required for the project. The Designer should engage a utility locating service during design development or the early construction document phase and work closely with the utility locating service and the owner of each utility, including the University utilities operating groups to ensure all utilities are located accurately on the drawings used for the design of the building. The designer is also responsible for reviewing existing record drawings for prior work in area of project to determine location of existing utilities, including building subsurface utility connections, supplies and storm and foundation drainage connections. UNC Electric Distribution Systems coordinates all underground utility locating for Energy Services utilities; contact them at 919-962-8394 to schedule the locates. Locates for public utilities can be requested through NC One Call at 800-632-4949.

Contracting utility locating services: At the Designer’s request, the University’s Project Manager will send a letter asking the Designer to hire a utility locator. The Designer together with engineering consultants will outline the required scope of this work.

Utility Kick-off Meeting: UNC-CH utility personnel and Designers will meet in the initial phases of the design process to identify utility issues. Representatives from all campus utilities (steam, chilled water, electric distribution, telecommunications, water, wastewater, and stormwater) as well as OWASA (if required) and PSNC (if required) will attend the meeting. Additionally, a representative of the UNC-CH Public Safety Department will attend regarding issues of road closings and construction scheduling.
Coordination with UNC utility providers:
The Designer is responsible for coordinating with UNC utility providers. Click the links below for more information:

a. Electrical Distribution

b. Communications Infrastructure Guidelines

c. Steam Distribution Guidelines

d. Chilled Water Design Guidelines

e. Stormwater Guidelines

f. Water & Wastewater

g. Non-Potable Water Guidelines

h. Utility System Master Plans: contact Energy Services for more information. http://www.energy.unc.edu/

   c. Water & Sewer Master Plan, October 2002, and Critical Facilities Plan
   d. Stormwater Capital Improvement Plan, Fall 2010

Coordination with off-campus utility providers:
The Designer is responsible for coordinating with utility providers (including OWASA, PSNG and any others) and Energy Services. Tasks include:

a. Obtaining and using OWASA’s design guidelines at:
   (http://www.owasa.org/client_resources/whatwedo/spec/table%20of%20contents%202011%20pdf%207-18-2012%20reduced.pdf) for all design work involving water and/or sewer connections; main replacements and/or extensions; and any work in the area of OWASA water and sewer mains, and coordinating with additional University requirements.

b. Scheduling a meeting with UNC Energy Services Water, Wastewater and Stormwater and OWASA officials early in the design process to identify issues related to water, reclaimed water, sewer and fire protection

c. Note: If sprinklers are being added to the building, a fire flow test will be necessary. To obtain a fire flow test, contact OWASA. Added sprinklers will require a RPZ.

d. Note: RPZ will require above grade installation. The University standard is to install inside building on an exterior wall to discharge above grade.

e. Note: All food handling facilities will need to meet OWASA grease interceptor requirements, including coffee bars and coffee shops.
f. The Designer is responsible for ascertaining that the capacity of the water, non-potable, and sewer system is sufficient for the intended use.

g. The Designer must submit drawings to OWASA for review and approval at all design phases. Written sign-off from OWASA is required before the start of construction.

h. If design necessitates tapping lines in roads, additional approvals may be required from the UNC-CH Department of Public Safety and the Town of Chapel Hill (www.ci.Chapel-Hill.nc.us) and/or the NC Department of Transportation (http://www.ncdot.gov/). DOT roads require a 3-party encroachment agreement among UNC-CH, OWASA and DOT. The Designer should arrange this during the project design, to avoid construction delays.

i. The Designer is responsible for coordinating with PSNC for the Natural Gas Utility (http://www.psncenergy.com/en/builder-developer-services/)

Electric Metering
All electrical installations are typically metered for KWH/KWD for utilities billing purposes at the transformer. Electric Distribution Systems will furnish and install all pad mounted transformer metering equipment including meter, meter base, current transformers, potential transformers and wiring. Cost of this installation will be included in the project cost.

Submit all electrical installations requiring special metering to Electric Distribution Systems for approval.
B-21 – Water Supply & Sanitary Sewer

This document includes general utility requirements for all Water, Wastewater, Stormwater and Non-Potable Water utilities. See the Stormwater and Non-Potable Water Design Standards for the utility specific design standards.

Demolition
Water, wastewater, non-potable water, reclaimed water, stormwater piping and facilities which are being permanently removed from service must be fully removed, and not abandoned in place. Exceptions will be considered for cases where these are located under trees, walls or buildings which are to remain. All piping and facilities which can be removed up to the point that damage would be caused to what is to remain, as noted above, must be removed. That which is to remain must be permanently and completely filled and sealed, including any possible void spaces which may have formed around the exterior of these utilities. This information will then need to be included on the project as-built plans.

Access
Access must be considered and incorporated into the design for all water, wastewater, non-potable water, reclaimed water, and stormwater facilities.
Provide access at all ends, corners, changes in direction, and junctions of underground storage vaults and pipes, at all pipe junctions, and all pipe tie-in points to underground structures. Provide steps at access points to the bottom of the structure.

Water, Non-potable Water, and Reclaimed Water Utility Lines
Provide valves on all sides of all tees and crosses.

All utility boxes and lids shall be designed for a minimum loading of H20 unless a higher loading is required. This applies to all meter, blow-off, valve, and any other appurtenance, or access point box.

Install all pipe materials per manufacturer’s recommendations. For materials subject to expansion and contraction, design and layout must take into consideration full life of the installation, and the temperature ranges which may occur when the piping is in an unconditioned space. Interior piping must be designed taking full possible temperature ranges into consideration, assuming the space is unconditioned at a time during the life of the installation.

Water Supply Piping
Water supply piping shall comply with OWASA standards, plus additional requirements, as noted. Water supply piping shall also be ductile iron restrained joint pipe.

Provide valves at all sides of tees and crosses. This applies to all tees and crosses, including, but not limited to, mains, laterals, fire hydrants, irrigation systems, and other water service uses.

RPZ shall be located inside a building on an outside wall and shall drain to natural grade in a manner which is non-erosive, does not pool, and is not a slip or winter ice hazard.
Internal to buildings, water supply piping shall be designed to provide high quality water for human consumption. This includes carefully routing the water so that the water supplied to break room sinks and drinking fountains is located on a high turn-over part of the pipe, and not off a long, stagnant length of pipe or dead end.

**Fire Systems**
Fire supply flow testing and drain down points shall be designed to not create erosion problems, flooding, water hazard, or ice hazard problems.

**Sanitary Sewer**
Sanitary sewer piping and laterals shall comply with OWASA standards, plus additional requirements, as noted. UNC owned OWASA manholes shall be provided with steps to the bottom of the manhole. Design sanitary sewer within building to drain by gravity out of building without pumping. Where a building has an area below the grade of the outside sanitary sewer, design everything which can drain by gravity to exit the building by gravity, so that the subgrade sewer pump is only responsible for the waste which cannot get out of the building by any other method.

Existing buildings shall be evaluated by the designer to determine whether the floor drains are connected to the sanitary sewer system. If the floor drains are not connected to the sanitary sewer system, they must be connected to the sanitary sewer system.

Existing buildings also need to be evaluated to confirm that the roof drains are connected to the storm system, and correct to connect to the storm system, if connected to the sanitary sewer system.

Elevators shall be equipped with a sump pump with an oil sensing shut off, and the sump pump shall be connected to the sanitary sewer.

Dumpster and waste handling areas shall be drained to the sanitary sewer. These areas shall be graded so that only the area which needs to drain to the sanitary sewer is drained to the sanitary sewer. This is to keep contaminants out of the storm system.

**Non-Potable Water**
Refer to Non-Potable Water Design Standards.

**Stormwater Standards**
Refer to Stormwater Design Standards.
B-22 - Non-Potable Water

Definitions

- **Harvested Rainwater** – Rainwater collected from rooftops or other surfaces and stored in cisterns.
- **Non-Potable Water (NPW)** – Non-drinking water from a variety of sources that is allowable for irrigation, toilet flushing, and other specific uses.
- **Reclaimed Water (RCW)** – Highly treated wastewater distributed to UNC-CH by OWASA. Allowable uses, irrigation application rates, labeling and identification requirements, and permitting requirements are regulated by 15A NCAC 02T .0900

Regulations

The following regulations apply to Non-Potable Water projects. Their applicability is further described in subsequent sections.

a. **North Carolina Administrative Code – Reclaimed Water Regulations**
   Currently section 15A NCAC 02T .0900. Proposed rule changes would relocate the Reclaimed Water regulations to section 15A NCAC 02U. These rules are administered by the NCDENR DWQ Land Applications Unit.

b. **North Carolina Plumbing Code**
   Currently appendix C-1 addresses rainwater harvesting.

c. **OWASA Ordinance for the Control of Backflow and Cross-Connections**
   The OWASA ordinance and associated Manual implement State level regulations within the OWASA service area. At the State level, the NCDENR DEH Public Water Supply section administers cross-connection control and distribution line extensions.

d. **OWASA Rainwater System Requirements and Charges Policy**
   This policy addresses cross-connection control and sewer charges.

Permitting

a. **All Reclaimed Water Uses**
   All RCW uses require a site-specific amendment to UNC-CH’s utilization permit from the Division of Water Quality Land Application Unit. Contact UNC-CH EHS to review permit submittal requirements and obtain the proper, partially completed form. The Project Designer is responsible for completing the Division of Water Quality application form, providing the required specifications and drawings, obtaining a soil scientist / agronomist report for irrigation projects, and providing the application fee. The draft application materials will be submitted to UNC-CH EHS for internal review, applicant signature, and submittal to DWQ.

b. **Extensions to Reclaimed Water Distribution Lines**
   Any project extending the OWASA reclaimed water distribution lines must submit a Reclaimed Water Distribution System application. This application process will be conducted by the Project Designer and UNC-CH Project Manager with OWASA.
Distribution Lines

a. **OWASA Requirements**
   Extensions to the OWASA reclaimed water distribution system will be reviewed by OWASA based on the OWASA *Manual of Specifications, Standards, and Design* and the NC Administrative Code (NCAC) – 15A NCAC 02T .0909 requirement for Reclaimed Water distribution systems.

b. **UNC-CH Standards**
   Reclaimed water and combined non-potable water distribution lines to be owned by UNC-CH will follow the OWASA reclaimed water distribution standards unless otherwise specified in this document or by the UNC-CH Energy Services Non-Potable Water Manager.

Plumbing for Toilet and Urinal Flushing Applications
The UNC-CH design requirements for non-potable water use in indoor plumbing for toilet and urinal flushing rely on several sources described below.

a. **Applicability**
   All new toilet and urinal systems shall be designed with dual plumbing for use of non-potable water.

b. **Materials**
The following UNC-CH requirements for RCW and NPW systems serve as a further safeguard against cross-connections with potable water and provide greater corrosion resistance.

i. Pipe material shall be CPVC Schedule 80, Cell Class 24448 (up to 6”) or 23447 (8” or greater).

ii. Fittings, valves, and other appurtenances shall be CPVC Schedule 80, Cell Class 23447.

iii. All brass fittings, including flush valves, shall be DZR (dezincification resistant).

c. **Pipe Color**
The color currently designated for plumbing systems with reclaimed water, harvested rainwater, and blended non-potable waters is purple (Pantone 522).

This color requirement can be found in the NC Administrative Code Reclaimed Water Regulations and the NC Plumbing Code.

d. **Labeling**
   All pipes, fixtures, valves, and other fittings must be labeled per the NC Administrative Code – Reclaimed Water Regulations (RCW only) and the NC Plumbing Code (all NPW). These regulations specify locations, wording, frequency, colors, size, etc.
The University requires the following language to be included in the labeling:

   RECLAIMED WATER – DO NOT DRINK – NO TOMAR
   or
   NON-POTABLE WATER – DO NOT DRINK – NO TOMAR
e. **Point of Use Signage**

Signs must be placed in every toilet stall and over each group of urinals where NPW is in use. The University has developed standard signage for this purpose that can be produced by the UNC-CH Sign Shop. This fulfills requirements in the NC Administrative Code – Reclaimed Water Regulations.

The standard signage for toilet and urinal flushing sites uses the following language:

```
UNC-CH CONSERVES DRINKING WATER BY
FLUSHING THESE TOILETS AND URINALS WITH NON-POTABLE WATER
DO NOT DRINK – NO TOMAR
```

f. **Cross-Connection Control**

Connections between potable and non-potable water systems are not permitted. The OWASA ordinance and State regulations require an air gap between potable and non-potable water distribution lines. If a potable back-up without an air gap is deemed necessary and is acceptable to UNC-CH Facilities and EHS, then an application for a site-specific alternative cross-connection measure must be submitted to NCDENR DEH Public Water Supply.

g. **Meters**

For accurate billing for sanitary sewer utilization, the OWASA Rainwater System Requirements and Charges Policy requires measurement of NPW entering the building.

If the building uses reclaimed water only, the OWASA reclaimed water meter will be used to bill for sewer charges.

If the building uses rainwater only or a combination of reclaimed water with other non-potable water sources, an OWASA meter measuring NPW entering the building will be used to bill for sewer charges from OWASA.

The OWASA meters will also be used to bill for NPW usage.

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**Irrigation Systems**

The UNC-CH design requirements for irrigation systems utilizing non-potable water rely on several sources described below.

a. **Applicability**

Irrigation systems planning for reclaimed water utilization must meet the NC Administrative Code Reclaimed Water Regulations for set-backs from wells and surface waters.

It is recommended that all new irrigation systems use pipe and other components meeting non-potable water standards to prevent future costs associated with retrofits.

b. **Pipe and Fixture Color**
The color currently designated for irrigation systems with reclaimed water, harvested rainwater, and blended non-potable waters is purple (Pantone 522).

This color requirement can be found in the NC Administrative Code Reclaimed Water Regulations.

c. **Sprinkler Heads**
   The NC Administrative Code considers sprinkler heads to be part of the distribution system that must be color-coded and labeled.

d. **Spigots and Hose Bibs**
   Per the NC Administrative and NC Plumbing code spigots, hose bibs/connections, and other outlets must either:
   
   i. Be located in locked, below grade vaults and labeled.
   ii. Require operation with a tool that permits operation by authorized personnel only and be labeled.

e. **Labeling**
   All pipes, sprinkler heads, fixtures, valves, and other fittings must be labeled per the NC Administrative Code – Reclaimed Water Regulations. UNC-CH requires that all NPW irrigation systems utilize the labeling in this regulation. These regulations specify locations, wording, frequency, colors, size, etc.

   The University requires the following language to be included in the labeling:

   RECLAIMED WATER – DO NOT DRINK – NO TOMAR
   
   or
   
   NON-POTABLE WATER – DO NOT DRINK – NO TOMAR

f. **Irrigation Area Signage**
   Signs must be placed at every site where Reclaimed Water is in use for irrigation. The University has developed standard signage for this purpose that can be produced by the UNC-CH Sign Shop. This fulfills requirements in the NC Administrative Code – Reclaimed Water Regulations.

   The standard signage for irrigation sites uses the following language:

   UNC-CH CONSERVES DRINKING WATER BY
   IRRIGATING WITH NON-POTABLE WATER IN THIS AREA.
   
   DO NOT DRINK – NO TOMAR

g. **Cross-Connection Control**
   Connections between potable and non-potable water systems are not permitted. The OWASA ordinance and State regulations require an air gap between potable and non-potable water distribution lines. If a potable back-up without an air gap is deemed necessary and is acceptable to department maintaining the irrigation system and to UNC-CH EHS, then an application for a site-specific alternative cross-connection measure must be submitted to NCDENR DEH Public Water Supply.
h. **Meters**

A meter is required at each new NPW Irrigation site. Meters will be used to fulfill record keeping requirements under the UNC-CH Reclaimed Water Utilization Permit. Meters will also be used to bill for NPW usage.

If a site is served by RCW only, the OWASA RCW meter will serve the above purposes if the meter serves the irrigation use only.

If a site is served by rainwater only or a combination of reclaimed water with other non-potable water sources, a separate UNC-CH NPW meter is required for measuring the combined NPW utilized for irrigation only. The UNC-CH NPW meters will conform to OWASA meter standards unless otherwise approved by UNC-CH Energy Services Non-Potable Water Manager.

**Condensate Recovery**

Use of condensate in non-potable water systems is allowed and may be blended with rainwater when the provision of the NC Plumbing Code and the following UNC-CH Requirements are followed:

a. Only condensate from UV treated air handling units accepted.
b. A valve on the condensate drain line must be provided to divert coil cleaning wastewater to sanitary sewer drain.
c. A raised drain to the storm/roof drainage system is necessary to prevent accidental collection of any wastewater.
d. Signage indicating “No Biocide – Drains to Storm” must be placed on the air handler access doors.

**Rainwater Harvesting**

Further design guidance on harvested rainwater treatment and cisterns is forthcoming. The following are minimum standards.

a. Harvested Rainwater for Indoor toilet and urinal flushing uses is required by the NC Plumbing Code to be filtered and disinfected. UNC-CH requires UV as the disinfection method.
b. Filtering prior to distribution within the irrigation system is recommended to protect irrigation heads.
B-23 - ELECTRIC DISTRIBUTION SYSTEMS

TECHNICAL DESIGN AND CONSTRUCTION
GUIDELINES AND STANDARDS

Revised JUNE 2020

DIVISION 26 – ELECTRICAL

260100 - General
260100-A - Service and Distribution
260100-B - Photovoltaic Solar Power Generation
2605(13&19) - Wire and Cable
260533 - Conduits
260543 - Conduits-Primary Service (15 kV)
261219 - Transformers - Pad Mounted
261800 - Primary Voltage Switchgear
265600 - Site Lighting

Appendix A - (Solar Electric Generation Policy)
Appendix B - (Old Standard Area Lighting)

Notes:

1. References for UNC-CH Electric Distribution Systems (UNC-CH EDS) standards and guidelines would normally be contained in the current version of Section 26 of the N.C. State Construction Office Electrical Guidelines and Policies are contained herein with that same reference section. Section 26 has not been included in its entirety, which includes electrical facilities other than medium voltage and site lighting.
2. Specifications for switchgear, transformers, cable, meters, sight lighting and other equipment are available from UNC-CH EDS, on request and when appropriate to the project considered.
3. Please direct questions or concerns regarding design and materials to the UNC-CH EDS Manager, telephone 919-962-5244.
4. Listed standards and guidelines are provided under the authority and direction of the UNC-CH EDS Manager.
**Figures and Tables Index**

**Figure 1:** Electric and/or Telecom Manholes Plan Layouts

**Figure 2:** Meter Base & CT Cabinet Details

**Table 1:** Separation of Underground Lines from Other Underground Utilities

**Figure 3:** Electrical Conduits End Points Stubbed Up with End Bells and Plugs

**Figure 4:** Electrical Conduits Terminate to Existing Manhole

**Figure 5:** Ductbank Sloped Between Manholes

**Figure 6:** Concrete Encased Ductbank

**Figure 7:** Ductbank Spacer

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**Table 2:** Aluminum Test Mandrels

**Figure 9:** Joint Ductbank with Electric and Telecommunication Cross Section Detail

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**Figure 19:** Minimum Illumination Inspection

**Figure 20:** Free Standing Lighting Pedestal
Figure 21: Screw In Pole Base

Figure 22: Screw In Pole Base Kelly Bar Adapters

Figure 23: Screw In Pole Base Drive Tool

Figure 24: Concrete Pedestrian Pole Base Detail

Figure 25: Concrete Site Pole Base Detail

Figure 26: Area Aluminum Tube Light Poles
DIVISION 26 – ELECTRICAL

260100 General

Description

This division provides information on basic materials and methods for providing and installing electrical service, distribution, lighting, special systems, communications and controls for new construction and renovation projects at The University of North Carolina, Chapel Hill.

Applicable Codes, Regulations, and Standards

- The following codes (latest edition) shall apply:
  - National Electrical Safety Code (NESC)
  - National Electrical Code (NEC)
  - The State Building Code
  - Occupational Safety and Health Act of North Carolina (OSHANC)
  - Code of Federal Regulations (CFR) 1910.269
  - Code of Federal Regulations (CFR) 1946
  - Illuminating Engineering Society (IES)

- The following standards shall apply:
  - Underwriters Laboratory (UL)
  - Electric Testing Laboratory (ETL)
  - National Fire Protection Association (NFPA)
  - National Electrical Manufacturers Association (NEMA)
  - American National Standards Institute (ANSI)
  - Institute of Electrical and Electronic Engineers (IEEE)

Local utility regulations governing connections and metering require an electrical inspection certificate from the State Construction Electrical Inspector, Department of Administration prior to approval for final payment and before energizing any new transformers and electrical service.

Where above guidelines conflict with this specification, the more stringent of the two shall prevail.

Any and all work in streets or sidewalks will require proper permits and traffic control plans should be submitted to NCDOT, Town Engineer and UCD DPS for approval.

Any exceptions and/or variances from this specification shall be submitted to the UNC-CH EDS Manager for review and approval.
University Construction Drawings shall include the following drawings:

1. **Plan and Profile Drawings**
   a. Normally, prepare plan drawings using a scale of 1” = 50’ for the Plan view; prepare profile drawings using 1/4” = 1’. **Note:** For congestion areas use 1” = 5’ for the Plan view.
   b. Show end points of all ducts.
   c. Show ductbank cross sections for each change in separation or conjunction.
   d. Show all interference with any below grade installation and/or existing utility conflict in or adjacent to the ductbank route. **Note:** All interferences shall be field located for horizontal, vertical, and size dimensions. It is recommended to utilize a Subsurface Utility Engineering (SUE) group for identifying locates from a Quality Level A (QL-A). QL-A provides locating at the highest level of accuracy. It provides information for the precise plan and profile mapping of underground utilities through the nondestructive exposure of underground utilities, and provides the type, size, condition, material and other characteristics of underground features.
   e. Any new designed ductbank shall have a separation clearance as referenced from **Table 1**.

2. **Electrical Detail Drawings**
   a. Include manhole plans as reference from **UNC-CH EDS** standard manhole drawings (Size, Racking, Grounding, Entry Opening).
   
   **Note:** Any group of electrical and/or telecom manholes shall have a diagonal formation layout as seen from **Figure 1**.

   **Figure 1: Electric and/or Telecom Manholes Plan Layouts.**
   
   b. Provide details of ductbank configurations.
   c. Provide details of manhole construction.
   d. Provide details of foundations for pad-mount electrical equipment (switch and/or transformer).
e. Provide details of padmount electrical equipment ground grid.

Note: All detail drawings can be supplied by UNC-CH EDS Engineering group for reference. All drawings shall be reviewed and approved by UNC-CH EDS Engineering group prior to construction. Failure for UNC-CH EDS approval will result with additional costs and/or construction schedule slippage during the Construction phase.

260100-A Service and Distribution

Equipment main distribution panel with digital metering to measure the following:

- Voltage: Phase to neutral and phase to phase.
- Amperage: (True RMS) - each phase and neutral. Fundamental and harmonics through 19th.
- Kilowatt Demand
- Power Factor

Mount one copy of the electrical riser diagram near the main switchgear in the Mechanical Electrical Room under clear protective material. For partial renovations an updated copy of the complete electrical riser shall be provided in plans and mounted in main switchgear room by Contractor.

New and/or Modified Permanent Services

The Contractor is responsible for coordinating and acquiring all local inspections for new and/or modified permanent services. All new and/or modified electrical installations shall be inspected and approved by the SCO Electrical Inspector prior to energization. UNC-CH EDS shall not energize the building transformer until this approval notice is submitted to UNC-CH EDS.

Note: UNC-CH EDS will accept an Engineer of Record inspection only with written permission by the SCO Electrical Inspector. There are no exceptions or variances allowed.

Temporary Services

Standard temporary service is provided for the sole purpose of providing construction power for only the duration of the construction project. All such services shall comply with NESC, Section 1 and NEC Article 230. Such service does not alter service entrance code and safety requirements and shall not be used as a replacement for permanent service.

Temporary Services (where available) will be connected to the University underground electrical distribution system. The service voltage can be single phase 240/120 volts, three phase 208/120 volts, or three phase 480/277 volts. Temporary service costs, payable in advance, are based upon all non-reusable materials, labor to install and remove and appropriate overheads. This cost is a fixed cost, i.e., it is a lump sum cost and must be paid prior to UNC-CH EDS providing the temporary service.

Temporary services 320 amperes and under are metered with self-contained meters. Therefore, they only require a standard meter base, which is furnished by UNC-CH EDS. Temporary Services over 320 amperes
require current transformers for metering. This will require a Current Transformer (CT) cabinet, furnished by the Contractor. Reference Figure 2 for CT cabinet dimensions and requirements.

**Figure 2: Meter Base & CT Cabinet Details**

The Contractor shall contact **UNC-CH EDS** for the location of temporary service equipment, the appropriate size of any CT cabinets, and associated costs for this service. **Temporary service can be provided contingent of the availability of the temporary service capacity and/or system connectivity availability.** This temporary service will be located just inside the construction site fence at an agreed point of delivery as approved by **UNC-CH EDS**. Any damage to or relocation of the temporary service required by the contractor is at the contractor's expense.
UNC-CH EDS will provide one temporary service per site, unless the site qualifies for more than one (1) as described in NEC Article 230. If more than one temporary service is required, the cost for the second service is payable in advance.

The Contractor is responsible for coordinating and acquiring all local inspections and filing an application for service with the Energy Services Business Office. This filing date must allow adequate time (~2 Weeks) for UNC-CH EDS to provide the desired service. The construction project will be responsible for paying all monthly billing associated with the specified temporary service. No allowance for such billing will be assumed in the overall electrical bid for any project.

The Contractor shall provide a structure of enough strength and height to accept the appropriate overhead or underground supply conductors and to comply with appropriate local and NEC codes for height, voltage, clearances and utilization of power.

The temporary service shall be inspected and approved by the SCO Electrical Inspector prior to energization. UNC-CH EDS will require approval from the SCO Inspector before energizing the temporary service connection. Failure to do so will cause a delay at no fault to the University.

**Utility Metering**

All electrical installations are typically metered for Kilowatt Hours (KWH) for utilities billing purposes at the transformer. UNC-CH EDS will furnish and install all pad mounted transformer metering equipment including meter, meter base, current transformers, potential transformers and wiring. Cost of this installation will be included in the project cost.

Submit all electrical installations requiring special metering, to UNC-CH EDS for approval.

**260100-B Photovoltaic Solar Power Generation**

Photovoltaic solar cell power generation panels may be considered for installation on campus buildings or facilities. The design of such installations shall be in accordance with the ENERGY SERVICES SOLAR ELECTRIC GENERATION POLICY (SE-01, effective date: 3/18/2019, refer to Appendix A).

**2605(13&19) Wire and Cable**

The minimum size wire conductor is 12 AWG for premises wiring. Exception: 16 AWG and 14 AWG are acceptable for control and/or signal circuitry as allowed by the NEC and the Department of Administration. Branch circuit wiring shall be sized for a maximum of 3 % voltage drop. Fully loaded multi-outlet receptacle circuits shall be assumed in sizing wiring for receptacle outlets.

- Insulation for premises wiring is THHN for dry locations; THWN for wet.
- All conductors, without exception, shall be copper. Aluminum is strictly prohibited.
- Size all neutral wires for 3 phase systems equal to or larger wire size than the phase conductors. All Single phase branch circuits must have a dedicated neutral conduit for each circuit.
- No more than one (1) conductor for each phase plus individual neutrals and an equipment grounding conductor are allowed in a conduit.
• All wireways shall contain code sized equipment grounding conductor. All power wiring shall be in conduit. Conduit shall not be run in slab except where specifically approved and indicated in plans.
• MC, AC or “BX” cables are not allowed.

UNC-CH EDS will specify, furnish, install, terminate, splice and test all medium voltage (15 KV) cable. Cable will be single conductor, copper shielded, ethylene propylene rubber (EPR) insulated power cable rated 15 KV. Installation will include separate 600 volt neutral.

Although not prohibited by the NEC do not mix conductors serving two separate power systems (i.e., 208/120 volt and 480/277 volt) in the same raceway, pull box or junction box. Exception: Where control wiring is a different voltage from power for the same system. In this case the insulation voltage rating of these conductors shall be higher than the highest voltage system within the same race.

• Color code system wiring for standard clockwise rotation is shown below:

<table>
<thead>
<tr>
<th>208/120 volt systems</th>
<th>408/277 volt system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase A -- Black</td>
<td>Phase A -- Brown</td>
</tr>
<tr>
<td>Phase B -- Red</td>
<td>Phase B -- Orange</td>
</tr>
<tr>
<td>Phase C -- Blue</td>
<td>Phase C -- Yellow</td>
</tr>
<tr>
<td>Neutral -- White</td>
<td>Neutral -- Gray</td>
</tr>
<tr>
<td>Ground -- Green</td>
<td>Ground -- Green</td>
</tr>
</tbody>
</table>

260533 Conduits

Telecommunications Conduits must comply with the following:

All specifications noted in Section 260543 Conduits-Primary Service (15 KV) apply such as spacers, standard coupling kits, slip coupling kits, and terminator kits.

Install as per the manufacturer’s instructions. All installation requirements as stated in Section 260543, for handling, supporting, terminating, testing and sealing procedures, apply.

260543 Conduits-Primary Service (15 kV)

Approved Contractors

UNC-Chapel Hill EDS has special requirements for any Contractor or Subcontractor installing duct-banks, transformer pads, switch pads, and similar facilities that will ultimately be part of its joint electric/telecommunications distribution system. Therefore, UNC-CH EDS requires the following for all Approved Contractors.

• Any such Contractor or Subcontractor must have a North Carolina General Contractor’s License with a Public Utility - Electrical - Ahead of the Point of Delivery - Unlimited Classification per the North Carolina Licensing Board for General Contractors, Rules and Regulations, North Carolina Administrative Code, Title 21; Chapter 12.
• All such Contractor(s) or Subcontractor(s) must also be able to demonstrate to the satisfaction of the UNC-CH EDS Manager or the Manager appointees, through references or prior project work at the University. The Contractor(s) or Subcontractor(s) must have adequate, directly related experience to properly perform the electrical distribution construction work requested.

Note: The Contractor possessing the required license and meeting the experience test described must perform the work themselves. UNC-CH EDS has the right to cease work (at no penalty, fine, and/or change order) when a Contractor (or the Contractor hired Subcontractor) doesn’t obtain the appropriate license and/or demonstrate satisfactory work per UNC-CH EDS construction standards.

Detailed Ductbank Specifications:

A. Trenching and Excavations

• All utilities shall be located prior to any trenching and excavation. The Contractor is required to call 811 and UNC-CH EDS Main Phone Number (919-962-8394).

Note: Normal Locate Requests takes approximately three (3) working days (72 hours minimum, may take longer due to workload and coordination with other utilities) to complete and are good no more than 10 days after the utilities are located.

• Excavation and backfill shall conform to NC State Construction Office Guidelines except that heavy-duty, hydraulic-operated compaction equipment shall not be used.
• An erosion control permit must be approved by the University and NC Department of Environmental Quality (DEQ) prior to work.
• A tree protection plan shall be approved by the UNC Grounds Department prior to excavation.
• Trenches should be cut neatly, uniformly and as straight as field conditions permit, sloping uniformly to required pitch with smooth walls.
• Bottom of trenches to be smooth; uniform and free of loose dirt, rocks or other debris. Mud shall be mucked out and replaced with dry dirt or stone as needed. The bottom of the trench shall be properly compacted.
• Trench walls that have collapsed or where large rocks have been removed shall be formed with plywood to maintain a uniform side of the concrete encasement and to reduce concrete overflow.
• All Electrical trenches must allow acceptable separation from other underground conflicting utilities as referenced from Table 1.
Table 1: Separation of Underground Lines from Other Underground Utilities

<table>
<thead>
<tr>
<th>Electrical</th>
<th>Water</th>
<th>Sanitary Sewer Service</th>
<th>Sanitary Main or lines &gt; 8’ deep</th>
<th>Force Main</th>
<th>Storm Drain</th>
<th>Natura Gas</th>
<th>Steam or Hot Water</th>
<th>Telecom.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Separation at Perpendicular Crossing (Units in Inches)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>24</td>
<td>12</td>
</tr>
<tr>
<td>Minimum Separation for Parallel Crossing (Units in Inches)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>36</td>
<td>36</td>
<td>60</td>
<td>36</td>
<td>36</td>
<td>60</td>
<td>60</td>
<td>12</td>
</tr>
</tbody>
</table>

B. Back Filling

- All back-fill material shall be clean, dry, and free of rock, concrete, and other construction debris.
- Backfill shall be tamped in layers per NC SCO Guidelines.
- When a ductbank is installed through cut rock; at least three (3) inches of clean backfill such as sand, fine gravel or crush and run shall be placed in the bottom of the trench and properly compacted before conduits are installed.
- Any ductbank through existing or proposed asphalt or concrete must be completely back filled with flowable fill to avoid future settling.

C. Rock Removal

Rock excavation includes removal of rocks or boulders larger than $\frac{1}{2}$ cu. yard in volume and that occurs in beds, ledges, stratified or unstratified masses or in singular deposits. Qualifying rock or boulders are those which cannot be removed by heavy-duty rock excavating machinery or equipment without the use of a ram hoe, symmetrical drilling, blasting or ripping.

Removal costs for rock shall be based on unit prices included in the Contract Documents. A specific rock allowance may be requested on a project by project basis.

D. Conduits

All conduit runs used for primary voltage (15 kV) cables shall be PVC Schedule 40 or Rigid Galvanized Steel as specified in project documents. Typical conduit shall have a nominal (minimum inside) diameter of six (6) inches. Other size conduits may be required depending on the project needs. All conduits shall have one belled end per length.

Terminate all conduit end points in switching cabinets and at transformer pads no less than 2 inches and no more than 4 inches above grade or a finished slab. Use of steel conduit when required coverage is unattainable shall be approved by the UNC Facilities Construction Manager and UNC-CH EDS Engineering group. Reference Figure 3 for further illustration.

Terminate all PVC conduit end points in utility holes, switching cabinets, transformers, hand holes and buildings with end bells. The bell end of the conduits that enter manhole and handhole walls shall be flush with the wall. Seal conduit entrances into utility holes, hand holes and buildings on the end bell side of the entry. Plug all conduit entry end points with expandable reusable conduit plugs capable of withstanding 15 PSI minimum hydrostatic pressure. All conduit plugs shall have pull
strings (as referenced in the note below) connected at both ends. As an example, UNC Electric Distribution Systems uses blank plugs made by Jackmoon USA Inc. a division of Tyco Electronics. Refer to Figure 3 & Figure 4 for further illustration.

Note: All PVC conduits must terminate to manholes, hand holes or connect to the equipment pad. Stub out ductbank sections are not acceptable, unless the variance is approved by the UNC-CH EDS Manager.

Note: Waterproof marking cord shall be installed using ½ inch wide 1250-pound tensile test cord (marked at least every foot), equivalent to NEPTCO Inc. MuleTape Part # WP1250P, in all ducts, including spares, after thoroughly rodding, clearing and swabbing all lines free of any and all obstructions. DO NOT splice, tie or otherwise join shorter lengths together. Only a whole, unbroken length of tape to be installed in each duct.

Figure 3: Electrical Conduits End Point Stubbed Up with End Bells and Plugs.

![Figure 3: Electrical Conduits End Point Stubbed Up with End Bells and Plugs.](image)

Use MuleTape: WP1250P for each conduit pull string.

Figure 4: Electrical Conduits Terminate to Existing Manhole

![Figure 4: Electrical Conduits Terminate to Existing Manhole](image)

Flush, Grouted, Plugged With Bell Ends

Note: Any exceptions shall be submitted to UNC-CH EDS Engineering group for review and approval.
E. Conduit – In – Casing Construction (Jack & Bore)

The conduit-in-case construction procedure is a solution to the problem of laying power/communication cables under a surface obstruction without disrupting traffic or riverbed. The basic procedure shall be used:

1. Excavate and shore pits on both sides of the surface obstruction.
2. Bore under the surface obstruction connect the excavated pits and install a steel casing.
3. Place conduits within the steel casing.
4. There shall be a bore spacer designed for a casing that is straight and true.
5. It is essential that the bore spacers are held in place relative to the conduit. Use one bore spacer for every five (5) feet of ductbank.
6. Inject grout into the area between the conduits and steel casing. Be mindful of other utilities within the grout injection area(s). The Contractor shall not allow the excess grout to protrude other utilities.
7. The ductbank must be held in position at both ends to accommodate possible uneven thrust loads that may be generated during grout operation.
8. Allow the grout to cure.

Note: The steel casing is usually pushed into place with hydraulic jacks while the earth ahead of the casing is removed with special boring machines.

Note: The shore pits layout and bore spacer details shall be submitted for review and approval by UNC-CH EDS Engineering group.

F. Bends and Sweeps

All conduit bends shall be factory made bends (i.e. 11.25°, 22.5°, 30°, 45°, and 90°). All factory elbows shall have a minimum “standard” radius by size, as prescribed by NEMA.

All field bends (approved by UNC-CH EDS) shall be made only with approved equipment identified for that purpose and have a minimum standard radius by size, as prescribed by NEC Table 2, Chapter 9.

Use of special radius bends and elbows are encouraged. Special radius bends and elbows are those which have a larger (gentler) radius than the standard radius. Schedule 40 PVC shall be used for field bends.

The inside of conduits shall be beveled slightly when conduits are cut or when joining two different schedules of PVC conduit to prevent conductors from snagging on the inside edge.

All ductbank runs where the cumulative (Σ) effect of bends or elbows exceeds 180 degrees (degrees includes vertical and horizontal bends) must be approved by the UNC Project Manager and UNC-CH EDS Engineering group. All bends “Under No Circumstances” should the cumulative (Σ) effect of
field bends and factory elbows between termination points exceed 270 degrees or conduit lengths exceeds 500 feet between manholes.

Dimensions

Ducts should be pitched to drain toward manholes and hand holes and away from buildings and equipment. Minimum slope shall be 4 inches in 100 feet. Where necessary to achieve this between manholes, ducts should be sloped from a high point in the run to drain in both directions (See Figure 5 for Reference)

Design depth for the top surface of all ductbanks is 36 inches (minimum) below finished grade or concrete. The entire ductbank length shall include a Tracer wire installed within the ducts spacers as illustrated from Figure 6. This Tracer wire shall include a 20 feet tail extension at each final destination (i.e. manhole(s), handhole(s), vault(s), transformer pad, and/or switch pad(s).

Figure 5: Ductbank Sloped Between Manholes

Encase all PVC conduit in concrete, with a minimum 3 inch spacing between the outside of adjacent conduits, a minimum of 3 inches envelope around the ductbank, and a minimum of 3½ inches of concrete on the bottom of the ductbank. This is accomplished using only approved ductbank conduit spacers. Do not use other means, material or devices to achieve the required spacing. Refer to Figure 6 for illustration.
Note: The UNC-CH Electric Distribution System approved ductbank spacer is the Underground Devices, Inc. “WUNPEECE” spacer, web site www. Udevices.com. No other spacer is acceptable. See Figure 7 for Reference. All other spaces depicted in other Figures are for reference only.

Apply ductbank conduit spacers along each level of conduits no more than 5 feet apart. This provides required support in a manner which will minimize the creation of sheer joints, spacers at any given conduit level shall be staggered 1 foot relative to spacers at conduit levels above and below. Sheer joints are created when the spacers per each conduit level are applied all at the same point along the ductbank run. This creates a weak “joint” (wall of spacers) in the ductbank, due to the lack of concrete. Conduit spacers to the earth and to ducts should be secured or anchored to prevent floating during placement of concrete. Steel or tie wires shall not be used as they may form conductive or magnetic loops around ducts or duct groups. Refer to Figure 7 for illustration.

Preferred Spacer: UDI 6W30-2
Electric automation and control (1-1/4") conduits shall be placed within the open space of the conduit spacers and secured with plastic tie wraps. Reference Figure 7 for illustration.

If manholes and/or vaults come with existing Duct terminators, then the ductbank must start from the bottom center. Reference Figure 8 for illustration. If, the ductbank conduit count is less than the maximum number of terminators then the spare terminators on the manhole shall be the upper terminators.

**Figure 8: Ductbank Starting Point for Manhole and/or Vaults with Duct Terminators**

G. **Concrete**

All concrete shall be 3000 PSI or greater, 28-day compressive strength, with a slump at point of placement of 4 inches maximum and 3 inches minimum.

The top surface of the concrete ductbank envelope shall be raked smooth and level. The concrete shall be vibrated throughout in order to reduce and/or eliminate any air pockets when pouring and smoothing concrete to level.

At the end of each day’s pour, stop concrete at a 45 degrees angle and install reinforcing bars (minimum of six (6)) to strengthen the transition to future duct extensions.

H. **Marking, Testing and Inspecting**

Mark all ductbank runs with a warning tape, installed no less than 6 inches and no more than 12 inches above the top of the ductbank concrete. Place warning tape along the approximate center line of the ductbank run. Warning tape shall be permanent, bright-colored, continuous printed, plastic tape compounded for direct burial not less than 6 inches wide and 4 mils thick. Printed legend shall be indicative of general type of underground line below.
As part of acceptance testing, all conduits, including spares, shall be proof tested using an appropriately sized aluminum and/or steel mandrel approved and witnessed by UNC-CH EDS. The mandrel shall be a solid cylindrical type mandrel as referenced from Table 2.

**Table 2: Aluminum Test Mandrels**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Duct Size (in)</th>
<th>Body Length (in)</th>
<th>Max O.D. (in)</th>
<th>Load Capacity (lbs)</th>
<th>Load Capacity (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>08059515</td>
<td>11/2 38</td>
<td>1.74 44</td>
<td>1.18 30</td>
<td>2,200</td>
<td>9,786</td>
</tr>
<tr>
<td>08059520</td>
<td>2 51</td>
<td>2.40 61</td>
<td>1.62 41</td>
<td>2,200</td>
<td>9,786</td>
</tr>
<tr>
<td>08059525</td>
<td>21/2 64</td>
<td>2.98 76</td>
<td>2.00 51</td>
<td>2,200</td>
<td>9,786</td>
</tr>
<tr>
<td>08059530</td>
<td>3 76</td>
<td>3.50 89</td>
<td>2.37 61</td>
<td>2,200</td>
<td>9,786</td>
</tr>
<tr>
<td>08059535</td>
<td>31/2 89</td>
<td>4.10 104</td>
<td>2.75 70</td>
<td>4,500</td>
<td>20,016</td>
</tr>
<tr>
<td>08059540</td>
<td>4 102</td>
<td>4.84 123</td>
<td>3.25 83</td>
<td>4,500</td>
<td>20,016</td>
</tr>
<tr>
<td>08059550</td>
<td>5 127</td>
<td>5.98 152</td>
<td>4.00 102</td>
<td>4,500</td>
<td>20,016</td>
</tr>
<tr>
<td>08059560</td>
<td>6 152</td>
<td>7.08 180</td>
<td>4.75 121</td>
<td>4,500</td>
<td>20,016</td>
</tr>
<tr>
<td>08059580</td>
<td>8 203</td>
<td>9.44 240</td>
<td>6.375 162</td>
<td>4,500</td>
<td>20,016</td>
</tr>
</tbody>
</table>

In addition to the SCO Electrical Inspector, UNC-EDS shall inspect conduit installations prior to concrete encasement or backfill. If a weather event occurs prior to concrete encasement, then UNC-EDS shall re-inspect ductbank. Failure to receive this inspection could result in demolition and rebuild of the ductbank.

I. **Telecommunications Duct Systems**

All specifications noted above in the “Detailed Ductbank Specifications” ([Section 260543](#)) apply to telecommunications duct systems.

Telecommunications conduit needs vary. Telecommunications utilizes multiple conduit bundles designed to fit standard size conduit spacers. These bundles are to be secured together utilizing plastic tie wraps to prevent conduit sagging, bending, and movement.

All ductbanks installed for the sole use of telecommunications cables shall include a suitable locating wire.

Multi-cell conduits are not allowed and should not be used for ductbank installations. Contractor or Owner may request a variance for UNC-CH EDS approval.

J. **Joint Telecommunications and Electrical Duct Systems**
Telecommunications and Electrical conduits may run parallel and utilize the same concrete encased ductbank based on the following requirements.

All Telecommunication conduits shall be below all electrical conduits when within the same encased ductbank. Reference Figure 9 for further illustration.

Figure 9: Joint Ductbank with Electric and Telecommunication Cross Section Detail

The Telecommunication conduits and the Electrical conduits must separate and utilize their specified manholes (Telecom conduits run to Telecom Manhole, Electric conduits and Electrical controls conduits run to Electric Manhole). Reference Figure 10 for further details.

Figure 10: Joint Ductbank with Electric and Telecommunication Manhole Separation
Note: Any existing joint use manholes “Planned to be Abandoned” must be separated into two separate manholes (Telecom and Electric) when altered by a Construction project.

K. Manholes and/or Vaults

Telecommunication, electric distribution and electric transmission manholes shall consist of preformed concrete top and bottom elements with knockouts for ductbank installations. Each manhole shall be consistent with the specifications provided by UNC-CH EDS Engineering group for each new installation.

Minimum cover over manholes shall be 36 inches below finished grade and level. Reference Figure 5 for further illustration.

Manholes and/or Vaults shall be left clean of debris, water, mud and soil, with all ductbank entrances sealed as per specifications. Also, all Electrical Manhole and/or Vaults that are beneath a surface (other than dirt) shall have 6 feet by 6 feet square equipment access hatch with removable means.

An Electrical Manhole shall be a Precast Electric Manhole with a minimum 8’ width x 12’ length x 7’ deep (Inside Dimensions) rated for HS-20 highway rating. This precast manhole shall include a 36 inches diameter manhole entry ring (round) cover and sump window at the manhole center bottom. No Manhole entry ladder is required.

All Electrical Manholes and/or Vaults shall have metal cable racks bonded to the 4/0 AWG continuous ground ring. Each electrical manhole shall be grounded by ¾” x 10’ ground rods located at two (2) locations on the opposite corners within the manhole. Reference Figure 11 for illustration.

All Engineer designed (custom) Electrical Manholes and/or Vaults shall have pulling irons installed on each top/bottom center wall location. The customer Electrical Manholes and/or Vaults shall include cable racks installed along each side wall. Also, all custom Electrical Manholes and/or Vaults shall be reviewed and approved by UNC-CH EDS Engineering group.

Note: All Electrical Manhole and/or Vaults shall have no combustible material (i.e. plywood, sheetrock, wood paneling, plaster, drywall, etc...) installed.

Figure 11: Manhole Grounding and Loop
Each Manhole shall have a minimum working space of three (3) feet per each side. There shall be no structure or object installed within this area as referenced from Figure 12. Note: concrete, gravel, backfill (flowable fill), or asphalt is acceptable within this area.

**Figure 12: Electric or Telecom Manhole Working Clearance**

![Diagram of Electric or Telecom Manhole Working Clearance]

Note: If the working clearance above is not feasible then seek UNC-CH EDS approval for the minimum acceptable working clearance.

L. Abandoned Ductbanks and/or Manholes
No existing manholes can be removed and relocated to a different location. A new manhole and ductbank must be installed with rerouted routes. All new ductbanks must include the same number of ducts and add ducts intended for the new/renovated building use.

Any Abandoned ductbanks that needs to be demolished must be addressed by the UNC-CH EDS Engineering group prior to work. If abandoned ductbanks demolishing is approved, then the Contractor must treat the abandoned ductbank as energized. The Contractor must verify no utility cables are within the abandoned ductbank area.

Note: All abandoned ductbanks that are modified by construction project must be plugged and installed with locating ball and tracer wire attached. Contractor must contact UNC-CH EDS for inspection before backfilling abandoned ductbank section.

261219 Transformers - Pad Mounted

Transformers shall be dead front, loop feed, pad mounted design. UNC-CH EDS shall provide transformers for connection between the UNC 15 kV primary cable system and the building service. Transformers shall be located no closer to any building surface than 4.0’ and more than 10’ from any window. The transformers shall have a working clearance as illustrated from Figure 13.

Figure 13: Minimum Working Clearance for Padmount Transformers
UNC-CH EDS shall provide and install connectors to terminate Contractor installed service conductors on the transformer secondary spade terminals.

UNC-CH EDS shall make the final service conductor connections to the transformer secondary spade terminals.

*Working Clearance shall be clear with no obstacles (i.e. fences, walls, vegetation, etc...) and level. There shall not be more than one (1) foot drop from top of equipment pad to grade level.

Working Clearance shall always be accessible and allow Large Utility Vehicles to obtain access for Rigging (i.e. Cranes) and pulling cables. Typically, this accessible space needs to be approximately 30 feet wide by 50 feet long.

The costs of service transformers are included as part of the project cost. UNC-CH EDS Engineering group will provide the cost for the installation to the project designer for inclusion in the project. UNC-CH EDS Engineering group will make the size determination for all transformers installed on the campus for all service connections.

The Contractor is responsible for the following:

- Proper installation of the secondary/service conductors which shall include accurate cable phasing and marking, cutting conductors to the proper length, and insulation resistance testing for any insulation problems, short circuits, or cross phasing connections.
- Forming, pouring and installing transformer pad as per UNC-CH EDS standards.
- Contractor shall install direct buried ground loop, grid, or counterpoise requiring buried connections, these connections shall be exothermic weld type connections.

- The transformer ground ring shall be installed within 10 inches from transformer pad edge and at least 30 inches below grade exothermic weld connect to each ground rod (¾” x 10’). There shall be at least three (3) ground rods driven vertically within “Wet” dirt in an Equilateral Triangle shape. Also, there shall be one (1) ground rod (¾” x 10’) ground rod driven vertically within the front left corner of the transformer primary window. The transformer primary window ground rod shall protrude 2” above pad. Please refer to Figure 14 for illustration.
Note: The Contractor must prove to UNC-CH EDS that the ground rods cannot be driven vertically before requesting an exception. The ground rods shall not be installed directly below transformer pad or below ductbank.

Figure 14: Transformer Ground Ring

261800 Primary Voltage Switchgear

Normally, new connections to the electric distribution system are made at switches. Locate these switches in utility manholes or surface mounted on a concrete pad sized for the switch that will be installed. Information regarding the switch type and location will be provided to the project designer at or near Schematic Design review time.

Since these switches are part of the electric distribution system, the design associated with switch installations is the responsibility of UNC-CH EDS. Coordinate any proposed connection to the system with UNC-CH EDS. The costs of system connections, including additional switches needed for the connection, are included as part of the project cost. UNC-CH EDS will provide and install system switches and will provide the cost for the installation to the project designer for inclusion in the project.

The Contractor is responsible for:

- Forming, pouring and installing switch pad as per UNC-CH EDS standards. Reference Figures 15 & 16 for minimum working clearances.
• Contractor shall install direct buried ground loop, grid, or counterpoise requiring buried connections, these connections shall be exothermic weld type connections.
  o The switchgear ground ring shall be installed within **10 inches** from transformer pad edge and at least **30 inches** below grade exothermic weld connect to each ground rod (**¾” x 10’**). There shall be at least three (3) ground rods driven vertically within “Wet” dirt in an **Equilateral Triangle** shape. Also, there shall be one (1) ground rod (**¾” x 10’**) ground rod driven vertically within the front left corner of the pad window. The switch window ground rod shall protrude 2” above pad. Please refer to **Figure 17 & 18** for illustration.

  **Note:** The Contractor must prove to UNC-CH EDS that the ground rods cannot be driven vertically before requesting an exception. The ground rods shall not be installed directly below switchgear pad or below ductbank.

**Figure 15: PME-9, PMH-9, and Source Transfer Switch Minimum Working Clearance**

![Diagram of PME-9, PMH-9, and Source Transfer Switch Minimum Working Clearance]

- Working Clearance shall be clear with no obstacles (i.e. fences, walls, vegetation, etc…) and level. There shall not be more than one (1) foot drop from top of equipment pad to grade level.
- Working Clearance shall always be accessible and allow Large Utility Vehicles to obtain access for Rigging (i.e. Cranes) and pulling cables. Typically, this accessible space needs to be approximately **30 feet wide by 50 feet long**.

**Figure 16: High Speed Switch Minimum Working Clearance**
• *Control Side can be located either left or right side and must have four (4) feet clearance.
• Working Clearance shall be clear with no obstacles (i.e. fences, walls, vegetation, etc...) and level. There shall not be more than one (1) foot drop from top of equipment pad to grade level.
• Working Clearance shall always be accessible and allow Large Utility Vehicles to obtain access for Rigging (i.e. Cranes) and pulling cables. Typically, this accessible space needs to be approximately 30 feet wide by 50 feet long.

Figure 17: Padmount Switch Ground Ring
Figure 18: PME-9, PMH-9, and Source Transfer Switch Ground Ring

NOTES:
1. Ground rods to be 3/4 in dia. x 10 ft. long copper clad steel
2. Grounding conductor to be # 2/0 bare copper minimum
3. Grounding conductor depth to be 30 inches minimum
4. Mechanical/electrical connections in the ground shall be exothermic welds (ex. Cadweld)
5. Grounding conductor to be 10 to 12 inches from the edge of box pad.
6. Any variations or conflicts must be reviewed and approved by Electric Distribution engineering.
265600 Site Lighting

Exterior lighting constitutes the first line of defense in the overall security and safety plan of the campus. It provides the needed visibility for vehicles and more importantly, pedestrians to safely travel around the University campus. At the same time, lighting that illuminates perimeter neighborhoods or the night sky is actively avoided.

UNC-CH EDS provides standards, approves selections and ultimately maintains all outside, pole mounted area, walkway, parking lot, and street lighting on the UNC campus properties. For projects which involve typically less than five lights, UNC-CH EDS may elect to provide materials and installation using project funding. Projects involving larger numbers of lights should be included in the requirements for the electric contractor and are subject to UNC-CH EDS approval and inspection. Refer to Table 3 for UNC-CH EDS approved fixtures.

Exterior lighting typically falls into the following categories:

<table>
<thead>
<tr>
<th>TYPE</th>
<th>DESCRIPTION</th>
<th>MANUFACTURER / CATALOG #</th>
<th>LAMPS</th>
<th>VOLTS</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walkway Lighting</td>
<td>Main Street Lighting</td>
<td>AATF1410-L400-CL5</td>
<td>ONE</td>
<td>120/277</td>
<td>BULB SUPPLIED BY UNC-CH EDS</td>
</tr>
<tr>
<td>Parking Lot Lighting</td>
<td>GE Evolve LED Area Light</td>
<td>EALP030H4AF750NDD1DKBZ</td>
<td>140 WATT</td>
<td>120/277</td>
<td>LAMP SUPPLIED BY CONTRACTOR</td>
</tr>
<tr>
<td>Parking Lot Lighting</td>
<td>GE Evolve LED Area Light</td>
<td>EALPP010J4A0NDD1DKBZ</td>
<td>220 WATT</td>
<td>120 / 277</td>
<td>LAMP SUPPLIED BY CONTRACTOR</td>
</tr>
<tr>
<td>Streets Lighting</td>
<td>Cree Cobra Head LED Lighting</td>
<td>CREEBXSPAOFPAUS</td>
<td>101 WATT</td>
<td>120/277</td>
<td>LAMP SUPPLIED BY CONTRACTOR</td>
</tr>
</tbody>
</table>

In general, the University requires 1.5 footcandles (fc) minimum illumination for task lighting (i.e. Streets, Parking Lots, and Walkways). Note: This does not pertain to Athletics Facilities. The minimum illumination reading shall be recording by UNC-CH EDS between the fixtures midpoint segment as referenced from Figure 19.

Consideration shall be given to specifying exterior lighting such that exterior luminaries with more than 1,000 initial lamp lumens are shielded and all luminaries with more than 3500 initial lamp lumens meet the Full Cutoff IESNA Classification. In addition, consideration shall be to specifying luminaries within a distance of 2.5 times its mounting height from the property boundary to have shielding such that no light from those luminaries crosses the property boundary (IESNA RP-33-14).

Furthermore, lighting should be designed to reduce light pollution to the night sky. For more details on light pollution and light trespass, see the Illumination Engineering Society of North America’s Recommended Practices for outdoor lighting (IESNA RP-33-14).
It is the goal of the University to preserve the ambiance of the campus while ensuring well-lit areas of travel throughout the campus. This requires the consistency, as is feasible, of fixture types and luminaries. The availability of several voltages requires special attention in design. There may be multiple voltages within any one particular area. Typical voltages are \textbf{120}, \textbf{208} and \textbf{277}.

The electric source or feed for outside lighting shall be a minimum of one \textbf{60 amp}, \textbf{240} or \textbf{277 volts}, two pole circuit wired from the nearest service transformer.

New and/or replacement fixtures shall conform to existing fixtures in and around the general area under consideration and shall be of equal or better quality. Temporary lighting may be required during the construction phase to ensure a safe area at night. Temporary lighting will be the responsibility of the construction project. All such lighting shall be of a cutoff design to reduce any light distribution above a plane equal to the plane of the fixture lens.

All pedestrian pole lighting is Light Emitting Diode (LED) with “Old Standard” style in accordance with \textbf{UNC-CH EDS} specifications (Refer to Appendix B), ES 12-03 and ES 12-04. All such lighting shall be of a cutoff design to reduce any light distribution above a plane equal to the plane of the fixture lens. Further, consideration may be given to the use of LED light fixtures, in consultation with the \textbf{UNC-CH EDS Manager}.

All outdoor fixtures shall be fed from a free-standing lighting pedestal as referenced from \textbf{Figure 20}. There shall be at least three (3) feet clearance in front and back of this free-standing light pedestal.
Note: **No** other electrical and/or controls equipment may be wired directly from any Site Lighting circuits.

**Figure 20: Free Standing Light Pedestal**

Lighting Fixture Types

Lighting in relationship to a new or remodeled facility may typically involve:

- Removal and replacement of existing fixtures
- Addition of new self-standing fixtures
- Addition of new wall mounted fixtures
- Use of new technology LED type fixtures (subject to specific [UNC-CH EDS](https://unc-eds.com) conditions and specifications)

**Removal of Existing Fixtures**

It may be necessary to remove some existing fixtures to facilitate the transition between a new fixture and the existing fixtures or to improve the illumination level. Any light fixture removal must be addressed and approved by [UNC-CH EDS Engineering group](https://unc-eds.com). Contractor is not allowed to disconnect any lighting connections without EDS providing the approval to do so. [UNC-CH EDS](https://unc-eds.com) personnel accomplish removal of all existing fixtures. Associated cost for this work is to be included within the project budget.
Note: Any legacy fixtures that pre-dates electricity shall be demolished and replaced with Main Street Light fixture.

Addition of New Free-Standing Fixtures

When the need arises for adding new freestanding fixtures, care must be given to ensure uniformity in fixtures and lighting levels with surrounding fixtures and lighting levels. Detail should be given to all obstructions that result in a “cutoff” of the required light pattern. All new freestanding fixtures and site lighting systems shall be approved by UNC-CH EDS Engineering group. The new site lighting system shall be served by a free-standing light pedestal (referenced Figure 20) and directly fed by the nearest transformer.

Each outdoor light fixture shall be installed with a screw in pole base (preferred, Figure 21 - 23) or concrete base (alternate, Figure 24 & Figure 25). All bases and fixtures shall be approved by UNC-CH EDS Engineering Group.

Figure 21: Screw in Pole Base (Preferred)
Figure 22: Screw in Base Kelly Bar Adapters (See UNC-CH EDS Engineering Group for Consultation)
KELLY BAR ADAPTERS

Selecting the correct Kelly bar adapter is key to building a proper drive string.

Follow these two easy steps:
1. Measure the width from the drive end and carefully measure the X and Y dimensions of the Kelly bar.
2. Match the shape of the Kelly bar and the X and Y dimensions with the Kelly bar adapter charts below. The Y dimension on the Kelly bar adapter must be equal to or greater than the Y dimension on the intended Kelly bar.

A Note about Bolt Circles:
Chance® soderberg mounting tools are provided with appropriate bolt circles for the expected service. The torque limitations for the two standard bolt circles are given in the chart to the right. Never exceed the rated torque of any Chance® mounting tool.

<table>
<thead>
<tr>
<th>3-1/4&quot; BOLT CIRCLE KELLY BAR ADAPTER</th>
<th>7-5/8&quot; BOLT CIRCLE KELLY BAR ADAPTER</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Table 3</strong></td>
<td><strong>Table 4</strong></td>
</tr>
</tbody>
</table>

**BOLT CIRCLE ADAPTER**

The T305096N is for use between a tool having a 5-1/4" bolt circle end and one having a 7-5/8" bolt circle. It is limited to 10,000 ft-lb.

For 10,000 ft-lb Maximum Torque:
Each of these Kelly bar adapters has six holes for 5/8" bolts on a 5-1/4" bolt circle and comes with six 5/8" Grade 5 bolts, nuts & lockwashers, bent arm pin with collet.

**Figure 23:** Screw in Base Drive Tool (See UNC-CH EDS Engineering group for Consultation)
DRIVE TOOLS

SS DRIVE TOOLS

These tools include our proprietary alignment window that helps reduce chance of finger pinch when anchor is inserted into tool. Alignment window also makes it faster and easier to line up the anchor and anchor tool.

These drive tools require the appropriate Kelly bar adapter (page 5). Each comes with bolts, nuts and lock washers.

<table>
<thead>
<tr>
<th>Catalog No.</th>
<th>SS Anchor Series Tool</th>
<th>Bolt Circle, Holes</th>
<th>Approx. Weight (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C03031602</td>
<td>SS20</td>
<td>5-1/4&quot;, (6) 1/2&quot; holes</td>
<td>10</td>
</tr>
<tr>
<td>639001</td>
<td>SS5/SS150</td>
<td>5-1/4&quot;, (6) 1/2&quot; holes</td>
<td>8</td>
</tr>
<tr>
<td>C0303195°</td>
<td>SS175</td>
<td>7-5/8&quot;, (12) 5/8&quot; holes</td>
<td>18</td>
</tr>
<tr>
<td>C030201°</td>
<td>SS200</td>
<td>7-5/8&quot;, (12) 5/8&quot; holes</td>
<td>30</td>
</tr>
<tr>
<td>C030202°</td>
<td>SS225</td>
<td>7-5/8&quot;, (12) 5/8&quot; holes</td>
<td>30</td>
</tr>
</tbody>
</table>

*Coupling to a Kelly bar adapter with a 5-1/4" bolt circle requires use of T3031665 adapter and limits tool's maximum torque rating to 10,000 ft-lb.

Each of these drive tools includes an integral set of locking dogs that attach the drive tool to the anchor. There is no need to use bent arm pin and collar to attach these tools to an anchor.

These drive tools require the appropriate Kelly bar adapter, sold separately. Each comes with bolts, nuts and lock washers.

SS DRIVE TOOLS

TABLE 8

<table>
<thead>
<tr>
<th>Catalog No.</th>
<th>SS Anchor Series Tool</th>
<th>Bolt Circle, Holes</th>
<th>Approx. Weight (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C03031650</td>
<td>SS5, SS150</td>
<td>5-1/4&quot;, (6) 1/2&quot; holes</td>
<td>10</td>
</tr>
<tr>
<td>C03031645</td>
<td>SS175</td>
<td>7-5/8&quot;, (12) 5/8&quot; holes</td>
<td>21</td>
</tr>
</tbody>
</table>

Figure 24: Concrete Pedestrian Pole Base Detail (Only use per UNC-CH EDS Engineering group approval)
Figure 25: Concrete Site Pole Base Detail (Only use per UNC-CH EDS Engineering group approval)
Note: All free-standing light poles are typically thirty (30) feet unless stated otherwise and approved by the UNC-CH EDS Engineer group. Refer to Figure 26 for preferred area light poles.
Appendix A (Solar Electric Generation Policy)
ENERGY SERVICES

SOLAR ELECTRIC GENERATION POLICY

Revision: Initial issue
Approved: 
Director

Number SE-01
Effective Date: March 18, 2019

SCOPE

The electric distribution system of the University, including generation, is developed and controlled to provide the highest reliability and cost effectiveness to the advantage of all users. This is accomplished only through the appropriate ownership and management of all generation facilities on campus that are operated in parallel with the electric distribution system. This does not include emergency generation that is not part of the electric distribution system. This policy prescribes the responsibilities and authority to conduct the program for electric power generation by distributed generation equipment located on campus including those sustainable or renewable resources such as photovoltaic (PV) cells installed on the system, including those installed on buildings or any other structure.

DEFINITIONS

Photovoltaic A large area electronic device that converts solar energy into electricity by the photovoltaic (PV) effect.
Array A collection of PV cells that, when connected, provide the adequate voltage and current (electric power) output of the array to fully meet the electric-generation design and interconnect functions to provide electric power as desired or designed.
EDS University of North Carolina, Energy Services Department (specifically, Electric Distribution Systems)

POLICY

APPLICABILITY

This policy applies to all electric energy-producing installations of a permanent nature that will be connected to the electric distribution system on campus and that would be connected continuously.

SAFETY

PV cells, when used on the campus and if connected continuously to the electric distribution system, as applied in this policy, can generate and provide power to that system, with appropriate sunlight and energy input, at any time. They thus become a constant source of energy during sunlight hours. As such, they can and would provide electric energy to the electric distribution system regardless of the primary electric system condition. Safety for personnel working on the electric distribution system and for system integrity in general will have the highest priority in the management of the PV connections. Any connection from a PV source to the University electric distribution system shall be fully controlled in accordance with the connection policy below.
SYSTEM AND CONNECTION RESPONSIBILITY

The customer/building facility shall be responsible to submit the Duke Energy Interconnection Agreement, plus deposit (estimated: $20,000.00 (plus $1/kW)) to cover Duke Energy study expenses. Duke Energy assures most of these expenses will be refunded once the study is complete.

**Note:** All Generating Facilities connecting to lines greater than or equal to 35 kV are ineligible for the Duke Energy Fast Track Process, regardless of size. This pertains to all PVs connected to UNC electric distribution systems. The Duke Energy Interconnection Agreement must be approved by Duke Energy prior to construction.

The customer/building facility shall install PV System Meter CT Panel, meter base, 1 ¼” conduit, and lockable disconnect as defined in Figure 1 and Figure 2. The lockable disconnect shall be manual, load break, disconnect or safety switch with a clear, visible switch position indication between the University electric distribution system and the PV. This switch must have padlock provisions for locking in the “Open” position. The switch shall be readily accessible to EDS personnel. The switch must be in sight of the transformer serving the facility and on the PV array side of the point of electrical interconnection with the University electric distribution system. This switch must be labeled “Solar PV Disconnect Switch”. The switch may isolate the PV array only and its associated load from the University electric distribution system. EDS, in its sole discretion, determines if the switch is suitable and necessary.

All PV systems installed on University property shall have a documented and stamped PV system design, using an industry standard method and provided by a NC licensed Professional Electrical Engineer.

All PV systems shall be designed and installed per all University, Town of Chapel Hill, Department of Labor and National standard/regulations (i.e. National Electrical Code, NFPA 70E, EDS Design & Construction Standards, NC OSHA 1910.269 (29 CFR 1910), etc...). The NC State Construction Office and EDS shall review/approve all PV system designs. These same entities shall inspect/approve construction prior to operational use.

**EDS RESPONSIBILITIES**

a. Review/Approve application of all PV technology proposed for use on University facilities.

b. Manage the overall PV system operation.

c. Review/Approve the design and construction of all such installations regardless of location when installed on University property that is served by and connected to the University electric distribution system.

d. Ensure that all necessary and appropriate disconnect devices / switches are installed, in accordance with EDS design and construction standards, to disable energy input to the electric distribution system at the nearest point of the PV connection in the event of any disturbance or disconnect on the electric distribution system. Please refer to Figure 1 for additional details.

e. Provide needed maintenance (preventive, corrective, predictive) with EDS specialists or contracted maintenance services.

f. Evaluate major equipment and/or system failures. Council with Energy Services customer to make decisions regarding PV System replacement.
ENVIRONMENTAL BENEFITS

The environmental benefits are any and all quantifiable credits and allowances resulting from the connection of the renewable energy source (PV system) to the University’s electric distribution system. These may include Renewable Energy Certificates, Carbon Credits, offsets, Emissions allowances, “green tags”, and any other asset or term that may be used to describe the environmental benefit associated with the generation and use of a renewable energy source. Generally, these environmental benefits will be used to meet the University’s carbon reduction commitments. Energy Services shall be solely responsible to manage the environmental benefits associated with renewable energy sources for the University.

COST MANAGEMENT

All power generated from PV sources shall be metered at the output of the PV cell or array. This metering is to allow constant observation of power generated by the PV facility. When any PV cell or array is connected in parallel with or supplies power to the electric distribution system on-line with the system, all power produced by the PV cell or array will be considered to reduce the net power delivered by the electric distribution system. The building utilities account will be credited for electricity generated based on the average cost per kwh minus an operations/maintenance fee to cover EDS owners and maintenance expenses. This operations/maintenance fee will be evaluated annually within each upcoming Fiscal year.

The installation of all PV electric power generators shall be consistent with the University policy regarding the cost of such installations. The customer can decide based on LEED points, building project goals, and criteria other than economic. An economic analysis shall be made for all such proposed installation to ensure that the cost guidelines are followed.

REFERENCE

NC OSHA 1910.269 (29 CFR 1910)
NC Interconnection Procedures, Forms, and Agreements (October 9, 2018): Docket No. E-100, Sub 101 and E-2 Sub 1159
National Electrical Code Article 690
**FIGURE 1: SOLAR PV SYSTEM TYPICAL ONE-LINE**

**DETAIL NOTES:**

1) MOUNTING LOCATION AND HEIGHT DETERMINED BY EDS. CTs AND VOLTAGE TAPS PROVIDED BY EDS.

2) CT CABINET ENCLOSURE SUPPLIED BY CUSTOMER. REFER TO FIGURE 2 FOR ENCLOSURE SPECIFICATION AND DRAWING DETAILS.

3) INVERTERS HAVE TO BE TESTED AND LISTED FOR COMPLIANCE WITH THE LATEST PUBLISHED EDITION OF UL 1741 FOR UTILITY INTERACTIVE INVERTERS.

4) THREE-PHASE INVERTERS SHALL BE MANUFACTURED AFTER MARCH 7, 2007.

<table>
<thead>
<tr>
<th>INVERTER PROTECTIVE SETTINGS TABLE</th>
<th>UV SETPOINT (27-1)</th>
<th>0.95 PU, 2.0 SECOND DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>UV SETPOINT (27-2)</td>
<td>0.5 PU, 0.16 SECOND DELAY</td>
<td></td>
</tr>
<tr>
<td>CV SETPOINT (59-1)</td>
<td>1.10 PU, 1.6 SECOND DELAY</td>
<td></td>
</tr>
<tr>
<td>CV SETPOINT (59-2)</td>
<td>1.2 PU, 0.16 SECOND DELAY</td>
<td></td>
</tr>
<tr>
<td>UF SETPOINT (61F)</td>
<td>59.3 Hz, 0.16 SECOND DELAY</td>
<td></td>
</tr>
<tr>
<td>UF SETPOINT (61D)</td>
<td>50.3 Hz, 0.16 SECOND DELAY</td>
<td></td>
</tr>
</tbody>
</table>

*UV = UNDER VOLTAGE*   
*CV = OVER VOLTAGE*   
*UF = UNDER FREQUENCY*   
*OF = OVER FREQUENCY*
Appendix B (Old Standard Area Lighting)
EDS General Specification Number: ES 12-03

THE UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL
ELECTRIC DISTRIBUTION SYSTEMS GROUP
ENERGY SERVICES DEPARTMENT

OLD STANDARD AREA LIGHT POLE

GENERAL SPECIFICATION NO. ES 12-03  DATE: Nov 2009

SCOPE

This specification covers the physical and structural requirements for specific light poles that will be used in designated areas on the campus of UNC-CH. It includes the standard features required and any optional features that may be specified and indicated on a purchase order.

DESCRIPTION

This pole and base shall be manufactured by or under the specifications of the Union Metal Company and shall be of the Euclid family or manufactured by or under the specifications of the Sternberg Company, Oxford Series, or manufactured by Main Street Lighting. The pole shall include those specific features listed below. The manufacturer and pole style is required to match other existing luminaries and light poles installed across the campus. A picture of the pole to match is attached on page 3. The pictures illustrate a Union Metal fixture and poles that meet this specification.

I. PHYSICAL ATTRIBUTES - POST

Post Structure Material - The post shall be cast or extruded aluminum conforming to the requirements of AA356.0F or AA319.0F aluminum.

Post Height – The post height shall be nominal twelve (12) feet, including the base assembly height, with the exact height from the top of the luminaire final to the base foundation of 14'-10-3/8".

Design – The post shall have 16 evenly spaced Doric-type flutes around the periphery of the post throughout the entire length. Metal thickness at the base of each flute shall be at least 1/2 the total thickness of the post material at the thickest point. The radius of the flutes crest shall not exceed the thickness of the metal in the post. The post shall be of one piece construction with a smooth surface suitable for painting. The post shall have a continuous taper of .14" per foot and shall be welded to the cast aluminum base by means of a continuous weld with an adequate heat temper to provide the necessary structural strength. A fabricated aluminum tenon that meets the requirements for a 6063 aluminum alloy shall be welded to the top of the shaft and sized to accept the luminaire head to be installed (3" long, 3-1/2" OD tenon on the shaft). All flutes will be rolled simultaneously, with no flutes rolled individually. Flutes shall be an integral part of the pole and shall not be a sheath installed over a round pole.

Color – The color of the post, when finished, shall be UNC Dark Green RAL 6012, or equivalent. The post shall be coated to a finish coating (paint) thickness of 2 mils minimum.

II. ORNAMENTAL BASE ASSEMBLY

Base Material – The base, as a separate feature of the pole assembly, shall be by Union Metal, Sternberg or Main Street Lighting, to be compatible with the pole features and manufactured of cast aluminum conforming to the requirements of AA356.0F or AA319.0F aluminum. The base shall have 16 equally spaced flutes that conform to the shape of the flutes on the pole. It shall be one piece heavy wall construction with a removable access door suitable for hand access to connect wires internal in the base and secured with a bolt that requires an Allen wrench for installation or removal. The floor of the base shall be 1" thick and be an integral part of the base (also see Mounting Provisions below).
Height / Diameter – The base shall be 27 inches high from the foundation level to the post connection point. The base shall be 16.5” in diameter, round.

Electrical Connection – The base shall be furnished with a 1/2” – 13 UNC grounding provision internal in the base, including the stud, nut and washer, and be easily reached from the access door.

Mounting Provisions – The base shall have four (4) reinforced slots integrally cast into the bottom of the base to accept four (4) - 3/4” diameter anchor bolts on a 12” circle, one bolt per slot. The base shall also include 1-2” round holes on each opposite side of the base centerline, 3.5” on center from the centerline, to be used for conduit entry for conductors (2 holes total). The base shall not include mounting bolts as provisions other than cast-in-place concrete are made for providing the foundation.

Color – The color of the base assembly, when finished, shall be UNC Dark Green, RAL 6012 or similar, to match the pole and luminaire. The post shall be coated to a finish coating (paint) thickness of 2 mils minimum. Paint is to be polyester powder or acrylic enamel, baked for the final finish at sufficient heat to provide a long-life surface.
EDS General Specification Number: ES 12-04

THE UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL
ELECTRIC DISTRIBUTION SYSTEMS GROUP
ENERGY SERVICES DEPARTMENT

OLD STANDARD AREA LIGHTING FIXTURE HEAD

GENERAL SPECIFICATION NO. ES 12-04

APPROVED: John T. Laetz, Manager - Electric Distribution Systems  DATE: Rev November 23, 2009

SCOPE

This specification covers the mechanical and physical requirements of specific lighting fixture / luminaire mounting heads that will be used in designated areas on the campus of UNC-Ch. It includes the standard features required and any optional features that may be specified and indicated on a purchase order.

DESCRIPTION

The fixture head shall be manufactured by the Union Metal Company, Euclid family, or the Sternberg Company, Main Street family or the Main Street Lighting Company. This head shall include those specific features listed below. The style and type fixture specified herein is required to match other existing luminaries and lighting fixtures installed in designated areas across the campus. Pictures of the fixture and pole are included to assist in matching. The pictures illustrate a Union Metal fixture and pole that meet this specification.

I. PHYSICAL ATTRIBUTES

Body Design - The luminaire head shall consist of a framework that houses, in an octagonal pattern, lenses evenly spaced in accordance with the specifications used by Union Metal, Sternberg or Main Street. There shall be no upward spites on the fixture. The luminaire shall be cast aluminum conforming to the requirements in AA319.0F and shall include a cast, hinged roof for easy access. The cageholder / luminaire head shall sit on a Capital / Fitter, secured by three (3) stainless steel set screws that are at least 1/4” in diameter. The cageholder shall have a base diameter (ID) of 3-1/2” to accept the tenon size of the Capital or Fitter.

Capital – The Capital shall be similar to a Union Metal No. 1B and shall fit a No. 1 Cageholder, or similar. The Capital shall be sized to fit a 3-1/2” tenon on the support pole and shall be included with the luminaire as a complete unit when assembled. The Capital shall be secured by three (3) stainless steel set screws that are at least 1/4” in diameter, with Allen heads. The dimensions and appearance shall be similar to this for any Fitter to be used.

Size – The overall height of the luminaire head, measured from the point where the head mounts to the pole to the top of the finial, will be 34 1/2” +/- ½”. The finial will be 7-1/2” +/- ½” high. The overall outside width of the fixture shall be 17” +/- ½”, measured between the widest projections of the cage members on opposite sides (straight parts of the sides, not the corners).

Decorative Finial – The finial, approximately 7-1/2” tall, shall be cast aluminum conforming to AA319.0F and it shall be securely attached to the top of the luminaire body.

Color / Coating – The color of the luminaire, when finished and including the finial, shall be UNC Dark Green, RAL 6012 or equivalent. All parts (interior, exterior) of the assembly shall be coated to a finish coat thickness of 2 mils minimum. The coating will be a gloss type, polyester or acrylic enamel, applied over a prime coat and baked sufficiently to provide for a long life.

Internal Assembly Access – The top of the assembly shall be hinged to provide access, with the top held securely in place by a thumb screw.

EApearance – This specification includes color pictures of existing poles and fixtures to allow reasonable understanding of the fixture style, color, appearance, design and fitting complement, included to demonstrate the existing fixtures to match.

II. OPTICAL SYSTEM

A. The optical system shall consist of an octagonal shapes luminaire assembly with either:
• a single prismatic refractive acrylic lens panel that will securely fit into the inside of the assembly, with an extruded edge at the top and bottom to allow placement of the lens panel so as to seal the unit against entry of insects, water and dirt.
• Individual refractive lens panels arranged around the luminaire structure, each of which fits securely into the inside of the assembly and adequately sealed to prohibit entry by insects, water or dirt.

The top and bottom will be self-sealing, using a rubber gasket, with insertion of the lens panel into the assembly. The lens panel shall be made from a polycarbonate material similar to LEXAN ® or CELEBRE ®, with sufficient resistance to cracking or shattering if impacted by objects (e.g., bricks or stones of approximate 4 lbs weight each) thrown at the lamp. The lens panel shall be resistant to the effects of UV radiation for at least a life of 20 years. Alternatively, the lenses may be single for each panel and be retained by fasteners installed on the inside of the luminaire assembly at the top, bottom and on each side. Other attributes of the panel apply to the alternate. Light distribution, other than from or through the refractor lenses, shall be limited to a plane not higher than 90 degrees from the vertical centerline of the fixture.

B. There shall be no canopy reflector mounted in the head. shall be mounted at the top of the luminaire assembly to create an optical cut-off feature.

II. ELECTRICAL REQUIREMENTS

None. These will be used for lighting but with different lighting mechanisms inside.
# B-24 – STEAM SYSTEM

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Section Page: 1
1. **General Information**
The University owns, maintains, and operates a steam distribution system, and condensate return system serving the University campus and UNC Hospitals. All new facilities, and all expansion of existing facilities, shall utilize this district steam system for space heating, domestic hot water heating, sterilization, humidification, and other process whenever feasible. Deviation from the use of steam as the primary heat source requires analysis showing justification for the variance and written approval from the Director of Energy Services.

The University’s Cogeneration Facility is located at the west end of Cameron Avenue, approximately one mile from the center of campus. Steam is provided from the central facility via a low pressure system (LPS), a medium pressure system (MPS), and a high pressure system (HPS). The LPS shall be utilized for all HVAC loads including humidification. The MPS and HPS provides steam for such process equipment as sterilizes and cage washers that require higher pressures; the MPS and HPS shall not be utilized for HVAC loads including humidification with un-fired steam generators.

2. **System Boundaries**
The steam distribution system continues up to the main pressure reducing valve (PRV) station in a building or the first isolation valve, whichever comes first. The underground design requirements shall govern the design of any such PRV station, including materials and welding requirements.

3. **Safety Relief Valves**
The designer may not install any safety relief valves open to the campus steam distribution system. The distribution system already has safety valves installed and the building design shall not affect these settings. Any safety relief valves installed by a project shall be downstream of a building PRV and shall affect the building systems only. The campus system safety settings are 75 psig, 95 psig, and 195 psig for the LPS, MPS, and HPS respectively. If the building is designed without a PRV, the building equipment must be such that exposure to these pressure limits will not cause harm, and will meet all applicable codes.

4. **Supply Pressures**
The Designer shall calculate and submit the maximum steam demand for each system for any new building, addition, or renovation to the Cogeneration Facility Engineering Representative (CFER) for determination of the adequacy of the existing steam distribution system to meet anticipated demand. The CFER will determine if modifications to the steam distribution system are required. The maximum steam demand shall be expressed in pounds of steam per hour for both the total connected load and the actual expected maximum sustained demand with an appropriate diversity factor. The CFER will provide the Designer with supply steam pressures to be expected at the project door based upon the projected design loads.

5. **Condensate Return**
All building equipment which uses steam and does not contaminate the condensate shall return the condensate to the pressurized condensate return system. An example of contaminated condensate that should not be returned is the drainage from a cage washing unit. The designer shall prepare a breakdown of returned and dumped condensate and submit a summary to the CFER for approval.

The building steam and condensate systems should be chemically cleaned and flushed after construction to remove all debris and as much silica as possible. The campus condensate return system typically has an aggregate silica level of 50 ppb or less. The condensate from a new building or renovation will not be returned to the condensate system until the silica level drops below 200 ppb at the building pumps. Cleaning of the underground mains is covered in a later section.
6. **Tie-Ins to the Campus Steam Distribution System**

Any and all tie-in’s of the project steam and condensate systems to the campus steam and condensate systems shall be supervised by, scheduled with, and coordinated with UNC Cogeneration Facility personnel. Connections to the campus steam system shall be performed by the contractor under the supervision of Cogeneration Facility personnel. The Contractor shall furnish all fittings, pipe, valves, etc., for the tie-in. The tie-in will only be made at such a time when University operations permit an outage. This will typically be when the ambient temperature is between 50 and 80 degrees F. The Contractor shall notify the Designer and the CFER a minimum of fourteen (14) calendar days in advance of a requested steam outage to perform a tie-in. The CFER has final authority on any and all scheduling for such events. Steam will not be admitted to an installation until an account has been set up for the steam usage and a meter has been installed. Steam shall only be admitted to an installation by Cogeneration Systems personnel.

7. **Underground Steam and Hot Water Distribution Conduit (non-walkable)**

7.1. All steam and condensate lines shall be enclosed in a continuous concrete conduit system between manholes. The conduit system has the following general appearance. The pre-cast concrete covers may also have an arched shape. The tunnel system shall be installed with 36” minimum cover, with an emphasis on going no deeper than necessary.

7.2. **Foundation**

7.2.1. The conduit foundation shall consist of a continuous cast-in-place monolithic concrete foundation slab with appropriate expansion joints. The foundation will be poured with concrete having a 28-day minimum compressive strength of 4000 psi. Structural reinforcement shall be designed per the loading requirements by a licensed structural engineer, but in no case shall be less than 6 x 6 - W2 x W2.9 welded wire fabric (6 gage). The structural re-enforcing steel shall meet the requirements in the steel reinforcement section of this document. The foundation shall have a sloped floor and center drain allowing for proper drainage to the downstream manhole of any tramp water in the conduit system. The center drain shall have a minimum dimension of 1 ½"
depth by 5 ½” width. The foundation shall be keyed or notched on either side to accept the pre-cast covers ensuring proper alignment, and preventing lateral motion during backfill.

7.2.2. Slab surfaces shall be screeded straight and to proper grades and pitched uniformly to drainage points. The foundation slab and drain shall extend through building and manhole walls unless noted on the drawings. The top surface of the foundation slab shall be given a hand-rubbed, wood float finish. The openings to the manhole from the conduit system shall be sealed off with 4” thick block insulation to prevent air from drafting down the conduit system. The conduit center drains shall not be blocked off from the manhole. Other methods of removable insulation will be considered.

7.3. Pre-cast Covers

7.3.1. The pre-cast concrete covers in the conduit system shall not be used as a means of piping restraint or support in any manner. At expansion loops and elbows, conduit shall be sized to allow for expansion and contraction without damaging the insulation, piping, or conduit structure.

7.3.2. The pre-cast covers shall be manufactured by an industrial/commercial manufacturer who has been manufacturing the style cover selected for a minimum of five (5) years. The manufacturer must provide a minimum of five (5) reference projects where this cover has been used. The covers shall be cast with inside clearance dimensions as shown on the drawings. Suppliers of pre-cast tunnel covers must furnish calculations to the Designer to verify structural adequacy for design loading.

7.3.3. The pre-cast covers shall be designed with interlocking ends such that the covers joined together in a method similar to tongue-and-groove or lap-joint.

7.3.4. The concrete used in the covers shall have the minimum 28 day compressive strength as required by the licensed structural engineer, but shall not be less than 4000 psi in any case. The conduit system shall be designed to withstand all of the following loading conditions.

7.3.4.1. HS-20 highway loads at 2 feet of cover, and

7.3.4.2. Soil loading assuming a soil density of 100 lbm/cuft., at the installed depth of cover, or at 10 feet of cover, whichever is greater.

7.3.5. Structural reinforcement shall be designed per the loading requirements by a licensed structural engineer, but in no case shall be less than 6 x 6 - W2 x W2.9 welded wire fabric (6 gage). The structural re-enforcing steel shall meet the requirements in the steel reinforcement section of this document.

7.4. Sealants

7.4.1. A waterproofing sealant shall be used at all joints between foundation slab and pre-cast concrete covers, and at joints between adjacent pre-cast concrete cover sections. The sealants shall be butyl resin or one part polyurethane. The polyurethane sealants shall be equal to SikaSwell S as manufactured by SIKA. The butyl resin sealants shall be equal to ConSeal as manufactured by Concrete Sealants Inc.

7.4.2. The sealant shall be installed so as to provide full coverage of all concrete joint contact surfaces per the manufacturers recommendations. Place sealant on parts to be joined prior to final positioning of the pre-cast structures.

7.5. Waterproofing mastic

7.5.1. A heavy coat of non-asphalt, rubber/resin based mastic for underground use shall be applied a minimum of 12 inches wide to all joints after the joint is made. The mastic shall be equal to Sandell Special Nuflex Mastic as manufactured by Sandell Manufacturing Co., Inc.

7.6. Waterproofing Membrane
7.6.1. A waterproofing membrane shall be installed over the entire conduit system. The membrane shall be polyvinyl chloride. The membrane shall have a nominal thickness of 20 mils, and have a minimum tensile strength of 2300 psi.

7.6.2. The membrane shall be wide enough to drape over the conduit structure and lap over the foundation on both sides in one piece. The membrane shall be extended axially along the conduit system from a large roll so as to minimize the number of joints in the membrane.

7.6.3. The PVC membrane jacket shall be overlapped a minimum of 12 inches and sealed with a non-asphalt resin based sealant at membrane joints to produce a waterproof seal. The waterproofing membrane shall be adhered to the concrete joints and to itself at overlaps. The entire conduit system shall be made waterproof. All manufacturer’s installation recommendations shall be followed.

7.7. Waterproofing Backfill Protection

7.7.1. The waterproofing membrane shall be protected from backfill by a layer of non-woven polypropylene. The polypropylene protective layer shall have an approximate weight of ½ lb. per square yard. The polypropylene covering shall be equal to Terratex non-woven geotextile No. 8 as manufactured by Webtec, Inc. At wrap joints the materials shall overlap a minimum of 12 inches. The wrap joints shall not be coincident with waterproofing membrane joints. All manufacturer’s installation recommendations shall be followed.

7.8. Concrete Conduit Waterproofing Alternative

7.8.1. In lieu of the above membrane and mastic system, the same waterproofing system required for the manholes may be used for the entire conduit system, so long as butyl resin sealants are applied to the pre-cast joints as described in item 7.4.

8. Manholes

8.1. General Structure

8.1.1. Steam manholes shall contain only steam related systems (steam, condensate, heating hot water, and occasionally hot domestic water). Absolutely no other utilities such as sewer, cold domestic water, electrical duct banks, chilled water, etc. shall pass through the steam manholes, or steam conduit system.

8.1.2. Minimum manhole interior dimensions shall be L=10’ x W=10’ x H=8’. Manholes shall be sized in excess of this as required to provide adequate and safe movement within the finished manhole including piping insulation. Free and open access to all operational components such as valves, drains, trap stations, etc. shall be provided.

8.1.3. All steam and hot water manholes shall be constructed with a minimum of two egress paths, one on each side of major obstructions such as through piping, and generally on opposite sides of the manhole. Egress paths shall be coordinated with the manhole ventilation design.

8.1.4. All steam manholes shall have a high-low natural ventilation system. The ventilation system shall be designed to ventilate the manhole only, the conduit system will be blocked off with insulation from drafting with the manhole. The low vent shall be on the opposite side diagonally from the high vent if possible, or at a minimum on the opposite parallel side. The high vent can be common with a ladder access point. The high vent shall be positioned such that rain drops do not drop on top of equipment and piping. Typically, the low vent is constructed of 36” diameter ductile iron pipe adjacent to the manhole with a penetration six (6) inches above the manhole floor. Alternately the down shaft can be cast integrally with the manhole wall. The external ductile piping arrangement has proven to provide superior ventilation because the exterior shaft with separation stays coolest. In all cases the down shaft shall be exterior to the manhole, shall have a
cross-sectional area equal to or greater than a 36” diameter pipe, and shall penetrate the manhole six (6) inches above the floor. The penetration shall be sealed full wall thickness with non-shrink grout and shall be waterproofed according to the manhole waterproofing section of this document. The landscaping around the manhole shall prevent any surface water drainage to any manhole opening or cover. The diagram below shows a down-shaft arrangement for the low vent.

8.1.5. The manholes shall have a minimum of three (3) feet of cover, and the overall depth of manholes shall be kept to a minimum. Consideration shall be given to accessibility and maintainability when designing manholes.

8.1.6. The access points shall be a minimum of 30 inches in diameter. In non-roadways use 36” square HS-20 highway rated aluminum hinged doors. Even with such a rating, the aluminum doors are not suitable for actual roadway use (repeated traffic crossing). In an actual roadway the doors shall be standard 30” round cast iron manhole ring and covers. The accesses shall be designed for safety, accessibility to the equipment, maintainability, operability, adequate ventilation, and must be large enough to pass any equipment installed within. Regardless of installed location or type, all doors shall carry a HS-20 highway rating.

8.1.7. All access doors shall have an aluminum or stainless steel, welded on, tag that bears the identification number of the manhole. The letters shall be two (2) inches in height. The letters may be field “written” with a stainless or aluminum welding bead in lieu of a fabricated tag. The tag shall have the form “STM-XXX” where STM stands for steam, and XXX to be replaced with the Cogeneration Systems manhole number.
8.1.8. Drains shall be provided in all manholes. Open drains shall be routed to the nearest storm sewer or other suitable storm drainage location, as the purpose of these drains is simply to remove infiltrated rain water. These drains shall have a minimum diameter of four (4) inches. Where gravity drains cannot be installed, sump pumps may be utilized. The sump pumps shall be Little Giant High Temperature Sump Pumps only.

8.1.9. Whenever possible electrical switching equipment shall be located external to the manhole in an adjacent building. In no case shall electrical equipment be located in a non-ventilated manhole. All electrical equipment within manholes, including junction boxes, shall be suitable for continuous full load operation in a 100% relative humidity, 200 degrees F ambient condition.

8.1.10. All electrical conduit in manholes and in steam conduits shall be aluminum only. The only exception is naturally ventilated (with power assist) walk-able tunnels, where the conduit may be rigid galvanized.

8.1.11. All wiring shall be rated for a minimum of 200 degrees C and sized appropriately for the load. Referencing table 310-19 of the 1999 National Electric Code, the wiring shall be types, FEP, FEPB, or PFA.

8.1.12. Steps leading into manholes shall be meet OSHA standards and shall be designed to withstand a sustained temperature of 200F.

8.1.13. Ladders entering manholes shall be constructed of stainless steel, aluminum, or hot dipped galvanized. Fabricated ladder risers shall be 2 inch by 3/8 inch flat bar. Fabricated ladder rungs shall be 1 inch re-bar. Smooth, round rungs will not be accepted. The rungs shall rest in drilled holes and be welded in position. Similar pre-manufactured stainless steel, aluminum, or hot dipped galvanized ladders or components may be used with the owners written approval of a shop drawing. The ladders shall be anchored to the manhole wall using stainless steel only anchor bolts. Absolutely no individual step wall anchored type ladders will be allowed. No carbon steel ladders will be accepted. If hot dipped material is chosen, the ladder shall be dipped as a complete structure, not fabricated of individual pre-dipped components.

8.1.14. Structural reinforcement shall be designed per the loading requirements by a licensed structural engineer, but in no case shall be less than No. 4 reinforcing bar on twelve (12) inch centers. The structural reinforcing steel shall meet the requirements in the steel reinforcement section of this document.

8.1.15. The walls, roof, floor of the manholes shall be designed per the loading requirements by a licensed structural engineer, but in no case shall be less than eight (8) inches thick.

8.2. Manhole Waterproofing Materials

8.2.1. The primary waterproofing barrier shall be constructed of a sprayed on, or rolled on material that meets or exceeds all of the following requirements.

8.2.1.1. Material shall be non-toxic.

8.2.1.2. Water based, and can be applied to green, un-cured concrete.

8.2.1.3. Final cure must occur within 48 hours.

8.2.1.4. Tensile strength shall not be less than 50 psf.

8.2.1.5. Elongation without failure shall be at least 1000%.

8.2.1.6. Resilience (elongation recovery) shall be at least 95%.

8.2.1.7. Moisture vapor transmission shall be no greater than 0.02 gm/sq.ft./hr.

8.2.1.8. Shall be impenetrable to water up to 30 psig.

8.2.1.9. Shall bond to the concrete with a pull off force not less than 820 psf.

8.2.1.10. Shall remain stable and bonded up to 240 degrees F.
8.2.2. The primary waterproofing backfill protection membrane shall be a high strength polyethylene geomembrane slip sheet, and shall meet or exceed the following requirements.

8.2.2.1. Have a minimum thickness of 10 mils.
8.2.2.2. Have a minimum puncture resistance of 70 lbs.
8.2.2.3. Have a minimum tensile strength of 25 psi.

8.2.3. An example of these types of materials can be found at www.eproserv.com in the EcoLine-R, EcoLine-S, and EcoShield-E line of products, as manufactured by EPRO Waterproofing Systems.

8.3. Manhole Waterproofing Methods

8.3.1. Manhole waterproofing shall be a three step process consisting of detailing cold joints and penetrations, applying a sprayed on / rolled on membrane to provide overall waterproofing, and the application of a backfill protection membrane.

8.3.2. The first, or detailing step consists of applying a roll on coat of the waterproofing compound to all cold joints and penetrations at least 3 inches on either side of the joints and radial out from the penetrations. While still wet, an embedding fabric shall be placed in the membrane coat. Then a second coat shall be applied to the embedding fabric until saturated.

8.3.3. The second, or membrane application step is performed by rolling or spraying membrane material to the manhole exterior surface in wet lifts until the material is not less than 60 mils thick on the concrete surface. The surface shall be fully coated, and free of gaps and cracks.

8.3.4. The third, or protection layer is a process of applying a polyethylene geomembrane slip sheet that will protect the waterproofing membrane from backfill. This membrane shall be applied such that the overlaps are not less than 12”, and are sealed with a roller compressed wet layer of waterproofing material. Waterproofing seal tape shall be applied to seam overlapping 2 inches on either side of the seam.

8.3.5. In some circumstances there is a fourth process of applying a drainage membrane on the outside of the protection membrane to aid in ground water drainage away from the structure. In most cases however, the manhole is backfilled with a layer of pea-gravel which acts as the drainage mechanism.

9. Walk-Through Tunnels

9.1. Where walk through utility tunnels are applicable to the project, the walk through tunnel containing the steam systems shall be built and waterproofed to the same standards as defined in the manholes section of this document.

9.2. The only other utility that may share the tunnel space with the steam, condensate, and heating hot water is UNC Chilled Water. Standards of agreement are in place for the joint use of the tunnel for those two departments (Cogeneration Systems and Chilled Water Systems). All other utilities such as electric duct, sewer, domestic water, storm drainage, etc. are expressly forbidden.

9.3. All walk-through tunnels shall have a minimum of 8 feet of head clearance, and 3 feet of clear aisle space for walking and carrying materials.

9.4. All walk-through tunnels shall be cast-in-place.

9.5. Personnel shall have a means of egress at a maximum of 300 feet in any direction (600 feet between egress points).

9.6. The walk-through tunnel system shall have natural ventilation with fan powered assist. The fans shall be designed such that the noise emitted is not greater than 50 dbA at five feet (measured on the surface, distance from the inlet/exhaust). The fans shall have a hand/off/auto switch. In auto mode they shall be controlled by local thermostat.
9.7. Repairs to the piping systems will be made within the tunnel system. Provisions must be made to provide access points where 21 foot random length piping can be lowered into the tunnel and moved to the necessary locations. Room to make repairs to the piping shall be provided in the design.

9.8. Adequate lighting shall be provided throughout the tunnel for egress, operation, and maintenance.

9.9. Walk-through tunnels are the only place in the steam distribution system where expansion joints are allowed instead of expansion loops as a means of accommodating thermal expansion. Expansion joints used in walk-through tunnel systems shall meet the following requirements:

9.9.1. Expansion joints shall be designed for pressure, temperature, movement, spring rate and cycle life per Expansion Joint Manufactures Association (EJMA) standards.

9.9.2. Expansion joints shall be weld-end, packless, constructed of externally pressurized, double-ply (minimum) bellows.

9.9.3. The bellows material shall be 625 stainless, with carbon steel fittings.

9.9.4. Control Rings shall be constructed of cast steel, or high grade cast nickel-iron.

9.9.5. Expansion joints shall be suitable for continuous operation at 200 psig and 450F.

9.9.6. Provide joints with equalizing rings to reinforce the roots and walls of the corrugations against internal pressure.

9.9.7. Stretching of expansion joint to correct for piping misalignment or to accommodate available end-to-end spacing shall not be allowed.

9.9.8. Remove all shipping rods and spacers and clean inside of expansion joints thoroughly before putting joints into service.

9.9.9. Anchors and guides shall be installed per the project documents and per the manufactures guidelines prior to conducting piping system pressure tests or putting joints into service.

9.9.10. Manufacturer shall be present to instruct the Contractor and witness the installation of all expansion joints.

9.9.11. Manufacturer shall be required to review and approve, in writing, the alignment and installation of all expansion joints prior to conducting piping system pressure tests, or operation of system.

9.9.12. All expansion joints shall be provided with a minimum 5 year full replacement warranty.

10. Concrete Reinforcing Steel

10.1. All re-enforcing steel used in underground steam system structures including, but not limited to manholes, pre-cast members, tunnel slab, tunnel walls, etc. shall be epoxy coated.

10.2. Non-coated re-enforcing steel, bar or wire mesh, will not be accepted.

10.3. The epoxy coated re-enforcing steel shall be produced by a manufacturer who holds an Epoxy Coating Plant Certification issued by the Concrete Reinforcing Steel Institute (CRSI).

10.4. The coated re-enforcing materials shall meet or exceed the latest versions of all the following standards.

10.4.1. ASTM A775: Standard specification for epoxy coated steel reinforcing bars

10.4.2. ASTM A934: Standard specification for prefabricated epoxy coated steel reinforcing bars

10.4.3. ASTM D3963: Standard specification for the fabrication and job site handling of epoxy coated steel reinforcing bars

10.4.4. ASTM A884: Stand specification for epoxy coated steel wire and welded wire fabric for reinforcement.
11. Underground Steam System Routing

11.1. The Contractor shall coordinate the routing of all steam and steam condensate piping with other contractors prior to installation.

11.2. Furnish and install valves as required to allow for complete system venting and drain down.

11.3. Grade piping and piping conduit systems not less than 1/8th inch per foot in the direction indicated on the drawings.

11.4. Proper standoff shall be provided to protect other utilities from damage from construction, maintenance, or operating conditions. Consideration shall be given to potential damage to other utilities from high temperatures near steam lines.

11.5. Standoff from electrical utilities or systems shall be a minimum of 10 feet. When adequate standoff cannot be achieved, any portion of a duct bank within ten (10) feet of steam conduit in any direction shall be insulated with two (2) inches thick cellular glass on the three sides closest to the steam line, until at a point not closer than ten (10) feet.

11.6. Standoff from chilled water lines shall be a minimum of ten (10) feet. When adequate standoff between chilled water and steam lines and the chilled water lines cannot be achieved, the chilled water lines shall be insulated with a minimum of two (2) inches cellular glass insulation.

11.7. When steam and chilled water lines cannot be separated by ten (10) feet or more and they must run parallel for a distance of more than 50 feet, then consideration shall be given to a combined walk-through utility corridor, where the steam and chilled water systems share a common tunnel system.

11.8. Piping in non-walk-able systems shall have a locating wire and warning tape installed meeting the following requirements:

11.8.1. Direct bury a bright yellow plastic warning tape buried 12 inches above the center of the steam conduit structure. The tape shall read “WARNING STEAM – WARNING STEAM – WARNING STEAM”.

11.8.2. Along with the warning tape 12” above the steam conduit direct bury a locating wire. The wire shall be equivalent to Annixter #6Q-1202-05 (bright Yellow), direct burial 2 conductor, 12 gage stranded copper.

11.8.3. The wire shall penetrate the manholes through a one inch PVC sleeve, and be coiled on a hook inside of the manholes. The sleeve shall be sealed with a high temperature silicone sealant around the wire.

11.8.4. The wire shall not continue through manholes, but shall be broken inside of each manhole. The coiled wire inside of the manholes shall be of sufficient length that it will extend out of the manhole doors 10ft.

11.8.5. This wire will be used with Cogeneration Systems’ locating equipment to aid in finding buried steam lines. The wire shall be clearly labeled on the hooks inside of the manholes to say “Trace Wire”

12. Steam, Condensate, and Heating Hot Water Piping

12.1. All piping in the steam, condensate, and heating hot water piping distribution systems shall be built in accordance with the ASME B31.1 Power Piping Code. As dictated by the specifications, the requirements may be greater than explicitly implied in the code.

12.2. All steam, condensate, and heating hot water piping in the distribution system shall have welded joints. No threaded, flanged, or union joints will be permitted (except at pumps, traps, and pressure control valves).
12.3. No steam supply pipe less than 4” nominal shall be used in the central distribution system. No pumped condensate return line less than 2” nominal shall be used in the distribution system. Avoid half sizes (e.g. 2¼”, 3¾).

12.4. Piping which is sized 2” and smaller may be socket welded or butt welded. 2 ½” and larger shall be butt welded.

12.5. No piping smaller than 1” nominal shall be used for any service.

12.6. Butt-welded fittings shall be of a schedule matching the piping to which they are connected and installed in accordance with ASME B16.9.

12.7. Weld-o-lets and sock-o-lets may be used in lieu of tee’s and saddles for branch take-offs from mains 3” or larger provided that the branch take-off is two or more sizes smaller than the main and is not larger than 4” nominal. No "stub-ins" will be permitted. Weld-o-lets and sock-o-lets outside of these guidelines are expressly forbidden.

12.8. Use full size isolation valves throughout the steam distribution system. Do not place reducers in distribution piping for the sole purpose of accommodating smaller isolation valves. Size control valves as appropriate and use reducers to match.

12.9. All piping turns shall be made with standard long radius elbows. Where turns less than 45 degrees are required, a standard long radius fitting shall be cut down and welded in position, mitered joints (offset greater than 5 degrees) are NOT acceptable.

12.10. All piping shall bear the continuous marking of the manufacturer, ASTM grade, and schedule number. Piping found to be defective shall be immediately removed from the site. All piping shall be cleaned of foreign matter both inside and outside before installation. All burrs shall be removed.

12.11. Steam piping 2 inches and smaller: Carbon steel, ASTM A53B or ASTM A106B. Schedule extra standard (XSTD), seamless.

12.11.1. Fittings: ASTM A 105, forged steel, socket-weld, 3000# class, in accordance with ANSI B16.11.

12.11.2. Flanges: ASTM A105 forged steel, socket weld, 300# class, in accordance with ANSI B16.5.

12.12. Steam piping 2 ½ inches and larger: Carbon steel, ASTM A53B or ASTM A106B. Schedule standard (STD), seamless or ERW.

12.12.1. Fittings: ASTM A234-WPB, seamless or welded, butt-weld end, schedule standard. In accordance with B16.9

12.12.2. Flanges: ASTM A105 forged steel, weld-neck, 300# class, in accordance with ANSI B16.5.


12.13.2. Flanges: ASTM A105 forged steel, socket weld, 150# class, in accordance with ANSI B16.5.

12.14. Condensate piping 2 ½ inches and larger: Carbon steel, ASTM A53B or ASTM A106B. Schedule extra standard (XSTD), seamless or ERW.


12.15. Heating hot water piping 2 inches and smaller: Carbon steel, ASTM A53B or ASTM A106B. Schedule extra standard (XSTD), seamless.

12.15.1. Fittings: ASTM A 105, forged steel, socket-weld, 3000# class, in accordance with ANSI B16.11.

12.15.2. Flanges: ASTM A105 forged steel, socket weld, 150# class, in accordance with ANSI B16.5.
12.16. Heating hot water piping 2 ½ inches and larger: Carbon steel, ASTM A53B or ASTM A106B. Schedule extra standard (XSTD), seamless or ERW.
12.16.1. Fittings: ASTM A234-WPB, seamless or welded, butt-weld end, schedule standard. In accordance with B16.9
12.16.2. Flanges: ASTM A105 forged steel, weld-neck, 150# class, in accordance with ANSI B16.5.

13. Thermal Expansion
13.1. For the purposes of calculating piping stresses, anchor loading, etc. the designer shall consider the maximum working pressure of the steam and condensate piping to be 200 psig @ 450F. Every component of the steam and condensate system from anchors, to expansion loops, expansion joints, fittings, valves, trap bodies, etc. shall be capable of continuous operation at these conditions. (NOTE: Trap orifices shall be selected based on the operating condition, not the design condition. Orifice selection is covered in the “Steam Condensate Traps” section of this document).
13.2. For heating hot water systems the maximum working pressure shall be considered 200 psig @ 250F.
13.3. Expansion loops, Z’s, and L’s are the required method for incorporating piping flexibility. Expansion joints will only be considered in walk-through tunnel systems.

14. Piping Supports, Anchors, and Guides
14.1. All piping shall be supported with devices which permit the pipe to expand thermally without wear to the pipe. Slide type supports, or roller type supports may be used. When rollers are used, piping saddles matching or exceeding the insulation depth shall be used. When slides are used, a Teflon slide surface shall be integral to the slide design. All means of pipe supports shall be secured in position. Anchor and guide supports shall be cast into the base slab when it is poured. Supports providing only vertical support may be secured by stainless anchor bolts rather than cast in place.
14.2. All supporting and restraining devices must be selected as part of the system stress analysis. The devices shall be suitable to sustain the static and dynamic loads of the system as defined in the ASME B31.1 Power Piping Code.
14.3. No anchoring systems which use insulation as a means of piping restraint or support shall be allowed. Anchors shall be welded to piping. Saddles shall be tack welded to the piping. Guides structure shall be welded to the piping. All wear shall occur between saddles and roller, or between guides and substrate, with no wear at the piping.
14.4. All structural embedments and anchor bolts penetrating the concrete structures shall be stainless steel. An example would be a simple channel support where a horizontal channel is welded to two 3” pipes embedded into the concrete to create a flat support structure for an anchor, guide, support, etc. The pipes embedded in the concrete would be 304L stainless steel. The channel iron cross member would be carbon steel. Only the material penetrating the concrete needs to be stainless. In the case of 304L stainless pipe welded to carbon steel channel, SS309 filler material would be used to make the dissimilar metal weld. Carbon steel shall not be used within 2 inches of the floor of manholes or pipe conduits.
14.5. For piping systems in conduits with expansion loops, the piping anchors, at a minimum, shall consist of a structural steel channel welded to the pipe. The structural channel shall have a length equal the nominal diameter of the pipe, and a width equal to the ½ the nominal diameter of the pipe. For example, a 12 inch pipe will have a channel that is fully welded along the pipe axis at the contact lines not less than 12 inches, and 6 inches between the welds. A diagram of this example is shown below.
This channel is then welded to the substrate to create an anchor, or is riding on the Teflon surface to create a slide, etc. The channel could be an “H” beam, for a more heavy-duty application. The diagram is intended to show the minimum that will be allowed.

14.6. For systems with expansion joints instead of expansion loops (walk-through tunnels only) the anchoring system will be much more substantial to accommodate the increased loading. The piping shall be restrained in a box type restraint such that piping is restrained at all four quadrants at a minimum. This provides uniform circumferential loading on the pipe. The diagram below shows the minimum allowed attachments to the pipe, producing 8 axial welds evenly spaced around the pipe. In some cases halo rings may be required to further distribute the loading. The formula for length and width is the same as for the standard minimum anchor above.

14.7. Hangers or supports for steam, condensate, and heating hot water piping shall be spaced at maximum distances as shown in the following table:

<table>
<thead>
<tr>
<th>Nominal Pipe Size (inches)</th>
<th>1 to 2</th>
<th>2-1/2 to 3-1/2</th>
<th>4 to 8</th>
<th>10 and over</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Span (feet)</td>
<td>8</td>
<td>10</td>
<td>15</td>
<td>20</td>
</tr>
</tbody>
</table>
14.8. Hangers or supports shall be installed within two (2) feet of each change of direction, in any plane. Protect insulated steam and steam condensate piping at support points with saddles or extended slides welded to the pipe.

14.9. Hangers and supports shall be as manufactured by Fee & Mason, Grinnell, Modern, B-Line or an approved equal.

15. Piping Insulation

15.1. All insulation, coverings, and adhesives shall have a flame spread classification of 25 or less and a smoke developed rating of not more than 50.

15.2. All piping in the non-walk-able conduit systems and connecting manholes shall be insulated with cellular glass only. The cellular glass shall meet the following requirement:
15.2.1. Nominal compressive strength of 90 psi
15.2.2. Water vapor permeability of 0%
15.2.3. Thermal conductivity not greater than 0.29 Btu-in/hr-ft²-°F

15.3. Distribution piping in building mechanical rooms, and in completely ventilated, accessible, full walk-through tunnels can be insulated with 6 lbm/cu-ft, high density fiberglass as an alternate (this does not include normal manholes). The transition from cellular glass to fiberglass shall happen within the approved areas, and shall be clearly indicated on the drawings. Any fiberglass insulation that gets wet during construction will be removed and replaced at the contractors expense.

15.4. For both the fiberglass and cellular glass insulating systems the insulation thickness shall be in accordance with the table below.

<table>
<thead>
<tr>
<th>Nominal Pipe Size</th>
<th>Thickness (Steam)</th>
<th>Thickness (Condensate)</th>
<th>Thickness (Heating Hot Water)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot; to 2&quot;</td>
<td>2 1/2&quot;</td>
<td>1 1/2&quot;</td>
<td>1 1/2&quot;</td>
</tr>
<tr>
<td>2 1/2&quot; to 4&quot;</td>
<td>3&quot;</td>
<td>2&quot;</td>
<td>2&quot;</td>
</tr>
<tr>
<td>5&quot; or Greater</td>
<td>4&quot;</td>
<td>3&quot;</td>
<td>3&quot;</td>
</tr>
</tbody>
</table>

15.5. Pipe surfaces shall be clean and dry prior to insulating. Insulation may be temporarily held in place with stainless steel wire or fiber re-enforced tape overlapped a minimum of 6 inches prior to the jacketing being installed. The tape and/or wire may remain on the insulation beneath the final jacket.

15.6. Insulate all unions, flanges, and valves with removable blanket wraps such that the insulation can be removed for maintenance and operation, and then replaced.

15.7. All insulated piping shall be wrapped with 20 mil aluminum or stainless steel jacket. This includes piping in the non-personnel areas such as the underground concrete piping conduits.

15.8. At all points where insulated hot water, steam, and condensate pipes are supported, the pipe shall be fitted with an appropriately sized pipe saddle or extended slide prior to insulating. The saddle or slide shall be left exposed at the bearing surface; the insulation shall butt neatly against the ends and sides and fill the voids of the saddle or slide.

15.9. Insulation shall be extended continuously through pipe sleeves.

15.10. Only non-asbestos insulation materials shall be used for any insulating medium.
16. System Drainage

16.1. The steam distribution system shall have a drip leg and trap station at every low point in the system. The condensate return system, and hot water systems shall have drains at every low point, and shall have vents at every high point.

16.2. The steam distribution system shall have a drip and trap station at least every 450 lineal feet of piping run.

16.3. For every main line isolation valve in the steam system. Closing the valve creates a dead leg in the system with a high point and a low point. The side of the valve creating a low point (side that holds water) shall have a drip leg and trap station. The side draining away from the valve shall have a 2 inch full port manual drain. For valves with supply pressure on both sides, and where the valve is the low point relative to both sides, a trap station shall be installed on both sides of the valve.

16.4. The drip legs shall be full size through 8 inch piping and shall be at least ¼ the size of the main line for lines larger than 8 inch. (i.e. 10” drip leg on a 20” main). The legs shall be of sufficient depth to hold temporary condensate surges until the traps can remove the condensate.

16.5. The traps shall be located sufficiently above the bottom of the leg so as to prevent dirt from entering the trap line.

16.6. All blow down drain and vent valves shall be 2 inch 600# class, full port, socket welded gate valves. The drains shall have welded construction with the end of each drain terminating in a Sch. 80 threaded pipe nipple. The entrance end of the nipple shall have its threads cut off, prepped, and welded in position. A threaded cap shall be placed on the exit end of the nipple.

17. Steam Condensate Traps

17.1. All steam traps installed in the campus distribution system shall be of the inverted bucket type.

17.2. All steam traps in the distribution system will be standardized to one trap. The Armstrong inverted bucket model 813 with a 1" connection size. For the campus LPS system the orifice size shall be 5/16". For the campus MPS system the orifice size shall be 1/4". For the campus HPS system the orifice size shall be 7/32". These orifices are matched to the model 813 trap for the pressure differential in the systems.

17.3. The model 813 trap is 12 inches tall, and must be positioned below the steam line to effect proper drainage. This shall be taken into account in the design of the system.

17.4. Traps shall be installed with isolation valves, unions, check valves, and strainer. Blow down valves shall be provided on the strainers. Trap discharge shall be routed to an atmospherically vented flash tank, and then to a condensate return pump set, preferably in the closest building mechanical room. Injecting trap discharge into a condensate return main is not permitted.

18. Valves

18.1. All valves shall be brand new, un-refurbished, first quality.

18.2. All isolation valves 2 ½” and above in the steam distribution system, up to and including the first valve inside of a building, shall be full port, butt-weld-end 300# class, gate valves suitable for operation at 450F. No brass or copper shall be permitted.

18.3. All isolation valves 2” and below shall be full port, socket weld 600# class, gate valves suitable for operation at 450F. No brass or copper shall be permitted.

18.4. Where possible, a project shall provide valves from one manufacturer in the underground steam, condensate, and hot water systems.

18.5. The acceptable isolation valve manufactures are (in no order):

18.5.1. Crane
19. Condensate Return Units

19.1. All building and trap condensate shall be routed to an atmospherically vented flash tank prior to entering the condensate receiver.

19.2. Condensate return pump/tank sets shall be duplex type provided with a float-operated mechanical alternating switch, sight glass, and check and gate valves on each pump discharge line.

19.3. The pump set must utilize “off the shelf” electric motors that can be purchased from any typical motor supplier. The motors cannot be custom to the design of the pump or manufacturer.

19.4. The pump set must be rated for continuous operation while pumping 212°F water at a back pressure 75 psig.

19.5. The pump set shall be provided with integral back pressure regulators for the pumps.

19.6. The pump set must come standard with a tank that is elevated 2 feet above the pumps as a pre-manufactured set.

19.7. The unit shall be installed such that the motors are not less than one foot above floor level, with two feet preferred in manholes and pits.

19.8. The pump set should be as manufactured by SHIPCO Pumps, type PEC (Propeller Elevated Condensate) or equivalent.

20. Condensate Meters

20.1. The contractor shall provide and install a condensate meter for every building to measure the condensate returned from the building.

20.2. Condensate meters shall be Niagara hot water meters of type MTX or WPX as sizing dictates, with local mechanical totalizers and integrated dry contact closures. Dry contacts should not be confused with a pulse output, the contacts provide momentary contact closure once per block unit of total. It does not provide rate as a pulse transmitter does. The contacts shall be left disconnected, they will be connected at a later date by Cogeneration Systems. The engineering specifications and cut sheets can be found at www.niagarameters.com.

20.3. The meter shall be sized to handle the full pumping rate of the condensate return unit, with both pumps running in a high-high tank level condition.

20.4. Strainers shall be provided upstream of each meter with mesh sizing per the meter manufacturer’s recommendation.

20.5. An isolation gate valve shall be provided on the discharge side of the meter, isolating the meter from the campus condensate system.

20.6. A check valve shall be provided in the meter discharge line downstream of the meter and installed according to the manufacturer’s recommendations.

20.7. The meter shall be installed in a horizontal pipe with the dial facing up, and shall be easily accessible. The reader shall not have to climb a ladder, or enter a pit to read the meter.
20.8. The meter shall be installed with no obstructions of any kind for a distance of ten (10) pipe diameters upstream of the meter, and 5 pipe diameters downstream of the meter. A general installation diagram is shown below.

21. Steam Meters

21.1. UNC Cogeneration Systems will provide, install, and commission a steam meter to monitor building steam usage for each feed to the building. The project shall provide a monetary reserve in the amount of $7,500 payable to UNC Cogeneration Systems to cover the cost of the equipment and installation. If the building has dual feeds (high and low pressure) the reserve shall be $10,000.

21.2. The project shall leave a 15 pipe diameter, horizontal, accessible pipe run inside of the building for the meter placement. Within the 15 pipe diameter run, a 180 degree section (left or right, not top or bottom), two feet long, shall be left completely unobstructed for a radius of 18 inches away from the pipe. This unobstructed section shall be centered 10 pipe diameters from the inlet of the pipe section. There shall be no other instruments in this section. See the diagram below.
21.3. The meter section location shall be indicated on the design drawings. The drawings shall indicate this section of piping is reserved for UNC Cogeneration Systems, and that nothing can be placed in this section of piping.

21.4. Meter section placement can be upstream or downstream of the building PRV. However, the meter section shall always be placed upstream of any building use points or branch lines. The designer shall coordinate the meter placement with the CFER so the proper elements can be purchased.

21.5. The electronics for the meter will be housed in a 20x20x10 inch deep control enclosure. UNC Cogeneration Systems will provide this enclosure, and turn it over to the contractor for mounting so that he has a termination point for the required wiring.

21.6. The enclosure shall be mounted such that the bottom face is 56" above finished floor elevation.

21.7. The enclosure shall be mounted in an area as close to the meter piping section as feasible, but where the ambient air temperature will not exceed 100°F. The designer shall show the appropriate location on the contract drawings, and the contractor shall confirm with the CFER when taking delivery of the enclosure.
21.8. The project shall provide a dedicated 115V circuit for the steam meter with conduit and wiring brought to the meter control enclosure. The power conduit shall not be less than \( \frac{3}{4} \)" and shall enter the enclosure at the top right corner. This circuit shall have a dedicated 15 amp breaker, and nothing else shall connect to this circuit.

21.9. The project shall provide a data connection running from the building main data switch to the meter control enclosure. The data conduit shall not be less than \( \frac{3}{4} \)" and shall enter the enclosure at the top left corner. The data cable shall be connected to the Steam V-LAN at the building switch, and be labeled as such. The data cable shall terminate in a surface mount RJ-45 receptacle in the enclosure. The data connection shall meet UNC Telecomm standards for the building.

22. Welding Methodology

22.1.1. Welding shall be done using only the following processes:

22.1.1.1. Shielded Metal Arc Welding (SMAW), also known as "stick" welding
22.1.1.2. Gas Tungsten Arc Welding (GTAW), also known as TIG and Heliarc welding
22.1.1.3. Metal Inert Gas Welding (MIG)
22.1.1.4. Submerged Arc Welding (SAW)

22.1.2. For stainless steel piping, root passes must be applied by the GTAW process with argon gas purge, only.

22.1.3. Fabrication, installation, inspection, examination and testing shall be in accordance with B31.1, and further as the project documents require.

22.1.4. Backing rings (chill rings) or consumable inserts are not allowed.

22.1.5. All completed welds shall be wire brushed a minimum of 2 inches on either side and coated with rust inhibitive primer prior to being insulated.

23. Welder Qualifications

23.1. All welding shall be performed by qualified welders who are regularly engaged in welding of piping systems. The welders’ certifications shall cover the exact procedure(s) to be used on the project piping systems.

23.2. All Welding Procedure Specifications (WPS's) and their supporting Procedure Qualification Records (PQR's) shall be submitted to Engineer of Record for review and approval prior to performing any welding. These documents shall meet requirements of ASME B31.1. Submit a copy of the Manufacturer's Record of Welder or Welding Operator Qualification Tests as required by Section IX of ASME Boiler and Pressure Vessel Code for all welding procedures to be performed by the welding operator.

23.3. The qualifying test segment shall be 2" nominal pipe size with wall thickness within range of WPS for each pipe material specified in this Section. Test position shall be arranged in "6G position".

23.4. Welders shall be qualified in accordance with ASME B31.1. The welding qualification tests shall have an independent witness. The witness shall be a representative of independent testing laboratory, Authorized (Code) Inspector, or consultant approved by National Certified Pipe Welding Bureau.

23.5. Welder qualifications must be current. If qualification test is more than 6 months old, provide record of welding continuity for each welder. Record of welding continuity shall include, at a minimum, the following:

23.5.1. Welder's employer name and address
23.5.2. Date Welder Qualification Test was passed
23.5.3. Dates of work performed and type indicating welding continuity.
23.5.4. If the continuity record is not satisfactory to the Engineer or the owner, the welder shall re-
qualify before performing any work.

24. Weld record
24.1. For all pipe welding the contractors shall submit to the Engineer for approval an administrative 
procedure for recording, locating, monitoring and maintaining the quality of all welds to be performed 
on the project. This quality control document record shall include but not be limited to:
24.2. Drawings and schedules identifying location of each weld by individual number, identification of 
welder who performed each weld by individual welder’s name, stamp number, date, and WPS used.
24.3. Once the procedure is approved, the Contractor shall carry out the procedure and the Engineer shall 
review the weld record documents monthly.
24.4. A finalized copy of the weld record shall be turned over to the CFER at the completion of the project.

25. Weld Examination
25.1. 100% of the welds in the steam, condensate, and heating hot water distribution system will be 
inspected and tested by non-destructive examination.
25.2. All tests shall be performed by an AWS-CWI (American Welding Society Certified Welding Inspector). 
The firm providing these services shall be agreed upon by the mechanical engineer and the owner.
25.3. All butt welds shall be tested by means of radiography. The criterion for pass/fail of this test will be 
as defined in the latest edition of the ASME B31.1 Power Piping code.
25.4. All socket weld connections shall be tested by means of dye penetrate or magnetic particle analysis. 
The criterion for pass/fail of this test will be as defined in the latest edition of the ASME B31.1 Power 
Piping code.
25.5. In the rare occurrence where radiography cannot be used to test a weld due to site restrictions the 
weld may be visually inspected by an AWS certified welding inspector provided that all the following 
conditions are met.
25.5.1. The CFER and design engineer must agree that a radiographic test cannot be reasonably 
achieved.
25.5.2. The pipe joint fit up must be inspected prior to welding by an AWS-CWI.
25.5.3. All welding passes must be inspected by an AWS-CWI including the root pass, hot pass, and all 
fill and cover passes.
25.5.4. If any of these steps are bypassed, and radiography cannot be utilized to verify the joint 
integrity, then the joint will be rejected outright and it will be replaced at the contractors expense. 
The replacement joint will be subject to the same testing requirements.
25.6. All initial testing will be funded by the owner through the project testing funds.
25.7. All repairs, and re-examination of repaired welds will be at the contractors expense

26. Acceptance Testing
All steam and steam condensate piping systems shall be tested at a hydrostatic pressure of 300 psig. The test 
shall be for a period not less than four hours with no pressure drop and shall be performed in the presence of 
the Designer. After any leaks are found and corrected the test shall be repeated.

27. Manhole and Building Penetrations
27.1. Where feasible the concrete steam conduit shall penetrate the manhole wall or building wall 
through the wall thickness and end flush with the inside wall face.
27.2. The wall shall either be integrally cast around the conduit to create a true cold joint, or if the conduit is placed through a pre-cut opening, the opening shall be “walled up” with masonry, concrete, and non-shrink grout as needed to provide a seal around the conduit.

27.3. The air space between the piping and conduit walls shall be blocked insulation to prevent drafting of the conduit system into the manholes or buildings.

27.4. Where lines must penetrate through walls, floors, and ceilings where there is no conduit, sleeves must be furnished and installed. The sleeves shall be schedule 40 black steel pipe and large enough to provide clear design movement of the pipe without damaging the piping insulation. Sleeves through walls and ceilings shall be flush, sleeves through floors shall extend 1" above the finished floor. Sleeves in the floor and in exterior walls shall be sealed with "Chase Foam" by Chase Foam Technologies, or equivalent. The contractor shall be responsible for the accurate placement of all sleeves.

28. Cleaning – Steam and Condensate Piping

28.1. All steam and condensate piping in the distribution system shall be cleaned prior to its connection to the University’s district energy system.

28.2. The steam and condensate piping shall be cleaned by means of steam blow only.

28.3. The contractor shall procure the services of qualified company to perform the steam blow(s) or may elect to have the University self perform the work.

28.4. The required steam blows may be completed by the University’s Cogeneration Systems Group or by a qualified industrial cleaning service contractor meeting the requirements of this specification. The Contractor can contact the CFER at UNC Cogeneration Systems for details and pricing related to the steam blow. If the Contractor wishes to use an external company rather than proceeding with the University, then it is highly recommended that he request “an approved equal” status for the cleaning contractor prior to the bid.

28.5. All in-line instruments and devices shall be removed prior flushing and steam blowing, and replaced with spool pieces if necessary. After the completion of the cleaning, the Contractor shall reinstall all instruments.

28.6. All permanent piping shall have passed its hydrostatic test and be flushed with water to remove loose debris prior to any steam blow.

28.7. All steam and condensate lines shall be blown three separate times with cool down periods between each blow to cause thermal cycling of the piping. This is to facilitate the release of welding slag and other bonded debris.

28.8. During the final blow for each pipe, the process shall generate not less than 250 feet per second of steam flow velocity in all sections of the permanent piping, and maintain this velocity for period not less than one hour. The blow shall continue until the piping is deemed clean enough to connect to the University’s district energy system by the CFER.

28.9. The steam blow shall be witnessed by the CFER and the mechanical design engineer of record, or their designated representatives.

28.10. The steam blow shall not be conducted when the ambient air temperature is less than 50 degrees F or greater than 80 degrees F. Any such event shall be scheduled with Cogeneration Systems personnel. The scheduling of such events will be dependent on campus load, and steam availability, and outages required. Cogeneration Systems has final authority on the scheduling of all such events.

28.11. The steam blow shall minimize stress to the system components caused by excessive temperature and/or pressure changes.
28.12. The arrangement of the temporary piping shall be designed in accordance with ASME B31.1. The piping arrangement and steam blow shall not cause the stress levels in any permanent or temporary piping component to exceed the allowable levels listed in ASME B31.1.

28.13. Any low points created as a result of the temporary piping arrangement shall have manual drains installed for proper drainage during the blow. If the drains are installed in permanent piping they shall be installed in accordance with the permanent piping standards for this project, and shall remain. If they are temporary to be removed after the steam blow, they may be of suitable temporary construction, such as threaded brass or bronze valves.

28.14. The exhaust end of the line(s) being blown shall be muffled and/or quenched as required to maintain 85 dBA or less at a distance of 50 feet from the steam discharge point.

28.15. Steam discharge shall not produce shock waves or air born particulate which could settle on parked cars, people, buildings, etc. This includes small material which may soil clothing, buildings, cars, etc.

28.16. Modifications to any permanent fixtures or systems to accommodate the steam blow shall be repaired and or replaced at the completion of the event to the satisfaction of the University and the designer of record.

28.17. The contractor shall provide barricades, warning tapes, and signage as necessary to secure the immediate area during the steam blow.

28.18. The contractor and his cleaning sub-contractor shall provide all necessary temporary piping, valves, mufflers, etc. needed to accomplish the steam blow(s) safely and within the guidelines of this specification.

28.19. If a cleaning contractor other than the University is selected, that contractor shall submit the following for approval by the designer and the CFER prior to any cleaning equipment coming onsite:

28.19.1. Only firms experienced in performing steam blows in noise sensitive areas for similar projects shall be considered. The proposed service company shall submit a list of projects where they have performed steam blows in noise sensitive areas for projects of similar size and flow requirements to this project. The list shall include five projects where distribution lines have been blow within the past ten years. This list shall include a brief description of the scope of work for each project, including the size of the piping blown, the name and location of the facility generating the steam, and a contact name and telephone number for each facility. For each project provide a brief description of the noise sensitive issues, what was done to satisfy the requirements, and the general results of those actions. Failure to provide qualifications in this format will result in rejection of the proposed service company.

28.19.2. Steam blow procedure indicating pressure required, quantity of flow, and duration.

28.19.3. An description of how much temporary piping is going to be installed, and what size.

28.19.4. Acceptance criterion for each blow.

28.19.5. Process flow diagram showing steam flow direction through the temporary and permanent piping.

28.19.6. Layout drawings depicting the setup of the temporary equipment and its connection to the piping to be cleaned.

28.19.7. Maximum noise levels that will be emitted during the cleaning process.

28.19.8. MSDS of all chemicals used, if any. Include a description of the proper disposal method for any waste.

29. Cleaning – Heating Hot Water Piping

29.1. All heating hot water piping in the distribution system shall be cleaned by means of chemical flush and filter.
29.2. The chemical flush shall be performed by a qualified contractor who has performed this type of work for industrial systems continuously for a period not less than five (5) years.

29.3. The cleaning contractor shall provide in writing the acceptance criterion for the cleaning process per the cleaning contractors standards as part of the submittal process.

29.4. The submittals shall include MSDS of all chemicals used, including a description of the proper disposal method for any waste.

29.5. Temporary filters shall be used during the flush to remove debris loosened by the cleaning process.

29.6. The supply and return lines shall be tied together on each end and the cleaning solution shall be circulated by temporary cleaning pump until filter checks show the fluid is clean, or twenty-four (24) hours, whichever is longer.

29.7. All instrumentation, and any system component not compatible with the cleaning process shall be removed before the cleaning agent is applied.

29.8. The system shall be flushed and circulated with clean water after the cleaning process until the system is free of the cleaning solution, and is in a neutral pH state.

29.9. Proper disposal of any contaminated fluids shall be the responsibility of the contractor.
# B-25 - CHILLED WATER DISTRIBUTION

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DESCRIPTION OF CHILLED WATER SYSTEM

The University of North Carolina at Chapel Hill owns, maintains and operates a district cooling system comprised of 5 production plants and a thermal energy storage system, distribution system consisting of over 25 miles of underground piping, and building bridge systems consisting of over 150 bridges controlling chilled water in over 140 buildings or locations. The chilled water group also operates and maintains remote systems located outside the district cooling system.

The production plant capacities are:

<table>
<thead>
<tr>
<th>Name</th>
<th>Number of chillers</th>
<th>Tons Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>8</td>
<td>12,000</td>
</tr>
<tr>
<td>South</td>
<td>12</td>
<td>19,000</td>
</tr>
<tr>
<td>Cobb</td>
<td>5</td>
<td>10,000</td>
</tr>
<tr>
<td>Tomkins</td>
<td>3</td>
<td>6,000</td>
</tr>
<tr>
<td>East</td>
<td>3</td>
<td>2,635</td>
</tr>
<tr>
<td>Thermal Energy Storage</td>
<td></td>
<td>40,000 ton hrs</td>
</tr>
</tbody>
</table>

The remote systems include:

<table>
<thead>
<tr>
<th>Name/Location</th>
<th>Number of chillers</th>
<th>Tons Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brooks Hall</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>Family Physician’s Center (Aycock Family Medicine)</td>
<td>1</td>
<td>187</td>
</tr>
<tr>
<td>Frank Development Center Porter Graham</td>
<td>1</td>
<td>80</td>
</tr>
<tr>
<td>General Administration</td>
<td>2</td>
<td>265</td>
</tr>
<tr>
<td>440 West Franklin</td>
<td>3</td>
<td>253</td>
</tr>
<tr>
<td>Radio Station</td>
<td>1</td>
<td>80</td>
</tr>
<tr>
<td>Friday Center</td>
<td>2</td>
<td>875</td>
</tr>
<tr>
<td>Facility Services Chilled Water Plant</td>
<td>2</td>
<td>394</td>
</tr>
<tr>
<td>Mobile (Trailer Mounted)</td>
<td>1</td>
<td>185</td>
</tr>
</tbody>
</table>
Chilled water is centrally produced and distributed throughout the campus, and this district cooling system shall be utilized wherever possible. The district cooling system is comprised of four major subsystems; the production system, the distribution system, the building bridge system, and the building cooling system. The Designer responsible for connecting to this system is primarily concerned with the last two subsystems. Designer shall provide all necessary information in specifications and drawing so that contractor may provide and install all instrumentation and control valves as described in this specification.

BUILDING SYSTEM - GENERALLY

The building system includes all chilled water piping in the building; the chilled water pump and all cooling coils, heat exchangers and other equipment using chilled water. The Designer must consider the following when designing the building chilled water systems.

The maximum allowable elevation of chilled water piping in the building is 565 feet above sea level and not less than 350 feet above sea level.

Designer must calculate chilled water static plus dynamic head for each project and determine if pressure limits of the chilled water system are exceeded. Buildings that require higher or lower elevations or higher heads must have plate and frame heat exchangers. Plate and frame heat exchangers must have the flow regulated on the primary (or supply) side of the heat exchanger by means of a properly sized control valve. The temperature sensor must be located on the secondary side of the heat exchanger in the leaving water line for controlling the chilled water supply temperature to the loads.

The cooling coils and heat exchangers must be designed for variable flow, constant temperature differential. At design conditions these units must have a return temperature of at least 59 degrees F (60 degrees F if a heat exchanger is used) and not require a supply temperature of less than 45 degrees F. The return temperature during low load conditions shall not drop below 55 degrees F.

The bridge enable shall be a hardwired 4 to 20MA signal (4=0% load and 20=100% load) from the Building Automation System to the Chilled Water Bridge controller. This signal represents the actual live total Chilled Water load in the building.

For example, all the cooling control valve positions would be averaged together to base the output signal on. If there were three cooling control valves that represented 100% of the total cooling load and valve 1 was 25% open, valve 2 was 50% open and valve 3 was 75% open the average load would 50% and the bridge enable signal would be at 12 mA. If there is equipment with no feedback some other means of accounting for actual live load shall be factored in to the total load.

All factors that are considered in the total load formula shall be bound out into a network output that can be read directly from the Building Automation System with our SCADA system via Modbus TCP. If necessary a device such as a fieldserver or other approved device may need to be installed to ensure that the most reliable and most direct means of data transmission is accomplished. The cooling coil tube velocity at design flow shall not be less than 4 FPS. Provide a leaving chilled water temperature sensor on all heat exchangers (cooling coils) over 10 tons rated cooling capacity.
Chilled water from this system shall not be used for any application where the temperature of the heat exchanger surface in contact with the chilled water exceeds 75 degrees F.

The building pump must be selected for the building system head and flow requirements. A variable volume pump is recommended, particularly in buildings with large cooling loads.

The control valves and control systems on equipment served by the chilled water system must be capable of accurate low load control and close off across the building pump shutoff head.

Use a separate bridge interface system for unusual or special cooling loads. A special load may require an elevated supply temperature, such as process equipment, or may be an essential load in a building with only non-essential AC loads, such as a computer room.

PRIMARY/SECONDARY BUILDING BRIDGE SYSTEM – GENERALLY

By definition a primary secondary bridge connection exists when the primary circuit (distribution mains) is connected to the secondary circuit (building system) by means of a low pressure loss pipe common to both circuits. The correct operation of the district cooling system is dependent on the design and operation of the primary/secondary bridge.

Factors that affect the operation of the primary/secondary bridge are described below.

Flow head loss in distribution mains from production plant to point of connection. This value varies primarily with changes in distribution system load.

Flow head loss in branch lines between the bridge and the mains. This value varies primarily with changes in building system load. Generally, the branch piping should be designed with a velocity of 3 to 6 FPS depending on actual length. When determining the flow in the pipe, consider what future loads may be imposed upon it. Use the following schedule to determine branch piping size: (length = total equivalent feet of supply + return runs).
### Bridge Return Temperature Control Valve (TCV-A) Design Criteria

The operation of the Bridge Return Temperature Control Valve (TCV-A) is of critical importance to the efficient operation of the district chilled water system. This valve(s) shall be designed to control the temperature and limit the flow of water from the building secondary system to the primary distribution system. The Designer must pay particular attention to the installed characteristic of this valve. Several factors related to the above described factors must be considered when specifying this valve.

*The valve's specified “control head" or the minimum pressure drop across the valve required for satisfactory operation.*

*The “building load turndown” that the valve is required to control through the bridge connection. This may be 3:1 or as much as 300:1 depending on the type of load.*

<table>
<thead>
<tr>
<th>GPM</th>
<th>LENGTH (ft)</th>
<th>PIPE SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-150</td>
<td>0-400</td>
<td>4”</td>
</tr>
<tr>
<td>150-250</td>
<td>0-200</td>
<td>4”</td>
</tr>
<tr>
<td></td>
<td>200-1000</td>
<td>6”</td>
</tr>
<tr>
<td>250-600</td>
<td>0-250</td>
<td>6”</td>
</tr>
<tr>
<td></td>
<td>250-1000</td>
<td>8”</td>
</tr>
<tr>
<td>600-1000</td>
<td>0-400</td>
<td>8”</td>
</tr>
<tr>
<td></td>
<td>400-1000</td>
<td>10’</td>
</tr>
<tr>
<td>1000-1500</td>
<td>0-500</td>
<td>10”</td>
</tr>
<tr>
<td></td>
<td>500-1000</td>
<td>12”</td>
</tr>
<tr>
<td>1500-2000</td>
<td>0-800</td>
<td>12”</td>
</tr>
<tr>
<td></td>
<td>800-1200</td>
<td>14”</td>
</tr>
<tr>
<td>2000-4000</td>
<td>0-500</td>
<td>14”</td>
</tr>
<tr>
<td></td>
<td>500-1000</td>
<td>16”</td>
</tr>
</tbody>
</table>
The “distribution pressure turndown” that the valve is required to work against. This is the lowest and highest pressure differential that the CHW Main will impose across the valve and is independent of the “load turndown”. The distance the bridge is located from the production/distribution plant(s) will influence this variable pressure differential. In the case of a building located near a production plant that can be shut down and connected to another plant in the system, high and low pressure differentials will be imposed at different times. Typical pressures close to the plant vary from 5 to 25 psid and far from the plant they may vary from 5.0 to 10 psid.

The pipe to valve size ratio: This is commonly referred to as the “piping geometry factor”. Simply stated, swaging induces turbulence which changes the valve’s flow capacity and must be accounted for in the sizing equation.

The degree to which the valve will cavitate: Cavitation is a performance limit that fluid properties, pressure drop, and trim design impose upon valve operation.

The designer shall follow these specifications when specifying this valve:

The Bridge Return Temperature Control Valve (TCV-A) shall have a low sensitivity through the first part of its travel with increasing sensitivity as 100% of travel is approached. This equal percentage characteristic valve shall have an installed characteristic that approaches a linear response as valve travel changes with flow.

The designer will obtain from the Chilled Water Engineer (1) the minimum and maximum differential pressures in the mains at the branch connection to the building, (2) the distribution system static pressure in the mains at the branch connection to the building. These pressures must be assumed by the designer to be independent of building load. TCV-A must control flow from design down to 20% of the smallest unit load (coil, heat exchanger, or group of coils that constitute a minimum unit load) within the range of distribution system differential pressures specified by the Chilled Water Engineer. At the lowest building load and highest distribution system differential pressure, the valve must be at no less than 1% of its full range travel. At design flow and lowest mains differential, the valve must be at no more than 90% of its full range travel. If it is not possible to provide this type of response to changes in load with one valve, the designer may use parallel valves, sequentially controlled. Valve leakage at shut-off shall be no greater than 0.6% of design flow at 30 psid. The valve actuator shall be capable of valve shut-off against 50 psi differential.

The designer must specify a control valve for this application. The designer must include in the specifications a Bridge Performance Table and a Bridge Return Temperature Control Valve Table.

The bridge performance table shall have the following information:

**Item 1:** Average return temperature from all building loads at design conditions (designer must calculate value). This average return temperature will be the set point for TCV-A. A return temperature of 59°F or more is preferred for all building loads at design conditions (designer must calculate value). The supply temperature must not be less than 45°F. A separate interface must be provided if specific equipment needs a lower supply temperature.
Item 2: Total flow for all building loads at design conditions (designer must calculate value)

Item 3: Distribution system supply temperature (from Chilled Water Engineer)

Item 4: CHW flow in distribution system branch connections to building at design conditions (designer must calculate value)

Item 5: Pressure differential across the distribution mains at the point where the branch lines to the building are connected (from Chilled Water Engineer)

Item 6: Flow head loss due to piping in the branch lines between the distribution mains and the chilled water bridge bypass tees at design conditions (designer must calculate value)

Example: Bridge Performance Table

| Building CHW design return temp | 59 degrees F |
| Building CHW design supply temp | 45 degrees F |
| Building design CHW flow        | 545 GPM      |
| Distribution system supply temp | 45 degrees F |
| CHW Bridge flow                 | 449 – 545 GPM|
| Press differential at mains     | Max: 20 psi  |
|                                 | Min: 5 psi   |

Pipe flow resistance from mains to bridge bypass tees at CHW Bridge flow 3 psi.

The bridge return temperature control valve table shall have the following information:

Column 1 shall be percent of valve rotation with increments of 0%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100%.

Column 2 shall be the percent of design bridge flow at the rotation indicated in the first column and additional conditions in columns 3-5.

Column 3 shall be the piping pressure loss that develops in the branch lines due to water flow at each increment of valve travel (based on item 7 above).

Column 4 shall be the pressure drop across the control valve.

Column 5 shall be the installed valve capacity factor.

Column 6 shall be the manufacturer’s specified valve capacity at each increment of rotation.
Column 7 shall be the manufacturer’s specified swaging factor when the valve is installed adjacent to one or more reducers at each increment of valve rotation.

Example:

<table>
<thead>
<tr>
<th>Valve Rotation (%)</th>
<th>Bridge Flow (%)</th>
<th>Bridge PSID</th>
<th>Valve PSID</th>
<th>Installed Valve CV</th>
<th>Catalog Valve CV</th>
<th>Swaging Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0%</td>
<td>0.00</td>
<td>5.00</td>
<td>0</td>
<td>0.00</td>
<td>00</td>
</tr>
<tr>
<td>10</td>
<td>7%</td>
<td>0.01</td>
<td>4.99</td>
<td>14</td>
<td>14.00</td>
<td>00</td>
</tr>
<tr>
<td>20</td>
<td>20%</td>
<td>0.05</td>
<td>4.95</td>
<td>38</td>
<td>38.00</td>
<td>00</td>
</tr>
<tr>
<td>30</td>
<td>35%</td>
<td>0.16</td>
<td>4.84</td>
<td>67</td>
<td>67.00</td>
<td>00</td>
</tr>
<tr>
<td>40</td>
<td>54%</td>
<td>0.38</td>
<td>4.62</td>
<td>105</td>
<td>105.00</td>
<td>00</td>
</tr>
<tr>
<td>50</td>
<td>77%</td>
<td>0.78</td>
<td>4.22</td>
<td>158</td>
<td>161.00</td>
<td>98</td>
</tr>
<tr>
<td>60</td>
<td>99%</td>
<td>1.27</td>
<td>3.73</td>
<td>214</td>
<td>228.00</td>
<td>94</td>
</tr>
<tr>
<td>70</td>
<td>114%</td>
<td>1.68</td>
<td>3.32</td>
<td>262</td>
<td>285.00</td>
<td>92</td>
</tr>
<tr>
<td>80</td>
<td>127%</td>
<td>2.09</td>
<td>2.91</td>
<td>312</td>
<td>351.00</td>
<td>89</td>
</tr>
<tr>
<td>90</td>
<td>138%</td>
<td>2.47</td>
<td>2.53</td>
<td>364</td>
<td>418.00</td>
<td>87</td>
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<tr>
<td>100</td>
<td>143%</td>
<td>2.67</td>
<td>2.33</td>
<td>394</td>
<td>475.00</td>
<td>83</td>
</tr>
</tbody>
</table>

UNDERGROUND CHILLED WATER DISTRIBUTION PIPING

GENERAL
Use only new material, free from defects, rust, scale, and guarantee for services intended. Use material meeting the latest revision of the ASTM specifications as listed in this specification. Use only long radius elbows having a centerline radius of 1.5 diameters unless otherwise indicated. Unless otherwise indicated, fittings and accessories connected to the pipe shall be of the same material as the pipe.

Contractor Qualifications

The Engineer must approve the contractor performing the underground chilled water work. Submit contractor qualifications and references for five (5) similar projects performed in the last 5 years. The contractor must also meet the following minimum requirements:

- Performed a minimum of three (3) underground ductile iron pipeline installations for 24” pipe and larger within the last 5 years.
- Has been in the underground pipeline utility business and has been performing this type of work for a minimum of 5 years.
- Is licensed to perform work in the State of North Carolina.

Submittals (Copies to Chilled Water Engineer)

Submit shop drawings for all pipe sizes including, but not limited to, the following:

- Pipe; ASTM/ANSI/AWWA number, grade if known, class, type, wall thickness, material.
- Fittings; ASTM/ANSI/AWWA number, grade if known, class, type, wall thickness, material.
- Flanges; ASTM number, grade, class, type, material.
- Valves; Manufacturer, type, model number, materials of construction, manufacturer’s data sheet (clearly cross-referenced).
- Isometric drawings showing all piping installed with joints, fittings and thrust blocks, as required for installation.
- Test Pressure and media.
- Pipe cleaning method

Record Documentation

Prior to acceptance of installation and use, contractor shall deliver two (2) copies of survey quality as built construction drawings for UNC to review and approve. Drawing to include GIS survey of points including change of directions, valves & tie in locations. A photograph library of the installation prior to backfilling is required. Photographs should include changes in direction, thrust block installation, pipe restraints and other pertinent information. The photographs must include background landmarks to verify location, orientation and physical attributes of the installation.
Product Delivery, Storage and Handling

Furnish all pipes with plastic end-caps/plugs on each end of pipe. Maintain end-caps/plugs through shipping, storage and handling to prevent pipe end damage and eliminate dirt and construction debris from accumulating inside the pipe.

Pipe Materials

The pipe and fittings shall be suitable for a minimum working pressure of 300 psi, ANSI C151/A21.51, with asphalt coating and cement mortar lining ANSI/AWWA C104/A21.4. Nominal piping wall thickness shall be as follows:

<table>
<thead>
<tr>
<th>Piping Diameter (in)</th>
<th>Wall Thickness (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 – 8</td>
<td>0.25</td>
</tr>
<tr>
<td>10</td>
<td>0.26</td>
</tr>
<tr>
<td>12</td>
<td>0.28</td>
</tr>
<tr>
<td>14</td>
<td>0.30</td>
</tr>
<tr>
<td>16</td>
<td>0.32</td>
</tr>
<tr>
<td>18</td>
<td>0.34</td>
</tr>
<tr>
<td>20</td>
<td>0.36</td>
</tr>
<tr>
<td>24</td>
<td>0.40</td>
</tr>
<tr>
<td>30</td>
<td>0.45</td>
</tr>
<tr>
<td>36</td>
<td>0.51</td>
</tr>
</tbody>
</table>

Fittings shall be ductile iron mechanical joint type manufactured in accordance with ANSI/AWWA C110/A21-10, rated for 250 psi working pressure. Straight pipe joints and fittings are to be restrained joint-type. Joints and fittings shall be flexible and shall be designed to provide positive restraint against end-wise separation due to thrust.

Piping shall be US Pipe “TR-Flex” or American Cast Iron Pipe “Flex Ring” or approved equal. American Cast Iron Pipe “Fastite” joint or US Pipe “Tytton” joint with EBBA Iron Series 1100 for new piping or Series 1700 harness type restraints may be provided for existing piping. All joints must be restrained for permanent piping. Pressure rating of 250 psi minimum.

All bolts shall be low alloy, high strength steel bolts having minimum yield strength of 45,000 psi and which are cathodic to the pipe, meeting requirements of AWWA C111.
Restrained type joint fittings shall be equal to EBBA Iron Series 1100 Megalug restraint systems for mechanical joint ductile iron piping, fittings and valves. Series 1100 solid ring restraints shall have a rated working pressure of 350 psi up to 16” pipe and 250 psi for 18” to 36” pipe. Series 1100 split ring restraints shall have a rated working pressure of 300 psi up to 16” and 200 psi for 18” to 36” pipe. Gasket material shall be SBR.

When piping is installed and to be left unattended or overnight, installation of non-pressure pipe plugs is required, or permanent plugs must be installed. Non-pressure plugs shall be equal to Taylor Made Plastics Bell End or Spigot End Plugs. The plugs shall be polyethylene with gaskets designed to keep pipes clean.

VALVES

Butterfly Valves

Valves to be designed for direct buried application and shall conform to latest revision of AWWA C504 in addition to the requirements listed below.

Valves shall be rated for AWWA C504 Class 250B, 250 psi non-shock working pressure-minimum. Valves to be bubble-tight at the rated pressure in either direction, and shall be suitable for throttling service and operation after long periods of inactivity. Valves to be hydrostatic and leak tested in accordance with AWWA C504.

Ductile iron body ASTM A536, restrained mechanical joint (AWWA C111/ANSI 21.11) ends. Valve shall be furnished complete with all required MJ joint accessories (bolts, nuts, gaskets and glands).

Valve discs shall be constructed of cast iron ASTM A126, Class B, or ductile iron ASTM A536. Disc shall have ASTM A276-Type 316 continuous stainless steel seating edge to mate with valve seat.

Valve shaft to be corrosion resistant, ASTM A276-Type 304; ASTM A276-Type 316; ASTM A564 Grade 65-45-12 or approved equal.

Resilient seat shall be natural rubber (BUNA-N). Seat shall be bonded or mechanically retained in the valve body only. The seat shall be capable of mechanical adjustment in the field and/or in the field replacement.

Valve assembly shall be furnished with a non-adjustable, factory set, thrust bearing designed to center the valve disc at all times. Shaft bearings shall be contained in the integral hubs of the valve body and shall be self-lubricated sleeve type and shall be sealed in place with self-adjusting packing.

Valves to be complete with grease packed buried service gear operator in compliance with latest revision of AWWA C504. Actuator shall have adjustable open and closed mechanical position stops that can withstand input torque of 450 ft-lbs. Operator shall include shaft extensions to within one foot of finished grade, centering disk(s) located on shaft, and all required soil pipes. Refer to drawings for length of shaft extensions and soil pipes.

Manufacturers: DeZurik, Pratt, or approved equal.

Valve Boxes
Valve boxes shall be 2 – piece cast iron, screw type, 5.25” shaft with stay-put heavy duty traffic weight lid marked “CHILLED WATER”. Boxes shall be equal to figure UTL 273, as manufactured by Charlotte Pipe and Foundry Co., Dewey Brothers or Tyler.

Valve boxes to be coated with coal tar for direct buried service application.

Vent Valve Boxes

Vent valve boxes shall be 2-piece cast iron, 12 inch diameter box with a cover with a highway H20 rating. Boxes shall be located directly above the installed corporation stop. Mark cover as “Chilled Water”.

Tapping Sleeves

NOTE: Tapping sleeves can be used if approved by Chilled Water Manager.

Tapping sleeves shall be manufactured from Type 304 stainless steel plate with a stainless steel ring flange, compatible with ANSI Class 125 and 150 bolt circles. The body and outlet shall be chemically passivated after welding for maximum corrosion resistance. The side bars shall be heavy gauge stainless steel. Trackhead bolts shall be 304 stainless steel with heavy nuts with UNC thread. Nuts shall be coated to prevent galling. Tapping sleeve shall be Romac STS420, no exceptions allowed.

Flange shall be stainless steel class “D” plate flange, with proper recessing for tapping valves. Flange will accommodate tapping flanges per MSS SP-60.

Gaskets for the flange and outlet sealing gaskets shall be Styrene Butadiene Rubber (SBR) compounded for water and sewer in accordance with ASTM D2000.

Gate Valves (For Tapping Service Only)

Conform to latest version of the AWWA Standard C-509 for resilient seated gate valves. There shall be a non-rising stem. The stem shall be cast bronze. The stem stuffing box shall be the O-ring seal type with two rings located above the thrust collar. The valve shall have a smooth full diameter waterway with no recesses.

The valve body and wedge shall be cast iron or ductile iron and shall be coated inside and outside with epoxy. The epoxy coating must meet or exceed AWWA C-550. The valve shall be designed for a pressure rating of 200 psig and shall be hydrostatically tested at 400 psig. The wedge must be completely encapsulated with rubber. Valves shall be furnished with ground level indicators and extension stems.

Manufacturers: U S Pipe, Clow or approved equal.

INSTALLATION

DESIGN & INSTALLATION NOTE: If installation is to connect to existing piping and that piping is unrestrained, a thrust block must be designed and installed before excavation can begin to the installation of the new piping. See details for design requirements of thrust block.
When digging within 10 feet of chilled water piping and the piping is unrestrained:

Locate chilled water pipes.

If the centerline of the chilled water lines and the proposed utility are less than 8 feet apart and any part of the proposed utility is below the top of the chilled water pipe, install the utility as follows:

Locate both chilled water lines and the proposed utility, excavate joints one at a time and install split ring megalug restraints.

When the restraints have been installed, backfill and compact to 90%. Backfill to original grade.

Install proposed utility section and proceed to next unrestrained joint. If required, all of the restraint work can be completed before any of the proposed work is started.

All pipe, valves and fittings shall be installed as indicated on the drawings and according to the manufacturers’ instructions and UNC Chilled Water details.

Provide vents at all high points of pipe sections. Coordinate location of drains with Chilled Water Engineer. Whenever possible the drain lines shall be run to the sanitary sewer system. If sanitary sewer is not available provide a pump out manhole (see Standard Details).

Provide a stabilizing concrete pad around all valve boxes (see Standard Details). Do not locate valve boxes in parking spaces or in other inaccessible locations unless approved by Chilled Water Engineer.

Provide a chilled water monument marker at each change of direction, branch, and 200 feet of straight run of pipe. The marker shall consist of a chilled water marker (provided by Chilled Water). The marker shall be located midway between the two chilled water pipes. Physical location of the markers will be done using as-built drawings supplied by contractor and coordinated with Chilled Water.

Install locate wire on top of pipe with an anode bag at the connection to the main piping. The wire shall be taped to the pipe at 10 foot intervals and run full length to the piping. At the building the wire shall be brought to the surface and terminate in a locate wire box. The box shall consist of an electrical handybox with hinged opening and an 18” length of ¾” rigid conduit extended out the bottom of the box. All joints in the locate wire shall be done with Nicotap fittings and shrink wrap.

INSTALLATION NOTE: All items, including wire, needed to install the locate wire shall be supplied by UNC. Use extreme caution to keep the wire on top of pipe and not to damage the wire during backfill operations.

Install chilled water marking tape 2 feet above each pipe installed.

CLEANING AND FLUSHING OF UNDERGROUND PIPING

Chilled Water (4” to 42”
Contractor shall visually inspect internal portion of each length of pipe during installation. Remove all dirt and foreign matter prior to installing additional lengths.

After each major section of piping has been installed, it shall be cleaned and flushed utilizing a high-pressure water “hydro-jet” process. The hydro-jet process involves passing a high pressure, high volume spray type cleaning head through the piping. The head is inserted in each section of piping and activated with full water pressure and flow. Through hydraulic force from directional spray nozzles the head propels itself forward up the pipe section. Once the head reaches the end of the pipe section it is retracted while maintaining maximum water pressure and flow. The length of the piping section shall be determined ahead of time so that the proper amount of travel can be tracked with calibrated markings on the spray head feed water hose or a meter on the hose reel. While traveling through the piping the pressurized water spray knocks debris loose and carries it back to the open end of the piping where it is collected and removed from the system. For each section of piping the process shall be performed a minimum of two times and may need to be repeated until the water exiting the end of the pipe is clear and free of debris as determined by the Owner/Engineer.

The hydro-jet equipment utilized shall be capable of providing a minimum of 50 GPM at 2000 PSI. All cleaning and flushing shall be performed so that all debris will be pulled or flushed downhill. All cleaning and flushing shall be initiated from all low points in the system and shall terminate at the nearest adjacent high point in the system.

Coordinate the limitations and requirements of hydro-jet process with the flushing subcontractor such that the piping is installed in a sequence and manner that allows every section of the new pipeline to be cleaned and flushed. Limitations may include maximum length of the pipe section, maximum number and/or degree of bends in the pipe section, maximum slope of the pipe section, equipment and excavation access requirements, and the minimum size of the openings required in the piping to allow for insertion and retraction of the cleaning head.

Contractor shall provide access at all low points through valves, tees, flanges, etc. to facilitate the cleaning and flushing process. If temporary fittings or piping is required it shall be provided by the Contractor and removed by the Contractor after successful cleaning.

After flushing and cleaning is completed, contractor shall provide necessary pipe and fittings required to complete the piping system. Each cleaned section of piping shall be capped and protected to keep mud, debris, water, etc. from entering the piping. If a piping section is left open or unprotected, or is contaminated, it shall be re-cleaned prior to being filled and activated at no cost to the Owner.

Contractor shall provide all water for flushing and testing. Coordinate rental of fire hydrant meters with local Fire Department(s), or the University as required.

Contractor shall provide all temporary piping from water source to piping system and shall provide means for conducting cleaning water from underground piping system to the appropriate sewer; i.e. pumps, piping, hoses, tanks, etc. Contractor to remove all temporary piping, pumps, hoses, etc. from site immediately after flushing has been completed.
TESTING

The chilled water piping shall be leakage rate tested. Leakage rate test shall be conducted at the same time as the hydrostatic pressure test. Leakage rate is defined as the quantity of water that must be supplied into the respective underground piping system to maintain the pressure within 5 psig of the specified hydrostatic test pressure after air in piping system has been removed and piping system has been filled with water. The test pressure shall be 180 psig at the highest point of the piping being tested.

The pressure tests shall be sustained for not less than four hours and or long as the Chilled Water Engineer/Representative requires assuring that:

The scale of the test gauge must be a minimum of 50 psi higher than the anticipated test pressure and the incremental reading of the gauge is 2 psi.

No air pockets are in the line.

No broken pipe or defective materials are in the line.

No leaking joints have been made.

Before applying the specified test pressure, all air shall be expelled from the pipe. If outlets are not available at high places, the Contractor shall make the necessary taps at points of highest elevations before the test is made. After the test is completed, corporation cocks shall be installed at these points and marked by the installation of a valve box.

Tests may be made of isolated portions of such piping as will facilitate general progress of the installation. Any revisions made in the piping systems will subsequently necessitate re-testing of such affected portions of the piping systems.

Any defective material or defects in workmanship that develop during the tests shall be remedied and the subject piping shall be re-tested.

Determine the maximum allowable amount of leakage by the following formula:

\[ L = S \cdot D \cdot \sqrt{P} / 200,000 \]

\[ L = \text{allowable leakage in gallons per hour} \]

\[ S = \text{length of pipe tested, in feet} \]

\[ D = \text{nominal diameter of pipe in inches} \]

\[ P = \text{average test pressure during leakage test in pounds per square inch} \]
The Contractor is required to furnish all pumps, gauges, instruments, test equipment, and personnel required for tests and make provisions for removal of test equipment and draining of pipes after tests have been made. All testing shall be made in the presence of the Engineer. The allowable leak rate is acceptable only when an approved meter is used, approved by the Chilled Water Engineer and applies only to testing single lines.

<table>
<thead>
<tr>
<th>Pip Size</th>
<th>Lenth of Pipe (Fe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0.03, 0.04, 0.05, 0.08, 0.13, 0.19, 0.27</td>
</tr>
<tr>
<td>6</td>
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<td>0.09, 0.14, 0.19, 0.28, 0.47, 0.66, 0.94</td>
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<td>0.11, 0.16, 0.21, 0.32, 0.54, 0.75, 1.07</td>
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<td>0.13, 0.20, 0.27, 0.40, 0.67, 0.94, 1.34</td>
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<tr>
<td>36</td>
<td>0.24, 0.36, 0.48, 0.72, 1.21, 1.69, 2.41</td>
</tr>
</tbody>
</table>
CHILLED WATER BRIDGE

GENERAL

A specification of an item in this or any other sections shall not relieve Contractor from providing all items, articles, materials, operations, methods, labor, equipment and incidental necessary for a complete and functional system.

Where size for a pipe segment is not indicated, the pipe segment size shall be equal to the largest pipe segment to which it is connected. Transition to smaller size shall occur on the side of fitting where smaller size is indicated.

All pipe, valves, fittings and pumps shall be installed as indicated on the drawings and according to the manufacturer’s instructions and installation drawings. All welding shall be performed to meet ASTM B31.1 unless noted by designer as otherwise.

General Locations and Arrangements Drawings (plans, details, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout shall take into consideration pipe sizing, friction loss, pump sizing, maintenance accessibility and other design considerations. So far as possible, install piping as indicated.

Design Note: Design of the bridge piping shall place bridge inside mechanical room and install bridge controller cabinet, all instruments, valves and meter between building isolation and utility isolation valves, excluding the end of line differential pressure transmitter.

Contractor Qualifications

The Engineer must approve the contractor performing building piping work. Submit contractor qualifications and references for five (5) similar projects performed in the last 5 years. The contractor must also meet the following minimum requirements:

Performed a minimum of three (3) institutional building piping installations within the last 5 years.

Has been in the institutional building piping business and has been performing this type of work for a minimum of 5 years.

Is licensed to perform work in the State of North Carolina.
Submittals (Copies to Chilled Water Engineer)

Submit shop drawings for all pipe sizes including, but not limited to, the following:

Pipe; ASTM/ANSI number, grade if known, class, type, wall thickness, material.

Fittings; ASTM/ANSI number, grade if known, class, type, wall thickness, material.

Flanges; ASTM number, grade, class, type, material.

Isometric drawings showing routing, sensor location, valve location and hanger locations.

Test Pressure and media.

Pipe cleaning method.

Valves; manufacturer cut sheets, size, materials, actuator size, pressure rating.

Pumps; manufacturer cut sheets, pump curves, including design capacity and head, motor cut sheets, pump base design, pump installation requirements, pump manufacturers alignment specifications, flexible coupling design and cut sheet.

Variable speed drive; manufacturer cut sheets, size, installation requirements.

Welder certifications.

Thermowells; material, size.

Thermometer; manufacturer cut sheet, size, range.

Pressure Transmitter; type, manufacturer, manufacturer’s cut sheet, size, range.

PRODUCT DELIVERY, STORAGE AND HANDLING

Before shipping, all carbon steel piping shall be free of rust and scale, and furnished with plastic end caps/plugs on each end of pipe. Protect flanges, fittings, and specialties from moisture and dirt by inside storage and enclosure, or by packing with durable waterproof wrapping.

Store and handle all materials in accordance with Manufacturer's recommendations to prevent their deterioration and damage. Store all materials in the original containers or bundles with labels informing about manufacturer, product name, and any potential damage.

Where possible, store all materials inside and protect from weather. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed the structural capacity of the floor.
VALVES

Butterfly Valves

For Control Valves see Chilled Water Control Valves Specifications, starting on page 45. For the Chilled Water Bridge System, other than Control Valves, provide high performance butterfly valves.
The valve shall have a lugged wafer style body of carbon steel or ductile iron rated for ANSI class 150 service. The seat material shall be fluoropolymer based blend with no fillers or PTFE filled. Disk and shaft shall be 316 Stainless steel construction. Disk to shaft connection shall be non-shear tangential pinning. Disk shall be offset from shaft centerline. The valve shall have upper and lower shaft bushing/bearings of a 316 stainless steel carrier and PTFE liner. Shaft seal shall be multiple rings of V-flex style PTFE packing with 316 stainless steel packing ring.

Valves shall be full lug type permitting removal of downstream piping while using valve for system shut-off. Bidirectional dead end pressure rating to be minimum 150 psig with no downstream flange/piping attached.

Standard applications shall use 10-position lever operators for valve sizes 6” and smaller, gear operator for larger sizes.

Manufacturers: Jamesbury, or approved equal.

Butterfly Valve Installation

Install valves as shown on plans, details and according to valve manufacturer's installation recommendations.

Valves may be used to facilitate the fit-up of weld neck flanges, but the valve must be removed before the flanges are welded. During fit-up, metal pancakes or solid pieces of gasket material shall be used to ensure that valve is not damaged from sparks or spatter.

Valves with gear operators or actuators are to be installed with stems at or above centerline wherever possible, but in no case with the stems straight down. Valves with actuators and position indicators shall be installed so that the indicator is visible from the floor. Any valve installed with reducers nearby must have appropriate spacing to remove any bolt without pipe disassembly.

Before tightening flange bolts, adjust the disc of the valve to the full open position. Tighten bolts to specification in a criss-cross pattern. After tightening, rotate disc to closed position to assure proper operation.

After piping systems have been pressure tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust, replace packing or replace valves to stop leaks.
Chain Wheel Operators

Provide chain operators for manually operated valves 6" and larger, located more than 8 ft. above equipment room floor.

Cast iron or ductile iron adjustable sprocket rims and chain guides. Use galvanized or brass chain and chain closure links to form continuous loop of chain at each operator.

Ball Valves

Ball valves for use in chilled water system to be rated for 250 psig at 100°F. Provide valve neck extensions with sufficient length to allow for insulation.

Drains/ Vents

Provide drain valves at all low points and vents at high points of piping systems (even if not shown on drawings) for complete drainage of systems between isolation valves and elsewhere as noted on flow diagram, plans and details. Whenever possible the vent lines shall be run with a second isolation valve accessible from floor level and the discharge to be run to the sanitary sewer system.

Connections to the pipe shall be made using thread-o-lets and Schedule 80 nipples. For drains, provide ball valves of type specified above and size specified below with hose thread adapter and cap.

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Drain Size</th>
<th>Vent Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>6” and less</td>
<td>Minimum ¾”</td>
<td>Minimum ¾”</td>
</tr>
<tr>
<td>8” to 10”</td>
<td>Minimum 1”</td>
<td>Minimum ¾”</td>
</tr>
<tr>
<td>12” to 14”</td>
<td>Minimum 1½”</td>
<td>Minimum ¾”</td>
</tr>
<tr>
<td>16” and greater</td>
<td>Minimum 2”</td>
<td>Minimum ¾”</td>
</tr>
</tbody>
</table>

INSTRUMENTATION

Use ¾” thread-o-lets for the installation of temperature sensor and thermometer thermowells. Temperature sensors are to be installed on the sides of horizontal run piping.

Thread-o-lets for differential pressure sensors/transmitters taps are to be a minimum ½”; bushed down to1/4” and are to be installed on the sides of horizontal run piping. The tubing for differential pressure instrument shall be installed with continuous runs from isolation valve to transmitter connection.
Provide a single pressure gauge connected to both sides of strainers, pump suction, pump discharge, and pump discharge after check valve or balancing valve (whichever is furthest downstream). Gauge is to be connected to the system through a manifold system where each branch can be isolated and pressure can be relieved from the gauge. Gauge indicator shall have a maximum reading of 150 psi, higher readings may be required at certain parts of campus (Dean Smith Center requires 200 psi range).

Gauges shall be Weksler, or equal. Install gauges with a ½” or ¾” thread-o-let, bushing, ¼” schedule 80 carbon steel nipple and ¼” ball valve.

Compressed air tubing must be copper or stainless steel from isolation valve to instrument or control valve and shall be run in a manner that will not promote trapping of water. Each end-user of compressed air shall have individual isolation valves and control valves with positioners which shall have filters and separators with have fully automatic drains. Compressed air lines must be sized for all components using their delivery rates. Branch lines shall be 3/8 inch minimum with no more than 5 feet from the isolation valve to the pressure set or solenoid. If more than two components are being served main line size should be run to the last component served.

Install four thermometers; four temperature sensors; flow meter; pressure differential transmitter with local digital readout and remote pressure differential transmitter as per flow diagrams between the four bridge isolation valves.

Install V-Cone flow meter, supplied by the University, as per flow diagram. The preferred meter installation is in horizontal pipe runs. For a meter being installed in same size bridge piping there shall be a minimum of 5 pipe diameters before the meter and three pipe diameters after the meter. If installing smaller meter than the bridge piping, have four pipe diameters between the meter flanges and the reducers on both sides of the meter, the same requirement shall be used for any fittings used adjacent to the meter. For horizontal installation, this meter must be installed in either the three o’clock or nine o’clock positions or a maximum of 45 degrees below these positions. If the meter must be installed in a vertical run, the flow must come from under the meter so that the cone will not entrap air. The meter must not be installed downstream from a control valve. The meter must not be installed in the highest point of a pipe system.

BUILDING CHILLED WATER PUMP

Design Criteria

Pump sizes, capacities, pressures and operating characteristics shall be as scheduled. Where pumps are indicated for parallel operation, each pump must be capable of delivering at least 80% of the building’s full load flow.

Pumps shall have a minimum clearance of 24" on sides and ends of pumps and motors to allow access for service and repair. Pumps shall have isolation valves to allow removal of pumps for repair. Pumps shall have bleed valves and gauge ports at accessible locations. All pumps shall be serviceable without removing the volute from piping connections. Pumps shall meet or exceed operating efficiencies scheduled.
Furnish pumps complete with premium efficiency inverter-duty motors, drive assemblies, coupling guard where required and accessories as specified. Select motor with sufficient horsepower rating for non-overloading operation over entire pump curve.

Furnish each pump and motor with name plate giving manufacturer’s name, serial number of pump, capacity in GPM and head in feet at design condition, horsepower, voltage, frequency, speed, and full load current. Test all pumps hydraulically at 150% of rated pressure, clean and paint before shipment. Manufacturer shall certify all pump ratings and contractor will supply performance information as part of the submittal.

All pumps shall operate without objectionable noise or vibration with maximum noise level of 85 dBA.

Furnish one set of seals and bearings for each new pump to Owner.

Centrifugal Pumps

Pumps to be base mounted and flexible coupled with working pressure of 175 psi and operating temperature of 250 degrees F intermittent. Efficiency of the pump shall be greater than 85%. Pump design must allow for servicing without disturbing piping, motor or requiring shaft realignment. Pumps shall be designed and tested to Hydraulic Institute Standards.

Casings shall be cast iron having a minimum tensile strength of 35,000 psi. Removal of impeller or rotating assembly shall be accomplished without disconnecting suction and discharge piping. Casings to have tapped and plugged openings for vent, drain, and suction and discharge gauge connections.

Impellers to be made of cast bronze, hydraulically and dynamically balanced, keyed and locked to pump shafts with replaceable shaft sleeves. Rotating elements shall be mounted in heavy-duty ball bearings (greasable preferred) and shall be equipped with water slingers on the side next to pump glands.

Chilled water pumps to be furnished with single inside, unbalanced mechanical seals with carbon rotating faces, ceramic stationary seats, Buna-N elastomer and 316 SS metal hardware, similar to John Crane Type 1 Seal, rated up to 225 degrees F continuous operation.

If pumps are supplied with couplings, drop-out spacer type couplings with flexible neoprene sleeves are to be used to allow for pump servicing. Diaphragm couplings may be used with high horsepower pumps.

Pumps shall be supplied with groutable steel base plates with stainless steel drip pans under the pump assembly with threaded drain connections, to be field routed during installation. Provide drain pan constructed of 16-gauge stainless steel, all welded under pump heads and inlet/outlet flanges, including flanges of connection pipe. Drain pan shall be sized to accommodate entire pump head area from flange to flange. Provide silicone sealant between pump feet and drain pan to make pan leak-proof. Provide ¼” drain opening in drain pan to be extended to nearest floor drain during the installation.

Inline pumps may be used in situations not allowing for base mounted pumps. The motors for inline pumps must not exceed 5 HP and the pumps must be independently supported from the piping, either to the floor or from a wall structure.
Manufacturers; Allis Chalmers, Aurora, Peerless, PACO, Worthington, Flowserve, or Dresser-Rand, Bell & Gossett.

MOTORS

Motor submittal shall include manufacturer, horsepower, voltage, phase, hertz, RPM, motor type, motor enclosure type, frame type, insulation class, NEMA design designation, service factor, nominal full load efficiency, full load power factor, full load amps, weight and all other appropriate data.

Motors driven by variable frequency drives (VFD) shall comply with the latest NEMA MG-1, Section IV, Part 31 unless otherwise noted and shall be inverter duty type. Starter insulation shall be designed to operate under maximum voltage peak of not less than 1600 volts with time reset not greater than 0.1 micro-seconds. Motors shall have corona resistant stator insulation. Motors shall be rated for 90ºC temperature rise with 40ºC ambient.

Motors shall have 1.15 service factor in 40ºC maximum ambient temperature. Select motors so they do not exceed nameplate rating nor operate into service factor to meet specified duty.

Motors shall have totally enclosed fan enclosures.

Motors shall have greaseable ball bearings with ANSI/AFBMA L-10 rating of 200,000 hours.

Motors vibration shall not exceed 0.15 inch per second, unfiltered peak.

Motor Grounding

Provide additional grounding of VFD driven motors to help protect the motor and its components from harmful transients generated by the VFD.

All motors driven by VFDs shall be grounded as specified;

1. Mechanical contractor shall provide shaft grounding ring (AEGIS SGR or equal) on motor shaft. Soft carbon brushes are not acceptable. Install per manufacturer’s written instructions.

2. The electrical contractor shall bond motor casing to local structural steel with braided straps of bare flat copper conductor cable, width to be specified by designing engineer.

3. The electrical contractor shall bond motor feeder equipment grounding conductor to the motor
terminal box. The contractor shall make sure to clean and prepare paint so that the connection for the ground will be clean and permanent.

4. The electrical contractor shall provide 3-conductor plus ground shielded cable from the VFD to the motor. The shield shall be grounded at the motor terminal box and at the VFD. The shield shall remain continuous for the entire run from the VFD to the motor.

NOTE: Item 3 pertains to all motors.

Installation

Protect electric motors from premature failure by assuring that their windings are not subjected to concrete dust and other contaminates.

Set base mounted pumps on concrete bases (housekeeping pad), or concrete inertia base. The concrete pads must be dowelled to the floor at 12 inch intervals and have one mat of ¼ inch rebar to provide the base strength. Hold down bolts must penetrate this housekeeping pad and go into the existing floor pad a minimum of 5 inches.

Level the base and bolt down prior to grouting. Fill entire base with non-shrinking grout. Use end caps during grouting to prevent overflow when end caps are not integral with base plates. Housekeeping pad may be extended to allow for suction diffuser support.

INSTALLATION NOTE: Piping/pump alignment verification shall be completed in the presence of the Chilled Water representative.
Install all pumps in strict accordance with manufacturer’s instructions to avoid any stress and misalignment. Piping connections to pumps shall not create stress on pump casing. After final connections are completed, the contractor shall remove bolts from flanged connections at pumps. Piping shall remain aligned with pump connections after all bolts have been removed. If piping becomes misaligned after bolts have been removed, or if bolts cannot be removed by hand, the contractor shall revise piping to align piping with pump connection. If after completion of the strain free verification the piping system must be disassembled at any point in the system, the strain free verification shall be repeated. During final assembly after successful test the gaskets shall be replaced.

Contractor shall employ a technician certified by the selected pump manufacturer to field align flexible coupled pumps after the base has been grouted, the pipe/pump alignment check and flushing and cleaning procedures have been completed. Align pump and motor in all four planes: vertical angular, horizontal angular, vertical parallel and horizontal parallel. Alignment shall be within the recommended value by pump manufacturer (not coupler manufacturer), but not over .002” parallel and .003” angular per radius inch. Record and submit all results of alignment procedure to Engineer. Soft foot measurements must be less than 0.005” on each foot.

INSTALLATION NOTE: Pump/Motor alignment verification shall be completed independently by a Chilled Water representative.

Contractor shall provide two days notice to Chilled Water for alignment verifications. Contractor shall produce a copy of the pump manufacturer’s alignment specifications (not pump coupler manufacturer’s specification) at the time of Chilled Water verification or with pump submittals.

Where pump connection size and indicated line sizes are not identical provide necessary concentric reducers/increasers for vertical piping at pump connection and eccentric reducers/increasers for horizontal piping at pump connection. Install eccentric reducers/increasers with top of pipe level. All isolation valves and flexible connections are to be full line size.

Pump Startup

NOTE: To avoid damage to mechanical seals, never start or run pump in dry condition.

To perform pump startup:

Verify that piping system has been tested, flushed, clean and filled.

Verify that pipe/pump alignment has been verified by UNC Chilled Water representative.

Verify that pump/motor alignment has been independently verified by UNC Chilled Water representative.

Verify the VFD has been certified, with UNC Chilled Water technician present.

Verify pump rotation.

Prime pump and vent air from casing.
PIPE MATERIALS

Use only new material, free from defects, rust, scale, and guarantee for services intended.

All Chilled Water piping lines shall be standard weight, Schedule 40 black steel ASTM A53 GRB. Chilled Water pipes larger than 2” shall have welded joints and fittings that shall be standard weight Schedule 40 black steel. Threaded nipples shall be Schedule 80 black steel. Use only long radius elbows.

Flanges

ASTM A105, ANSI B16.5, hot forged steel, welding neck pattern are to be used whenever possible. Bore dimension of welding neck flange shall match inside diameter of connected pipe. Valves may be used to facilitate the fit-up of their flanges, but must be removed before the flanges are welded. During fit-up, metal pancakes or solid pieces of gasket material shall be used to ensure that valve is not damaged from sparks or spatter. Use raised face flanges for mating with other raised face flanges with self centering flat ring gaskets. Use flat face flanges for mating with other flat face flanges with full face gaskets.

Flange Gaskets

Gaskets shall be asbestos free fiber type. During installation, apply an antiseize compound to the gasket or flanges. Position gasket concentrically so compression is equally distributed over entire gasket surface.

Bolting

Bolts and nuts shall be Grade 5 NC. Bolts, bolt studs, nuts and washers shall have zinc/cadmium plated finish.

Note: Threaded rods are not allowed as fastening elements. If studs are to be used, they are to be individually factory stamped with grade identification.

PIPING INSTALLATION

Remove scale, slag, dirt, and debris from both inside and outside of piping and fittings before assembly. Install valves, control valves and piping specialties, including items furnished by others, as specified and/or detailed. Refer to drawings and/or manufacturer's recommendations.

Use fittings for all changes in direction and all branch connections. Mitered ells, welded branch connections, notched tees and "orange peel" reducers are not allowed. Weld-o-lets may be used in lieu of fittings for branch take-offs from mains 2" or larger provided that the branch take-offs is two or more sizes smaller than the main. Do not use "stub-ins" for making piping connections.

Threadolets must be used at vent and drain connections and for thermowells or other instrument locations. Materials of "Weldolets" and "Threadolets" shall match material of piping. Any hole shall be made with a drill or holesaw.
Reducers in horizontal piping shall be the eccentric type with the top level. Reducers in vertical piping shall be concentric. All reducers must be installed to allow bolt installation and removal after all equipment is in place.

Provide drain valves at all low points and vents at high points of piping systems (even if not shown on drawings) for complete drainage of systems. This includes but is not limited to all low points, bases of all risers, at each branch take-off and between isolation valves. See drain and vent sizing chart on page 23.

Welded Pipe Joints

All welding shall be performed to meet ASTM B31.1 unless noted by designer as otherwise. Inspect pipe and pipe fittings for roundness before they are fit-up or set in place. Properly clean fittings; clean and bevel plain ends of steel pipe before fit-up.

Pipe Welding

All welding shall be performed by a certified welder who is regularly engaged in welding of piping systems. All welders’ certifications must be on file with the contractor and available to Owner upon request. Owner’s representative will perform any observations deemed necessary before, during, or after fabrication to assure, to Owner’s satisfaction, that proper welding is provided. Owner reserves the right to perform independent testing of welds. If test results of such examination are unsatisfactory, Owner reserves the right to stop in progress welding work, without any cost to Owner, until resolution satisfactory to Owner is reached.

Unless otherwise indicated, welding shall be done using only the following processes:

a. Shielded Metal Arc Welding (SMAW), also known as "stick" welding.

b. Gas Tungsten Arc Welding (GTAW), also known as TIG and Heliarc welding.

Backings rings (chill rings) or consumable inserts are not allowed, unless specifically requested by Owner or Engineer.

Ground clamp must be placed as close as possible to work so as not to damage electronic equipment in this system or elsewhere in the mechanical room.
Repair any welds not meeting the acceptance criteria at no cost to the Owner.

PIPE HANGERS AND SUPPORTS

Hanger Rods (Metallic)

Rods shall have electro-plated zinc or hot dip galvanized finish.

Bolts, Nuts, Studs and Washers

Bolts, nuts, studs and washers shall have electro-plated zinc or hot dip galvanized finish.

Installation

Support all piping from building structural members using beam clamps, ceiling plates, wall brackets, or floor stands. At no time shall hangers and supports overload building structural members. Fasten ceiling plates and wall brackets securely to structure and test to demonstrate adequacy of fastening.

Coordinate hanger and support installation to properly group piping of all trades.

Suspend hangers by means of hanger rods. Perforated band iron or flat wire (strap iron) is not allowed.

Piping shall not be supported by other piping, ductwork, or conduit.

Pipe hangers or supports are not allowed to penetrate vapor barrier of pipe insulation.

Install adequate supports during erection of piping so as not to over stress either piping or equipment to which piping is connected.
Hangers and Support Spacing

Space pipe hangers and supports for steel pipe in accordance with the following schedule, with exceptions as indicated herein:

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Max Spacing</th>
<th>Pipe Size</th>
<th>Max Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up through 1 ¼”</td>
<td>7’-0”</td>
<td>10”</td>
<td>20’-0”</td>
</tr>
<tr>
<td>1 ½”</td>
<td>9’-0”</td>
<td>12”</td>
<td>23’-0”</td>
</tr>
<tr>
<td>2”</td>
<td>10’-0”</td>
<td>14”</td>
<td>24’-0”</td>
</tr>
<tr>
<td>2 ½”</td>
<td>11’-0”</td>
<td>16”</td>
<td>27’-0”</td>
</tr>
<tr>
<td>3”</td>
<td>12’-0”</td>
<td>18”</td>
<td>28’-0”</td>
</tr>
<tr>
<td>4”</td>
<td>14’-0”</td>
<td>20”</td>
<td>30’-0”</td>
</tr>
<tr>
<td>5” and 6”</td>
<td>17’-0”</td>
<td>24”</td>
<td>32’-0”</td>
</tr>
<tr>
<td>8”</td>
<td>19’-0”</td>
<td>30”</td>
<td>33’-0”</td>
</tr>
</tbody>
</table>

Spacing less than indicated above may be required to conform with building structure design and/or loading limitations. If pipe size changes between support points, maximum spacing shall be based on the smaller pipe size. Install hangers and supports to bear on outside of insulation. Place hangers and supports within one foot of either side of each fitting such as elbow and tee and at each valve, strainer, and other piping specialty for piping 4” and above.
PIPING SYSTEM PRESSURE TEST

Coordinate pressure tests with Engineer and Chilled Water Engineer, in writing, at least 7 days in advance of its occurrence and conduct tests in presence of Engineer. Engineer has right to waive requirement for witnessing test. If engineer is not present, conduct test in presence of Construction Manager’s representative. Representative shall sign report-verifying results. Contractor shall notify engineer of all tests to be performed.

Conduct pressure test prior to flushing and cleaning of piping systems. No systems shall be fully insulated until it has been successfully tested. Prior to the test being completed insulation can be installed if it does not cover welds, joints, fittings or penetrations.

Conduct hydrostatic (HYDRO) test at 150 psig with test medium of water unless otherwise indicated. For hydrostatic tests, remove air from piping being tested by means of air vents. If outlets are not available at high points, the Contractor shall make the necessary taps at points of highest elevations before the test is made.

The testing of the system shall be performed by a contractor experienced in pipe testing. The Contractor shall perform all phases of testing including supervision and provide pumps, calibrated gauges, instruments, test equipment, temporary piping and personnel required for tests and provide removal of test equipment and draining of pipes after tests have been successfully conducted.

Contractor should perform preliminary pressure test prior to witnessed record test to verify system will pass record test on first attempt. Pressure tests may be made of isolated portions of piping systems to facilitate general progress of installation. Any revisions made in piping systems require retesting of affected portions of piping systems. No pressure drop shall occur during test period. Any pressure drop during test period indicates leakage. If leaks are found, repair with new materials and repeat test; caulking or “JB Weld” will not be acceptable.

Measure and record test pressure at high point in system. Where test pressure at high point in system causes excessive pressure at low point in system, due to static head, portions of piping system may be isolated and tested separately to avoid undue pressure. However, every portion of piping system must be tested at the specified minimum test pressure.

Minimum test time shall be 4 hours plus such additional time as Chilled Water Engineer may require insuring there are no air pockets in the line, no broken pipe or defective materials are in the line, and no leaking joints have been made.

Repair system and retest all portions of system when equipment or system fails to meet minimum test requirements.

Submit results of each test to Engineer within 3 days of test occurrence for review.

FLUSHING AND CHEMICAL CLEANING OF CHILLED WATER ABOVE GROUND PIPE SYSTEMS

Contractor Qualifications
The Engineer must approve the contractor performing cleaning or supplying of the chemicals. Submit contractor qualifications and references for five (5) similar projects performed in the last 5 years. The contractor must also meet the following minimum requirements:

Performed a minimum of three (3) institutional piping cleanings within the last 5 years.

Has been in the chemical pipe cleaning or treatment business and has been performing this type of work for a minimum of 5 years.

Is licensed to perform work in the State of North Carolina.

Submittals

NOTE: The Contractor shall provide their flushing plan to the designer at least two weeks before flushing is planned to begin. The designer shall verify the temporary piping is adequately sized to attain the required velocities in the piping.

Submit the following information:

Detailed plans on performing the flushing and cleaning. The plan must include a strainer with opening no larger than 0.45 inches. The strainer will be removed several times during the process for inspection.

Chemicals; description of chemicals, its composition and function.

Material Safety Data Sheets (MSDS): Submit directly to Owner the MSDS for all chemicals used for pipe cleaning. Include with MSDS written notice of Owner’s responsibility to notify its employees of the use of those chemicals.

Capacities/ratings

Materials of construction

Dimensions and weights

All other appropriate data

Chemical Manufacturers

Nalco or approved equal.

Piping System Cleaner

Use cleaning compound similar to Nalco 2567 - to remove organic soil, hydrocarbons, flux, pipe mill, varnish, pipe compounds, iron oxide, and like deleterious substances - with or without inhibitor, suitable for system metals without deleterious effects. Cleaner shall contain no trisodium phosphate.

Batch Chemical Feeder
Provide by-pass type batch feeder to receive chemicals in liquid or pellet form. Remove feeder from ME room when process is completed.

Execution

**DESIGNER NOTE:** Designer shall provide contractor with flushing flow needed to ensure the velocities in any section of piping exceeds 3.0 fps. This will be the minimum flow required to properly flush the entire system.

**DESIGNER AND CONTRACTOR NOTE:** The building chilled water pump may be used; if approved for use by the Chilled Water Manager; the pump has been aligned and verified by Chilled Water Personnel; VFD has been certified by VFD supplier and checked by Chilled Water personnel; flow is deemed sufficient by the designing engineer; is requested in writing 2 weeks in advance and a pump inspection is scheduled with the pump manufacturer’s service representative to determine no degradation is found. At a minimum the seal will be replaced during reassembly. If the building chilled water pump is not used, contractor shall isolate the building chilled water pumps and supply temporary pump and piping to perform flushing. Ensure that the temporary 1/8” mesh strainer is in place before the cleaning begins.

The Contractor shall install temporary piping to facilitate the flushing at the end of piping runs. The temporary piping will be line size or 1/3 main line size depending upon location. The temporary piping will be installed off the bottom of the permanent piping, top take offs will not be allowed for flushing and cleaning. This will ensure that all foreign material is removed during cleaning. If horizontal connection is required for cleaning it must be line size and any reducers must be eccentric with the flat install on bottom edge of piping. The Contractor shall bypass all necessary equipment and sensitive components. The Contractor shall verify all lines being flushed are open with no strainers or filters in any line.

Contractor to flush and clean all new chilled water piping systems after the system has been successfully pressure tested. Chilled Water personnel shall witness the flushing and cleaning procedures. The Contractor shall provide all water for flushing and cleaning. Flushing water and cleaning solutions shall be discharged to the sanitary sewer system.

**Flushing**

Flush all chilled water pipe thoroughly for 30 minutes or longer, as required to remove all dirt and foreign matter from the system. UNC Construction Management representative will make determination if piping flush is complete before the Contractor can proceed to the cleaning step.

**Cleaning**
Drain the system.

Verify the strainer is clean before proceeding. Fill the system with water, vent and add recommended amount of cleaner. The cleaner should be diluted by at least a 3:1 ratio to prevent excessive attack on metal surfaces at the point of application. (Do not allow any chemicals to come in contact with galvanized surfaces.

Circulate system for a minimum of 24 hours at the flow rate recommended by the chemical manufacturer. Remove the temporary mesh strainer and debris. If temporary mesh strainer is not clean, reinstall and continue cleaning.

If UNC Construction Management representative determines the temporary mesh strainer is clean, completely drain system and continue to next step.

Fill system with clean water, vent and circulate for one hour. Drain system.

If installed, remove the temporary piping and pump. If building chilled water pumps were used, commence inspection with pump manufacturer’s service representative. After pump is inspected, realign and have alignment verified. Re-inspect for leakage and if no leakage is noted, delivery one new seal kit and bearings to Chilled Water representative.

Final Fill

If piping is to be isolated from the system for more than 7 days, add inhibitor to prevent corrosion. Inhibitor shall be NALCO 3DT279. Molybdate inhibitor shall not be used. If the piping is being placed in service in less than 7 days, Chilled Water Personnel will fill the system with water from the University Chilled Water System.

MECHANICAL INSULATION

Product Delivery, Storage and Handling

All insulation material shall be delivered to project site in original, unbroken factory packaging labeled with product designation and thickness. Shipment of materials from manufacturer to installation location shall be in weathertight transportation. Insulation materials delivered to jobsite shall be stored so as to protect materials...
from moisture and weather during storage and installation. Insulation material shall be protected from long exposure to UV light from sun.

Application

Install Polyisocyanurate insulation as per manufacturer’s specifications.

Installation

Do not insulate any sections of piping that contain welded joints, threaded joints, flanges or instrumentation taps until the pressure test has been completed. Any removal and reinstallation to correct system defects, prior to end of guarantee period shall be accomplished at no expense to Owner.

All insulation installation methods shall be performed in accordance with the latest edition of National Commercial and Industrial Insulation Standards published by MICA (Midwest Insulation Contractors Association) and manufacturer's installation instructions, except as modified in this Section of specifications.

Install all products with good workmanship, with smooth and even surfaces. Use full-length factory furnished material where possible. Do not use scrap piecing. Apply insulation only on clean, dry surfaces, after all rust and scale have been removed and testing of systems has been completed.

For pipes 1-1/2” and smaller, specified pipe insulation and jacket shall be continuous through hanger or support locations and insulation protection shields shall be provided to protect insulation from compressing.

For pipes 2” and larger, where manufactured pre-insulated pipe supports are used at hanger or support locations, extend insulation to insulated pipe supports. To ensure vapor barrier, the contractor shall be responsible for continuity of vapor barrier at insulated pipe supports. Use 3” wide vapor barrier tape at pipe supports.
For contractor fabricated anchors, secure insulation directly to pipe surface and extend up anchor for distance of 4 times insulation thickness. For pre-insulated anchors, cover entire surface of anchors with Type A insulation. Take special care to assure vapor seal at anchor.

PIPE IDENTIFICATION
Install pipe identification on each system. Place flow directional arrows at each pipe identification location. Identify piping with marker system. Markers shall be "snap-on" or "strap-on" type depending on applicable pipe size. Identify all piping, not less than once every 25 ft, not less than once in each room, at each branch, adjacent to each access door or panel, at each valve and where exposed piping passes through walls and floors.

Pipe identification labels shall be abbreviated as follows:

<table>
<thead>
<tr>
<th>Piping System</th>
<th>Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chilled Water Supply</td>
<td>CWS</td>
</tr>
<tr>
<td>Chilled Water Return</td>
<td>CWR</td>
</tr>
</tbody>
</table>

Markers to comply with ANSI A13.1 for color, length of color field and include flow directional arrows integrated into the marker.

For insulated pipe systems, lettering sizes are as follows:

For pipes up to 1 inch, use 1 inch letters.

For pipes 1-1/4 inch to 2 inches, use 2 inch letters.

For pipes 2-1/2 inches to 6 inches, use 3 inch letters.

For pipes above 6 inches, use 4 inch letters.
BRIDGE CONTROLS

PRIMARY/SECONDARY BUILDING BRIDGE SYSTEM - DESCRIPTION OF OPERATION

A chilled water bridge system shall fall into one of two categories, depending on the kind of building loads that are served. The building category will be designated when the designer/engineer have reviewed the building loads with the Chilled Water Engineer/Manager. These categories are: (1) essential loads, (2) non-essential loads. The “non-essential loads” category generally includes comfort-cooling applications. The “essential loads” category includes research facilities, their auxiliary equipment, medical facilities with operating rooms, and computer facilities.

BRIDGE OPERATION FOR NON-ESSENTIAL AND ESSENTIAL LOADS

Building and EMCS Interface

The bridge enable shall be a hardwired 4 to 20MA signal (4=0% load and 20=100% load) from the Building Automation System to the Chilled Water Bridge controller. This signal represents the actual live total Chilled Water load in the building.

Current transformers (CTs) on pump starter input to the bridge controller and the bridge controller will energize solenoids for FV(B), which opens and FV(P) which closes. Where variable frequency drives are used, the bridge controller will energize the solenoids. When the building control system is used to provide this signal, outdoor air temperature, cooling coil valve output, or other parameters may be used to initiate bridge operation/shutdown. Designer shall specify parameter to be used. Bridge modes of operation will be controlled by chilled water based on the 4 to 20 mA signal from the BAS.

For an essential bridge, when building load drops below a predetermined level or in the event of a failure of the bridge controls/pumps, the bridge switches to the “coupled” mode.

Boost Coupled Mode

The mode is activated by Chilled Water when the Chilled Water Bridge pump motor can realize power savings without adversely affecting the utility return water temperature or when sufficient cooling cannot be achieved otherwise. This is accomplished by shutting the pump by-pass valve FV-P, shutting the bridge by-pass valve FV-B and forcing the TCV-A valve to 100% open. Pump speed modulates according to end of line differential set point or if no means of modulation is available then the pump is at full speed.
Decoupled Mode

Water flow across the bridge interface is controlled by a two position spring-return-to-closed valve (FV-B) in the bridge bypass line, a two-position spring-return-to-open valve (FV-P) in the pump bypass line and a temperature control valve (TCV-A) in the distribution return branch line, and a VFD on the pump. A multi-loop digital controller (MC-1) provides regulatory and discreet control of the bridge system components. The normal mode of operation of the chilled water bridge is to “decouple” the building system from the chilled water distribution system.

In this mode the bridge bypass valve is open, the pump bypass valve is closed, the pump(s) is energized, and the bridge return temperature control valve regulates the flow of water across the bridge interface with the building system. The pump(s) circulates chilled water to the building loads at the required flow and pressure. A temperature control loop, consisting of temperature controller (MC-1), temperature sensors (TS-1) and (TS-3), and bridge return temperature control valve (TCV-A), regulates chilled water circulation between the chilled water distribution mains and the building system. The control loop maintains a return water temperature equal to or greater than set point. Set point is determined by the design cooling coil leaving water temperature.

Variable volume pumping shall be under the control of the bridge controller, provided by UNC Chilled Water. Provide differential pressure transmitter(s), PDT-1(2) and Variable Speed Drive(s). The control loop maintains a differential pressure equal to or greater than set point. Set point is determined by the design cooling coil and control valve requirements. The following signals must be provided between the variable frequency drive(s) and the bridge controller:

1. 4-20 mA isolated process follower output from bridge controller to drive(s).
2. 4-20 mA isolated Hz or % speed input to bridge controller from drive(s).
3. Dry contact is normally closed when the drive is de-energized or in the event of a fault. This dry contact shall be open when the drive is energized and not in fault.
4. Where a bypass starter is used, a dry contact to indicate bypass status.
5. Start/Stop command.
6. Run status.
7. kW
8. Spare

Coupled Mode

The mode is activated whenever the building load drops below a predetermined level. The designer shall provide for a signal from the building control system to switch to this mode under normal operating conditions. This signal shall cause the CHW circulation pumps(s) to stop, pump bypass valve FV-P to open, bridge bypass
valve FV-B to close, and bridge return temperature control valve TCV-A to open and/or regulate to chilled water return set point.

Failure Mode

In a failure of the bridge controls or pump failure the position of the TCV-A will be determined by the type of bridge, in the event of a failure a non-essential valve will fail in the closed position and an essential valve will fail in the open position.

INTERLOCKS AND METERING

BTU metering is available as an output of the MC-1 digital controller. The temperature difference of the distribution supply and return as sensed by TS-1 and TS-2 is multiplied by the flow rate as sensed by FE/FT-1. This value is integrated and becomes a digital output to totalizer NQI-I.

INSTRUMENT SPECIFICATIONS

The following field-mounted devices and functions shall be provided for all applications:

<table>
<thead>
<tr>
<th>TAG NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>PANEL</td>
<td>Bridge Panel/Control Cabinet</td>
</tr>
</tbody>
</table>

The Bridge panel is supplied by UNC – Chilled Water Department at a time when requested by the contractor through UNC Construction Management. The panel is mounted in a place agreed upon by contractor and UNC Chilled Water Engineer. The power conduit shall enter the cabinet on the left side near the top of the cabinet. The network conduit shall enter the cabinet on the right side near the top of the cabinet. The panel shall be mounted and conduits and wiring to the field instruments installed before the back plane is requested and delivered. The wiring will be terminated in the panel by UNC – Chilled Water Department personnel.

INSTALLATION NOTE: No penetrations are allowed in the top of the panel box. All penetrations must be made with liquidtight connectors.

| MC-1   | Multi Loop Digital Controller |
All control functions for this system are performed by a multi-loop controller. This controller will be purchased, programmed and installed in a control panel by Chilled Water Department. Before the installation of the back plane, the instruments and transmitters shall be checked out for communication and operational capability by UNC – Chilled Water personnel. To perform this testing all associated equipment for the operation must be completed, including compressed air lines and any other required equipment. Once this testing is completed, the back plane will be turned over to the contractor for installation. The controller shall be provided with two ethernet connections to the campus network.
VFD  Variable Frequency Drive

Designer Note: The VFD must not be powered up or operated until it has been certified by the VFD supplier’s personnel and verified by Chilled Water Personnel.

Drive efficiency, transient protection and harmonic distortion - Single phase, ground fault and short circuit protection (including bypass, if supplied), coordinated AC transient protection system consisting of 4-120 joule rated MOV’s (phase to phase and phase to ground), a capacitor clamp and 5% impedance reactors, (5% impedance may be from dual (positive and negative DC bus) reactors, or 5% AC line reactors), EMI/RFI filter, input current rating of the VFD shall be no more than 3% greater than the output current rating. Compliance to: Standard 519-1992, IEEE Guide for Harmonic Content and Control, UL508C, IEC 16800 Parts 1 and 2.

Operating Limits – Tolerated voltage window shall allow the VFD to operate from a line of +10% nominal, and -15% nominal voltage as a minimum. Environmental operating conditions: 0 to 40ºC continuous. VFD’s that can operate at 40ºC intermittently (during a 24 hour period) are not acceptable and must be oversized. Altitude 0 to 3300 feet above sea level, less than 95% humidity, non-condensing.

Motor winding protection – Standing wave attenuation between motor and drive shall be provided that limits rise time of the output PWM waveform to approximately 1.2 µs at highest carrier frequency, limits peak voltage to 1 kV, and reduces the voltage rise to less than 500 volts per micro-second. This effect shall be confirmed at the startup of the drive by measuring the PWM waveform voltages at the VFD and motor junctions, storing the waveforms with a digital oscilloscope, and generating a report with printed waveforms to be given to Chilled Water Personnel.

Control Features – Local drive interface shall be digital display and keypad, regardless of horsepower rating. The keypad shall allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs. The keypad shall include Hand-Off-Auto selections, manual speed control, and fault reset. The drive shall incorporate “bump-less transfer” of speed reference when switching between “Hand” and “Auto” modes. All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of three operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable):

<table>
<thead>
<tr>
<th>Output frequency</th>
<th>Motor Speed (RPM, %, or EU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor Current</td>
<td>Calculated Motor Torque</td>
</tr>
<tr>
<td>Calculated Motor Power (kW)</td>
<td>DC Bus Voltage</td>
</tr>
<tr>
<td>Output Voltage</td>
<td></td>
</tr>
</tbody>
</table>

Two (2) programmable analog inputs shall accept 4-20 ma current signals.
If the input reference (4-20 ma or 2-10V) is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communication bus.

The VFD shall have programmable “Sleep” and “Wake up” functions to allow the drive to be started and stopped from the level of a process feedback signal.

Two (2) programmable analog 4-20 ma outputs. The outputs may be programmed to output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus Voltage, Active Reference.

Six (6) programmable digital inputs for maximum flexibility in interfacing with external devices. All digital inputs shall be programmable to initiate upon an application or removal of 24 VDC or a dry contact.

Three (3) programmable digital Form-C relay outputs. The relays shall include programmable on and off delay times and adjustable hysteresis. Default settings shall be for run, not faulted (fail safe), and run permissive. The relays shall be rated for maximum switching current of 8 amps at 24 VDC and 0.4 amps at 250 VAC; maximum voltages of 300 VDC and 250 VAC; continuous current rating of 2 amps RMS. Outputs shall be true form C type contacts; open collector outputs are not acceptable.

Two independently adjustable accel and decel ramps with 1 – 1800 seconds adjustable time ramps.

The VFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and audible motor noise.

The VFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual VFD temperature that allows the highest carrier frequency without de-rating the VFD or operating at higher frequency only at low speeds.

The VFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to set-point without safety tripping or component damage (flying start).

The VFD shall have the ability to automatically restart after an over-current, over-voltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable.

The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430-150 for 4-pole motors.

The VFD shall include password protection against parameter changes.
Construction and Serviceability – The VFD shall have cooling fans that are designed for easy replacement. The fans shall be designed for replacement without removing the VFD from its mounting or removal of circuit boards. The VFD cooling fans shall operate only when required. To extend the fan and bearing operating life and limit condensation, operating temperature will be monitored and used to cycle the fans on and off as required. The VFD cabinet must be a NEMA 3R rated enclosure with fused service disconnect, manual bypass, and mechanical motor overloads. It shall allow the motor to be operated across the line with full over-current protection while drive is removed for repair/replacement. The manual bypass feature shall be activated by a selector switch and control circuit separate from the drive controls. Drive and bypass contactors must be energized by manual door mounted switches, via an internal control transformer. There must be no “electronic bypass” provided. Electronic ‘bypass’ consist of control boards that energize contactors, and provide electronic motor overload protection. It much provide status for bypass operation. Motors are to be located within 50 feet from drive, output cables shall be installed in rigid steel conduit. Output filter or load reactor, if required, shall be mounted in drive cabinet.

Communication – Modbus RTU serial communication protocol, RS 485 multi-drop. The use of third party gateways or multiplexers is not acceptable. Serial communication capabilities shall include, but not limited to; run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, accel/decal time adjustments, and lock and unlock the keypad. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed/frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. Status monitoring the VFD relay output status, digital input status, and all analog input and analog output values, keypad “Hand” or “Auto” selected, bypass selected, and the ability to force the unit to bypass (if bypass is specified). All diagnostic warning and fault information shall be transmitted over the serial communication bus. Remote VFD fault reset shall be possible.

Startup – A certified start-up form shall be filled out for each drive with a copy provided to Chilled Water, a copy provided with project documentation and a copy kept on file at the drive manufacturer.

Design Note: No auto transfer to bypass in case of drive fault.

Design Note: No DCS start command required for bypass operation.

Installation Note: Separate conduit shall be used for input power wiring, motor wiring, control and communications wiring and if supplied, brake unit wiring.

Start Up Note: Testing needs to be coordinated with UNC-Chilled Water to allow UNC personnel to be on hand during startup.

TCV-A Return Temperature Control Valve

For valve sizes 2” and larger use a high performance butterfly control valve with a 60 psi pneumatic rotary diaphragm actuator and positioner capable of receiving a 4-20mA control signal, with integral HART communication. The valve and the actuator shafts shall be connected with a two piece no play coupling. The coupling and connecting bracket shall be manufacturer supplied and not shop built.
The valve shall have a lugged wafer style body of carbon steel, ductile iron or stainless steel rated for ANSI class 150 service. The seat material shall be fluoropolymer based blend with no fillers or PTFE filled. Disk and shaft shall be 316 Stainless steel construction. Disk to shaft connection shall be non-shear tangential pinning. Disk shall be offset from shaft centerline. The valve shall have upper and lower shaft bushing/bearings of a 316 stainless steel carrier and PTFE liner. Shaft seal shall be multiple rings of V-flex style PTFE packing with 316 stainless steel packing ring.

Actuator shall have a position indicator with pointer and scale showing 0 to 100% rotation or “open” “closed”. Actuator shall be capable of opening and closing valve against 50 psi differential. Actuator shall be spring to close for non-essential applications and spring to open for essential applications. The actuator shall be sized for an air supply of 60 PSIG and shall be supplied with an automatic filter regulator with a minimum 5 micron filter supplied with the assembly.

Preferred valve orientation is with the shaft in the horizontal plane. When mounted in the vertical plane, the actuator assembly must not be located at the bottom of the pipe. The position indicator must be visible from the ME room floor. There must be sufficient clearance to remove the actuator assembly from the valve. Specify actuator mounting position with valve order. Slip-on flanges shall not be used for control valve installation and can only be used if approved for installation by UNC Chilled Water Manager.

Positioner shall have 4 – 20 mA control signal with integral HART communication and use <0.07 scfm of compressed air when bleeding off.
INSTALLATION NOTE: Bench-check valve action and travel limits before installation. Notify UNC-CM representative of bench-check so UNC-CW personnel can witness testing.

Manufacturer: Jamesbury (valve size in inches), 815 L - 11 21 36 XZ – QP(n)C/M with ND9000 series positioner or approved equal.

Alternate TCV-A Return Temperature Control Valve

For valves 1” to 6” in spaces where compressed air is not available, use a single V-ball control valve with an electric actuator and positioner capable of receiving a 4-20 mA control signal, with integral HART communication.

The valve body shall have ANSI 150 lb flange ends, carbon steel body, removable soft seat, stainless steel ball and stem with splined connection, PTFE V-ring packing and low flow restriction design. The valve shall have upper and lower shaft bushing/bearings of a 316 stainless steel carrier and PTFE liner.

Actuator shall be 120 VAC power with a 4-20 mA feedback module, capable of HART communication. Actuator shall have a position indicator with pointer and scale. The valve and the actuator shafts shall be connected with a two piece no play coupling. The coupling and connecting bracket shall be manufacturer supplied and not shop built. Actuator shall be capable of opening and closing the valve against 50 psi differential. Actuator will have 100% duty factor and sufficient power to move with breakaway torque levels at any position. The actuator shall be spring close or spring open depending upon application or the valve will be supplied with alternate power option which will allow the valve to be moved and held in its failure position.

Manufacturer: KTM model W0601 valve, with EPI2 electric actuator or approved equal

FV-B, FV-P Bypass Valves

Both FV-B and FV-P, the bridge bypass valve and the pump bypass valve respectively, are to be line size valves.

For valve sizes 2” and larger use a high performance butterfly control valve with a 60 psi pneumatic rotary diaphragm actuator. The assembly shall be capable of being field reversible for changing operation. The valve and the actuator shafts shall be connected with a two piece no play coupling. The coupling and connecting bracket shall be manufacturer supplied and not shop built.

The valve shall have a lugged wafer style body of carbon steel or ductile iron rated for ANSI class 150 service. The seat material shall be fluoropolymer based blend with no fillers or PTFE filled. Disk and shaft shall be 316 Stainless steel construction. Disk to shaft connection shall be non-shear tangential pinning. Disk shall be offset from shaft centerline. The valve shall have upper and lower shaft bushing/bearings of a 316 stainless steel carrier and PTFE liner. Shaft seal shall be multiple rings of V-flex style PTFE packing with 316 stainless steel packing ring.
Actuator shall have a position indicator with pointer and scale showing 0 to 100% rotation or “open” “closed”. Actuator shall be capable of opening and closing valve against 50 psi differential. FV-B shall be spring-to-close, FV-P shall be spring-to-open. The actuator will be supplied with a 115 VAC solenoid. The solenoid shall be integral with the actuator. The actuator shall be sized for an air supply of 60 PSIG and shall be supplied with an automatic filter regulator with a minimum 5 micron filter supplied with the assembly. A separate 120 VAC power circuit is required for each solenoid.

Preferred valve orientation is with the shaft in the horizontal plane. When mounted in the vertical plane, the actuator assembly must not be located at the bottom of the pipe. The position indicator must be visible from the ME room floor. There must be sufficient clearance to remove the actuator assembly from the valve. Specify actuator mounting position with valve order. Slip-on flanges shall not be used for control valve installation.

INSTALLATION NOTE: Bench-check valve action and travel limits before installation. Notify UNC-CM representative of bench-check so UNC-CW personnel can witness testing.

Manufacturer type: Jamesbury (valve size in inches), 815 L - 11 21 36 XZ – QP(n)C/M or approved equal.

Alternate FV-B, FV-P Bypass Valves

For valves 1” to 6” in spaces where compressed air is not available, use a single V ball control valve with an electric actuator. Actuator shall be 120 VAC power with a 4-20 mA feedback module. Actuator shall have a position indicator with pointer and scale. The valve and actuator shafts shall be connected with a two piece no play coupling. The connecting bracket shall be manufactured supplied and not shop built. Actuator shall be capable of opening and closing the valve against 50 psi differential. The valve shall have ANSI 150 lb flange ends, carbon steel body, SS316 laminated seat, stainless steel ball and stem, PTFE V-ring packing and full bore design. The actuator shall be supplied with alternate power option which will allow the valve to be moved and held in its failure position.

Manufacturer: KTM model W0601 valve, with EPI2 electric actuator, or approved equal.

FE/FT 1 Flow Element/Transmitter

V-cone type flow element: This flow element and transmitter assembly will be provided by UNC. The Chilled Water Department will purchase this equipment with project funds. The mechanical contractor shall install this flow element in the piping system as specified by the designer. The contractor shall furnish and install flanges for flow meter. Designer shall clearly show the orientation and mounting of the flow element on the construction drawings. The preferred meter installation is in horizontal pipe runs. If installing smaller meter than the bridge piping, have four pipe diameters between the meter flanges and the reducers on both sides of the meter, the same requirement shall be used for any fittings used adjacent to the meter. For horizontal installation, this meter must be installed in either the three o’clock or nine o’clock positions or a maximum of 45 degrees below these positions. If the meter must be installed in a vertical run, the flow must come from under the meter so that the cone will not entrap air. The meter must not be installed downstream from a control valve. The meter must not be installed in the highest point of a pipe system.
RTU, STU, RTB, STB  Temperature Sensor Assembly

RTU – Return Temperature Utility – must be installed a minimum of 7 pipe diameters from the downstream weld connection of the tee. The thermowell must be installed in the same plane or above the tee and upstream of the control valve to avoid cold trap.

STU, RTB, STB – Supply Temperature Utility, Return Temperature Building, Supply Temperature Building – must be installed a minimum of 3 pipe diameters from pipe fittings.

RTD SENSOR: This spring-loaded type sensor shall be a 100 ohm platinum with three 6” stranded/tinned copper, teflon insulated leads. Sheath shall be 316 stainless steel, 0.25 inch diameter. The sensitive portion shall not exceed 1” from the sensor tip. The spring loading mechanism shall allow the sensor to be removed from the thermowell without disconnecting or twisting the sensor/transmitter leads.

PERFORMANCE:

Temperature Span: -50 to 200 degrees C
Temperature Coefficient: 0.00385 ohm/ohm/deg C
Accuracy: +.12% at 32 degrees F (class B)
Conformance: DIN-IEC 751

Installation Note: Install with enough length in seal –tite and leads to allow removal of the RTD for calibration without disconnecting wiring or seal-tite. Ensure the thermowell is installed on the side of the pipe.

Thermowell for RTD Sensor

The thermowell shall have 1.75”connection head length with ½” FNPT instrument mounting, ¾” MNPT process-mount, .5” outside diameter and .26” bore. The insertion depth shall be as stated in chart below. The thermowell shall be compatible with the specified temperature sensor and be constructed of 316 stainless.

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Insertion Depth</th>
<th>Sensor Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 4”</td>
<td>2.5”</td>
<td>7”</td>
</tr>
<tr>
<td>6”-12”</td>
<td>4.5”</td>
<td>9”</td>
</tr>
<tr>
<td>12” and above</td>
<td>7.5”</td>
<td>12”</td>
</tr>
</tbody>
</table>
Thermometers

Select devices for highest pressures and temperatures existing in respective systems in accordance with ANSI specifications.

Glass thermometer: Thermometer shall be an industrial glass thermometer with cast aluminum body and have a 9” scale. The scale will be from 30º to 120ºF degree scale with 2ºF degree division. The thermometer shall have a 3 ½” stem and variable degree angle adjustment and union connection.

Solar thermometer: Thermometer shall be an industrial solar powered thermometer capable of reading a temperature range 30º to 120ºF with an accuracy of ± 2%.

Thermowell for Thermometer

The thermowell shall have ¾” MNPT process mount, with 1 1/8” instrument mounting, and 3 ½” length. The thermowell shall be compatible with the specified thermometer and be constructed of brass.

BE Bridge Enable Signal

The bridge enable shall be a hardwired 4 to 20MA signal (4=0% load and 20=100% load) from the Building Automation System to the Chilled Water Bridge controller. This signal represents the actual live total Chilled Water load in the building.

For example, all the cooling control valve positions would be averaged together to base the output signal on. If there were three cooling control valves that represented 100% of the total cooling load and valve 1 was 25% open, valve 2 was 50% open and valve 3 was 75% open the average load would 50% and the bridge enable signal would be at 12 mA. If there is equipment with no feedback some other means of accounting for actual live load shall be factored in to the total load.

All factors that are considered in the total load formula shall be bound out into a network output that can be read directly from the Building Automation System with our SCADA system via Modbus TCP. If necessary a device such as a fieldserver or other approved device may need to be installed to ensure that the most reliable and most direct means of data transmission is accomplished. The cooling coil tube velocity at design flow shall not be less than 4 FPS. Provide a leaving chilled water temperature sensor on all heat exchangers (cooling coils) over 10 tons rated cooling capacity.

PDT-1, 2 Differential Pressure Transmitter

PDT-1 shall provide a linear output signal proportional to process differential pressure (DP) for control of building chilled water pump VFD. Sensor shall be capacitance-type.

PDT-2 shall provide a linear output signal proportional to process differential pressure (DP) for control of Chilled Water production. Sensor shall be capacitance-type.

The instrument shall be microprocessor based. It shall be fully field configurable via the Highway Addressable Remote Transmitter (HART) communication protocol from the controller card.
Diaphragm Material: Hastelloy
Fill Fluid: Silicone
Process Connection: ½” Stainless Steel
Power Supply Voltage: 13 – 35VDC unregulated
Output Signal: 4-20 ma
Damping: Adjustable damping with minimum of 0.2 seconds.
Over Pressure: Minimum overpressure rating shall be 1500 psig or twice the maximum Sensor range, whichever is greater.
Operating Temperature: -20 to +180 degrees F
Minimum Enclosure: NEMA 4
Performance: Overall performance 0.25% of span for + 50degF and + 1000 psi line and 1:1-5:1 range down.
Range: 0-1000” water column.
Zero: Zero control shall be continuously adjustable between –50% and 100% of upper range limit. Total calibrated span and zero adjustment cannot exceed upper range limit. Zero and span shall be independently field adjustable with no interaction.
Accuracy: ± 0.1% of calibrated span, including effects of linearity, hysteresis, repeatability dead band.
Stability: ±0.25% of upper range limit for five years.
Power Supply Effect: Less than 0.005% of calibrated span per volt.
RFI Effect: ±-0.1% of span from 20 to 1000MHz, and for field strength up to 30V/m
Local Digital Indicator: For PDT-2 Only
Hazardous Area Class: Not required
Manufacturer: Rosemount, Toshiba, Siemens, Yokogawa, or approved equal.

The transmitter shall be supplied with a stainless steel coplanar manifold capable of allowing calibration and equalization.

Installation Note: Verify taps for PDTs are mounted on the side of horizontal runs in piping, not on top or bottom. PDTs shall be mounted with connection taps on top of unit and tubing run up to connections. Tubing runs must be run so air is not trapped in lines.
Electrical Interlocks for Pump(s)

The contractor shall provide all interfaces between starter or variable speed drive and bridge control panel. Contacts shall be rated for low level electronic signal loads. $\leq 10\text{mA}$ at 24vdc. This shall include a circuit to start and stop the pump(s) and an isolated circuit for pump(s) status indication.

Installation Note: All power cables shall be installed in one continuous run.

Instrumentation Cables

Control cable type: Alpha no. 2241C or Belden no. 8760, 2-conductor twisted, 18 gauge, foil shield with drain wire, Stranded, Tinned, PVC jacket.

RTD Temperature Sensors: Alpha no. 2413C or Belden no. 8772, 3-conductor twisted, 18 gauge, foil shield with drain wire, Stranded, Tinned, PVC jacket

Installation Note: The cables shall be installed in one continuous run with all shield drain wires grounded at the control panel. The field ends of the shield drain wires shall be dressed and insulated. VFD and controller ends will be dressed with shrink wrap and labeled per Chilled Water provided termination sheet.

Pneumatic or Instrumentation Lines

All pneumatic lines for chilled water valves must be run from an air dryer and supplied with a filter regulator set. All lines must be stainless steel or soldered copper, plastic air lines are not permitted.

Conduit for Power and Instrumentation

All conduit for wiring shall be rigid galvanized steel conduit. Conduit will be run for all bridge panel wiring. All conduits will have similar wiring installed only.
Appendix A  Exposed Utility Temporary Support

(A) Shored Trench

- FINISHED GRADE
- 18" MAX
- 5' MAX
- 14"X30 MIN STEEL I-BEAM
- 18" MAX

(B) Hanger/Support

- PIPE CLAMP 1/2" X 2"
- SIMILAR TO GRINNELL
- FINISHED GRADE
- 18" MAX
- 5' MAX
- 14"X30 MIN STEEL I-BEAM
- REFER TO SPECIFICATION FOR BACKFILL MATERIALS AND COMPACTION REQUIREMENTS

(C) SLOPED TRENCH

- EXPOSED UTILITY TEMPORARY SUPPORT

Scale: None

NOTE:
(1) INSTALL RESTRAINT ON UNRESTRAINED PIPING BEFORE CONTINUING EXCAVATION (TYP.)

Refer to specification for backfill materials and compaction requirements.
Appendix B  Typical Chilled Water Trench thru Paved Area

![Diagram of chilled water trench through paved area]

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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<td>1'0&quot;</td>
<td>1'0&quot;</td>
</tr>
<tr>
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<td>1'0&quot;</td>
<td>1'6&quot;</td>
<td>1'0&quot;</td>
</tr>
<tr>
<td>8&quot;</td>
<td>4'10&quot;</td>
<td>1'0&quot;</td>
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<td>1'0&quot;</td>
</tr>
<tr>
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<tr>
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<td>1'6&quot;</td>
<td>1'6&quot;</td>
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<tr>
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<tr>
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<td>2'0&quot;</td>
</tr>
</tbody>
</table>

**Note:**
1. EXISTING CHILLED WATER PIPING EXPOSED DURING EXCAVATION AND CHILLED WATER PIPING SHOWN TO HAVE MECHANICAL RESTRAINTS ADDED ARE TO BE BACKFILLED AS SHOWN HERE FOR NEW PIPING.
2. MINIMUM BURIAL DEPTH SHALL BE 36".
Appendix C  Typical Chilled Water Trench thru Landscaped Area

THRU LANDSCAPED AREA
SCALE: NONE

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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<td>4&quot;</td>
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NOTE:
EXISTING CHILLED WATER PIPING EXPOSED DURING EXCAVATION AND CHILLED WATER PIPING SHOWN TO HAVE MECHANICAL RESTRAINTS ADDED ARE TO BE BACKFILLED AS SHOWN HERE FOR NEW PIPING.

MINIMUM BURIAL DEPTH SHALL BE 36".

TYPICAL CHILLED WATER TRENCH DETAIL
SCALE: NONE
Appendix D  Utility Butterfly Valve Installation

[Diagram of butterfly valve installation with labels and annotations]

- VALVE BOX STABILIZING PAD
- PLAN VIEW
- SIDE VIEW
- BUTTERFLY VALVE INSTALLATION

Notes:
- Offset piping as necessary to allow for chilled water valve installation.
- Riser pipe shall be on compressible filler, not on valve.
- Bricks pier required to plumb operator nuts.
- Butterfly valve, keep concrete clear of joints, bolts, and mechanical devices.
- Wrap mechanical connections in polyethylene prior to backfilling.
Appendix E  Chilled Water Drain Assembly

Notes:
1. Connect supply and return line drain into common drain line before entering manhole.
2. Install drain piping as shallow as possible below chilled water main piping.
3. Install drain valves (supply & return) parallel so that valve boxes may be encased by a common stabilizing pad.

Chilled Water Drain Assembly

Scale: None
Appendix F  Chilled Water Air Vent Handhold

NOTES:
(1) VENT VALVE MUST BE 6 INCHES BELOW GRADE SO THE COVER DOES NOT CONTACT THE VALVE

CHILLED WATER AIR VENT HANDHOLE

SCALE: NONE
Appendix G  Ductile Iron/Steel Pipe Transition At Wall Penetration

- **Schedule 40 Wall Sleeve with Water Stop**
- **3/4" Vent Valve with Cap Where Butterfly Valve is Provided**
- **1" Drain Valve w/Cap Where Butterfly Valve is Provided**
- **Chilled Water Piping**
- **(2) Modular Wall and Casing Seal Use 316 Stainless Steel Nuts and Bolts**
- **Lugged Style Butterfly Valve, Provide Where Shown on Drawings**
- **Carbon Steel Class 150 Flat Faced Flange**
- **Ductile Iron C110 Flanged End/PE Pipe to Mate Class 150 Steel Flat Face Flange. Provide O-Ring Full Face Gasket. Threaded Flanges Not Allowed**

**Scale: None**
Appendix H  Utility Piping Termination

CHILLED WATER LINES

PROVIDE RESTRAINED CAP WITH 1" VENT CORP., BALL VALVES AND PLUG AT TOP OF CAP TO ALLOW FOR COMPLETE VENTING OF AIR.

NOTES:
(1) BRING VENT PIPING TO SURFACE USING CHILLED WATER AIR VENT HANDHOLE DETAIL.

PIPING TERMINATION
SCALE: NONE
Appendix J  Pump Differential Pressure Gauge Detail

NOTES:

(1) SUPPORT TO PLACE NO STRAIN ON INSTRUMENT CONNECTIONS.

(2) PLACEMENT OF PIPING AND INSTRUMENT WILL VARY. PLACE IMPULSE LINES AND INSTRUMENT MOUNTING AS FIELD CONDITIONS REQUIRE. IMPULSE LINES AND INSTRUMENT SUPPORT MUST BE LOCATED TO AVOID INTERFERENCE WITH PUMP MAINTENANCE. MAXIMUM LENGTH OF IMPULSE LINE SHALL BE 5’-0”. FIELD VERIFY LOCATION OF INSTRUMENT SUPPORT, INSTRUMENT TAPS, AND IMPULSE LINES WITH OWNER/DESIGNER PRIOR TO INSTALLATION.

(3) MOUNT TRANSMITTER FROM PIPE SUPPORT MOUNTED TO STRUCTURE.

(4) CONTRACTOR SHALL FIELD VERIFY MOUNTING METHOD AND RECEIVE OWNER/DESIGNER APPROVAL PRIOR TO MOUNTING.

(5) INSTALL A FOURTH TAP FOR READING PRESSURE IF A STRAINER IS INSTALLED.

DIFFERENTIAL PRESSURE GAUGE DETAIL

TYPICAL
Appendix K  Requesting Outage for Chilled Water Service

Requests for planned outages of chilled water to any facility will only be accepted from the Facility Service Department involved in the work being done, Construction Management or a Contractor providing construction or renovation services on campus. All requests must be received no less than 5 business days in advance of the start date of the work.

Procedure for Requesting a Chilled Water Outage

1. Gather the following information and submit to UNC Chilled Water Department using Appendix L of these Specifications:
   - Name of Facility Service Department, Construction Manager or Contractor submitting request along with their contact information.
   - Description of work to be performed.
   - Name of Customer/Department and Building Name.
   - List of any Building Contacts or occupants who are aware of the work that needs to be accomplished.
   - Begin and End Times for Outage.

2. Prior to confirming an outage can be accommodated, Chilled Water will review the real or potential impact of the request. The review will include:
   - Impact on other customers
   - Potential impact of weather to initiate or complete the service outage
   - Any special or unusual material needs for service restoration
   - A plan to complete work and restore chilled water to the affected buildings
   - Time required to complete work and restore chilled water to the affected buildings

3. Once the review is completed and outage is acceptable, confirmation will be provided to the requesting party. Should any considerations be of sufficient concern to require further evaluation or delay, Chilled Water will inform the requesting party of reasons and alternatives.

4. Once the outage request has been accepted UNC Customer Service will be notified. They will issue a blanket notification to building occupants and other UNC Departments that might be affected. Chilled Water will post notices on the building no later than 48 hours prior to the outage starting.
5. Prior to restoring service, Chilled Water will contact the requesting party to confirm the system can safely be restored with no danger to any personnel associated with or involved in the outage.

6. At the completion of the outage, Chilled Water will issue a blanket notification to building occupants and other UNC Departments through UNC Customer Service and will remove posted notices.

Contact Information

For any questions or concerns, please contact Chilled Water at 962-1448.

Appendix L Request for Chilled Water Outage

Request for a Chilled Water Outage

A request for a chilled water outage needs to be submitted at least 5 working days before the outage is needed. This allows us to set the outage up with the proper contacts and arrange for any personnel needs that the outage may require.

Organization requesting outage: ____________________________________________

Person requesting outage: ________________________________________________

Outage location: __________________________________________________________

Reason for outage: _________________________________________________________

Date and duration of outage: _______________________________________________

Contact Person: ___________________________________________________________
B-26 – COMMUNICATIONS INFRASTRUCTURE

About This Document
This document provides the University’s guidelines for architects, engineers, and designers who are developing construction plans and specifications for new buildings and renovations for the University of North Carolina at Chapel Hill.

The document provides information about telecommunications services, standards, and practices for communications systems at the University. It covers topics such as copper and fiber optic cabling, duct banks, interior raceways and conduits, data communications, voice telephony systems, and cable television services. The document describes guidelines that designers are required to follow when creating plans and specifications, with the intention that the applicable portions be applied and organized according to the Construction Standards Institute (CSI) MasterFormat specification.

Scope: CSI Divisions and Groups
This document describes only guidelines related to CSI Division 27 (Communications). Where references to other sections are important, those references are included in the section text.

- Procurement and Contracting Requirements [Not Used]
- Specifications
  - General Requirements [Not Used]
  - Facility Construction [Not Used]
  - Facility Services
    - Division 20 – Reserved [Not Used]
    - Division 21 – Fire Suppression [Not Used]
    - Division 22 – Plumbing [Not Used]
    - Division 23 – Heating, Ventilation, and Air Conditioning [Not Used]
    - Division 24 – Reserved [Not Used]
    - Division 25 – Integrated Automation [Not Used]
    - Division 26 – Electrical [Not Used]
      - Division 27 – Communications
        - Division 28 – Electronic Safety and Security [Not Used]
        - Division 29 – Reserved [Not Used]
  - Site and Infrastructure [Not Used]
  - Process Equipment [Not Used]
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1. Abbreviations

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<th>Description</th>
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<tr>
<td>ADA</td>
<td>Americans with Disabilities Act</td>
</tr>
<tr>
<td>AFF</td>
<td>Above Finished Floor</td>
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<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
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<tr>
<td>ATS</td>
<td>Automatic Transfer Switch</td>
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<tr>
<td>AWG</td>
<td>American Wire Gauge</td>
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<td>BBC</td>
<td>Backbone Bonding Conductor (ANSI/TIA-607-C, equivalent to GE)</td>
</tr>
<tr>
<td>BCT</td>
<td>Bonding Conductor for Telecommunications (ANSI/TIA-607-B and prior, equivalent to TBC)</td>
</tr>
<tr>
<td>BICSI</td>
<td>Building Industry Consulting Services International</td>
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<tr>
<td>CA</td>
<td>Construction Administration</td>
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<tr>
<td>CATV</td>
<td>Cable Access Television System (sometimes called Master Antenna Television System)</td>
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<tr>
<td>CD</td>
<td>Construction Documents</td>
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<tr>
<td>CIG</td>
<td>Communications Infrastructure Guidelines</td>
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<tr>
<td>CSI</td>
<td>Construction Specifications Institute</td>
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<td>CommTech Engineering</td>
<td>The Communication Technologies Engineering group in the Information Technology Services Department at the University of North Carolina at Chapel Hill</td>
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<tr>
<td>DAS</td>
<td>Distributed Antenna System</td>
</tr>
<tr>
<td>DD</td>
<td>Design Development</td>
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<tr>
<td>EIDF</td>
<td>Extended Intermediate Distribution Frame</td>
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<tr>
<td>EF</td>
<td>Entrance Facility</td>
</tr>
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<td>ELFEXT</td>
<td>Equal Level Far End Crosstalk</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
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<tr>
<td>EMT</td>
<td>Electrical Metallic Tubing</td>
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<tr>
<td>ETL</td>
<td>Electrical Testing Laboratories (Intertek)</td>
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<td>GE</td>
<td>Grounding Equalizer (ANSI/TIA-607-B and prior, equivalent to BBC)</td>
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<tr>
<td>IDF</td>
<td>Intermediate Distribution Frame, floor/area distribution point, horizontal cross-connect</td>
</tr>
<tr>
<td>ITS</td>
<td>The Information Technology Services Department at the University of North Carolina at Chapel Hill</td>
</tr>
<tr>
<td>MDF</td>
<td>Main Distribution Frame, building distribution point, main cross-connect</td>
</tr>
<tr>
<td>MM</td>
<td>Multimode (fiber optic cable)</td>
</tr>
<tr>
<td>NEC</td>
<td>National Electrical Code</td>
</tr>
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<td>NEXT</td>
<td>Near End Cross Talk</td>
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<tr>
<td>NFPA</td>
<td>National Fire Protection Association</td>
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<td>OCC</td>
<td>Optical Cable Corporation</td>
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<td>OEM</td>
<td>Original Equipment Manufacturer</td>
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<tr>
<td>OSP</td>
<td>Outside Plant cabling or support structure</td>
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<td>OTDR</td>
<td>Optical Time Domain Reflectometer</td>
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<td>PBB</td>
<td>Primary Bonding Busbar (ANSI/TIA-607-C, equivalent to TMGB)</td>
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<td>PDF</td>
<td>Portable Document Format from Adobe Corporation</td>
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<tr>
<td>PLAR</td>
<td>Private Line Automatic Ringdown</td>
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<tr>
<td>PSTN</td>
<td>Public Switched Telephone Network</td>
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<tr>
<td>RCDD</td>
<td>Registered Communications Distribution Designer (via BICSI)</td>
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<tr>
<td>RF</td>
<td>Radio Frequency</td>
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<td>RFI</td>
<td>Request for Information</td>
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2. Definitions

- **Bonding Conductor for Telecommunications (BCT):** A conductor that interconnects the telecommunications bonding system to the main electrical service (power) grounding system.

- **Division 27:** Three-part CSI-formatted section of project manual concerning communications

- **Duct Bank:** Underground conduit set serving building from outside
• **Entrance Facility**: Location of emergence of outside plant cabling in building

• **Extended Intermediate Distribution Frame (EIDF)**: A space in a building that houses a small set of telecommunications equipment intended for a limited and specific purpose. EIDFs often consist of ceiling or wall-mounted enclosures.

• **Faceplate**: A communications outlet frame into which communication inserts, blanks, and jacks are secured in support of voice, data, and video services.

• **Floor Box**: Opening in floor intended to provide electrical and communications outlets for a conference table or workstation or other area, usually away from a wall.

• **Grounding Equalizer (GE)**: A conductor that interconnects two or more TBBs within a multistory building.

• **Intermediate Distribution Frame (IDF)**: A room in a building that houses telecommunications equipment for distribution of signals on a specific floor. In industry, this may be referred to as a satellite distribution room (SDR) or a floor distributor (FD).

• **Main Distribution Frame (MDF)**: The primary room in a building in which active telecommunications equipment is located. Typically, this equipment provides service to IDFs located on other floors. In industry, this may be referred to as a primary distribution room (PDR) or a building distributor (BD).

• **Patch Panel**: Passive communications hardware utilized to terminate voice, data, security and signaling cable with the purpose of identification and patching. Most often used to patch passive cabling to active components, patch panels may be mounted in equipment racks or be wall-mounted.

• **Poke Through**: Conduit sleeve through a floor to the ceiling space of the floor below, providing a pathway for communications cabling, typically utilized to serve conference rooms or modular furniture.

• **Power Pole**: Vertical metallic raceway with a separate dedicated channels for electrical service and communications cabling, typically utilized to extend electrical and communications service from a ceiling to modular furniture situated in open floor areas not adjacent to a wall.

• **Ring-Down Emergency Phone**: A wall-mounted or free-standing tower analog emergency phone with central office generator backed up dial tone installed in parking decks and on campus grounds. These emergency devices are equipped with a push button activation hook-switch that when activated automatically dials the UNC Department of Public Safety Emergency Operations Center.

• **SER-MDF**: A combined service entrance room (SER) and main distribution frame (MDF). i.e., a room that houses both the outside cable termination and the primary electronic distribution equipment.

• **Service Entrance Passthrough (SEP)**: A room in a building in which a telecommunications cable transitions from outside to inside and thence passes to a separate service entrance room.
• **Service Entrance Room (SER):** The primary room in a building in which telecommunications cables terminate from their outside origin. In industry, this may be referred to as an Entrance Facility (EF).

• **Static Load:** In cable tray systems, the weight of the empty installed cable tray system together with the weight of the installed cables. For equipment racks, the weight of the empty installed rack together with the weight of the installed equipment.

• **Telecommunications Bonding Backbone (TBB):** A conductor that bonds a TGB (usually in an IDF) to the TMGB (usually in the MDF.)

• **Telecommunications Grounding Busbar (TGB):** The primary telecommunications grounding connection point in an IDF.

• **Telecommunications Main Grounding Busbar (TMGB):** The primary telecommunications grounding connection point in the MDF, connected to the main building service equipment ground and to each TGB.

• **Telecommunications Room (TR):** Any room whose primary function is to contain telecommunications equipment, e.g. an SER, MDF, or IDF (but not necessarily a SEP or EIDF).

• **Termination Block:** Passive communications hardware utilized to terminate voice, data, security and signaling cables with the purpose of identification and cross-connection. Typically wall mounted and most often used to cross-connect voice circuits.

3. **Reference Documents**

Designers shall utilize the following standards or the latest versions thereof when developing specifications for communication systems at the University of North Carolina at Chapel Hill.

• BICSI, Telecommunications Distribution Methods Manual, 12th Edition


• Telecommunications Industry Association, TIA-568-C.0 (February 2012), Generic Telecommunications Cabling for Customer Premises

• Telecommunications Industry Association, TIA-568-C.1 (February 2009), Commercial Building Telecommunications Cabling Standard

• Telecommunications Industry Association, TIA-568-C.2 (August 2009), Balanced Twisted-Pair Telecommunications Cabling and Components Standards

• Telecommunications Industry Association, TIA-568.3-D.3 (October 2016), Optical Fiber Cabling and Components Standard

• Telecommunications Industry Association, TIA-568-C.4 (July 2011), Broadband Coaxial Cabling and Components Standard

• Telecommunications Industry Association, TIA-598-C (January 2005), Optical Fiber Cable Color Coding
• Telecommunications Industry Association, TIA-606-B (June 2012), Administration Standard for Telecommunications Infrastructure

• Telecommunications Industry Association, TIA-607-C (November 2015), Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

• Telecommunications Industry Association, TSB-140 (February 2004), Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems
CIG01 – Communications

1. Introduction

The telecommunications infrastructure of the University of North Carolina at Chapel Hill is a foundational element of the institution’s academic, research, and service environments. The scale of this infrastructure is a reflection of the size of the campus, including over 720 acres and millions of square feet of buildings. In many respects, the University’s telecommunications infrastructure is comparable to that of a small city, with similar requirements and challenges. Its complexity is a reflection of the long history and evolution of voice, data, and video technologies throughout the campus.

Communications infrastructure guidelines (including this document) are managed on behalf of the University by the Communication Technologies Engineering Group (CommTech Engineering) in the Information Technology Services (ITS) Division of the University. Of course, wiring standards are complex and evolve rapidly to keep pace with the technology requirements of the University. As a result, designers and contractors must consult with CommTech Engineering for clarification about current cable types and standards before completing telecom designs and specifications, purchasing materials, and commencing work.

This Communications Infrastructure Guidelines document is of a general nature and is intended to inform the development of a project’s design documents and guide the construction process. Specifications may be modified by the University’s Communication Technologies Office as necessary to accommodate design or functional requirements of specific projects.

For all new and renovated buildings and facilities, the scope of this guideline includes but is not limited to underground service entrance ducts and cables, telecommunications rooms, pathway and conduit riser systems, and building telecommunications wiring.

2. The Campus Communications Environment

The campus is provisioned with an extensive underground duct bank system and outside cable plant. The outside cable plant includes legacy copper trunk cables, legacy coaxial cables, and an extensive network of fiber optic cables. Going forward the outside cable plant will consist primarily of fiber optic cables except in rare instances. In some cases, locations remote from the campus are served by broadband RF microwave systems.

Each building is typically provisioned internally with fiber, copper, and coaxial cables. Outside plant cables terminate in a service entrance room, providing connectivity to a main distribution frame. Intermediate distribution frames on each floor provide horizontal connectivity.

Together, the outside and inside cable plants support multiple services including Ethernet for data and VoIP telephony, backhaul for mobile data services, security systems and cameras, CATV, energy management, and traditional POTS telephony.
3. Designer of Record Responsibilities

Each University project shall include a full telecommunications wiring infrastructure design, including horizontal and vertical cabling, telecommunications room racks and treatment, and linkages to outside cable plant as appropriate. Each design shall include reviewed and approved plans and specifications (construction documents) that are a part of each project’s overall set of construction contract documents. Each design shall comply with the requirements of this guideline.

At the beginning of the design process, the Designer of Record shall review in detail the current Communications Infrastructure Guidelines, and contact CommTech Engineering to determine if there are any unusual criteria that pertain to the project.

The Designer of Record shall harmonize the Communications Infrastructure Guidelines with the overall project contract requirements, along with national, state, and local codes and regulations.

All exceptions to these guidelines must be reviewed and approved by CommTech Engineering prior to implementation.

The Designer of Record shall be required to attend at least one face-to-face meeting between the Designer’s telecommunications experts and CommTech Engineering, prior to commencing telecommunications infrastructure design activities on any project. This shall be coordinated through the UNC-CH Facilities Planning and Construction Management Office.

The Designer of Record shall ensure that all telecommunications infrastructure plans and specifications are provided to CommTech Engineering as required in the Submittals section of this document.

The Designer of Record is responsible for ensuring that telecommunications infrastructure plans and specifications are appropriately communicated and enforced across relevant construction trades. In particular, electrical and telecommunications systems shall be closely coordinated, especially with regard to grounding and conduit systems.

A detailed list of the responsibilities of the Designer of Record can be found in Appendix 1.

The full body and content of the University Design Guidelines are hereby incorporated by reference (http://facilities.unc.edu/design-guidelines/).

4. Contractor of Record Responsibilities

For the purposes of this guideline, the Contractor of Record (or “Contractor”) shall be collectively defined as the Prime or General Contractor (and/or Construction Manager at Risk) and any subcontractor, sub-trade or installer thereunder.

The Contractor of Record will be required to purchase, install, test, and document all communications infrastructure systems and components as specified within the Designer of Record’s telecommunications infrastructure plans and specifications. The Contractor of Record may be required to provide communications manholes/duct bank within the scope of selected projects and associated construction contract documents.

The Contractor of Record shall be required to attend at least one face-to-face meeting between the Contractor’s telecommunications experts and CommTech Engineering, prior to commencing...
procurement or other telecommunications infrastructure work on any project. This meeting shall be coordinated through the UNC-CH Facilities Planning and Construction Management Office.

The Contractor of Record shall submit all communications equipment and materials for review and approval by both the Designer of Record and CommTech Engineering prior to any procurement as described in the Submittals sections of this document. The Contractor of Record shall refer to the project bid document and the construction contract documents for all details of scope and responsibility.

Along with equipment and materials submittals, the Contractor of Record shall include the names and contact information for any telecommunications subcontractors or installers, which shall be subject to review and approval by both the Designer of Record and CommTech Engineering. During the project construction phase, the Contractor of Record shall not be permitted to change telecommunications subcontractors or installers without the express written permission of UNC-CH Facilities Planning and Construction Management Office, and CommTech Engineering. The Contractor of Record is responsible for all testing. See “Execution>Testing and Acceptance” of this section for full requirements.

The Contractor of Record is responsible for ensuring proper coordination across subcontract trades. In particular, coordination between electrical subcontractors and telecommunications subcontractors is critical. For example, in some cases bonding systems and conduit systems may be installed either by the electrical or telecommunications contractor. Both must be kept abreast of the specifications and contract requirements.

5. **Design Scope: Network Electronics vs Infrastructure**

While the Designer of Record is responsible for physical communications infrastructure (wiring, telecommunications rooms, pathway, ductbank, etc.) as detailed in this document, the Designer of Record is not responsible for network electronics, except for providing adequate rack space, power, cooling, etc. The University generally handles the selection and installation of network electronics (switches, routers, wireless access points, telephones, etc.) itself. As such, these devices are out of scope and should not be included in the design.

**Include in Design Package:**

- Ductbank and service entrance infrastructure (section CIG10)
- Telecom rooms including racks, patch panels, cable management, access control, and treatments (sections CIG03, CIG16, CIG17, CIG18, CIG19)
- Horizontal and riser cabling systems for data, voice, and CATV (sections CIG20, CIG21, CIG22, CIG23, CIG24, CIG25, CIG26, CIG27)
- Wi-Fi cabling design (section CIG37)
- Conduit, raceway, and other pathway components (section CIG04, CIG05, CIG06, CIG07, CIG08, CIG09)
- Electrical service and grounding systems (sections CIG03, CIG19)
- Rooftop access (section CIG11)
• HVAC (section CIG19)
• Testing and documentation (section CIG02, CIG13, CIG14)

**Do Not Include:**

• Switches, routers, wireless access points
• Telephones or VoIP instruments
• Patch cables
Design Scope
Communications Infrastructure
This drawing identifies the major components to include in a design package. Not intended for schematic purposes.
6. Qualifications

6.1. Designer of Record Qualifications

The Designer of Record must have at least five (5) years of experience in the successful development of specifications and designs for telecommunications infrastructure in projects of a similar scale and complexity as the proposed project.

UNC-CH requires that the Designer of Record maintain a currently-certified RCDD on the project team that can be available for all project meetings and significant communications with CommTech Engineering.

6.2. Telecommunications Contractor of Record Qualifications

The Telecommunications Contractor of Record shall be duly licensed in the State of North Carolina.

The Telecommunications Contractor of Record shall have at least 5 years of verifiable installation experience with projects utilizing unshielded twisted pair (UTP), Category 6, and Category 6A cabling in compliance with the latest edition of TIA-568 and related industry standards.

The Telecommunications Contractor of Record shall have at least one duly licensed RCDD on staff. Also on staff shall be a Hubbell MCCI certified installer. Certificates verifying these credentials shall be submitted with bid documents.

The Telecommunications Contractor of Record’s lead telecommunications technician shall be BICSI certified with such certification at least at the technician level. The same technician shall be the lead technician for the duration of the project or shall be replaced by a technician with the same or higher credentials and qualifications. Proof of BICSI Technician qualification shall be submitted with bid documents.

Grounding and bonding systems shall be installed by a contractor duly licensed in the State of North Carolina for the installation of electrical conductors.

Where the installation of any rooftop access assembly requires the penetration or compromise of a building roof, the Contractor of Record shall be certified to perform such work specific to the exact existing roofing system and type.

6.3. Manufacturer Qualifications

Unless otherwise approved by CommTech Engineering, all materials shall be provided by manufacturers regularly engaged in the manufacture of unshielded twisted pair, coaxial cables, fiber optics, connectors, hardware, and related systems.

Manufacturers must have products in satisfactory use for a minimum of five years.
7. Execution

7.1. Telecommunications Designer Scope of Services

The designer shall provide a complete telecommunications design package. A full enumeration of all services and their associated construction phases can be found in Appendix 1.

7.2. Pre-installation Meeting

The Contractor shall attend a meeting with CommTech Engineering prior to commencing installation activities. This meeting will be held at UNC-CH at a location determined by CommTech Engineering and may include a site visit. The purpose of the meeting is to review project specifics and requirements. See Appendix 3 for details.

7.3. Installation Methods Governance

Installation of all systems and materials shall be accomplished in accordance with this document. Installations shall comply with all applicable national, state and local regulations, the NEC, and all other standards and guidelines noted herein.

7.4. Submittals

Submittals shall be prepared in a line-by-line format corresponding to the applicable section of the contract document specifications and shall indicate compliance with each requirement specified herein. Indicate deviations, if any, from the Communications Infrastructure Guidelines.

Drawings, specifications and product data sheets shall be enumerated and referenced for easy identification.

Complete and accurate submittal data for each individual section shall be submitted as a single package.

No installation work may begin until submittals are received, reviewed, and approved by CommTech Engineering and the Designer of Record.

A comprehensive table of submittal requirements is detailed in Appendix 2.

7.4.1. AutoCAD Drawings

All AutoCAD drawings shall be provided to CommTech Engineering as electronic files in version 2000 or later format.

All telecommunications elements shall be on a distinct layer of the drawing so that they can be easily isolated.

All plan view drawings shall be georeferenced with respect to the State Plane Coordinate System.
7.4.2. Product Data Sheets

Product data sheets are required for ALL components proposed for use. Product data sheets shall be submitted in PDF format.

The submittal of product data sheets is a key component of the design process. Any products for which we require data sheets must be approved by CommTech Engineering prior to installation.

Product data sheet submittals shall include manufacturer installation instructions.

7.5. Testing and Acceptance

The Designer of Record shall create a testing and acceptance plan for each communications infrastructure component as a part of the design phase. CommTech Engineering must approve the testing and acceptance plan before any installation work can commence. The test plan submittal shall include a sample of testing documentation and proposed test equipment.

The Contractor of Record shall conduct all testing and document results. The Contractor of record shall supply all personnel, materials, and equipment required to conduct testing.

Contractor of Record shall notify CommTech Engineering through UNC Facilities Planning and Construction a minimum of twenty-one (21) work days in advance of any testing to be performed with details about the specific location of the test and functions to be tested. CommTech Engineering reserves the right to be present for none, any, or all tests performed.

At the request of CommTech Engineering, the Contractor of Record shall re-test any component that CommTech Engineering deems not acceptable by virtue of the component in question failing the prescribed test or for which the testing methodology is in question. CommTech Engineering must be present for any re-testing that it requests. All personnel, materials, and equipment required for re-testing shall be provided by the Contractor of Record without additional cost to the University.
CommTech Engineering reserves the right to independently perform its own testing of materials and systems.

Test procedures shall confirm that each specification statement has been met or exceeded. The Contractor of Record shall provide an actual demonstration of each system requirement. All tests are subject to validation by means of a re-test, by Contractor, in the presence of the Owner’s Representative.

Owner reserves the right to reject any component, work, or system that does not comply with the specifications described herein.

These are general test criteria that apply to all testing and acceptance activities. Testing criteria for specific components are defined in their respective sections in this document. Note that some wiring components are best tested as a system. Details on this type of testing can be found in CIG02 – Testing and Acceptance of Cabling Systems.
8. Contacts

Designers, Contractors and vendors are encouraged to communicate directly and proactively with the CommTech Engineering staff. Contact information including staff locations, direct phone numbers, mailing addresses, and email addresses can be found at the following link:

http://its.unc.edu/about-us/what-we-do/communication-technologies/communication-technologies-engineering/
CIG02 – Testing and Acceptance of Cabling Systems

1. General
This section defines end to end testing requirements for the subsystem components described in the following specifications:

- CIG17 - Communications Termination Blocks and Patch Panels
- CIG21 - Communications Copper Cable Splicing and Terminations
- CIG22 - Communications Optical Fiber Backbone Cabling
- CIG23 - Communications Optical Fiber Splicing and Terminations
- CIG25 Communications Copper Horizontal Cabling

2. Execution

2.1. Testing
All testing shall be accomplished in accordance with CIG01.

Prior to testing, the Telecommunications Contractor shall submit a Certification Test Plan, subject to approval by UNC ITS CommTech Engineering, that reflect the requirements of this section.

If the test results are unsatisfactory the contractor shall replace the entire cable and retest.

Testing shall consist of an end-to-end system test, encompassing the cable, patch panel termination, and faceplate termination, as appropriate.

The contractor shall test UTP cable in accordance with TIA-568-C series standards, including TIA-568-C.0, TIA-568-C.1, TIA-568-C.2, TIA-568-C.3, TIA-568-C.4, and TSB-140. Each UTP cable shall be tested and the results documented and delivered to the owner’s representative for review/acceptance.

Copper cabling shall be fully tested for Cat 6 or Cat6A compliance, as appropriate, in the TIA specifications, including the following parameters:

- DC resistance
- Open pairs
- Shorted pairs
- Split pairs
- Reversed conductors
- NEXT (test from both ends)
- ELFEXT
- Return loss
- Delay skew
CIG03 - Grounding and Bonding for Communications Systems

1. General

Grounding and bonding for communications systems are supplemental to the electrical power grounding system and devoted to the communications system infrastructure. Bonding and grounding of telecommunications systems is a requirement in each building on campus. Its purpose is to protect personnel and equipment from unwanted electrical currents associated with the communications infrastructure and equipment.

Grounding and bonding responsibilities are divided and shared between the electrical contractor and the communications contractor. The designer of record shall be responsible for coordinating the activities of these groups and ensuring that specifications are consistent across trades.

Grounding and Bonding applies to all communications systems elements, but especially to the following specifications:

- CIG04 Pathways for Communications Systems
- CIG06 Conduits and Backboxes for Communications Systems
- CIG07 Cable Trays for Communications Systems
- CIG16 Communications Cabinets, Racks, Frames and Enclosures
- CIG18 Communications Cable Management and Ladder Rack

2. Execution

2.1. Bonding Conductor for Telecommunications (BCT)

The bonding conductor for communications shall bond the TMGB to the main electrical service (power) grounding system. The BCT originates in the MDF and terminates at the electrical service ground for the building. The BCT shall be a continuous copper conductor sized according to length. This conductor shall be installed in EMT, bonded to the conduit at each end and be sized, as a minimum, the same size as the largest TBB.

2.2. Telecommunications Bonding Backbone (TBB)

This conductor interconnects the TGB with the TMGB. The TBB shall be routed in a separate conduit alongside the telecommunications riser cables. The TBB shall be insulated and be a continuous conductor without splices that is connected to both the TGB and the TMGB via exothermic weld or irreversible compression connection. The TBB shall be a copper conductor sized per TIA-607 (based on 2kcmil/lf), with a minimum conductor size of 6 AWG.

2.3. Installation Compliance.

Provide grounding connections for cable systems as required by manufacturer's recommendations and in compliance with TIA-607-C and as required by the NEC.
2.4. Telecom Room Infrastructure Bonding
Bond all installed equipment racks, cable tray, and other metallic components to grounding bus bar in telecom room with a minimum 6 AWG copper conductor with green colored insulation.

2.5. TBB Sizing Requirements
The TBB should be sized per the table below with the TBB length calculated from the last TGB in the run to the TMGB.

<table>
<thead>
<tr>
<th>TBB Length (LF)</th>
<th>TBB Size (AWG)</th>
<th>TBB Length (LF)</th>
<th>TBB Size (AWG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 13</td>
<td>6</td>
<td>85-105</td>
<td>4/0</td>
</tr>
<tr>
<td>14-20</td>
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<td>600 MCM</td>
</tr>
<tr>
<td>53-66</td>
<td>2/0</td>
<td>&gt; 300</td>
<td>750 MCM</td>
</tr>
<tr>
<td>67-84</td>
<td>3/0</td>
<td></td>
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</tr>
</tbody>
</table>

2.6. Telecommunications Main Grounding Busbar (TMGB)
The TMGB is located in the BDF and is bonded by means of a bonding conductor for telecommunications to the main building service equipment ground. It should be installed at 7’ 6” AFF onto the wall-mounted plywood. The bar should be electrically insulated from its mounting hardware. In addition to being bonded to the main electrical service ground, the TMGB should be bonded to building steel if available. This does not apply to buildings constructed of reinforced concrete.

2.7. Telecommunications Grounding Busbar (TGB)
The TGB is the interface to the building telecommunications grounding system located in each IDF and serves as the communications grounding system for that room. It shall be installed onto the wall-mounted plywood at 7’ 6”’ AFF. The bar shall be electrically insulated from its mounting hardware. In addition to being bonded to the TMGB, the TGB shall be bonded to building steel if available. This does not apply to buildings constructed of reinforced concrete.

2.8. Grounding Equalizer (GE)
Whenever two of more TBBs are installed in a building the TBBs shall be bonded together with a GE. This conductor connects the TGBs in IDFs on the same floor in a building at the top floor and at a minimum of every third floor in between per TIA-607-C.

2.9. Cable Tray/Basket
A #6 AWG TBB conductor shall be installed for the TGB to the cable tray or basket with each section bonded together per manufacturer and NEC requirements.
2.10. Pathway Components
A #6 AWG TBB insulated grounding conductor shall be installed to each pathway component per manufacturer and NEC requirements.

2.11. Equipment Cabinets and Racks
A #6 AWG TBB insulated grounding conductor shall be installed between the TMGB or TGB and all equipment racks.

2.12. Interconnection with Building Ground
The grounding system for telecommunications is for telecommunications systems only. No other building or system grounds may be made to the TMGB, TGB, or communications systems components.

3. Testing
Resistance to building ground shall be measured from each TGB/TMGB to building ground and shall not exceed maximum allowable fall of potential as determined by project electrical engineer.
CIG04 - Pathways for Communications Systems

1. General
   This section provides direction to designers regarding communications pathways installed through walls and floors to facilitate the placement of communications cabling in new construction and renovations. These pathways are also referred to as sleeves and typically provide a pathway between stacked telecommunication rooms, telecommunication rooms and cable trays routing through corridors, and pathways through inaccessible ceilings between sections of cable trays or equipment rooms. This section also covers firestopping of penetrations.

2. Execution
   2.1. Sleeves
      2.1.1. EMT Use
      EMT conduit shall be used as sleeves in the following areas:
      1. Interior partitions.
      2. Above suspended ceilings.
      3. Above solid ceilings with limited access.
      4. Floor penetrations.
      EMT conduit shall not be used where tubing, couplings, elbows and fittings would be in direct contact with the earth or underground.
      2.1.2. RGS Use
      RGS conduit will be used as sleeves in the following areas:
      1. Corrosive environments.
      2. Building entrance sleeves extending from the duct-bank system that exceed 50’ to the SER shall have one (1) of the compliment of sleeves be RGS.

2.2. Bushings
   All conduit sleeves larger than 2” shall be fitted with "screw-on" type plastic bushings (installed on an EMT connector when EMT is used). Push-on type bushings are permitted on conduits 2” or smaller.

2.3. Specific Deployment Requirements
   All sleeves shall be sized for the number connections required plus an additional 15% for future growth.
2.3.1. In Telecommunications Rooms

In telecommunications rooms sleeves shall be installed 4” AFF and 4” off of the wall with adequate separation to support installation of faceplate hardware and bushings.

2.3.2. Ceiling Penetrations

Sleeves that penetrate ceilings shall extend to 10’ AFF so that they can be accessed easily via ladder.

2.3.3. Horizontal Sleeves in Telecommunications Rooms

Sleeves that reach into telecommunications rooms shall extend 2” into the room. On the outside of the telecommunications room the sleeve shall extend to 4” from the edge of the cable tray.

2.4. Penetration Seals for Fire Stopping

All seals shall utilized UL approved fire stopping assemblies that are approved for that penetration type.

Communications pathways shall be fire stopped according to all state and local code requirements and per the NEC. Non-cementitious firestopping shall be used to seal the interior of sleeves and must be of a type that will remain pliable for ease of removal in future cable installations.

2.5. Grounding

Communications pathways should be bonded to the telecommunications grounding system per section CIG03.
CIG05 - Hangers and Supports for Communications Systems

1. General

Communications cabling hangers and supports are only to be used in isolated instances such as minor renovations or moves, adds, and changes where there are no cable trays and conduit raceways available to support cable installations.

Use of cable hangers and J-hooks is only permitted with approval by CommTech Engineering.

2. Execution

All communications cabling must be supported with hangers and supports such as open-top J-hooks. J-hooks should be located on 4’-5’ centers to adequately support the communications cabling and typically attached to steel beams or direct to structure.
CIG06 - Conduits and Backboxes for Communications Systems

1. General

Conduits and backboxes provide a pathway and physical protection for all horizontal communications cabling between the MDF/IDF and workplace outlet locations. Unless otherwise noted, all cabling for University properties will be housed in conduit/backbox systems (as opposed to surface mounted or hung cabling). The scope of conduit/backbox use includes cabling for voice and data communications, CATV, elevator emergency phone, security cameras, fire alarm phone lines, automatic transfer switches, emergency generators, and miscellaneous building and freezer alarm lines.

2. Execution

2.1. Conduit Bends

A maximum of 180 degrees will be allowed between pull points. Conduit runs exceeding 180 degrees of turns require the installation of a fully accessible pull box to facilitate cable installation. The use of LB-type or similar conduits is not permissible.

2.2. Looping

Telecommunications outlets may not be “looped” in the same run of conduit.

2.3. EMT

Each Telecommunications outlet will have a 1” minimum EMT conduit routed from the recessed outlet box that extends to within 4” of a cable tray or home run back to the nearest Telecommunication Room. RGS conduit should be used in corrosive environments.

2.4. Box Size

Standard telecommunications outlet boxes shall consist of a 4” (or 4-11/16”) square back box that is 3-1/2” deep and equipped with an appropriate plaster ring. The outlet conduit shall terminate toward the rear of the outlet box. In cases where wall construction precludes a 3-1/2” box depth, the maximum practicable box depth shall be provided, using box extensions as necessary. Outlets shall be installed at 18” AFF and/or shall be level with nearby electrical outlets. In cases where outlets are installed above countertops the outlet height shall be determined by the designer and noted on the drawings.

2.5. Surface Mounting

Surface mounted raceways in labs or classroom environments must be designed per room based on number of connections and outlet locations. See Section CIG09 - Surface Raceways for Communications Systems for details. Note that this is not the preferred architecture.
2.6.  **Special Purpose Links**

Conduits serving elevator emergency phones, fire alarm phone lines, alarm lines for research freezers, and emergency generator/ATS alarm lines shall home run back to the MDF/IDF or UNC-CH Life-Safety designated equipment location.

2.7.  **Wall Phones**

Outlets for wall phones shall be 4” X 2-1/4” X 2-1/8” single gang with height noted for each location on drawings. Wall phone heights shall comply with ADA accessibility guidelines where applicable.

2.8.  **Penetration Seals**

Penetrations shall utilize UL approved fire stopping assemblies as described in section CIG04, including the use of non-cementitious firestopping to seal the interior of sleeves and remain pliable for ease of removal in future cable installations.
CIG07 - Cable Trays for Communications Systems

1. General
Cable trays and basket systems for communications systems provide a pathway, physical protection, and support for communications cabling.

2. Execution
The cable tray system is intended to carry telecommunications cable only; power wiring, control wiring, and fire alarm system cabling are not permitted in the cable tray system.

The system shall be installed according to the drawings and shall consist of a complete cable tray system including straight tray sections, horizontal elbows, vertical risers, crosses, tees, wyes, reducers, coupling accessories, splice plates, and cable tray supports.

2.1. Implementation

2.1.1. General
Cable tray and basket systems shall be top rung type and shall be installed with rung-caps sized to meet or exceed cable fill requirement.

Wall-mounted cable tray of similar manufacture may be presented to CommTech Engineering as a proposed alternative if field conditions dictate.

Intersections, bends, tees, etc. shall use fittings of the same type and model series as straight run sections.

Cable tray system sections shall be joined using only manufacturer-supplied prefabricated splice plates.

Blind end plates shall be provided for trays that dead end. Full width dropouts shall be provided where cables exit from trays.

Nicks, scratches and ends of cut sections in galvanized components shall be deburred and coated with a cold galvanizing compound after tray installation. Application of cold galvanizing compound shall be performed in a manner so as to produce a smooth finish and in accordance with the manufacturer’s recommendations.

2.1.2. Accessibility
Tray system shall be easily accessible and with at least 12” of space maintained about the top and sides of cable trays to permit access for installation and maintenance of cables.

Contractor shall utilize cable tray manufacturer’s hardware to accomplish bends and intersections. Connections shall maintain full accessibility and full use of both sides of cable tray once installed.
2.1.3. Expansion

Contractor shall install a set of manufacturer prefabricated expansion splice plates at intervals of 48 ft in straight runs and where cable tray systems cross building expansion joints.

Contractor shall provide a minimum of one (1) expansion splice plate in straight runs which exceed 12 ft for tray installations in exterior areas.

2.1.4. Support

Trapeze hangers are not permitted to support cable tray systems unless required by field conditions.

Cable tray shall be supported by threaded rods that comply with manufacturer’s recommended support and loading requirements.

Total vertical tray deflection shall not exceed manufacturer’s recommendations.

Cable shall be equally distributed between both sides of the cable tray to equally distribute weight of cables.

2.2. Grounding

Each cable tray system subassembly shall be connected to building ground as described in section CIG03.
CIG08 - Power Poles, Floor Boxes, and Poke Throughs for Communications Systems

1. General

This section provides direction to designers and contractors for new construction and renovation projects for the installation of power poles, floor boxes, and poke throughs for Communications Systems. These devices are typically utilized to provide communications cabling to classroom podiums, conference room tables, and modular furniture.
CIG09 - Surface Raceways for Communications Systems

1. General
Surface raceways are intended to provide a pathway, physical protection, and support for communications cabling. Surface raceways are typically installed in laboratory or classroom environments to route communications cabling on solid walls and ceiling structure. The use of surface raceway is discouraged except in instances where internal wiring is impractical.

2. Execution

2.1. General
Surface raceways shall be sized for the number of connections required per the manufacturer’s requirements.

Surface raceways shall be installed with factory fittings to maintain proper cable bend radius and provide physical separation from electrical wiring.

2.2. Coordination with Electrical Contractor
If the raceway is installed by an electrical contractor (by code or contractual requirement) then the electrical contractor shall provide the faceplates to the communications contractor.
CIG10 - Underground Ducts and Raceways for Communications Systems

* See CIG-39 – Auxiliary Networks & Devices section 3.1 for information on underground conduit for single devices and small-scale exterior underground pathway.

1. General
In order to preserve the historic aesthetic of the campus, nearly all utilities and services are underground. The University is its own utility service provider for electricity, steam, chilled water, storm water and telecommunications. Electrical primary cables, electrical secondary cables and telecommunications cables are routed underground in a network of manholes and concrete-encased ducts.

The Communications Technology (CommTech) office of UNC’s Information Technology Services is responsible for telephone, CATV and computer network connections, including the majority of the University’s underground communications cable plant. While ITS CommTech administers this cable plant, it is the Electric Distribution System (EDS) division of the campus Energy Services Department that administers the underground pathways in which the cable plant resides. EDS plans, installs, repairs and maintains the campus electrical and communications duct bank and manhole network. CommTech and EDS maintain a formal interdepartmental agreement that describes the technical scope and terms of their relationship.

University documents supporting this section of the CommTech guideline can be found at the following website:


The above design standards are to be strictly adhered to regardless of the circumstance or purpose of the parties engaged in duct bank design, construction or use. Furthermore, these design standards are to be used when planning, designing and constructing telecommunications duct bank system including but not limited to the following system components.

2. Execution
Execution of duct bank design and construction shall include coordination of exterior duct bank construction with EDS and in-building routing with CommTech Engineering.

2.1. Service Entrance Facilities:
Campus buildings and facilities are generally fed by a duct bank lateral from the primary duct back distribution trunks throughout campus. These laterals are comprised of more granular conduit systems than the trunks. CommTech Engineering will identify the closest manhole for each facility and the Designer shall develop plans for getting from that point to the building. Generally, the duct bank should terminate directly in the building’s service entrance room (SER). However, in some cases it may be necessary to for the duct bank to transition to a conduit system and traverse a Service Entrance Passthrough (SEP). Use of a SEP must be approved by CommTech Engineering.
2.2. **Communications Manholes:**

All communications manholes shall be constructed in accordance with the plan and section view drawings in the UNC-Chapel Hill University Design and Construction Guidelines. All new manholes shall be fitted with cable racking hardware.

2.3. **Service Entrance Ducts:**

Unless specifically directed by the UNC-Chapel Hill ITS-Communication Technologies Office, all new buildings will be designed with a minimum quantity of four 4” entrance conduits. These conduits will be of rigid metallic construction or 4” Schedule 40 PVC encased in concrete, as determined by CommTech Engineering and EDS. These entrance conduits shall extend from a communications manhole, designated by CommTech Engineering, to the service entrance room in the building.

No more than two 90 degree bends between the manhole and the building will be permitted.

All conduits and inner ducts shall be installed with marked pull tapes.

The service entrance conduits shall appear and be positioned in the right rear corner of the SER, 4” from the rear wall and shall be stubbed 4” above the finished floor, unless otherwise approved by CommTech Engineering.

Plastic bushings shall be installed on each entrance duct. The use of LB, LL, or LR fittings will not be approved. All metallic entrance conduits shall be installed in accordance with the National Electrical Code.

If the service entrance ducts penetrate or appear in the building before they finally terminate in the building SER, they should transition to metallic conduit (if PVC) in an accessible and appropriately sized junction box per the NEC. If the distance between the point of transition and the building SER exceeds 50 ft, then at least one of the quantity of exposed entrance conduits MUST be rigid.

Contractor shall consult with CommTech Engineering when special pull boxes or junction boxes are required.

2.4. **Duct Bank between Manholes:**

Reference EDS’ specification section for Manholes and Duct bank for a further description of duct bank construction practices. Special thermal protection design considerations must be employed when telecommunications duct bank crosses or runs in same vicinity as steam lines. See the University guidelines for infrastructure in proximity to steam lines.

2.5. **Acceptance of Duct Banks:**

All duct banks both from the manhole to the building, and between manholes shall be inspected and approved by either the State Construction Office Electrical Inspector or an Electric Distribution Systems representative (by mutual agreement between the two) or BOTH prior to the placement of any concrete. Capital Building Projects:
When utility extensions are required as a part of the scope of work for a capital building project, the Designer of Record shall reference the guidelines published for Electric Distribution Systems.
CIG11 - Rooftop Access for Communication Systems

1. General

Rooftop access for communications systems is a growing requirement at UNC-CH, particularly in support of RF applications. Building roofs may host towers for point-to-point microwave, cellular telephony, and related applications. As a result UNC-CH requires rooftop access readiness as a general requirement for buildings in anticipation of future needs.

2. Execution

All new building and complete renovation project designs shall provide some level of rooftop cabling access system assembly as part of design components. The minimum access shall be two (2) penetrations of 2” diameter each, however, access assemblies may range in complexity from simple weather head / pitch-pocket assemblies to fully engineered rooftop “huts.” The Designer of Record shall discuss the rooftop access requirements for each project early in the design phase to have a good understanding of the programming requirements.

Type, quantity and location of cable access devices shall be determined by function of building and in consultation with CommTech Engineering

In a renovation, the contractor shall be required to work with the original roofer in an effort to maintain the roof warranty.

All work shall be inspected by UNC Facilities Services prior to project acceptance.
CIG12 – Utility Poles for Communications Systems

1. General

To provide the best physical cable protection and for aesthetic appearances, utility poles for communications system are typically not allowed on the UNC Chapel Hill campus. There may be instances on capital projects where a temporary aerial segment of fiber optic or telephone cable is required as a work-around during site preparation and that cable segment will be removed as soon as the buried duct bank system is completed and the permanent fiber optic and telephone service has been restored. In capital projects where a temporary aerial segment of cable is required to maintain telephone and network connectivity the project is responsible for all design, installation, and cut-over costs associated.
CIG13 - Identification for Communications Systems

1. General
This section describes labeling requirements for communications systems. Labeling is a critical requirement and should be attended to in detail.

2. Execution
The Designer of Record shall communicate with CommTech Engineering to obtain precise naming details for communications systems components, and these names shall be used on all drawings.

The University prescribes a detailed labeling methodology. When the University’s cable identification methods do not specify format, cable identification method shall comply with TIA-606-B as a minimum and be coordinated with the University’s Representative.

Unless otherwise specified, professional, non-erasable, adhesive, machine-printed labels shall be used and bear the approved cable identification method. Labels for stainless steel faceplates shall be clear adhesive type with black lettering.

2.1. Buildings and Rooms
BuildingIDs and room numbers are assigned by UNC Facilities. The Contractor should check with the UNC project manager to ensure the proper building ID and room numbers are used when labeling communications systems components. Note that the Building ID is generally a 3-digit code. This should always be used instead of the common name, which can change.

2.2. Racks
Racks in TRs shall be labeled sequentially starting with 1. The label shall be machine generated, at least 1.5” high and have black letters on a white background. The label shall be plastic or vinyl and adhered to the upper right corner of the rack if possible.

2.3. Risers
All riser communications cabling such as single mode OS2 fiber and 0.500” coax trunk shall be labeled on each end. This is to include originating and terminating Telecom room information, individual fiber strand, and riser patch panel port information. Riser patch panel labeling shall be consecutive.

2.4. Fiber Optic Cabling and Systems
Fiber optic cables and segments have a long lifespan at the University and must conform to University labeling requirements to support identification and computerized management systems already in place.
2.4.1. Segments

2.4.1.1. Naming

A fiber segment is a jacketed set of fiber optic cables, themselves generally enclosed in buffer tubes. A fiber segment is intended to represent the physical cable itself, irrespective of mid-span connections. Mid-spans are given their own segment name. Segments are assigned a unique index of the form:

\[ FS.index \]

FS indicates that the cable is a fiber optic cable segment. Index is a unique integer. Index does not include leading zeros.

Examples:

FS.400
FS.32
FS.1022

Note that in Fiber Manager, each portion of a cable segment must be renamed whenever an existing cable is spliced in order to maintain unique names. By convention, these segments shall be renamed with a lowercase alphabetic postfix, segment.a, segment.b, etc. within Fiber Manager. This index shall not be carried into the field on labels, but is an internal Fiber Manager issue only.

Examples:

FS.400.b – indicates the second segment in Fiber Manager of cable FS.400.

2.4.1.2. Labeling

Cable segments shall be labeled within 24 inches of any entrance or exit to a conduit, splice enclosure, patch panel, manhole, hand hole, or other transition from visible to concealed location.

All external labels shall be constructed of embossed stainless steel tags. Internal labels shall be made of plastic and machine-generated.

The label shall indicate the segment number.
2.4.2. Individual Fibers

2.4.2.1. Naming

Individual fibers are referred to by the segment name, followed by a fiber identifier. The fiber identifier may either be an index, starting with 1, or a fiber color indicator as specified in TIA-598-C.

Both naming forms are acceptable. In general, the color form is more useful for macro-level design drawings and communications with field technicians. The index form may be more useful when referring to specific fibers singled out from a bundle.

The syntax is of the index form is:

```
segment.index
```

The syntax is of the fiber color indicator is:

```
segment.buffer_tube.strand_color
```

Examples:

- FS.400.1
- FS.400.blue.blue  // equivalent form of FS.400.1
- FS.32.144
- FS.32.aqua.aqua  // equivalent form of FS.aqua.aqua

2.4.2.2. Labeling

Individual fibers are not generally labeled.

2.4.3. Patch Panels

2.4.3.1. Naming

Patch panels are assigned a unique numeric number of the form:

```
FP.building_number.room.index.[module].[port]
```

The `building_number` element is the official UNC building number. The `room` element is the room number where the patch panel is located. Note that leading zeros shall only be included if included in the official building or room name in the EIS documentation. The `index` element distinguishes between multiple patch panels in the same room. Indices start at 1 for the first patch panel in each room and increment. An index of 1 is required in the name even if there is only a single patch panel in the room. The `module` is a letter indicating the module or card number in the panel frame. The `port` element is the specific port on the patch panel.
Note that module port numbers are not needed when naming patch panels, but are included when specifying individual ports for patching or termination purposes.

Examples:

   FP.039.29.3 – indicates a patch panel in ITS Phillips (building 039), room 29, patch panel number 3.

   FP.625.2905.2.G.5 – indicates a patch panel in ITS Manning (building 625), room 2905, patch panel #2, module G. port 5.

2.4.3.2. Labeling

All patch panels shall be labeled to indicate the patch panel name. Labels shall be machine-generated, high contrast and between 1/2” and 1” high.

2.4.4. Splice Enclosures

2.4.4.1. Naming

Splice enclosures are named according to the form:

   FE.location.room.index

The location element is generally the building number, but if MH is present it indicates instead that the location is a manhole. This taxonomy can be extended to include other structures (e.g. TW for tower, etc.) The room element is the room number in which the splice enclosure is located. If MH is present in the location field then the room element shall be populated with the manhole name.

Examples:

   FE.039.29.1 – Indicates fiber enclosure #1 in room 29 of Phillips Hall.

   FE.MH.U11-B.1 – Indicates fiber enclosure #1 in manhole U11-B.1

   Note that there is a potential name space collision if Facilities ever changes the namespace for building numbers.

2.4.4.2. Labeling

Splice enclosures in manholes and exposed areas shall be labeled on their exteriors with embossed stainless steel tags. Interior splice enclosure labels shall be constructed of plastic and be machine-generated.
2.4.5. Splice Trays

2.4.5.1. Naming

Splice trays names are optional and can be specified by appending a number index to the fiber enclosure name.

Example:

FE.039.29.1.4 – Indicates the 4th splice tray in fiber enclosure #1 in room 29 of Phillips Hall.

2.4.5.2. Labeling

Splice trays may be optionally required to be labeled by Engineering using a machine-generated plastic label. Because of space constraints the label may exclude the full fiber enclosure name and simply display the index (e.g. 1, 2, 3, etc.)

2.5. Copper Data Cabling and Systems

2.5.1. System Drawings

Contractor shall provide three (3) sets of drawings marked with jack numbers. Drawings shall also be provided on a CD in AutoCAD format. One set of cable drawings shall be installed in each telecommunications room. This is a pre-construction submittal requirement due 120 days prior to beneficial occupancy.

2.5.2. Labeling

All cable shall be labeled both at the outlet and the patch panel with an alpha/numeric identification code using the following format: (T-1) indicates telephone one, (T-2) indicates telephone two, (D-1) indicates data one, (D-2) indicates data two, (R-1 indicates riser one, R-2 indicates riser two) etc. In the event a floor is served by more than one Telecom room due to cable distances exceeding 90 meters or other physical restraints, each communications outlet shall be labeled with serving Telecom room number.

Communication outlets served from a TR not on that floor or where more than one TR is required per floor shall be labeled with the serving TR room number on the telecomm outlet faceplate.

Each horizontal cable shall be labeled within 6” of cable termination.

2.5.3. Data Horizontal Cabling

2.5.3.1. Cable Destination Chart

Each TR shall contain a Cable Destination Chart that shows the room number destination of each cable leaving that TR. The Cable Destination Chart shall be printed on 8.5” x 11” paper, placed in a clear, plastic sleeve, and hung from the primary rack housing patch panels.
Additionally, Contractor shall submit a chart of installed cables in Microsoft Excel spreadsheet (or .csv) format.

The chart shall have one worksheet for each TR showing the destination label of each cable as indicated on the faceplate. All worksheets for a building shall be integrated into a single building spreadsheet. The name of the worksheet shall be the TR room number. A sample is shown below.

### Termination | Room Number
--- | ---
D100 | G013
D101 | G013
D102 | G015
D103 | G015
D104 | G110

#### 2.5.3.2. Data Patch Panels

48 port Category 6A data patch panels shall be labeled consecutively beginning with port 1 through 48. Subsequent patch panel port shall be labeled 49-96, 97-144 etc.

#### 2.5.4. Voice Cabling and Systems

Voice connections requiring analog service for Life Safety such as Fire Alarm lines, Elevator Phones, and Emergency Phones shall be labeled with standard "T" numbers at each end. Where voice cables are terminated on 66M1-50 terminating blocks in the Telecomm room, those "T" numbers shall be supplemented with additional labeling on the 66M1-50 termination identifying where each cable is utilized. For Fire Alarm lines “FA-1 / FA-2”, for Elevator phones “Elev 1 / Elev 2”, and for Emergency phones “Emer 1 /Emer 2”.

#### 2.6. Hand Holes

Each hand hole shall include a unique, weather-proof label affixed to the top surface. ITS Communication Technologies maintains a registry of hand hole labels and will provide the exact label text upon request. In general, labels are of the form:

UNC-ITS 919.962.4357

HH.xxxx

In this example “HH” indicates hand hole and “xxxx” is the unique hand hole identifier provided by ITS. ITS Communication Technologies Engineering keeps these records in its shared storage space under “Tools/Handhole Master List.xls”. The telephone number is included in the label to assist technicians in the field.
CIG14 - Schedules for Communications

The Designer of Record is responsible for including the identified components (or their equivalents) in the design package.

The Designer of Record is responsible for ensuring that all components are properly justified, along with the identification of acceptable alternates, in compliance with all State of North Carolina purchasing regulations and North Carolina General Statue §133-3 in particular.

Components and approved vendors are listed by section/functional area.

Preferred products are listed below.

1. Preferred Products

The University strongly prefers the components listed in the following table.
<table>
<thead>
<tr>
<th>#</th>
<th>Category</th>
<th>Manufacturer</th>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CABLE MANAGEMENT</td>
<td>HUBBELL</td>
<td>ECMBR3</td>
<td>Rear Mounting Bar, 19” X 3” Offset, Rack Mount</td>
</tr>
<tr>
<td>2</td>
<td>CABLE MANAGEMENT</td>
<td>PANDUIT</td>
<td>CMPHH2</td>
<td>Cable Manager, Horizontal D-rings Installed on Panel, 3.5”H x 19.0”W x 5.7”D (88mm x 483mm x 144mm), Front Only 2 Rack-Unit (2U)</td>
</tr>
<tr>
<td>3</td>
<td>CABLE MANAGEMENT</td>
<td>PANDUIT</td>
<td>WMPV45E</td>
<td>NetRunner Vertical Cable Manager</td>
</tr>
<tr>
<td>4</td>
<td>CABLE MANAGEMENT</td>
<td>WIREMADE</td>
<td>Per requirement</td>
<td>Cable basket/tray</td>
</tr>
<tr>
<td>5</td>
<td>CONNECTOR</td>
<td>CORNING</td>
<td>GF-6-AHS-USA</td>
<td>RG-6 F connector, crimp on</td>
</tr>
<tr>
<td>6</td>
<td>CONNECTOR</td>
<td>CORNING</td>
<td>95-200-99</td>
<td>Fiber Optic Connector, Corning Unicam High-performance Connector, LC, Single-mode (OS2), Ceramic Ferrule, Logo, 25 In Organizer Pack, Blue Housing, Blue Boot</td>
</tr>
<tr>
<td>7</td>
<td>CONNECTOR</td>
<td>CORNING</td>
<td>CCH-CP12-A9</td>
<td>Fiber Optic Panel, Closet Connector Housing Panels (CCH-CP), LC adapters, Duplex, UPC, 12 fiber, Single-mode (OS2)</td>
</tr>
<tr>
<td>8</td>
<td>CONNECTOR</td>
<td>HUBBELL</td>
<td>SFFX</td>
<td>F-Type coax connector, 25-Pack, Office White</td>
</tr>
<tr>
<td>9</td>
<td>CONNECTOR</td>
<td>HUBBELL</td>
<td>HJU6AR</td>
<td>Category 6A jack with Cobra-Lock termination, red</td>
</tr>
<tr>
<td>10</td>
<td>CONNECTOR</td>
<td>SIEMON</td>
<td>S66M1-50</td>
<td>66 Block, M Series, 50 pair</td>
</tr>
<tr>
<td>11</td>
<td>DATA JACK</td>
<td>HUBBELL</td>
<td>HJU6AR24</td>
<td>NextSpeed - Ascent, Category 6A jack with Cobra-Lock termination, 24-Pack, Red</td>
</tr>
<tr>
<td>12</td>
<td>ENCLOSURE</td>
<td>CORNING</td>
<td>PCH-04U</td>
<td>Fiber Optic Enclosure, Corning Closet Connector Housing (CCH), Black, Empty, 4 Rack Unit (4U), Holds Twelve CCH Connector Panels</td>
</tr>
<tr>
<td></td>
<td>ENCLOSURE</td>
<td>CORNING</td>
<td>PCH-02U</td>
<td>Pretium Connector Housing, 2 Rack Unit (2U), Holds four CCH Connector Panels</td>
</tr>
<tr>
<td>---</td>
<td>-----------</td>
<td>---------</td>
<td>---------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>14</td>
<td>ENCLOSURE</td>
<td>CORNING</td>
<td>PCH-01U</td>
<td>Pretium Connector Housing, 1 Rack Unit (1U), Holds two CCH Connector Panels</td>
</tr>
<tr>
<td>15</td>
<td>FACEPLATE</td>
<td>HUBBELL</td>
<td>IMB15W</td>
<td>Snap-In Blank for Faceplate, Hubbell Audio/Video Module, Blank, 1.5 Unit, 10-Pack, White</td>
</tr>
<tr>
<td>16</td>
<td>FACEPLATE</td>
<td>HUBBELL</td>
<td>IM2IA5W</td>
<td>Faceplate, Keystone Insert Angled Plate, 2-Port, White</td>
</tr>
<tr>
<td>17</td>
<td>FACEPLATE</td>
<td>HUBBELL</td>
<td>IMF2W</td>
<td>Faceplate, 2-Gang, Hubbell INFINe Station Modular Plate Frame, White</td>
</tr>
<tr>
<td>18</td>
<td>SURFACE OUTLET BOX</td>
<td>HUBBELL</td>
<td>HSB2WP</td>
<td>UL Plenum Rated Surface Mount Box, 2-Port, White</td>
</tr>
<tr>
<td>19</td>
<td>FIBER</td>
<td>CORNING</td>
<td>012E81-33131-24</td>
<td>MIC Tight-Buffered Cable, Riser, 12 fiber, Single-mode (OS2)</td>
</tr>
<tr>
<td>20</td>
<td>INNERDUCT</td>
<td>Carlon</td>
<td>CG4X1C</td>
<td>plenum, 1 1/4&quot; ORANGE, corrugated with pull tape</td>
</tr>
<tr>
<td>21</td>
<td>PATCH PANEL</td>
<td>HUBBELL</td>
<td>UDX48E1U</td>
<td>Patch Panel, Multimedia Panel, Hubbell XCELERATOR, Unloaded, 48-Port, 1 Rack Unit (1U)</td>
</tr>
<tr>
<td>22</td>
<td>WIRE</td>
<td>BERK TEK LANmark</td>
<td>11101255</td>
<td>LANmark XTP, Category 6A, CMP, Plenum, White, 1000 FT/Reel-In-A-Box</td>
</tr>
<tr>
<td>23</td>
<td>WIRE</td>
<td>BERK TEK LANmark</td>
<td>11101258</td>
<td>LANmark XTP, Category 6A, CMP, Plenum, White, 1000 FT/Reel</td>
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<tr>
<td>24</td>
<td>WIRE</td>
<td>BERK TEK LANmark</td>
<td>11082063</td>
<td>LANmark XTP, Category 6A, CMR, Riser, White, 1000 FT/Reel</td>
</tr>
<tr>
<td>25</td>
<td>WIRE</td>
<td>BERK TEK LANmark</td>
<td>11101255</td>
<td>LANmark XTP, Category 6A, CMR, Riser, White, 1000 FT/Reel-In-A-Box</td>
</tr>
<tr>
<td>Page</td>
<td>Wire</td>
<td>Manufacturer</td>
<td>Model</td>
<td>Description</td>
</tr>
<tr>
<td>------</td>
<td>------</td>
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<tr>
<td>26</td>
<td>WIRE</td>
<td>CommScope</td>
<td>5401803</td>
<td>Coaxial Cable, CommScope P3 500 JCAR SM PR2667, 75 Ohm P3 Trunk and Distribution Cable, Black Flame Retardant PE Jacket, Riser, Reel</td>
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<tr>
<td>27</td>
<td>WIRE</td>
<td>HUBBELL</td>
<td>C6ASPDSW</td>
<td>NEXTSPEED Ascent, Category 6A, CMP, Plenum, White, 1000 FT/Reel-In-A-Box</td>
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<tr>
<td>28</td>
<td>WIRE</td>
<td>HUBBELL</td>
<td>C6ASPPDSW</td>
<td>NEXTSPEED Ascent, Category 6A, CMP, Plenum, White, 1000 FT/Reel</td>
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<tr>
<td>29</td>
<td>WIRE</td>
<td>HUBBELL</td>
<td>C6ASRDSW</td>
<td>NEXTSPEED Ascent, Category 6A, CMR, Riser, White, 1000 FT/Reel-In-A-Box</td>
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<tr>
<td>30</td>
<td>WIRE</td>
<td>HUBBELL</td>
<td>C6ASPRDSW</td>
<td>NEXTSPEED Ascent, Category 6A, CMR, Riser, White, 1000 FT/Reel</td>
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<tr>
<td>31</td>
<td>WIRE</td>
<td>CommScope</td>
<td>5781</td>
<td>Coaxial Cable, RG-6 Type Quad Shield, 60% Braid, Riser (CMR)</td>
</tr>
<tr>
<td>32</td>
<td>WIRE</td>
<td>CommScope</td>
<td>2227V</td>
<td>Coaxial Cable, RG-6 Type Quad Shield Plenum Video Coaxial Cable, 60% Braid, Plenum (CMP)</td>
</tr>
<tr>
<td>33</td>
<td>WIRE</td>
<td>SUPERIOR ESSEX</td>
<td>6H-246-4B</td>
<td>10Gain XP, Category 6A, CMP, Plenum, White, 1000 FT/Reel-In-A-Box</td>
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<tr>
<td>34</td>
<td>WIRE</td>
<td>SUPERIOR ESSEX</td>
<td>6H-272-4B</td>
<td>10Gain XP, Category 6A, CMP, Plenum, White, 1000 FT/Reel</td>
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<td>35</td>
<td>WIRE</td>
<td>SUPERIOR ESSEX</td>
<td>6H-246-4A</td>
<td>10Gain XP, Category 6A, CMR, Riser, White, 1000 FT/Reel-In-A-Box</td>
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<tr>
<td>36</td>
<td>WIRE</td>
<td>SUPERIOR ESSEX</td>
<td>6H-272-4A</td>
<td>10Gain XP, Category 6A, CMR, Riser, White, 1000 FT/Reel</td>
</tr>
<tr>
<td>37</td>
<td>WIRE</td>
<td>OPTICAL CABLE CORPORATION (OCC)</td>
<td>RTC series</td>
<td>Fiberoptic cabinets with OCC 616MDLC or 616DKC50G termination hardware as appropriate and series 600 blank coupler plates as required.</td>
</tr>
</tbody>
</table>
CIG15 - Communications Entrance Protection

1. General

Cables that enter a building from outside require electrical surge protection. Generally, communication cables that enter a building are provided by service providers under contract with the University. It is therefore not the responsibility of the Designer of Record to provide communications entrance protection for capital construction projects and renovations. However, it is the responsibility of the Designer of Record to coordinate with the owner and service provider to ensure that adequate space exists in telecommunications areas for protective equipment.
CIG16 - Communications Cabinets, Racks, Frames, and Enclosures

1. General
Communications cabinets, racks, frames, and enclosures are intended to provide physical protection and mounting support for active and passive communications hardware.

2. Execution
Communications cabinets, racks, frames and enclosures shall be grounded and bonded as described in section CIG03.

All cabinets, racks, frames, and enclosures shall be installed according to manufacturer’s recommendations, including secure mounting to the floor or other structure as appropriate.

2.1. Equipment Racks
Owner’s preferred item: Hubbell Part No. HPW84RR19 or equal.

Racks shall be constructed of aluminum and painted in black at the factory.

Channel uprights shall be spaced to accommodate industry standard 19" mounting.

Each rack shall be supplied with spare screws.

Each rack shall be 84" in height and shall be self-supporting.

Each rack shall be double-side drilled and tapped to accept 12-24 screws.

Uprights shall be drilled on the back to accept cable brackets, clamps, power strip(s), etc.

2.2. Cable Management for Equipment Racks
Owner preferred rear horizontal manager Hubbell ECMBR3. Rear managers shall be placed above and below each data patch panel.

Owner preferred vertical wire management bracket OCC part number VCM6 or equal. Vertical wire manager shall be placed between each equipment rack.

2.3. Placement
Final placement of telecommunications components shall be determined by CommTech during an on-site meeting.
CIG17 - Communications Termination Blocks and Patch Panels

1. General

Communications termination blocks and patch panels are utilized to terminate voice, data, security and signaling cable with the purpose of identification, patching and cross-connection of passive communications cabling.

2. Execution

Termination blocks and patch panels shall be installed per Designer’s detailed telecom room layout drawings and as directed by UNC ITS Engineering at the pre-installation meeting and throughout the duration of the project.

Provide front and rear horizontal cable management and vertical cable management as directed in section CIG18 Communications Cable Management and Ladder Rack.

2.1. Copper Cabling for Data

All copper data cabling shall be Category 6A Ethernet. Riser cables shall be fiber, not copper. Quantity of riser links specified will vary with project. Typical quantity is 15 links to each IDF from the building MDF.

Each data station cable shall be terminated in a patch panel as specified in CIG14. Patch panels supporting station cabling shall be mounted in 7’ floor rack dedicated to horizontal/station cabling. Horizontal (rear and front side) and vertical cable management devices, as indicated and listed in CIG18, shall be installed on those floor racks carrying horizontal/station cable termination patch panels.

2.2. Copper Cabling for Voice

All copper voice cabling shall be Category 6A Ethernet. All voice riser/backbone cables shall terminate in a “riser cable field” on a 66M1-50 terminating block. Each 66M1-50 terminating block shall be secured to an 89D mounting bracket which in turn shall be secured to a 183A1 metal mounting backboard. Location or placement of the “riser cable field” shall be as indicated on project drawings/details and/or as directed by UNC-Chapel Hill – ITS-Communication Technology representative(s).

Provide sufficient 66M1-50 termination blocks to terminate all voice pairs to be located in each equipment room. Mount blocks on 183 series metal backboards with 89D brackets. Use 187B1 metal backboards with mushroom spools for wire management. Backboards shall be double stacked vertically.

Each voice station/horizontal cable shall be terminated in a “station cable field” on a 66M1-50 terminating block. Each 66M1-50 terminating block shall be secured to an 89D mounting bracket which in turn shall be secured to a 183A1 metal mounting backboard. Location or placement of the
“station cable field” shall be as indicated on project drawings/details and/or as directed by UNC-Chapel Hill – ITS-Communication Technology representative(s).

2.3. Fiber Optic Cabling

Fiber Optic Patch Panels and coupling assemblies shall be installed at the MDF and IDF s. Blank covers for unused coupling assembly spaces in panels. Assembly spaces shall be utilized in consecutive order, without skipping module spaces.

Panels shall be enclosed assemblies affording protection to cable subassemblies and terminated fiber strand ends. Enclosures shall incorporate hinged or retractable front cover designed to protect Mount patch panels and horizontal cable management in 19" equipment racks.

Riser cables shall be single mode fiber terminating in Hubbell EDX48E1U panels.

See CIG-14 for preferred optical products.

3. Testing

All communications cabling system components shall be tested per section CIG02.
CIG18 - Communications Cable Management and Ladder Rack

1. General
This section provides direction to designers for new construction and renovation projects for the installation of communications cable management and ladder rack. Communications cable management and ladder rack are utilized to route voice and data cabling in telecom rooms for the purpose of providing routing and support for communications cabling.

2. Execution

2.1. Ladder Rack
Ladder rack shall be black in color and sized based on the projected amount of cable it supports.

Ladder rack shall be grounded per CIG03.

Cable runway shall be tubular stringer style B-Line SB-17-18, or equal by Chalfant, Globe.

Cable Runway shall be constructed of 0.065” thick steel and utilize tubular stringers to support rungs.

Cable Runway stringers shall be 1-1/2” high. Rungs shall be welded to stringers and shall be spaced 9” on center.

Cable Runway width(s) shall be 12” unless otherwise noted on drawings.

Cable Runway shall be UL Classified. Black Powder Coat is an acceptable color option for ladder runway.

Cable runways shall be supported from the wall, using hardware from cable runway manufacturer specifically intended for that purpose, with 4” separation from edge of tray to the edge of mounting wall.

2.2. Cable Management
Cable management for racks shall include both vertical and horizontal components.

2.2.1. Vertical Cable Management
Vertical Cable management shall be 6” wide, 7’-0” tall, double sided, with black finish and “D” rings approximately 8” on center.

- Approved products: Panduit, Superior Modular Products, Ortronics, or Chatsworth.
- Owner’s preferred item: Panduit WMPV45E.
2.2.2. **Horizontal Cable Management (Front of Rack)**

Horizontal Cable Management (front of rack) shall be 3.5” high, 5.7” deep, 19” wide, two rack unit device with four horizontal split distribution (“D”) rings.

- Approved products: Panduit, Superior Modular Products, Ortronics, or Chatsworth.
- Owner’s preferred item: Panduit CMPHH2.

2.2.3. **Horizontal Cable Management (Front of Rack)**

Horizontal Cable Management (rear of rack) shall be 3” high, 3” deep, 19” wide, device with cable management fingers, cable pass-throughs and hinged solid cover.

- Approved products: Hubbell, Panduit, Superior Modular Products, Ortronics, or Chatsworth.
- Owner’s preferred item: Hubbell ECMBR3.
CIG19 - Communications Equipment Room Fittings

1. General

This section provides direction to designers and contractors when ‘provisioning’ a telecommunications room (TR). It covers general configuration details for the room, including size, materials, and power requirements.

This section applies to Main Distribution Frame (MDF) and Intermediate Distribution Frame (IDF) rooms.

2. Execution

2.1. Physical

TRs shall be 10’ X 10’ minimum in size.

TRs shall be “stacked” vertically between floors if possible.

Buildings with multiple floors shall have one (1) TR per floor when possible.

TRs shall be centrally located to limit cable distances when possible. TR placement shall limit installed cable distances to a maximum of 90 meters. Multiple TRs may need to exist on a floor to meet this requirement.

TR floor covering shall be low static, VCT flooring. Sealed concrete shall not be allowed in TRs.

3/4” AC grade plywood shall be installed on all walls from the floor to 8’ AFF and painted white with fire-rated stamp taped off for building inspector approval. Plywood shall be attached to walls utilizing flush-mounted hardware.

Entry doors to TRs shall open out.

Buildings with tenants not associated with UNC shall have a dedicated and securely divisible TR on each floor for tenants.

Ceiling height shall be minimum 8’ with 10’ being preferable and be open to deck above for maximum accessibility. Lay-in type ceilings are not allowed in TR rooms.

Telecomm room doors shall have UNC ONE CARD access reader and door locks installed.

2.2. Environmental

TRs must maintain continuous and dedicated 24 hour/ 365 days TR environmental control not to be affected by building HVAC shut down. Branch electrical circuits serving TR environmental control equipment shall be fed from building emergency generator/ building UPS if available. Environmental control shall maintain positive pressure with one air change per hour required.
2.3. Power Requirements

In buildings with multiple TRs, the MDF shall be fitted with a dedicated electrical power panel that will serve all IDFs throughout the building. Dedicated electrical panels shall be fed from the building generator/building UPS if available.

Each TR shall be served with electrical circuits dedicated exclusively to the TR. Such electrical circuits are not permitted to be shared with any other load(s). Refer to the project’s electrical drawings for the branch electrical circuits and exact location of power serving the TR.

When it is not practical to have a dedicated electrical panel in the MDF, each serving circuit breaker shall be fitted with a mechanical breaker lock to prevent the circuit from being inadvertently switched off. Each TR electrical power circuit shall be fed from the building generator/building UPS if available.

Each TR shall be provisioned with a minimum of two separate 120 VAC, 20A branch power circuits. Each rack shall have one power receptacle mounted immediately above it. Receptacles shall be NEMA 5-20R, duplex, 20A, 125VAC with steel cover plate. In addition to the above described rack power receptacles, each TR wall (except wall with door) shall be fitted with one flush mounted receptacle, NEMA 5-20R, duplex, 20A, 125VAC with steel cover plate, mounted at 72” above finished floor.

Each rack or wall receptacle should be clearly labeled with: panel room number, panel number, and circuit number.

Each rack shall be furnished with one Wiremold-Perma (part number R5BZ-20 or equivalent) power strip/surge protector with a minimum 15’ cord. Power strip/surge protectors shall be delivered directly to the CommTech Engineering project manager.

2.4. Bonding and Grounding

All equipment and cable shields shall be properly bonded as described in CIG03.

The TMGB shall be mounted at 7’ 6” AFF in the MDF.

The TGB shall be mounted at 7’ 6” AFF in the IDF.

2.5. Lighting

Provide adequate lighting fixtures to provide a minimum 500 lux (50 footcandles) measured at 1 meter AFF. Lighting fixtures shall be mounted at a minimum of 8.5” AFF and be fitted with wire guard to prevent accidental bulb damage.

TR lighting circuits shall be on emergency power if available.
2.6. Fire Protection

Provide fire sprinkler pipes per applicable code requirements. Where sprinkler heads are installed, install wire sprinkler cages to prevent accidental operation. Drainage troughs shall be installed to prevent equipment damage in the event of accidental leakage.

TRs shall not be located below potential sources of flooding like restrooms, roof drains, or kitchens.

All penetrations shall be firestopped as described in CIG04.

2.7. Equipment Racks

TRs shall be fitted with a minimum of three (3) equipment racks with front and rear horizontal and vertical cable management as detailed in section CIG16 Communications Cabinets, Racks, Frames, and Enclosures.

2.8. Cable Pathway in TRs

A minimum of four (4) 4” conduits are required from the serving manhole to the SER. In the event that the conduit distance exceeds 50’ from serving manhole to SER, one 4” conduit shall be Rigid Galvanized Steel (RGS).

Horizontal cable trays and sleeves shall enter TR no lower than 7’6” and no higher than 10’. Cable trays, horizontal and vertical sleeves shall extend 4” into TR. Conduits and sleeves entering TRs shall have screw-on type bushings. Vertical sleeves shall be 4” off wall and trimmed to 4” AFF of TR that sleeve stubs up into and 10’ AFF of TR that sleeve stubs down into.

Cable runway shall be tubular stringer style B-Line SB-17-12, or equal.

Cable runway shall be constructed of 0.065” thick steel and utilize tubular stringers to support rungs.

Cable runway stringers shall be 1-1/2" high. Rungs shall be welded to stringers and shall be spaced 9" on center.

Cable runway width(s) shall be 12" unless otherwise noted on drawings. Cable runway width shall be calculated based on manufacture’s requirements for number of cables to be supported plus 15% growth capacity.

Provide runway and accessories necessary for complete system.

Provide cable drop-outs at all equipment rack locations and as required in design drawings.

Fasten runway to top of equipment racks with equipment manufactured for this purpose.

Provide wall support kits to support runway from building walls and provide cable runway support kits to secure runway to equipment rack.

Contractor shall install the cable runway so that it is 4” off the surface of the wall in each TR.
2.9. Cabling

Velcro style reusable self-gripping cable ties shall be used to route and secure communications cabling in the PDR/SDR.

2.10. Cable Destination Charts

Each TR shall have a cable destination chart as described CIG13 - Identification for Communications Systems, section 2.5.3.1.
CIG20 - Communications Copper Backbone Cabling

1. General
Copper backbone cabling supports risers for legacy voice and Ethernet data connectivity.

2. Execution

2.1. Data
Installation of copper backbone cabling shall follow the same procedures as horizontal cable installation as described in CIG25.

2.2. Voice
Installation of copper backbone cabling shall follow the same procedures as horizontal cable installation as described in CIG25 except that Category 3 multi-pair riser cable shall be used.

3. Testing
All communications cabling system components shall be tested per section CIG02.
CIG21 - Communications Copper Cable Splicing and Terminations

1. General
This Section describes work associated with terminating copper UTP cable. For the purpose of this document, copper cable shall refer to Category 6A UTP cable used and installed for voice and data applications.

2. Execution
Splicing of copper UTP cables is NOT permitted for any permanent work.

2.1. At Faceplate

2.1.1. Data Cables
Each Category 6A data cable shall be terminated in a Category 6A jack. Jacks shall be wired as per TIA-568-C.0 using T-568B pinout. Data jacks shall be secured in faceplate in top and middle position on right side of six-position faceplate.

2.1.2. Voice Cables
In those faceplates where analog voice connections are required, each Category 6A voice cable shall be terminated in a USOC jack. Jacks shall be wired using T-568B pinout. Where a voice jack is required, it shall be secured in a wall telephone faceplate or in the top position on the left side of a six-position two-gang faceplate.

2.2. In Telecommunications Room
Termination of cables in telecommunications rooms is described in section CIG17 - Communications Termination Blocks and Patch Panels.

3. Testing
All communications cabling system components shall be tested per section CIG02.
CIG22 - Communications Optical Fiber Backbone Cabling

1. **General**
   
   This section describes design requirements associated with the installation of building backbone/riser optical fiber cables. In general, Campus building Telecommunications Room cable riser systems shall be fitted with a single mode fiber riser system sized per building requirements.

2. **Execution**

   All cable, equipment and hardware shall be arranged to provide a neat appearance and accessibility for servicing.

   Designer shall supply estimated loss measurements for each cable run.

2.1. **Inner Duct**

   Fiber optic cabling shall be installed in 1-inch inner duct when:
   
   - Installed in 4" conduit runs.
   - Installed in cable tray.
   - Installed in riser sleeves and spaces.

2.2. **Riser Conduit Sleeve**

   Install all riser fiber optic cabling in a stacked riser conduit sleeve separately from the other riser cables.

   Completely utilize full placement capacities of each riser conduit sleeve before placing cable in the next empty conduit sleeve.

2.3. **Splicing and Connection**

   Install fiber optic cable runs continuous and un-spliced, from outlet boxes to termination panels.

   Provide sufficient cable in each termination location to properly terminate cables.

2.4. **Preparation of Interior Raceway Systems**

   Ensure that all cable tray, conduit and other confined routing are free and clear of all debris before cable placement.

   Cable shall not be installed into conduit ends that are not reamed and bushed.

2.5. **Specifications**

   Maximum allowable connector loss: 0.75dB
Maximum allowable splice loss: 0.3dB

2.6. Cable Identification

Cables shall be labeled as described in section CIG13.

3. Testing

Link testing shall not include any active or passive devices other than the cable, connectors, and splices.

3.1. Presentation of Test Results

Installation Contractor shall utilize test equipment capable of saving results in electronic and printed form. Test results shall be presented in PDF form. Test results shall be saved and labeled according to UNC naming conventions (see CIG13), typically FS.[sheath_number].[strand_number]. For example, cable segment FS.801 shall have strands FS.801.1, FS.801.2, FS.801.3, etc. Contact CommTech Engineering for naming specifics prior to testing.

OTDR traces shall not show backscatter beyond the end of the fiber.

In addition to PDF requirements, OTDR traces shall be provide in digital form. Contractor shall supply CommTech Engineering with a fully-licensed copy of software capable of viewing the trace details.

3.2. Testing Requirements

Test equipment shall be within the calibration period recommended by the vendor in order to achieve vendor-specified measurement accuracy.

3.2.1. Power Meter Testing

Power meter testing shall be required of all fiber optic cable.

3.2.2. OTDR Testing

OTDR testing shall be required of all fiber optic cable exceeding 100m (328’).

Traces shall be taken from both ends of the fiber.

Launch jumpers shall be used at each end of the fiber. Launch jumpers shall be 100m (328’) in length.

Reflected ghost patterns that obscure critical trace information are not permitted.

For each test, ensure that that traces are viewable at the same linear scale.

Traces shall be taken at 850nm and 1300nm for multimode fiber, and at 1310nm and 1550nm for singlemode fiber.

The OTDR pulse width shall be set small enough to resolve the launch cable connection to the fiber under test.
3.2.3. Unsatisfactory Test Results

Any measurements that show attenuation in excess of the calculated loss shall require the cable in question to be completely removed and a new cable to be installed at no expense to UNC.
CIG23 - Communications Optical Fiber Splicing and Terminations

1. General
This section describes design requirements associated with the splicing and termination of optical fiber cable.

2. Execution

2.1. Connectors
Unless otherwise specified, fiber shall be terminated in duplex LC type connectors.

2.2. Patch Panels
Termination of cables in telecommunications rooms is described in section CIG17 - Communications Termination Blocks and Patch Panels.

2.3. Splices
Splices are not allowed unless specifically requested and/or approved by CommTech Engineering.

3. Testing
See CIG22 for testing requirements.
CIG24 - Communications Coaxial Backbone Cabling

1. General
The University utilizes a hybrid fiber/coax system for CATV. Signals are delivered to a building via optical fiber and converted to coax in the PDF. The coaxial riser backbone system transports the CATV signal between floors.

2. Execution
A single segment of CommScope P3 500 JCAR or equivalent coaxial cable shall be installed between the MDF and each IDF. A 30-foot coil shall be left at each end (entering and exiting) of the cable segment(s).

3. Testing
No testing requirement.
CIG25 - Communications Copper Horizontal Cabling

1. **General**
   This Section details product and execution requirements for Horizontal Coaxial Cable for the University of North Carolina at Chapel Hill for both voice and data.

2. **Execution**
   
   **2.1. Cable Type**
   All horizontal cable for voice and data shall be Category 6A Unshielded Twisted Pair (UTP).

   **2.2. Cable Placement**
   Install cables splice-free unless otherwise specified.

   Contractor shall provide all required installation tools to facilitate cable pulling without damage to cable jacket.

   Pull all cable by hand unless installation conditions require mechanical assistance. Where mechanical assistance is used, care shall be taken to insure that maximum tensile load for cable as defined by these specifications is not exceeded. This may be in the form of continuous monitoring of pulling tension, use of “break-away” or other approved method.

   Pull cables in accordance with cable manufacturer’s recommendations and NFPA-70. All cabling shall be installed in compliance with the latest edition of TIA- 568 and related standards. Manufacturer’s recommendations shall be part of cable submittal. Recommended pulling tensions and pulling bending radius shall not be exceeded. Any cables bent or kinked to radius less than recommended dimension will not be allowed.

   During pulling operation adequate number of workers shall be present to allow cable observation at all points of raceway entry and exit, as well as to feed cable and operate pulling machinery.

   Pulling lubricant may be used to ease pulling tensions. Lubricant shall be of type that is non-injurious to cable jacket and other materials used. Lubricant shall not harden or become adhesive with age.

   Pull string (nylon; 1/8” minimum) shall be installed with cable installed in all conduits and innerducts. Pull strings shall be tagged in PDR and SDR and at each corresponding outlet to identify where the string terminates on each floor.

   **2.3. Cable Dressing and Placement**
   Cable tray shall be loaded equally.

   Install cable in conduit or secured metal raceway system (enclosed wireway) in public areas or as designated on plans. All other routing, such as that found in typical MDF/IDF, shall be kept clear of other trades work and supported according to code utilizing overhead cable runway.
Cabling shall be neatly laced, dressed, and supported. Work not done to the satisfaction of the UNC - Telecommunications Office and the Designer shall be reworked at no cost to the Owner.

2.4. **Damage**

Contractor shall be responsible for identifying and reporting to Designer any existing damage to walls, flooring, tiles and furnishings in work area prior to start of work. Repair damage to interior spaces caused by installation of cable, raceway or other hardware. Repairs must match preexisting color and finish of walls, floors and ceilings. Replace any contractor-damaged ceiling tiles to match color, size, style and texture.

3. **Testing**

Testing shall be accomplished as described in CIG02
CIG26 - Communications Coaxial Horizontal Cabling

1. General
This Section details product and execution requirements for Horizontal Coaxial Cable for the University of North Carolina at Chapel Hill.

2. Execution
All horizontal coaxial cable and associated termination hardware shall be installed in compliance with an F-type connector.

3. Testing
All horizontal coaxial cabling shall be tested after termination for continuity, DC resistance, length, and attenuation sweeps from DC to 5000MHz.
CIG27 - Communications Faceplates and Connectors

1. General

This Section provides direction with regards to communication outlet faceplates and connectors that typically are installed in those faceplates.

2. Execution

All faceplates and associated termination hardware shall be installed in compliance with TIA-568-C series standards.

Faceplates shall be labeled as describe in CIG13.

3. Testing

All communications cabling system components shall be tested per section CIG02.
CIG28 - Communications Custom Cable Assemblies

1. General

Communications Custom Cable Assemblies are special and unique cable requirements above and beyond the standard building wiring specified in this document. These may include nursing station cables, audio-visual system cables, and specialty networking cables.

Unless otherwise specified for the project, Communications Custom Cable Assemblies are not the responsibility of the Communications Contractor.

See CIG29 for patch cords, station cords and cross-connect wire.
CIG29 - Communications Patch Cords, Station Cords, and Cross Connect Wire

1. General

Neither the Designer of Record nor the Contractor of Record is responsible for the following items. These will be provided by the University.

1. **Patch cords**: short cables that connect between two ports on the front side of a patch panel, or between patch panels.

2. **Station cords**: short cables that connect telephony instruments to a communication outlet.

3. **Cross connect wire**: short wires to interconnect telephony signals on punch-down terminals.
CIG30 – Data Communications

1. General

Active electronics for data communications, including routers, switches, supporting UPS system, and related equipment are designed, procured, installed, and maintained by the University. The Designer of Record shall not provide work in this area.

2. Scheduled Access

Data communications is a fundamental campus utility and must precede most other building occupation activities. Therefore, the Designer of Record and Contractor of Record shall work with CommTech Engineering to support building access by University personnel to install and test data communications equipment in telecommunications rooms in the weeks leading up to final building acceptance. This support shall consist of the following activities.

- Inclusion of data networking electronics installation in the project schedule.
- Early keying of locks on telecommunications rooms to allow the equipment to be securely placed.
- Access to telecommunications rooms by University personnel to install the electronics.
CIG31 - Voice Communications

1. General

The University of North Carolina has for many years utilized Centrex voice services provided by a third party carrier. More recently, the University has begun to deliver voice services via VoIP, also provided by a third party carrier.

The University maintains a staff of customer service and technical support personnel to manage service delivery and instrument deployments. Thus, the Designer need not consider general purpose voice services in a project design. However, there are a number of exceptions at the periphery of the voice services network for which the Designer must account. These include elevator phones, emergency phones, alarm lines, and similar ancillary connections. These are discussed in specific sections of this document.

Related sections:

CIG19 Communications Equipment Room Fittings
27 15 00 Communications Horizontal Cabling
CIG33 Elevator Telephones
CIG34 Ring-Down Emergency Telephones
CIG32 – Telephone Sets

1. General

Telephone sets are provided as an available service option to UNC ITS customers and are not included as part of the capital project designers responsibility. Horizontal cabling for phone connectivity is to be included in capital project design as referenced in sections 27 15 00 Communications Horizontal Cabling, CIG33 Elevator Telephones, and CIG34 Ring-Down Emergency Telephones.
CIG33 – Elevator Telephones

1. General

This section provides direction to designers for new construction and renovation projects for the installation of emergency telephones for elevators and chairlifts. Emergency telephone for elevators and chairlifts are required and operate as ring-down telephones, contacting the Department Of Public Safety. These systems operate using dedicated PSTN telephony and are not a part of the campus VoIP system.

2. Execution

Elevator phones are to be provided and installed by the elevator manufacturer or their contractor as part of the elevator installation.

The installation of a ¾” homerun conduit from the nearest Telecom room to each elevator control cabinet is required with a Category 6A cable installed to each elevator control cabinet as described in section CIG25 Communications Copper Horizontal Cabling.

CommTech Engineering must be notified 15 days in advance of elevator phone service dial tone requirement to provide service provider adequate time to complete service order.

3. Testing

Testing of elevator phones shall comply with State Construction Office and NC Department of Insurance requirements.
CIG34 – Ring-Down Emergency Telephones

1. General

This section provides direction to designers for new construction and renovation projects for the installation of Ring-Down Emergency Telephones. Emergency telephones are required at designated areas on campus as determined by the Department of Public Safety.

2. Execution

During project design the designer, building owner, and DPS representative shall meet to discuss requirements for wall-mounted or free standing ring-down emergency phones. Any required ring-down emergency phones shall be referenced in the project contract documentation including marked drawings of emergency phone location and installation details.

The installation of a ¾” homerun conduit from the nearest telecom room to each ring-down emergency phone is required with a Category 6A cable installed to each emergency phone as described in section CIG25 Communications Copper Horizontal Cabling. In the event underground conduit is required the cable shall be rated for direct bury/duct placement with no splice points allowed between the emergency phone and nearest telecom room.

Each emergency phone requires the installation of a 110 volt 20 amp circuit served from the dedicated telecom room electrical panel if possible. If there is no dedicated electric panel in the serving telecom room the circuit breaker serving the emergency phone should be fitted with a mechanical lock to prevent the emergency phone power from being inadvertently disconnected.

3. Testing

Upon emergency phone installation completion UNC ITS technicians completing the service order for analog phone service shall test the ring-down circuit and verify that caller ID information appears appropriately at the Department of Public Safety operations center.

* Important: Emergency alarm lines shall be installed early in the process because these lines must be provisioned within UNC’s internal systems and the external voice carriers before 911 can be tested. Caller ID will not profile correctly if this process is not completed at least one day in advance of testing.
1. General

The University operates its own campus-wide cable television service that delivers over 100 channels of standard definition and HDTV programming. Programming is collected at a headend facility and distributed via a hybrid fiber-coax system. Each building receives CATV signals via fiber. These optical signals are converted to electrical signals, typically in the MDF, and distributed via coaxial riser and horizontal cables.

Designers and Contractors are responsible for identifying areas that require service and installing cables. Taps and amplifiers are installed as appropriate by University technicians to distribute the signal. The University then provides the signal to the building.

More information on the CATV system can be found at http://its.unc.edu/service/cable-tv-channel-lineup/.
CIG36 – RF Systems

1. General

The University operates numerous systems that utilize radio frequency (RF) communications. These include a pervasive Wi-Fi network, a distributed antennae system (DAS) for mobile voice/data carriers, an emergency responders network, multiple microwave links, and two radio stations. Care must be taken to ensure that systems newly-introduced to campus do not interfere with existing systems and that RF spectrum is managed appropriately for the University’s growing wireless needs. Toward that end, designers considering the use of RF systems should be aware of the following:

A. Operation at 2.4GHz and 5GHz ISM bands will not be permitted due to interference with the University’s Wi-Fi network.

B. Operation in the unlicensed “Internet of Things” bands including 433MHz and 902-928MHz may become objectionable in the future as the University develops its own sensor networks to operate critical infrastructure. However, at this time, those networks do not exist.

C. The FCC is in the process of re-allocating the 600MHz spectrum and will re-groom the 500MHz spectrum starting in 2020. This will cause changes in the permissible use of RF on campus and may necessitate changes to systems operating in these bands.

D. In general, the use of licensed spectrum is far less problematic for the University than the use of unlicensed spectrum.

E. RF transmission of University data shall be encrypted at all times.

2. Design and Operational Considerations

Designers shall submit to the University a map showing the location of all proposed devices that emit RF energy, including the latitude and longitude, operating frequency, and power level of each device. Any proposed changes to the location, operating frequency, or power level of RF devices shall be submitted to the University for an additional engineering review.

3. Third-party RF Networks

Non-University entities will not be permitted to operated RF systems on the campus or its leased locations except under a written and duly-executed license agreement.

4. Changes to RF Operations

The University reserves the right to restrict RF usage on campus without notice.
CIG37 - Wi-Fi

The University maintains a pervasive Wi-Fi deployment across campus. This network is designed and operated internally by the University’s Information Technology Services Communication Technologies group and is tightly integrated with the campus wired data network.

1. Design Scope
Designers shall include wiring infrastructure for Wi-Fi in all new projects. This includes conduit and cabling from the telecommunications room to the access point location. However, the design should not include the actual access point electronics, which will be provided and installed by the University.

2. Budgeting
Each project should estimate one access point per 1000 square feet in order to accommodate the density of users expected on campus.

3. Design Process
Designers shall include a zoned Wi-Fi infrastructure design, showing ceiling-based data outlet locations based on TIA TSB-162-A, but applying approximately a 30-foot grid. Where building grid lines are of similar dimensions (plus or minus), the building grid pattern may serve as the zoning pattern for Wi-Fi cabling. Provide for one ceiling-based data outlet at the center of each zone.

4. Wiring
Each ceiling-based data outlet for Wi-Fi shall be served by the nearest telecommunications room with two Category 6A cables. To allow for potentially long connecting cords between access point devices and data outlets, horizontal cabling links serving Wi-Fi data outlets shall be limited to 80 meters (262 feet), which the designer shall emphasize in drawing notes and horizontal cabling specification documents. All data jacks in ceiling-based data outlets shall be equipped with protective shutters to prevent dust infiltration. Wiring of ceiling-based data outlets shall comply with CIG25.

5. Conduit
All data outlet cabling serving Wi-Fi locations shall be contained in conduit along its entire route from the outlet location to the nearest cable tray or home run to the nearest telecommunications room. 1” shall be the minimum conduit size. Where required, larger conduit sizes shall be specified in accordance with the conduit guidance provided in this document.

6. Power
No power shall be provided for access points. All access points will be operated by Power-Over-Ethernet service from the University-provided data switches.
CIG38 - Cable Color Codes

The following table describes current and historical uses of cabling jacket colors used at the University of North Carolina at Chapel Hill.

<table>
<thead>
<tr>
<th>Color</th>
<th>Type</th>
<th>Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>beige</td>
<td>category 3</td>
<td>voice</td>
<td>historical</td>
</tr>
<tr>
<td>blue</td>
<td>category 5e</td>
<td>voice</td>
<td>historical</td>
</tr>
<tr>
<td>yellow</td>
<td>category 5e</td>
<td>data</td>
<td>historical</td>
</tr>
<tr>
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CIG-39 – Auxiliary Networks & Devices

Designers may be called upon to provide devices or networks of devices which connect to the campus data network or are independently housed in UNC buildings. These devices and networks can include sensors, audio-visual equipment, surveillance cameras, environmental control systems, and various controllers. Some systems may even employ data switches for device aggregation and signal distribution. The purpose of this section is to clarify how these systems can interconnect or otherwise coexist with the campus data network.

1. Equipment Compatibility Consultation and Verification

ITS Networking will work with designers and integrators to test proposed equipment and designs for compatibility with the campus network. Reach out to ITS Networking prior to Schematic Design to ensure that proposed systems and approaches are compatible. ITS cannot guarantee compatibility with all third-party equipment, so early communication is in everyone’s best interest.

1.1. Minimum Endpoint Connectivity Requirements

Devices connecting to the campus network should meet at least the following basic connectivity requirements.

1.1.1. Wired Network

Devices connecting to the campus wired data network should support 100Mb/s full duplex Ethernet at a minimum. Campus data network switches will provide PoE. PoE devices connected to the network should be compatible with IEEE 802.3at powering. For devices requiring 802.3bt powering, switch accommodation must be coordinated with ITS Networking.

1.1.2. Wi-Fi Network

Devices connecting to the Wi-Fi network should support IEEE 802.11n or later. Devices must support either WPA2-PSK or WPA2-Enterprise (EAP-TLS) authentication. Systems utilizing WPA2-PSK must support a passphrase length of up to 32 characters. No open Wi-Fi connectivity is supported. The University regularly changes the campus Wi-Fi passwords, so end users should be provided with a means to easily update passwords across devices.

1.1.3. Switches

The University prefers that devices connect directly to the campus network rather than through switches provided by designers and integrators, however, the University recognizes that this may not always be practicable due to the need for device integration or specific features. In this case, unmanaged switches should be utilized with no Spanning Tree protocol enabled. All switches will have to be approved by ITS Networking prior to being placed on the campus data network.
1.1.4. Routers & Related Devices

Routers, firewalls, and load balancers should not be included with any design as these may affect the operation of the campus network. If an application calls for these devices, contact ITS Networking for a consultation.

2. Auxiliary Networking Rooms

Due to various legislative statutes and State guidelines regarding privacy and security, access to campus telecommunications rooms is highly restricted. For this reason, only campus data network equipment and infrastructure can be located in telecommunications rooms. Third party equipment may not be located in telecommunications rooms, including servers, cameras, data switches, sensors, alarms, control systems, and patch panels. If users require space to house equipment, it is recommended that designers include auxiliary equipment rooms.

In some cases, as with audio-visual systems, the architecture will require that specialized devices distributed throughout a building connect back to a central location where interconnection, patching, routing, and switching may occur. We define this central interconnection point as an **auxiliary networking room**. In this case the preferred solution is an auxiliary networking room adjacent to the telecommunications room. This allows the user easy access to their specialized equipment, while facilitating simple, short run, and secure connection to campus data network infrastructure. This preferred solution is illustrated below.

The cable runway above the IT racks in the telecommunications room shall be extended to traverse the adjacent auxiliary networking room through a rectangular slot in the common wall between the two rooms. The slot shall consist of a finished opening that is wide enough to accommodate the width of the cable runway plus a minimum of one inch on each side, and high enough to facilitate convenient cable passage - no less than 6”H and no more than 12”H. Where the auxiliary networking room must be

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*Section Page: 78*
separated from the telecommunications room, the designer shall provide for a continuous pathway of similar capacity that complies with the requirements of this document for building pathways.

If an auxiliary equipment room must be located away from the telecommunications room, then the entire footprint of the wiring service area must be reduced so that the full path from end station to telecommunications room to auxiliary equipment room does not exceed the IEEE 802.3 maximum of a 100-meter channel between interconnected equipment ports (90 meters of permanent link cabling plus 10 meters of patch/connecting cords). This could result in a requirement for additional telecommunications rooms per floor, which is the reason for the strong adjacency preference.

3. Exterior Remote Connections

An increasing number of exterior edge devices require connectivity to a nearby campus building or point of presence. These include exterior cameras, parking gates, 5G small cell antennas, and other utilitarian devices. This section describes guidelines for pathways, media, and power for exterior remote devices.

3.1. Pathways

All underground conduit shall be sized for a maximum of 40% fill after cable placement is complete. The minimum conduit size shall be 1.0” trade size. Conduit composition shall be galvanized rigid metal or Schedule 40 PVC or as otherwise specified in UNC Electrical Distribution Guidelines. Depth of cover shall be a minimum of 18” or as otherwise specified in UNC Electrical Distribution Guidelines. Coordinate with ITS CommTech Engineering for any additional pathway hardening requirements, such as concrete encasement for certain critical applications. Provision shall be made for the future electronic location of all underground pathways. Route coordination shall be carefully coordinated with ITS CommTech Engineering as early as practicable in the design process, and all route planning shall comply with UNC GIS Design and Construction Surveying Guidelines.

3.2. Cabling

All fiber optic cabling, regardless of application, shall be single mode, minimum Type OS2, with G.655 preferred to support future DWDM applications. To preclude requirements for cable transition splicing, all fiber optic cable assemblies shall be rated for both outside plant duct placement and interior routing through plenum-rated environments. Where copper network cabling is to be used for shorter reach outside plant network distribution, it shall consist of a Category 6A cable assembly rated for outside plant duct placement with proper Category 6A compatible lightning protection on each end. All copper conductors, regardless of type, must be lightning protected.

3.3. Labelling

All fibers shall be labelled according to “CIG13 - Identification for Communications Systems” including exterior tags. See ITS Communication Technologies Engineering to obtain fiber numbers for labelling purposes.
3.4. PoE Powering

When facilitating PoE powering of remote network devices that will utilize fiber optic signaling, designers shall specify hybrid cables that incorporate both optical fibers and copper conductors under a shared cable sheath, so that a single cable assembly is used to connect the remote device location with the switch location. Copper conductors of such hybrid cables shall be sized to properly deliver PoE power compliant with IEEE 802.3bt, considering the line length between end points. Designers shall coordinate with UNC CommTech Engineering regarding methods for interfacing the copper pairs with PoE sources and end point devices. Designers shall specify that wire gauge of copper conductors be included in as-built documentation for each cable (wire gauges might differ for cables of different lengths). This configuration is illustrated below.

3.5. Documentation

All network cabling shall be certified with report submitted per the relevant requirements of this document. Final outside plant routing shall be indicated on as-built telecommunications and electrical site drawings. GIS details of proposed and built pathway routing and cable contents shall be provided to the University in both PDF and georeferenced AutoCAD formats during design phase and in as-built record drawings.
CIG-39 – Demolition

The demolition of any network cabling or other network components may be performed as general labor activity only if first carefully coordinated with ITS CommTech Engineering and only after notification from ITS CommTech Engineering that elements to be removed have been decommissioned and instructions for salvaging/preservation have been communicated. Demolition of network cabling and components that are operational may not be performed as general labor activity, and workers shall not be permitted to access operational telecommunications rooms. Where demolition is to occur in an active networking environment, it may be performed by qualified data communications technicians if first carefully coordinated with ITS CommTech Engineering. The applicable requirements of this section shall be communicated by the designer in project specifications and sheet notes.
Appendix 1: Telecommunications Designer Scope of Services

1. Scope of Services by Project Phase
The following is a summary of the tasks and deliverables required of the Telecommunications Designer of Record at each stage of a capital project.

A. Schematic Design (SD) Phase
   1. Provide site routing, duct bank and outside plant (OSP) cabling requirements to the following Professionals of Record:
      a. Architect
      b. Civil Engineer
      c. Electrical Engineer
      d. Plumbing Engineer
      e. Mechanical Engineer
   2. Provide telecommunications room (TR) space requirements to the Architect of Record
      a. Quantities and locations of TRs to facilitate standards-compliant horizontal cabling distances
      b. Minimum dimensions (not area) per TR
      c. Locations, sizes and swing directions of TR doors
      d. Restrictions on TR locations
         1. Non-adjacency (sides and above) to water flow spaces or locations subject to flooding
      e. Restrictions on non-TR functions being housed in or passing through TR spaces
   3. Provide telecommunications pathway/raceway requirements to the Electrical Engineer of Record
      a. Quantities and sizing of building entrance ducts, where applicable, and any associated outside plant duct bank and manholes
         1. Min. bend radius of 10x conduit diameter
      b. Quantities, sizing and schematic placement of backbone/riser conduits and sleeves
         1. Min. 4” trade size EMT or RMC
         2. Min. bend radius of 10x conduit diameter
         3. Criteria for use, sizing and placement of pull boxes
      c. Sizing criteria for basket-type corridor cable tray
         1. Max. 50% cable fill
      d. Box types for typical telecommunications outlets
1. Min. 4” square box, 3.5” deep
2. 2-gang plaster ring, matching thickness of wall board to create flush opening
3. Methods for securely mounting to building structure

**e. Outlet conduit requirements**
1. Min. 1” trade size EMT or RMC
2. Min. bend radius of 6x conduit diameter (10x for conduits greater than 2” size)
3. Criteria for use, sizing and placement of pull boxes
4. Continuous routing, stubbed to within 4” of cable tray (use of J-hooks not permitted)

4. Provide overall electrical requirements per TR to the Electrical Engineer of Record
   a. Rack power projected maximum load, plus 50% spare capacity
   b. Convenience power requirements on perimeter walls
   c. General lighting requirements per TR
   d. Restrictions on non-TR functions being housed in or routing through TR spaces

5. Provide bonding and grounding requirements for telecommunications to the Electrical Engineer of Record, based on the latest revision of ANSI/TIA-607, including sizing and other essential characteristics for the following [terminology beginning with Revision C / terminology prior to Revision C]:
   a. Telecommunications Bonding Conductor (TBC) / Bonding Conductor for Telecommunications (BCT)
   b. Telecommunications Bonding Backbone (TBB)
   c. Primary Bonding Busbar (PBB) / Telecommunications Main Grounding Busbar (TMGB)
   d. Secondary Bonding Busbar (SBB) / Telecommunications Grounding Busbar (TGB)
   e. Backbone Bonding Conductor (BBC) / Grounding Equalizer (GE)

6. Provide overall environmental requirements per TR to the Mechanical Engineer of Record
   a. Projected maximum heat load, plus 50% spare capacity
   b. Environmental conditions to be maintained
      1. Temperature range
      2. Humidity range (non-condensing)
      3. Air exchange cycle
      4. Positive air pressure relative to surrounding spaces
   c. Continuous 24/7 operation
   d. N+1 system redundancy
7. Provide overall requirements for floor loading in telecommunications rooms to the Structural Engineer of Record.
   a. Consideration especially given to racks containing substantial UPS gear
      1. Allow for future expansion of UPS systems – system capacity and run time

8. Provide general requirements to the Plumbing Engineer of Record
   a. Restrictions on non-TR functions being housed in or routing through TR spaces

9. Provide general requirements to the Security System Designer of Record
   a. Access control and monitoring requirements for TR spaces
   b. Restrictions on non-TR functions being housed in or routing through TR spaces

10. Provide preliminary requirements for fire suppression systems in TR spaces to the appropriate MEP Engineer of Record or other design professional, as appropriate.

11. Provide preliminary requirements for fire stopping of telecommunications pathways to the appropriate MEP Engineer of Record or other design professional, as appropriate.
   a. Fire stopping systems shall provide for ongoing re-entry, to enable altering of pathway contents, and subsequent restoration to required rating.

12. Advise the Architect and the designers of record for the following systems (and any others) about restrictions on the placement of any equipment, cabling, or other system components within the secured TR space.
   a. Audio-Visual Systems
   b. Digital Antenna Systems (DAS)
   c. Security Systems
   d. Fire Alarm Systems
   e. Building Management Systems

13. Provide project-specific general requirements for backbone and horizontal cabling systems.


15. Summary of SD Phase Deliverable Documents (at minimum) required of the Telecommunications Designer:
   a. Design Narrative
      1. Systems descriptions
      2. Citation of all requirements stated above
   b. Preliminary Cost Estimate
B. Design Development (DD) Phase

1. Coordinate and verify site routing, duct bank and outside plant (OSP) cabling requirements with the Architect and with Civil and MEP Engineers.

2. Coordinate and verify telecommunications room (TR) space requirements with the Architect
   a. Quantities and locations of TRs to facilitate standards-compliant horizontal cabling distances
   b. Dimensions (not area) per TR
   c. Locations, sizes and swing directions of TR doors
   d. Restrictions on TR locations
      1. Non-adjacency (sides and above) to water flow spaces or locations subject to flooding
   e. Restrictions on non-TR functions being housed in or passing through TR spaces

3. Coordinate and verify telecommunications pathway/raceway requirements with the Electrical Designer
   a. Quantities and sizing of building entrance ducts, where applicable, and any associated outside plant duct bank and manholes
      1. Min. bend radius of 10x conduit diameter
   b. Quantities, sizing and schematic placement of backbone/riser conduits and sleeves
      1. Min. 4” trade size EMT or RMC
      2. Min. bend radius of 10x conduit diameter
      3. Usage scenarios, sizing and placement of pull boxes
   c. Sizing and routing of basket-type corridor cable tray
      1. Max. 50% cable fill
      2. Clearances for cable tray access
      3. Transition to conduit of matching capacity for inaccessible areas
      4. Placement of access hatches as required in inaccessible ceilings
   d. Box types for typical telecommunications outlets
      1. Min. 4” square box, 3.5” deep
      2. 2-gang plaster ring, matching thickness of wall board
   e. Outlet conduit requirements
      1. Min. 1” trade size EMT or RMC
      2. Min. bend radius of 6x conduit diameter (10x for conduits greater than 2” size)
      3. Usage scenarios, sizing and placement of pull boxes

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4. Continuous routing, stubbed to within 4” of cable tray (use of J-hooks not permitted)

4. Coordinate building pathways, including any penetrations, with other building systems, including Structural, Mechanical, Electrical, Lighting, Fire Alarm, Security, Building Management, Plumbing, Sprinkler, and any other, as applicable.

5. Coordinate and verify electrical requirements per TR with the Electrical Designer
   a. Projected maximum equipment load, plus 50% spare capacity
   b. Power outlet configurations, quantities and placement
   c. Convenience power requirements on perimeter walls
   d. General lighting requirements per TR
   e. Restrictions on non-TR functions being housed in or routing through TR spaces

6. Coordinate and verify bonding and grounding requirements for telecommunications with the Electrical Designer, based on the latest revision of ANSI/TIA-607, including sizing and other essential characteristics for the following [terminology beginning with Revision C / terminology prior to Revision C]:
   a. Telecommunications Bonding Conductor (TBC) / Bonding Conductor for Telecommunications (BCT)
   b. Telecommunications Bonding Backbone (TBB)
   c. Primary Bonding Busbar (PBB) / Telecommunications Main Grounding Busbar (TMGB)
   d. Secondary Bonding Busbar (SBB) / Telecommunications Grounding Busbar (TGB)
   e. Backbone Bonding Conductor (BBC) / Grounding Equalizer (GE)

7. Coordinate and verify environmental requirements per TR with the HVAC Systems Designer
   a. Projected maximum heat load, plus 50% spare capacity
   b. Environmental conditions to be maintained
      1. Temperature range
      2. Humidity range (non-condensing)
      3. Air exchange cycle
      4. Positive air pressure relative to surrounding spaces
   c. Continuous 24/7 operation
   d. N+1 system redundancy

8. Coordinate and verify requirements for floor loading in telecommunications rooms with the Structural Engineer of Record.
   a. Consideration especially given to racks containing substantial UPS gear
   b. Allow for future expansion of UPS systems
1. System capacity
2. System run time

9. Coordinate and verify requirements with the Plumbing Designer
   a. Restrictions on non-TR functions being housed in or routing through TR spaces
   b. Drainage for HVAC condensate and sprinkler systems, where present

10. Coordinate and verify requirements with the Security System Designer
    a. Restrictions on non-TR functions being housed in or routing through TR spaces

11. Coordinate and verify requirements for fire suppression systems in TR spaces with the appropriate MEP Engineer of Record or other design professional, as appropriate.

12. Coordinate and verify requirements for fire stopping of telecommunications pathways with the appropriate MEP Engineer of Record or other design professional, as appropriate.
    a. Fire stopping systems shall provide for ongoing re-entry, to enable altering of pathway contents, and subsequent restoration to required rating.

13. Coordinate and verify with the Architect and systems designers for the following systems (and any others) about restrictions on the placement of any equipment, cabling, or other system components within the secured TR space.
    a. Audio-Visual Systems
    b. Digital Antenna Systems (DAS)
    c. Security Systems
    d. Fire Alarm Systems
    e. Building Management Systems

14. Specify equipment room layouts per TR
    a. Locations of penetrations / emergence of building pathway components
       1. Building entrance ducts
       2. Backbone/riser conduits/sleeves
       3. Horizontal cabling conduits/sleeves (interfacing with cable trays)
       4. Individual outlet conduits for horizontal cabling, where applicable
    b. Equipment rack quantities and placement, showing proper clearances
    c. Cable runway (ladder rack) sizing and placement
    d. Preferred location of SBB/TGB (or PBB/TMGB) – coordinate with Electrical
    e. Preferred location of power panel – coordinate with Electrical

15. Specify backbone cabling system
    a. Quantities, types and characteristics of backbone cabling and terminations
1. Fiber optic
2. Multipair copper
3. Coaxial
   b. Schematic point-to-point termination plan (i.e., riser diagram)

16. Specify horizontal cabling system
   a. Outlet configuration types
   b. Category 6A cable and jack types
   c. Coaxial cable and connector types, where applicable
   d. Horizontal fiber optic cable and connector types, where applicable

17. Provide DD-level detailed cost estimate.

18. Summary of DD Phase Deliverable Documents (at minimum) required of the Telecommunications Designer:
   a. Revised Design Narrative, as applicable
   b. Site Plans (Duct Bank and Outside Plant (OSP) Cabling Plans)
   c. Floor Plans (Data Outlet Location Plans)
   d. Enlarged Plans of Telecommunications Rooms
   e. Building Pathway Plan / Conduit Riser Diagram
   f. Grounding and Bonding for Telecommunications Riser Diagram
   g. Outline Specifications (Division 27)
   h. DD Cost Estimate
C. **Construction Documents (CD) Phase**

1. Specify bidder qualifications.
   a. 5 years of experience with projects of similar scope and magnitude
   b. All activity under purview of RCDD
   c. BICSI-certified technicians
   d. Hubbell Mission Critical certified contractor

2. Specify general scope of work associated with network support to be performed by general construction, trades, and other disciplines, outside of the scope of work of the Communications Contractor.
   a. Site construction
      1. Site routing
      2. Duct bank requirements
      3. Outside plant (OSP) cabling support
   b. TR construction
      1. Adjacency restrictions
      2. Minimum dimensions (not area)
      3. Door positioning
      4. Floor loading
      5. Plywood backboard requirements (all walls)
      6. Power requirements
      7. Lighting requirements
      8. Environmental requirements
      9. Fire protection requirements
      10. Fire stopping requirements
      11. Security requirements
   c. Building pathway/raceway systems (conduits, sleeves, cable trays)
      1. Pathway sizing / fill ratio
      2. Bend radius constraints
      3. Pull box sizing and positioning
      4. Outlet box configurations
      5. Fire stopping requirements
   d. Bonding and grounding for telecommunications
1. Sizing of bonding backbone conductors (TBB, TBC/BCT and BBC/GE)
2. Summary of bonding inclusions (panel ground, building steel, etc.)
3. Bonding methods (bonding lug types, exothermic welds, etc.)
4. Reference to latest revision of ANSI/TIA-607

3. Coordinate and verify all requirements reflected in the Design Development section, above.
   a. Telecommunications room (TR) placement and space characteristics
   b. Telecommunications building pathway/raceway requirements
   c. Electrical requirements per TR
   d. Bonding and grounding requirements for telecommunications, per ANSI/TIA-607
   e. Environmental requirements per TR
   f. Plumbing requirements per TR (condensate drainage, sprinklers, etc., as applicable)
   g. Restrictions on non-TR functions being housed in or routing through TR spaces

4. Provide detailed, enlarged plans (min. scale 1/4" = 1’-0") of each TR showing equipment layouts
   a. Locations of penetrations / emergence of building pathway components
      1. Building entrance ducts
      2. Backbone/riser conduits/sleeves
      3. Horizontal cabling conduits/sleeves (interfacing with cable trays)
      4. Individual outlet conduits for horizontal cabling, where applicable
   b. Equipment rack quantities and placement, labeling proper clearances
   c. Cable runway (ladder rack) sizing and placement
   d. Location of SBB/TGB (or PBB/TMGB), as coordinated with Electrical

5. Provide rack elevation drawings per TR showing all equipment racks and equipment mounting

6. Provide floor plans showing types and locations for all data outlets
   a. Provide TR assignment for each data outlet

7. Provide detailed specifications of equipment room fittings
   a. Equipment racks
   b. Vertical and horizontal cable management
   c. Fiber optic enclosures and copper patch panels
   d. Cable runway (ladder rack), including accessory components
   e. Bonding and grounding components for telecommunications

8. Provide detailed specifications of backbone cabling system

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a. Quantities, types and characteristics of backbone cabling and terminations
   1. Fiber optic
   2. Multipair copper
   3. Coaxial
b. Schematic point-to-point termination plan (i.e., riser diagram)

9. Provide detailed specifications of horizontal cabling system
   a. Outlet configuration types
   b. Category 6A cable and jack types
   c. Coaxial cable and connector types, where applicable
   d. Horizontal fiber optic cable and connector types, where applicable

10. Provide detailed specifications of labeling/identification system, per ANSI/TIA-606
    a. Labeling scheme (nomenclature, etc.)
    b. Label placement
    c. Label and ink types and materials

11. Provide detailed specifications of acceptance testing and commissioning requirements
    a. TIA-compliant parameters, methods and test equipment
    b. Test equipment factory/3rd-party calibration within prior year
    c. Reporting requirements
       1. Parametric test data per link
       2. Test procedures (equipment setups) per test type
       3. Proof of current test equipment calibration


13. Summary of CD Phase Deliverable Documents (at minimum) required of the Telecommunications Designer:
    a. Revised Design Narrative, as applicable
    b. General notes characterizing TR construction (including power, lighting and HVAC requirements), pathway systems (including pull box sizing and placement), grounding and bonding for telecommunications, and structured cabling systems (including routing constraints)
    c. Symbol legend defining counts and types of cables and terminations, back box types, data outlet elevations and other mounting requirements for each outlet type
    d. Site Plans (Duct Bank and Outside Plant (OSP) Cabling Plans)
    e. Floor Plans (Data Outlet Location Plans)
f. Enlarged Plans of Telecommunications Rooms

g. Rack Elevation Diagrams

h. Building Pathway Plan / Conduit Riser Diagram

i. Backbone / Riser Diagram and Termination Details

j. Data Outlet Details

k. Labeling Plan

l. Grounding and Bonding for Telecommunications Riser Diagram

m. Detailed Specifications (Division 27), including acceptance testing criteria

n. CD Cost Estimate
D. Construction Administration (CA) Phase

1. Respond to Requests for Information (RFI) from bidders, as required
2. Attend/host pre-bid conference and walk-through, as required
3. Review and comment on submitted bids for communications scope
   a. Bidder qualifications
   b. Apparent grasp of scope
   c. Pricing
      a. Commitment and ability to meet construction schedule
4. Review contractor submittals
   a. Identity and qualifications of key project personnel
   b. Product data
   c. Shop drawings
5. Attend/host construction meetings and walk-throughs, as required
6. Respond to Requests for Information (RFI) from contractors, as required
7. Conduct field inspections as required to verify scope compliance and workmanship
   a. Issue field reports as required
8. Generate punch lists to guide completion of work
9. Witness system acceptance testing, as required
10. Review test reports submitted by contractor
11. Perform final inspection and commissioning
12. Review close-out submittals from contractor
   a. As-built drawings
   b. Operation and Maintenance Manuals
13. Determine completeness of all communications scope of work
14. Summary of CA Phase Deliverable Documents (at minimum) required of the Telecommunications Designer:
   a. RFI Responses, as required
   b. Submittal Review
   c. Field Reports, as required
   d. Review of Contractor Pay Applications, as required
   e. Punch List(s)
   f. Test Report Reviews
g. Memorandum verifying completion of communications scope
Appendix 2: Submittals & Detailed Drawings

1. Submittal Requirements
The following tables summarize all submittals required for telecommunications infrastructure described in this document.
Submittals shall follow the format requirements described in CIG01.

1.1. Prior to Installation

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<tr>
<th>Section</th>
<th>Description</th>
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<tr>
<td>CIG01 – Communications</td>
<td>RCDD certificates for communication designers. BICSI Technician level certificate and Hubbell MCCI certificates for lead communications installers.</td>
<td>PDF</td>
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<tr>
<td>CIG02 – Testing and Acceptance of Cabling Systems</td>
<td>The test plan.</td>
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<tr>
<td>CIG03 - Grounding and Bonding for Communications Systems</td>
<td>Product data sheets for TMGB and TGB.</td>
<td>PDF</td>
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<tr>
<td>CIG03 - Grounding and Bonding for Communications Systems</td>
<td>Telecommunications grounding riser diagrams.</td>
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<tr>
<td>CIG05 - Hangers and Supports for Communications Systems</td>
<td>Product data sheets for all components used.</td>
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<tr>
<td>CIG05 - Hangers and Supports for Communications Systems</td>
<td>Plan view drawings down to outlet level showing the location of cable pathway segments that utilize hangars and supports and the type.</td>
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<tr>
<td><strong>CIG06</strong> - Conduits and Backboxes for Communications Systems</td>
<td>Plan view drawings showing all horizontal and vertical conduit routing, cable trays, and pull box locations. Conduit runs to individual outlets need not be indicated.</td>
<td>PDF</td>
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<tr>
<td><strong>CIG07</strong> - Cable Trays for Communications Systems</td>
<td>Plan view drawings showing all horizontal and vertical conduit routing, cable trays/baskets, and pull box locations. Conduit runs to individual outlets need not be indicated.</td>
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<tr>
<td><strong>CIG07</strong> - Cable Trays for Communications Systems</td>
<td>Elevation/coordination drawings showing relationship between cable trays, HVAC, fire suppression, etc.</td>
<td>PDF</td>
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| **CIG07** - Cable Trays for Communications Systems | Cable tray product data sheets and supplemental information showing:  
- Type of tray  
- Width, depth, length, thicknesses, and radius of bends (where applicable)  
- Rung spacing  
- Cable-bearing surface dimensions  
- Material construction and finish  
- Accessories | PDF |
<p>| <strong>CIG08</strong> - Power Poles, Floor Boxes, and Poke Throughs for Communications Systems | Prior to procurement and installation, all materials intended to be used in association with power poles, floor boxes, and poke throughs shall be submitted for review and approval by the designer and CommTech Engineering. | PDF |
| <strong>ccCIG08</strong> - Power Poles, Floor Boxes, and Poke Throughs for Communications Systems | Detailed plan and elevation view drawings showing room layout to include power pole, floor box, and poke through location. | PDF |</p>
<table>
<thead>
<tr>
<th>CIG08 - Power Poles, Floor Boxes, and Poke Throughs for Communications Systems</th>
<th>Detailed drawings showing product description and recommended manufacturer installation details to be included.</th>
<th>PDF</th>
</tr>
</thead>
</table>
| CIG09 - Surface Raceways for Communications Systems | Product data sheets showing  
Raceway part numbers with details on size and cable capacity  
Raceway fittings part numbers  
Raceway outlet box part numbers with details on faceplate capacity | PDF |
<p>| CIG10 - Underground Ducts and Raceways for Communications Systems | As per EDS requirements | ----- |
| CIG11 - Rooftop Access for Communication Systems | Elevation drawings showing penetration detail. | PDF |
| CIG11 - Rooftop Access for Communication Systems | Plan view drawings showing penetration detail. | PDF |
| CIG13 - Identification for Communications Systems | Provide a detailed sketch to CommTech Engineering of the faceplate identification and labeling method to be used if it deviates from that described herein. | PDF |
| CIG16 - Communications Cabinets, Racks, Frames, and Enclosures | Detailed rack elevation drawings showing all components. | PDF |
| CIG16 - Communications Cabinets, Racks, Frames, and Enclosures | Plan view room layout drawings showing rack placements. | PDF |
| CIG16 - Communications Cabinets, Racks, Frames, and Enclosures | Product data sheets for all racks, frames, enclosures, and related elements. | PDF |</p>
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| CIG33 – Elevator Telephones | Product data sheets for all proposed instruments and components. | PDF |
| CIG34 – Ring-Down Emergency Telephones | Product data sheets for all proposed instruments and components. | PDF |
| CIG36 – RF Systems | Map showing the location of all proposed devices that emit RF energy, including the latitude and longitude, operating frequency, and power level of each device. | PDF |
| CIG37 – Wi-Fi | Floorplans showing the proposed Wi-Fi access point deployment. The design shall include as much RF-sensitive building detail as possible such as wall/door/ceiling types so that RF propagation can be estimated. | PDF |
| CIG-39 – Auxiliary Networks & Devices | Telecommunications site plan for exterior remote devices including underground pathway, copper, and fiber in PDF and georeferenced AutoCAD formats. | PDF |
### 1.2. After Installation

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<td>CIG-39 – Auxiliary Networks &amp; Devices</td>
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Appendix 3: Pre-Installation Meeting

1. Submittal Requirements

A pre-installation meeting is required between the communications subcontractor and CommTech Engineering to review details of the work and procedural requirements.

The following topics will be covered in this meeting.

- Review the overall installation and review processes, including submittals, State Construction meetings, etc.
- Describe the role of ITS Communication Technologies Engineering and Operations representative.
- Review project responsibilities for ITS and communications contractors.
- Review scope and timetables.
- Review/confirm cable types. (color, CMR/CMP, etc.)
- Review telecom room layout and equipment placement.
- Review testing plan and procedures.
- Review labeling requirements.
- Review general installation practices.
- Review project-specific issues.
B-30 – LANDSCAPE ARCHITECTURE ELEMENTS

B-30.1 – Tree and Plant Protection

A Tree Protection Plan is required for all projects, beginning with the SD phase. This plan is developed by the designer in consultation with UNC Grounds Services University Forester and the University’s Facilities Planning & Design Project Manager. Placement of tree and landscape protection measures, such as fences (plastic or metal), protective mulch, protective fabric, and logging mats, should be indicated, as detailed below.

The Tree Protection plan sheet should include:
1. Tree diameter, canopy edge, species name and location of all trees within the project limits (this should be part of the survey information completed for the project)
2. Understory trees (for example dogwoods and redbuds) with a caliper 2” or greater measure at ground level
3. A symbol should indicate which trees and shrubs are to be removed from the site
4. A list of trees to be removed with a total # of diameter/inches
5. A note on the demolition plans should be provided: When trees and shrubs are removed, care must be taken to protect trees and other landscape elements that are to remain
6. Access routes and limits of excavation for all trenches necessary for installation of underground utility lines
7. The areas designated for project construction staging, parking, material storage, and waste removal
8. Definition of the overall project limits

Tree Loss Replacement Program
Projects that lose trees due to project impacts must pay for the tree loss. The fee for tree loss becomes a part of the UNC Tree Loss Replacement Program. The project will follow the protocol below.
1. Using the project survey, the Project Landscape Architect (LA) or University Arborist if the project doesn’t include a LA is responsible for producing an Existing Condition/Tree Survey/Plan identifying trees to be removed, and a list of those trees identified with species name, caliber (size), and quantities. The LA will also generate a report that lists the species name, caliber (size), quantities, and associated cost per diameter in inches ($200 x diameter inches) per tree, and a total cost. This information can be included on the required tree protection plan.
2. Survey/Plan and report is submitted to UNC Design Project Manager (PM), the report is reviewed and approved by UNC PM, Facilities Planning landscape architect, and UNC Arborist.
3. UNC design PM adds this cost as a line item in their project budget, this line item is not a part of the general contract.
4. Adjustments to tree loss costs: if tree loss changes during design or construction, Project LA will submit changes to UNC Arborist and Construction Manager (CM)/PM, who will in turn review and approve with the Facilities Planning landscape architect.

Requirements for tree protection during the construction project include:
1. The University Forester will identify the critical root zone for trees within the project limits, and any trees outside of the project limits with root zones that may be impacted.
2. Staging areas for the project should be outside of the critical root zone.
3. If staging must be within the critical root zone, the University Forrester will identify how mulch and...
other materials can be used to mitigate damage.

4. Trenches must be designed to avoid encroachment into the critical root zone of trees. In some cases, tunneling may be necessary to avoid damaging tree roots.

5. Severed tree roots over 1” are to be cut clean and covered with topsoil. This note should be included in the tree protection plan.

6. Definition of the areas designated for project construction staging, parking, material storage, and waste removal. Coordinate with the University Forester the following measures to mitigate compaction damage:
   a. Severe compaction zones (any staging within the drip line, travel lanes, vehicle parking in the root zone) - Provide fabric, logging mats and mulch.
   b. Moderate compaction zones (material storage) - Provide fabric and mulch, or mulch only.
   c. No compaction (e.g. trailer location) - No protection required. Indicate trees that require limbing up to avoid damage during construction.

7. Coordination of the following with the University Forester:
   a. Logging mats, fabric, and mulch: installed by Grounds Services. If Grounds Services installs measures, the project will provide funding designated as a separate line item (not a part of the general contract) for material and labor.
   b. Tree protection fencing is to be installed by Contractor. Fences should be checked daily. Locate utilities prior to driving any posts into the ground.

8. The University Forester is available to meet as needed during construction to review any tree issues.

B-30.2 - Landscape Design and Plant Selection

The Designer is responsible for a landscape plan and estimate, as part of basic design services. The UNC-Chapel Hill Grounds Services (Grounds) will review and comment on the plan and estimate. Grounds will provide and install all plant material according to the landscape plan. The designer’s estimate will be used as a reserve in the project budget to cover this work. The cost to install the landscape plan should be held as a separate line item in the overall project budget – this is not part of the general contractor’s contract.

The guidelines for planting are contained in the 2005 Landscape Heritage and Plant Diversity Task Force Report (add link here). The type of plantings may be influenced by the flora in and around the existing area.

In general, landscapes should be self-sustaining, low maintenance, and should support conservation and restoration of biological and water resources, including species diversity and habitat protection, soil stability, fertility, and aeration. Outdoor seating areas are encouraged where possible.

The landscape is a shared space with under and above ground utilities, and stormwater control measures (SCM). While there can be a separate landscape plan for estimating purposes, a landscape plan with all utilities, utility surface features, and SCM’s should be prepared for review.

For plantings in the vicinity of underground utilities, select plant materials appropriate to those locations, that will not be detrimental to the utility or block access to maintenance or control points (valves, meters, manholes, etc.) of utilities.
Preservation of the native flora is encouraged in those areas of campus where mature vegetation stands remain. Native plantings are encouraged where possible. Pollinator-friendly species and edible landscaping are encouraged where appropriate.

Invasive exotics as defined by the UNC Landscape Heritage and Plant Diversity Task Force Report in Appendix XI: https://facilities.unc.edu/master-plan/historical-plans/2008-historic-landscape-master-plan/landscape-heritage-plant-diversity/ are not allowed, except for the historic campus, and even there, they should be closely scrutinized for any potential long-term impacts.

Preferred plant types:

i. Low-maintenance native landscape is preferred over high-maintenance plantings.

ii. Specialized plantings should be limited to designated high profile areas defined during the programming of a particular project.

iii. Grass. If a lawn area is included within the project limits, UNC Grounds will determine, in coordination with the Facilities Planning Landscape Architect and the end users, what type of lawn will be planted.


B-30.3 - Topsoil and Soil Preparation

The designer is responsible for including the following information for topsoil and soil preparation in the plans and/or specifications.

Topsoil is to be provided for in the contract and installed by the contractor prior to the site being turned over to UNC. The Designer shall approve all topsoil prior to installation. The Contractor shall provide soil tests for any topsoil brought onto the site and obtain approval from the University before delivery. The Contractor shall insure that all topsoil is screened so that it contains no material larger than 1.0 inches in diameter or length and shall not contain slag, cinders, stones, lumps of soil, sticks, roots, trash, or other extraneous materials. The Contractor shall insure topsoil is free of plants or plant parts of Bermuda grass, Johnson grass, nut sedge, poison ivy, or other noxious weeds. The Contractor shall insure that topsoil is free of pollutants and toxic contaminants. The Contractor shall provide the source of the topsoil.

Prior to topsoil application, the contractor will scarify the soil areas where topsoil is to be applied to a depth of one foot (1') and remove and haul off all construction debris before spreading the topsoil. No scarification or subsoiling should be done within the dripline of any existing tree. The first 4” of topsoil needs to be mixed into the scarified top layer of existing soil. Continue adding soil in 4” lifts until finish grade is established.

A minimum of four inches (4”) of topsoil is to be applied in all disturbed areas. A minimum of twelve inches (12”) of topsoil is to be applied in all landscape plant bed areas. Exceptional care should be taken when spreading topsoil around trees. Soil around existing trees should not exceed the grade which existed prior to construction.

Grade lawn areas and beds to conform to finish grades and profiles indicated on drawings, assuring uninterrupted drainage pattern, free of hollows and pockets. In areas where subgrade is poorly drained,
provide corrective drainage indicated on drawings. If these measures do not correct drainage notify the Designer for direction prior to furtherwork.

An inspection of the construction site with Grounds, including site stabilization will occur prior to Grounds accepting the site.

Topsoil Mix
Topsoil should be purchased pre-mixed or mixing should be done off site prior to soil testing unless otherwise approved by the project Architect. The mix should be unless otherwise specified:
- 3 parts sandy-loam topsoil with additive required to bring pH to 5.5-6.5 range.
- 1 part composted pine bark organic material

B-30.4 - Site Stabilization at end of Construction
Repair and seed all areas that are disturbed during construction. Till disturbed area to a depth of 6 inches. Incorporate 18-24-12 fertilizer at a rate of 10 lb. per 1000 square feet. Evenly distribute Turf Type Fescue Blend grass and perennial rye seed at a rate of 10 lb. per 1000 square feet. Lightly rake seeded areas, mulch with 1" clean wheat straw, and water thoroughly. Areas that will be converted to plant beds can be stabilized using pine straw or organic mulch.

Clean Up
After the soils have been ripped, and before the required topsoil is spread, and final grades approved, clear the site of all surface trash and other objects that will hinder the installation and maintenance of the planted areas. The clean-up includes plant bed areas, lawn areas, rights-of-way adjacent to the site, buffer areas, and lay down areas.

B-30.5 - Irrigation Systems
Landscape irrigation plans should be designed and installed as part of the construction contract for all areas of lawn and landscape in the project. The irrigation systems should be developed in consultation with the University Grounds Services and must be approved by them. If there are site changes during construction that affect the landscape, Grounds Services should be contacted prior to installation to approve any changes to the irrigation system. The contractor will be responsible for installation of the irrigation system unless otherwise specified by UNC Grounds.

A water source for irrigation of landscape should be identified by UNC early in the design plan process. Coordination with UNC Grounds and Energy Services for water source is required. For water conservation, UNC’s preference is for a non-potable water source where possible.

Potential sources in order of preference:
1. Non-Potable Water (Reclaimed Water or Harvested Rainwater) – Refer to Guidelines Section B-22
2. Groundwater from Existing Well
3. Potable Water – Refer to Guidelines Section B-21
A permanent pop-up landscape irrigation system should be designed and installed as part of the construction contract for all areas of lawn. Drip irrigation may be designed and installed as part of the construction contract for all landscape beds. The irrigation systems should be developed in consultation with the University Grounds Services and must be approved by them. On some projects, Grounds may prefer to install drip irrigation themselves, therefore, the designer should always ask Grounds what they prefer. If there are site changes during construction that affect the landscape, Grounds Services should be contacted prior to installation to approve any changes to the irrigation system.

Below are some general guidelines on irrigation preferences:

- Sprinkler system spray patterns shall be directed away from the building façade and foundation areas (From EHS design for Indoor Air Quality).
- Spray irrigation must also be directed away from sidewalks, roads, and other impervious area. For systems using reclaimed water, see Guidelines Section B-22 for additional information on spray pattern requirements.
- Systems shall be designed for future conversion to non-potable water (reclaimed water or harvested rainwater) by using purple-colored pipes, valve boxes, etc., with labeling as defined in the Non-Potable Water Guidelines. For specifics on labeling, materials, and color-coding, see the UNC Non-Potable Water Guidelines (Section B-22).
- Irrigation systems must have a separate meter and backflow preventer. They may not be connected to building domestic meters.
- Toro brand irrigation should be included as a preferred alternate. UNC Grounds can provide additional information on system requirements.
- A smart irrigation controller should be a part of the irrigation system.
- All irrigation systems shall be turned over to UNC Grounds with appropriate training and manuals. Irrigation systems using non-potable water (reclaimed water or harvested rainwater) shall include Energy Services and EHS in the turnover process, as specified in the UNC Non-Potable Water Guidelines (Section B-22).
B-40 – SITE HARDSCAPE

Hardscape consists of sidewalks, exterior stairs and ramps, plazas, and service areas. These improvements are included in the contractor’s scope and will be installed by the project.

B-40.1 - Sidewalks

New sidewalks should be carefully planned to connect major destinations and offer pedestrians a safe, accessible, and relatively direct means of travel. The campus goal is to achieve a universally accessible campus using Universal Design principles that create walkways usable by all people to the greatest extent possible. This includes avoiding steps and features hazardous to the visually impaired. Give special consideration to locations where pedestrian pathways cross vehicular routes. New pavements materials should match existing.

Maintain consistent walk widths across the campus where possible. Standard widths are:

1. Major pedestrian corridors: 16 feet wide
2. Major pedestrian walks: 8-14 feet wide
3. Minimum walk width throughout campus: 8 feet wide

The Designer is expected to provide a design that will comply with the current versions of the North Carolina State Building Code and the Americans with Disabilities Act (ADA). The University requires some elements that exceed these codes and standards. They are listed below.

Path of Travel/Curb Cuts/Ramps

a. Exterior walkways should not exceed a slope of 1:20 in the direction of travel. If this cannot be achieved because of site topography, then a ramp may be used. Use of ramps should be kept to a minimum. Construction tolerances shall be considered in the design of sloped surfaces to ensure they do not exceed the maximum allowed.

b. Curb Cuts shall be concrete contrasting in color to the adjacent walkway and shall have detectable warnings in the lower 2’-0” for the width of the ramp portion. All curb cuts shall be in the direction of travel. Diagonal curb cuts at intersections should not be used.

c. Exterior stairs shall be kept to a minimum. They shall be concrete or approved material of contrasting color from the adjacent walkway. A step with a single riser shall not be used. All stairs shall have handrails on both sides.

Brick pavement

Red-flashed full range running bond brick pavement is the preferred pavement for campus walks. The typical running bond pattern runs perpendicular to the path of travel. This includes all paved areas. Brick is a local, sustainable material more easily replaced than any other pavement material.

Maintenance of pavement is a primary consideration in the material chosen, as the maintenance capability of the campus is limited. The ability to match materials throughout the life of the pavement is also a primary consideration. Historically, in areas where brick was not used, there are significant problems with the maintenance and repair to these areas. Brick walks should be dry-laid. Construct brick walks, which provide service or emergency vehicle access on a concrete base.
Brick walk detail including edge brick at lawn and landscape beds:

**Diagram Description**

- **RUNNING BOND BRICK, TYP.**
- **UNO OH CAMPUS STANDARD**
- **POLY FABRIC SAND**
- **SETTING BED**
- **BRICK STRETCHER**
- **COLLAGE ALONG EDGE, TYP.**
- **FILTER FABRIC**
- **CONCRETE FOOTING**
- **COMPACTED NAC**
- **COMPACTED SUBGRADE**

**Legend**

- **SAND SWEEP JOINTS, TYP.**
- **BRICK MAHDER SLITTED TIGHTLY TOGETHER**
- **CONCRETE FOOTING FOR STRETCHER COURSE (BELOW GRADE)**
- **BORDERS WITH MORTARED JOINTS**
- **BORDER STRETCHER EDGE CONDITION**

**Scale:** 1" = 1'-0"
B-40.2 - Exterior Stairs

Stairs should meet both NC Building Code and ADA requirements. Stair riser material used should provide a 70% visual contrast to paved areas immediately adjacent. Concrete is the preferred material for steps immediately adjacent to brick paths. Other steps materials that may be considered include: bluestone, granite, limestone.

The maintenance of the step material and the ability to patch/repair the material should be considered. Steps should meet all ADA requirements in all locations.

Provide railings and guards at stairwells, steps, loading docks and ramps. Treads and landings are to have positive drainage away from the building. Step groupings of less than 2 risers should not be used.

B-40.3 - Exterior Ramps

Exterior walkways should not exceed a slope of 1:20 in the direction of travel. If this cannot be achieved because of site topography, then a ramp shall be used. Use of ramps should be kept to a minimum. Ramps should meet both NC Building Code and ADA requirements.

Ramps and walking surfaces shall be designed to the following maximum slopes to allow for construction tolerances:

1. Ramp running slope = 7.5% maximum.
2. Walking surfaces running slope = 4.5% maximum.
3. Cross slopes for ramps and walking surfaces = 1.5% maximum.
4. Landings at ramps, stairs, and doors = 1.5% maximum in any direction.

B-40.4 - Plazas

Plazas promote outdoor gatherings of the campus community and are desirable elements where feasible.

Plazas should be ADA accessible, and accommodate programming coordinated with the associated department or community for which they will be built. Tenting as well as seating is often a desired program element.

Plazas at UNC are assumed to be paved. The pavement material is typically brick. Design standards for the creation or adaption of an existing plaza depend upon the programming for the space, consult with the University Architect and the Facilities Planning and Design.
B-40.5 – Building Entries & Access Points

Service Areas
Service areas should be screened. Requirements for service areas are found on the UNC Office of Waste Reduction and Recycling (OWRR) website: https://facilities.unc.edu/wp-content/uploads/sites/256/2016/03/OWRR-Design-Guidelines.pdf

Service driveways can serve as vehicular, bicycle, and pedestrian circulation, as well as access to service and service areas for buildings. In areas where the drives serve multiple transportation modes, there is a preference for use of brick as the pavement type. Examples of this include the brick paved driveways between Davie Hall and the Coker Arboretum, and between Hanes Art Center and Kenan Music Building. The brick pavers must be heavy duty brick pavement with adequate paver support beneath.

Vehicular service area (solid waste collection) interior pavement may be asphalt and/or concrete. If brick is to be used, it must meet weight loads required for the area. The pads for dumpster location must be concrete.

Primary Building Entrances
While the preference is for running bond brick pavement, other brick pavement patterns, or other pavement materials may be considered to assist in denoting primary building entrances. Other materials that can be considered include: concrete with special finishes, bluestone, and limestone. Please note that repair and maintenance must be taken into consideration. Pavements other than brick are difficult to match over time, and for this reason, we strongly prefer brick.

Pedestrian Safety
The Design of campus facilities should optimize opportunities for pedestrians, cyclists, and motorists to travel safely. Safe travel for all modes of transportation should be created and maintained at all times, especially during construction. Pedestrian safety planning shall be part of all University construction projects.

The Department of Public Safety and Facilities Planning will review, comment, and approve all pedestrian plans during all phases of a project. The University Pedestrian Safety Committee will also review all plans that affect pedestrian routes where they meet roadways.

Pedestrian safety planning must be part of all University construction projects. Design of campus facilities should optimize opportunities for pedestrians, cyclists, and motorists to behave safely. Safe travel ways for all modes of transportation should be created and maintained at all times, especially during construction.
B-41 - SITE FURNISHINGS

Site Furnishings include campus benches, bollards, waste/recycling receptacles, bus shelters, bike racks, and railing and guardrails.

B-41.1 - Campus Benches

Bench Locations
Approved benches may be placed on campus through donations to the campus development office or by specific landscape/building projects. The benches can be placed singly or in a group. The proposed locations are coordinated with the Facilities Planning & Design landscape architect, and then approved by the Chancellor’s Buildings & Grounds Committee. The benches are 5 feet in length, the material is teak. The approved standard bench is a Hyde Park, Kingsley Bates bench, or equivalent (including material and weight). The bench(es) must be ADA accessible. A memorial/honorary plaque is installed with the donor benches, the plaque language and installation are coordinated by Facilities Planning & Design.

Donor Benches
A donor bench will be maintained by Facilities Services for a time frame of 10 years. A bench installed by a building or landscape project must be maintained by the department responsible for its installation.

The benches may be installed through the building/landscape project, or through a work order placed with the small construction shops. Examples of benches are shown below.
B-41.2 - Bollards

Campus bollards are required wherever there is a need to limit or prohibit vehicular circulation in specific areas. These areas are to be determined in coordination with Facilities Planning & Design, Transportation & Parking, and the Environment Health and Safety Fire Marshall.

Metal Bollards

Below are details of typical metal bollards, fixed and removable, used throughout campus. This bollard can be fabricated by the UNC Shops. Other specialty metal bollards, including a type of “lay-down” bollard may be approved in coordination with the departments described above.

Bollards should have a minimum 48” separation from each other or other obstacles. The maximum distance between bollards is typically 5’. Distances between bollards may be reviewed individually for unique circumstances.
Stone Bollards

Stone bollards are a specialty type bollard that are typically an integral part of our pedestrian safety zone, which is a planted buffer between the back of curb and public sidewalk area. The stone for these bollards has the same requirements as our campus stone walls in stone type, color, and size. The use of these bollards is reviewed by the Facilities Planning Landscape Architect and Transportation and Parking. Where they occur in or near the public right-of-way, the NC Department of Transportation and the Town of Chapel may also require a review.
B-41.3 - Exterior Recycle/Waste Receptacles

Recycle/Waste receptacles are coordinated through the UNC Office of Waste Reduction and Recycling (OWRR) and Grounds Services. The need for Recycle/Waste receptacles will be determined with each individual project. The Facilities Planning Project Manager will assist in the coordination with OWRR and UNC Grounds Services.

Information on UNC’s recycling programs and detailed information about planning needs for these programs is found in the Walkway Sites section of the Site and Space Planning portion of the OWRR design Guidelines. For information about the recycling and waste collection needs based on building use, see Needs Based on Building Use within the Site and Space Planning section of the website:

B-41.4 - Bus Shelters

Bus shelters are a part of our campus street furnishings, but the shelter design and location of shelters around the perimeter of the campus is typically determined by the Town of Chapel Hill, in coordination with UNC Transportation & Parking and Facilities Planning & Design. The design and location of Shelters internal to campus locations will be reviewed and approved by the Facilities Planning and Design and UNC Transportation & Parking.

Bus Stops/Shelters within the historic portion of campus (the area between South Road and Franklin St.) will be reviewed and approved by the University Architect and Facilities Planning & Design.
B-41.5 - Bicycle Racks

Include bicycle parking racks and parking surface in the bid documents and consider as part of the construction costs.

Bicycle parking racks should be installed on a paved surface. Brick pavers are the preferred material. The number and site of bicycle racks is determined in joint consultation with the Department of Transportation and Parking and the Facilities Planning Project Manager and Landscape Architect. Bicycle parking sites shall be considered at the schematic design phase and final site locations indicated in the final construction documents. When siting bicycle racks choose locations that are accessible by bicycle; avoid paths with outdoor stairways. Locate each bicycle rack site as close as possible to the perceived destination of the bicyclist (doorways, entranceways, etc.) To afford protection from the elements, use building overhangs and other sheltered locations for bicycle racks when possible. Include street curb cuts and ramps for bicycle riding access to buildings and structures.

Image of the approved standard for bike racks, which is the U-shaped rack.
B-41.6 - Railings and Guardrails

All Railings and Guardrails on the University campus are required to meet the current versions of the NC Building Code and ADA accessibility standards.

The standard approved site railings are a “Julius Bloom & Co. style” handrail and a standard steel pipe rail, both painted a glossy black. The style # for the Julius Bloom is #4429.

Railings and Guardrails within the historic area of campus associated with buildings should be either the Julius Bloom style or metal pipe painted black, unless otherwise determined by the University Architect.

In areas other than the historic campus, railings and guardrails attached to the building may be of a material and style determined by the University Architect and the Facilities Planning Project Manager. Railings in the community space will be either the Julius Bloom style railing painted black, or a steel pipe rail painted black.
B-42 - Site Walls

B-42.1 – Seat Walls

Materials for Site Walls on the UNC Chapel Hill campus are typically stone or brick, depending upon the wall height.

Stone Walls
The low stone walls are much loved and ubiquitous throughout campus and the surrounding community. The original granite stone walls were built of “found” stones (not quarried) harvested locally, walls were piles of stacked stone with minimal chinking stones, and without mortar. Over time, more modern walls were built, using 2 parallel stacks of stones, creating a cavity in the middle filled with a variety of materials including left over granite of varying sizes, and leftover mortar. The footings consist of a leveling course of stone, or sometimes the bottom stone is simply partially buried. The chinking stones fit into the mortar and are more for appearances than holding an adjacent stone in place. Mortar is also applied in-between the stones on the top and sides.

More modern walls, particularly when they are retaining walls, are typically built as concrete-block stone veneer walls, with quarried stone from local vendors. Stone walls should not exceed 30” in height without the facilities planning university architect and facilities planning landscape architect approval. The walls can, in some cases, follow the grade of the existing topography, or be “flat”. This should be determined by a proposal from the project landscape architect, to be reviewed and approved by the university architect and facilities planning landscape architect.

Context
In general, walls within the “community space” (ie: not directly attached to the building) should be stone walls. Walls associated with a building can be of Chatham stone, but they can also be of materials associated with the building. A discussion of the preferred material with the university architect and the facilities planning landscape architect is required.

Material
The preference is for the traditional local granite, commonly referred to as “Chatham” stone. However, this material is increasing difficult to source. When the local granite is not available, quarried stone is acceptable, so long as the wall is similar to the solid granite stone walls in size, color, and arrangement of stone. There are local vendors who make a mix of quarried stone for this purpose, and these are generally acceptable. The designer should obtain samples of the complete range of the stone colors to be used for approval by the facilities planning landscape architect.

Structure
Freestanding low stone walls of the original Chatham stone that do not exceed 30” in height may be built as the “modern” solid stone walls described above. Footings are not required, a leveling course slightly below grade is typical. If Chatham stone is not available, a veneer wall may be acceptable, depending upon the context within which the wall is built (for example if the new wall is built in an area of existing solid stone walls, more effort to source Chatham stone is expected).
B-42.1 – Retaining Walls

Retaining walls must meet modern structural standards and typically result in a veneer wall. There are battered walls that may meet structural standards but would be an exception requiring approval by the Facilities Planning Landscape Architect and the Structural Engineer.

Height and overall size
Stone walls should not exceed 30” in height unless approved by the university architect and the facilities planning landscape architect. The minimum wall width is 24”. This allows for an 8” concrete block core with 8” veneers. Traditional solid stone walls can be 30” wide, and where appropriate, a new wall should match the width of the existing walls in the area.

Details of free-standing type and retaining type stone wall
Other Walls
Walls exceeding 30” in height, or walls associated with a building or other specialized built exterior area, may be built of other materials. Acceptable materials include: brick, bluestone, limestone, concrete, or other types of stone. The walls must meet modern structural standards, fit in with the surrounding environment, and be maintainable by campus facilities. These walls will be approved by the university architect and the Facilities Planning Landscape Architect.
B-42.3 - Screen Walls

Screen walls are typically required to enclose utility and service areas where feasible. The typical screen wall is brick, of the same or compatible brick color range/type as an adjacent building. The design of the wall(s) should reflect the context of the area.

For both types of uses, clearances and access to utilities and/or solid waste containers, walk-in recycle containers, and any other items within the enclosure must be included. The Facilities Planning Manager, FPD Landscape Architect, and Designer will coordinate the design and clearances with the appropriate end users (typically Office of Waste Reduction and Recycling and Housekeeping).

Screened enclosures
Where utilities are located, a 3-sided wall is typical as shown below. Where solid waste disposal containers and walk-in recycle containers are located, gates may be appropriate. Gates can be considered on a case-by-case basis, to be coordinated with OWRR, Facilities Planning, and Housekeeping. A separate pedestrian access without gates may also be required.

The pictures above show an example of a 3-sided screen wall located at Hamilton Hall. The fourth side is open for access to utilities.
B-44 - EXTERIOR SIGNS

In keeping with other site elements throughout our campus landscapes, the University desires consistent design for our exterior signs.

**Building Identification & Address Signs**
These are free-standing signs to identify the name of the building. Facilities Planning and Design reviews and approves these signs. If the signs include special elements not within the sign guidelines, review by Facilities Planning and approval by the Chancellors Buildings and Grounds Committee is required. If a project replaces or proposes a new sign for the building, the project is responsible for cost of installation. The UNC sign shops designs, fabricates, and installs the signs. Link to information about building identification signs: [https://facilities.unc.edu/resources/design-guidelines/signs/](https://facilities.unc.edu/resources/design-guidelines/signs/)

In addition, the location for and size, font, color & material of Building Address Signs shall be coordinated through Facilities Planning.

**Wayfinding Signs**
UNC-CH does not have a wayfinding sign system, although there is some provisions for way-finding to be found in the link: [https://facilities.unc.edu/resources/design-guidelines/signs/](https://facilities.unc.edu/resources/design-guidelines/signs/) For special conditions reviewed by Facilities Planning & Design and approved by the Chancellor’s Buildings and Grounds Committee, some way-finding signs can be designed and created for specific locations.

**Parking Lot/Decks Signs**
UNC Transportation and Safety creates and maintains signs to identify and establish rules for each parking lot/parking deck. The signs’ designs are coordinated through Transportation & Parking, and fabricated and installed by the UNC sign shop.

**Construction Signs**
Signs to identify and give information about construction projects are required with each construction project; and are a part of the pedestrian detour plan for the project. The location and information on the signs should be reviewed and approved by the Facilities Planning and Design Dept. project manager. Design for this type of sign is typically coordinated by the Project Manager with fabrication by the general contractor or a third party.

Example:


**Building & Street Banners**

Building Banners may not be used in lieu of the permanent signage described in this policy. Note: Student and Commercial signage policy is described by the Facilities Use Policy of the University.

A Department in a building facing onto a street may install Street Banners on utility poles bordering the building. The Department is responsible for the content, Maintenance, any timely removal of the banners. All such installations require the permission of the pole owner. Note: Student and Commercial signage policy is described by the Facilities Use Policy of the University.

**Temporary Signs**

Policies for the use of temporary signs are found under the Facilities Use Standard at:

https://unc.policystat.com/policy/7057463/latest/

**Accessibility Standards for Signage**

The University Office of Accessibility Resource Services https://ars.unc.edu/ provides guidance on standards for exterior and interior signage. Designers shall coordinate all proposed signs with the Project Manager and Facilities Planning & Design ahead of any fabrication.

**Plaques**

The policy on Permanent Markers on Campus can be found at:

https://policies.unc.edu/TDClient/2833/Portal/KB/ArticleDet?ID=132154

The markers or plaques are coordinated and reviewed by Facilities Planning & Design (University Architect, ADA Manager, Landscape Architect) prior to submittal to the Chancellor’s Buildings and Grounds Committees for material, size, and placement.
B-45 - PUBLIC ART

General
The University is in the process of implementing a public art program, “Arts Everywhere,” to become a model both within the state and among public universities nationwide. Arts Everywhere envisions a program that includes public works of temporary and permanent art and art activities throughout campus. The intent is for the campus to become a museum without walls, making art an integral part of the University, and a vital and indispensable part of the campus community.

All permanent exterior art will be reviewed and approved through the Campus Arts Advisory Committee (CAAC). All exterior art from a technical aspect will be considered for accessibility, integration with the existing campus landscape, signage, impacts on existing utilities, and maintainability. It will be coordinated through Facilities Planning & Design and the University Architect, Facilities Engineering, Facilities Construction, Grounds Services, Energy Services (utilities), and Environment Health & Safety.

All temporary exterior art will be reviewed from the technical aspect as above; but approved via the Arts Everywhere Initiative.

Exterior art sited in or acquired by the Ackland Art Museum or Alumni Sculpture Garden, or to any work of art acquired by any unit of the University for display within a building assigned wholly or in part to that unit for its use, does not require CAAC approval. However, it should be coordinated from a technical aspect as described above.

Campus Arts Advisory Committee
The campus arts advisory committee (CAAC) is an advisory committee to the Chancellor’s Buildings & Grounds Committee. The Advisory Committee shall advise the Chancellor (via the Chancellor’s Buildings & Grounds Committee) on: (1) the appropriateness for acceptance or acquisition for permanent or long-term display by the University of each proposed new work of public art, and (2) matters related to the University’s existing collection of public art, including its maintenance, relocation, and deaccession or decommissioning. The Advisory Committee shall advise the Buildings and Grounds Committee with respect to the location of works of public art. The Advisory Committee shall provide advice on such other matters related to public art as may be referred to the committee by the Chancellor or the Buildings and Grounds Committee.

Facilities Planning and & Design will participate in a review and approval of the art prior to and concurrent with the CAAC. They may also play a coordination role in this review. The University Architect and Facilities Planning Landscape Architect are ex-officio members of the CAAC.
B-50 - EXTERIOR LIGHTING

General Information
Exterior Lighting for capital projects on campus is coordinated with the Facilities Planning Project Manager and the Landscape Architect during the initial phases of the design process. This includes all free standing, pole mounted, and building façade mounted lighting applications.

All new and replacement of existing exterior lighting will meet the standards and specifications of UNC Electrical Distribution System (EDS), a Department of UNC Energy Services.

Link to EDS information follows:

Exterior Lighting requirements are found on pages 24-42
Blue Light Emergency Phones

Blue Light Emergency Phones are strategically located throughout the campus. Each design project is obligated to review the need for a blue light emergency call phone in coordination with the UNC Police Department.

Once the scope of the design project is defined, the project manager submits a map of the area, with existing blue light emergency phone locations shown, to UNC Police for evaluation of the need for additional phones. If it is determined that a phone is required, the location should be shown on the design plans. The project is responsible for design and installation costs.

Determining Locations

The need and proposed locations for Blue Light Emergency Phones (Call Box) determination will be made jointly by representatives from the UNC-CH Police Department, UNC-CH Energy Services, UNC-CH Information Technology Services (ITS), and various UNC-CH Project Managers associated with construction projects. The following procedures will be used to determine placement of call boxes:

1. CSU Sergeant (or his/her designee), the UNC-CH Project Manager, and the UNC-CH Department of Transportation and Parking (T&P) Construction Liaison survey the lot to determine the best location for the call box or boxes.
2. UNC-CH Project Manager contacts UNC-CH Facilities Planning and Design (Planning) and ITS about installation of the station(s).
3. UNC-CH Project Manager works with UNC-CH Energy Services and ITS to have the station(s) ordered and installed.
4. UNC-CH Project Manager works with UNC-CH Planning to ensure the station(s) are ADA compliant.
5. UNC-CH Project Manager works with the applicable UNC-CH Facilities Services shop(s) to have call box(es) installed.
6. UNC-CH Project Manager, T&P Construction Liaison, and CSU Sergeant (or his/her designee) check the call box(es) to ensure it is operational.

Examples of existing Blue Light Emergency Phones (Call Box)
C-01 – ARCHITECTURE

Space Planning Standards and Processes

In 1998 The University retained Eva Klein & Associates to provide space planning programming/design standards for the University buildings: University of North Carolina at Chapel Hill Space Planning Standards including offices, office support, classrooms, and equipment requirements.

The University continues to adapt its space planning guidelines and area standards to meet the needs of an ever-changing campus and evolving user group needs. Design Teams should expect to coordinate with Facilities Planning and Design for current standards in response to current events and changing needs.

Space Planning Standards

Housekeeping

1. Housekeeping/Janitor Closets
   i. One basic custodial closet should service every 6,000 square feet of usable building floor space (or portion thereof), with at least one custodial closet per floor. The closet should have room to store the wastebasket (24"x 36" or larger), mop, wringer, and supplies without lifting items to store them in the sink. Housekeeping sinks should be of the built into the floor type, with a low wall surrounding a drain to reduce lifting. Water Requirement: There should be hot and cold water in each Housekeeping closet that has a sink.
   ii. Closets should be spaced throughout the building to avoid moving cleaning equipment long distances. The minimum size for each closet is 36 net square feet. Closets and the other custodial and equipment storage areas are best located close to the building elevator. All closets should have door(s) with minimum 42-inch clear opening.
   iii. This space is for the exclusive use of custodial staff; it must not house plumbing, mechanical or electrical equipment.

2. Corridors/Stairwells
   i. Corridors should be equipped with electrical outlets at least every 40 feet. The outlets should be dedicated.
   ii. Housekeeping Services require electric outlets in each stairwell. They should be on the landing on at least every other floor.

Toilet Rooms, Bathrooms and Accessories

a. Toilet rooms shall not have vestibules.

b. Toilet rooms with more than 10 fixtures (water closets and urinals) should have a cased opening entrance without doors into the toilet room unless it is off an area where a door is desired (i.e. a waiting, reception or seating area).

c. Accessible toilet stalls should have a turning space within the stall as defined by the NCBC, (a 60” clear diameter circle).

d. The accessible paper towel dispenser shall be adjacent to the accessible lavatories.

e. If only one urinal is provided, it shall be accessible.
Gender Neutral Toilet Rooms

In new buildings and major building renovations that include toilet rooms at least one Equal Access Toilet Room shall be provided. This shall be a single use toilet room with a lockable door that includes the following features:

a. Compliant with the current ADAAG and NCBC for a single accessible toilet room
b. Signage shall read “Toilet Room” or “Unisex Toilet Room”

Lactation Rooms

Provide diaper changing and lactation areas within these restrooms in buildings such as libraries, museums, performing arts buildings and other location where they are most likely to be in demand. Verify with the Facilities Planning Project Manager if this is to be included in the project. In addition to the above also provide:

a. A fixed built-in diaper changing table / countertop separate from the lavatory.

b. An electrical outlet adjacent to the diaper changing table between 32” and 42” AFF. It shall be out of reach of a child on the table but within 36” of the surface

c. An area for a large chair for nursing mothers

d. Provide signage indicating additional uses

Electrical Closets

The size and locations of electrical closets for electrical distribution and security systems will be determined in the SD submittal. Where building does not allow flush panels in corridors, electrical closets will provide space for at least one future lighting and appliance sub-panel. Plans will identify floor space for future panel. The main electrical room is to be located on the building perimeter.

Campus Mail

A central mail exchange point shall be located in each facility on the main or ground floor, or in a location conveniently accessible to those who receive mail. The Designer shall meet with the manager of University Mail Services to program the need of each facility.

Space Planning for Recycling and Solid Waste Management

Designers are required to work with the University Office of Waste Reduction and Recycling to develop convenient spaces for waste handling containers and service access. The University is mandated by the “North Carolina Solid Waste Management Act of 1989” and North Carolina Executive Order 156 on State Government Environmental Sustainability, Reduction of Solid Waste, and Procurement of Environmentally Preferable Products to establish recycling programs and meet waste reduction goals.

Executive Order 156:
http://www.p2pays.org/ref/03/02221.pdf

As set forth in North Carolina General Statute 130A-309.14 all state agencies shall ensure that employees have access to containers for recycling (at a minimum) aluminum cans, high-grade office paper, and corrugated cardboard. All state employees are required to separate identified recyclables materials generated in the course of agency operations and place them in the appropriate recycling containers.

North Carolina General Statute 130A-309.14:
Recycling

Design considerations for waste and recycling containers must be based on the building’s usage and occupancy. In addition to indoor recycling, a building must, at a minimum, have access to a dumpster for trash, one for cardboard and outdoor recycling carts.

When the building contains food service operations, containers and exterior space must be allocated for grease collection and food waste recycling. Animal labs and quarters require exterior space for the collection of animal bedding for composting. Theatres, art studios, and maintenance shops often produce bulky waste that cannot be collected in front load dumpsters. Any building containing offices must have loading dock or service area access for paper collection. Residence Halls require extra refuse and recycling containers.

UNC-Chapel Hill collects the following materials for recycling:

3. Animal Bedding—Collected on the interior by the animal lab staff, and then stored outside for pickup
4. Bottles & Cans—Collected throughout the building on a space usage basis and in outdoor carts (especially in high volume areas like residence halls, catering areas, dining halls, etc.)
5. Cardboard—Housekeeping brings flattened boxes out of the building to dumpsters outside
6. Food Waste—Collected at kitchen areas inside and then stored outside for pick up
7. Grease—Collected at dining facilities and picked up by outside contractors
8. Mixed Paper, Newspaper & Magazines—Collected throughout the building on a space usage basis and in outdoor carts (especially in high volume areas such as residence halls, libraries, etc.)
9. Office Paper—Collected throughout the building on a space usage basis
10. Scrap Metal—Collected at shops and taken to county or in-house facilities
11. Clean Wood Waste—Collected at shops and taken to county or in-house facilities

For a list of UNC-Chapel Hill’s recycling programs and detailed information about planning needs for these programs, see the Site and Space Planning section of the OWRR design guidelines: [http://facilities.unc.edu/design-guidelines/waste-reduction/](http://facilities.unc.edu/design-guidelines/waste-reduction/). For more information about the recycling and waste collection needs based on building use, please see Needs Based on Building Use within the Site and Space Planning section of the website.
C-03 – EXTERIOR WALLS & BUILDING ENVELOPE

Windows
Acceptable window frames are painted or clad wood frames, or metal frames as project archetypes and aesthetics may require. Frame colors should be compatible with the building exterior and approved by the Project Manager and University Architect. Operable windows are encouraged. Windows on residence halls and other buildings may require security screens to discourage unauthorized entry.

Exterior Painting
The University must approve all exterior building colors. Design Teams shall coordinate the review of materials samples and mock-up panels and assemblies with the University Architect.

Exterior fixtures and equipment, such as lampposts, bicycle racks, railings, bollards, posts, barriers, drinking fountains, street signs, and trash receptacles should be painted in accordance with the University’s current standard color scheme.

Selection of Brick or Cast Panel for Exterior Walls
Designers shall present sample panels from Masonry and Brick Manufacturers to the University Architect for their selection from which sample panel patterns are to be erected or shown on the job site, after consultation with the Facilities Planning Department. The Construction Management Department will notify the architect’s representative where to locate these panels.

The Chancellor’s Buildings and Grounds Committee will review these panels and make the selection. At the time the brick panels are viewed by the committee, the contractor shall also have available samples of all significant exterior materials, including but not limited to pre-cast stone or limestone, window and door frames, glass and metal panels. The Construction Management Office will notify the designer of the final selection. In the case of cast stone panels, small samples may be submitted for selection purposes.

Completed panels must cure for at least three weeks before they are reviewed by the Chancellor’s Buildings and Grounds Committee. In addition, three weeks are required to schedule this review. Therefore, the panels must be completed by the contractor a minimum of six weeks before the brick selection is needed.

Masonry

1. Masonry Removals, Repair, and Reuse
In renovation projects, and for additions to existing brick buildings, carefully remove bricks in order to re-use the same units whenever possible. When replacement with new brick is necessary, the brick must match the existing masonry units. Masonry pavers, especially with renovation projects should be reused whenever possible to match existing adjacent pavers.

Perform masonry joint repairs for historic buildings in accordance with the best standards of the trade and with careful attention to specify proper mortar mix and color range.
For all historic structures, mortar joint profiles and mortar colors are critical and must be specifically approved by the University. Do not use Portland cement in making such repairs since the resulting strength of the mortar may exceed the strength of the brick.

Unit Masonry

1. **Sample Panels**
The Contractor shall prepare sample panels of all proposed exterior materials. The Designer shall recommend samples for the University's approval. Present all exterior samples for approval at the same time. Mark the approved panels and maintain until completion of the building for comparison with actual construction.

2. **Walls for Animal Quarters**
   a. All walls for animal care facilities shall have a medium dusting of boric acid powder put into the walls for pest control purposes immediately prior to sealing of walls.
   b. Completely seal all openings for piping, conduit, etc., on both sides of block wall.
   c. Seal all wall mounted fixtures such as cabinets, towel dispensers, etc., by caulking to prevent pest harborage.
   d. New Exterior, Load Bearing, Below Grade or Retaining Walls
   e. For exterior walls, load bearing walls, below grade walls or retaining walls, fully grout all cells.

Masonry Cleaning

Exercise caution to keep the masonry and adjacent surfaces clean during the erection of masonry. Clean wall surfaces as the work progresses, and to the extent practical, clean masonry on the same day in which it is laid. Rub excess mortar off the wall face when the mortar is sufficiently dry so that it will not smear and form a scum on the face of the masonry.

Clean brick or stone masonry with water and brushes with nonmetal bristles. Diluted detergents may be used if the water is containerized and pumped to the sanitary sewer. Repeated washings are preferred to fewer washings that are too abrasive or chemically laden. Acid content in washing solutions is forbidden. The Designer and Contractor are to make every effort to prevent infiltration of cleaning water into the storm sewer system during masonry cleaning. This is especially the case when very old masonry units or mortar joints are involved.

1. **Sandblasting of masonry is absolutely prohibited**
The Designer shall make every effort to specify "low salt" mortar and to assure that the best workmanship standard of the trade is used to prevent efflorescence. It is the responsibility of the Contractor to remove efflorescence and to correct the work as necessary to avoid further efflorescence.

The use of water-repellent masonry coatings is generally discouraged because of the on-going maintenance. This is particularly a problem with the high moisture content of walls in historic structures.
C-05 - PERMANENT FALL PROTECTION

Summary
This guideline sets a framework for establishing permanent fall protection systems on the facilities at the University of North Carolina at Chapel Hill (UNC). The intent of this document is to prevent exposure to fall hazards where possible and to protect personnel that are exposed to fall hazards at UNC.

Permanent fall prevention/protection measures must be included as an integral part of the design phase for all new construction projects and roof renovation/repair projects at UNC. All walking/working surfaces where employees are exposed to fall hazards (i.e. roof systems and floor openings) shall be permanently guarded or have qualified anchorages for personal fall arrest systems. Buildings that utilize powered platforms for exterior maintenance shall be provided with qualified anchorages and tie-in guides as necessary.

Governing Regulations

The American National Standards Institute (ANSI) has set voluntary consensus standards for personal fall arrest systems, subsystems, and components which supplement the above referenced regulations (ANSI Z359.1-1992 (R1999)). The scope of this ANSI standard establishes requirements for manufacturer’s design, performance, testing, and qualifications of personal fall arrest equipment. The standard also addresses requirements for user training, inspection, maintenance, and use of equipment used for personal fall arrest equipment.

In addition, ANSI and the International Window Cleaners Association (IWCA) have developed a standard governing safe window cleaning operations (IWCA I-14.1-2001).

It is important to note that compliance with ANSI/IWCA standard does not ensure compliance with the above referenced OSHA standards and vice versa.

Design Requirements
All new construction projects and renovations, alterations, or repairs to existing roof systems or roof mounted equipment must comply with the above regulations, as well as any applicable building codes. In addition, any installations or renovations of equipment that would subject personnel to fall hazards must incorporate fall protection solutions into the project design phase.

A qualified person with extensive experience in fall protection is required to plan, evaluate, design, and select the most appropriate fall prevention/protection solution. Building anchorages, tie-downs, and any other affected parts of the building shall be designed and certified by a registered Professional Engineer (PE) currently registered in North Carolina with expertise in fall protection systems.
A variety of fall protection solutions are available, and it is important to select a system based on the specific building type, roof system, or work application. It is imperative that the designers consider the continuity of the fall protection systems selected throughout campus. All fall protection systems shall be designed and installed similarly with compatible components to reduce variability in fall protection systems on campus. Users of these systems must be trained on how to properly use, inspect, and maintain the selected fall protection systems.

A complete understanding of the work procedures will enable the design team and/or qualified person to select the most appropriate fall protection system. The schematic design phase shall include consultation with affected campus maintenance personnel that are exposed to fall hazards. The purpose of this meeting will help identify specific building maintenance and/or equipment service activities required to be conducted throughout the life of the building. In addition, the design team can discuss maintenance and inspection requirements of the proposed personal fall arrest systems and identify areas of concern.

It is essential that during the design phase, the qualified person and/or contract designer gives consideration to the prevention of falls for future maintenance of the building, structure, or facility.

**Considerations should include the following:**

1. Safe access to or egress from any potential work area.
2. Provisions for permanent guardrail systems or edge protection such as parapets that meet the height criteria established for guardrails by OSHA.
3. Selection of materials that can withstand harsh environments.
4. Location of and safe access to equipment for maintenance purposes.
5. Identification and location of utilities that service the buildings (e.g., location of power lines, etc.)
6. Use of fall-arrest systems and devices, including the provision of suitably located permanent rooftop anchorages and field identification of all required anchorage point locations. (See Appendices A, B, & C for information on anchorages).

The primary goal of this guideline is to eliminate fall hazards where feasible. Where preventing exposure to the fall hazard is not possible, UNC shall provide the means for proper fall protection for all personnel working at elevated heights during construction, maintenance, and repair work.

**Hierarchy of Controls**

Control measures are not intended to be used independently and in many cases a combination of controls should be implemented to reduce exposure to fall hazards.

1. **Engineering Controls**
   Engineering Controls that are designed to eliminate hazards are the preferred method for protecting employees from or controlling exposure to fall hazards. Examples of engineering controls used to eliminate or reduce exposure are listed below:
   a. Changing equipment or processes to control hazard (e.g. using aerial lifts to access work area)
   b. Installing screens/gutter guards to reduce frequency of exposure
2. **Passive Fall Protection Systems**
   Passive Fall Protection Systems do not require operational involvement from the employee in order to be protected while performing work at elevated heights. Examples of passive systems are listed below:
   a. Installation of guardrail systems
   b. Construction of parapet walls meeting height criteria for guardrails

3. **Active Fall Protection Systems**
   Active Fall Protection Systems require that employees understand when they are exposed to fall hazards and have a working knowledge of the fall protection system available for their protection. Active systems begin with a qualified anchorage point and have components connected to the worker (body harness, lanyard, self-retracting lifeline, rope grab, etc). Proper training in the use of active systems is essential for an effective fall protection system.

4. **Personal Fall Arrest Systems (PFAS)**
   Personal Fall Arrest Systems (PFAS) are considered active systems and shall be incorporated into the building design when elimination of the fall hazard or a passive system is not feasible. Examples of PFAS are listed below:
   a. Fixed point anchors certified as an attachment point for workers that work locally
   b. Horizontal Lifeline (HLL) systems to serve as an anchorage attachment for continuous fall protection

   PFAS shall provide secure anchorages to arrest a fall while preventing the users from free falling more than six (6) feet. Anchorages must be easily accessible from the roof access in order to avoid fall hazards during connection to the fall protection system. Systems shall provide uninterrupted access to the entire length of the structure without having to disconnect from the system to pass through intermediate support points. All PFAS shall be capable of supporting at least two (2) workers at a time. All essential components shall be designed and tested as part of the system in order to provide a complete and fully operational fall arrest system.

*Specific Requirements*
Fall protection must be provided for each employee working on elevated surfaces 4 feet above a lower level or whenever there is a possibility of falling onto dangerous equipment or into a hazardous environment, or where there are impalement hazards present. The listed examples are not all inclusive.

1. **Skylights**
   Every skylight shall be guarded by a standard skylight screen or a fixed standard railing on all exposed sides. Skylight screens must be capable of withstanding a load of at least 200 lbs applied perpendicularly at any one point on the screen. In addition, screens must be constructed and mounted such that when subjected to ordinary loads they will not deflect downward and break the glass below the screen.

2. **Flat or Low Slope Roof Systems**
   Employees engaged in work on low slope roofs shall be protected from unprotected edges of the roof by one or more of the following methods:
   a. Approved Guardrail System or parapet wall meeting OSHA height criteria
   b. Safety Net System
   c. Employee use of a fall-restraint or fall-arrest system
3. **Steep Slope Roof Systems**

Employees engaged in work on steep slope roof shall be protected from falling from all unprotected edges of the roof by one or more of the following methods:

a. Employee use of a positioning devices, fall-restraint, or personal fall-arrest system (e.g. PFAS or HLL)

**Additional Requirement Notes**

1. Warning lines and safety monitor systems are prohibited on steep slope surfaces exceeding a 4 to12 pitch.
2. Mechanical equipment shall be placed only in areas where employees are protected by a warning-line system, fall restraint, or fall arrest systems.
3. The anchorage connectors and all components of fall arrest systems must be made of stainless steel or other corrosion resistant materials and comply with all sections of ANSI Z359.1.
4. A laminated reduced roof plan showing all fall protection system locations, anchor load ratings, number of authorized users that may attach to the system at one time, date of initial certification, and name of registered professional engineer who certified anchorages shall be posted at every roof access.
5. A logbook shall be maintained on site with a thorough description of certification and inspection procedures. The certification test and inspection results shall be entered into the logbook and signed and dated by the competent person.
6. Fall protection design shall consider prompt rescue procedures in the event an employee is subjected to a fall using a fall arrest system. Emergency contact information and rescue procedures shall be laminated and posted at all roof access points.
7. The certified fall arrest system must be marked on the as-built drawings with the PE seal.
8. Personal Fall Arrest Systems shall
   a. be rigged such that an employee can neither free fall more than six (6) feet or contact a lower level.
   b. limit the maximum arresting force on an employee to 1800 pounds when used with a full body harness
   c. bring an employee to a complete stop and limit the maximum deceleration travel distance to 42 inches.
   d. have sufficient strength to withstand twice the potential impact energy of an employee free falling six (6) feet or the free fall distance permitted by the system, whichever is less.
9. Fall arrest equipment subjected to an impact load shall be immediately removed from use and/or tagged
Appendix A - Requirements for Anchorage Design, Certification, and Identification

a. Anchorages shall be designed and installed under the supervision of a Professional Engineer (PE) in North Carolina and in strict accordance with the manufacturer’s instructions. The PE shall have significant experience in designing fall-protection systems. If there is a need to devise an anchor point from existing structural members such as beams, rafters, or columns, a PE shall be used to evaluate these anchorages. It is recommended that a structural engineer independent of the fall protection company evaluate and certify the structural integrity of the building.

b. Qualified anchorages used for personal fall arrest shall be: 1) independent of any anchorage used to support or suspend equipment or platforms, and 2) capable of supporting 5,000 pounds per employee attached or designed, installed, and used under the supervision of a qualified person as part of a complete fall-arrest system which maintains a safety factor of at least two.

c. The forces generated by arresting a fall; total loading; and impact on the structural members should be calculated in order to determine the optimal safe location and how to properly tie-off to qualified anchorages.

d. Only a P.E. shall certify the structural integrity of the anchorages. Anchorage conditions should be field verified by a qualified person.

e. Before initial use, the anchorage assemblies and fall arrest equipment shall be successfully load tested at the rated load and documentation provided to UNC. The load test shall be prescribed, defined, and certified by a registered PE. Elastic deformation of the test anchorage or anchorage connector may be determined by theoretical calculations performed and certified by a PE.

f. A laminated reduced roof plan showing all fall protection system locations, anchor load ratings, number of authorized users that may attach to the system at one time, date of last inspection, and name of registered professional engineer who certified anchorages shall be posted at every roof access.
Appendix B - Inspection and Re-Certification of Anchorages

a. Fall arrest, positioning, and restraint equipment shall be inspected by the user before each use and annually by a competent person in accordance with the manufacturer’s instructions. Workers are not qualified to inspect anchor points; however, they shall be trained to pay special attention to any cracks developing around the anchor points or if the anchor points are unstable or loose. End users shall not tie-off to unsafe anchorages and they must bring it to the attention of the competent person if such a situation exists. Questionable anchorages must be immediately tagged or labeled “Do Not Use” until recertification can be performed.

b. Anchorages that show signs of degradation during the inspection shall be reviewed by a qualified person to determine if recertification testing is required. If it is determined that testing is necessary, then a PE shall develop a non-destructive test procedure and certify the results.

c. A preventative maintenance program shall be developed for fall protection systems to include recertification requirements of permanent anchorages which should not exceed a five-year frequency.

d. Anchorage Recertification depends on the design, type, location, and the size of the structural member to which the anchorage is attached. The environment and weather conditions also contribute to how often anchorages should be inspected and recertified. The type and frequency of recertification shall be determined by the manufacturer or the PE who designed the fall protection system.

e. The recertification of anchorage connectors shall be done by the manufacturer’s representative or a qualified person under the supervision and direction of a PE.

f. Any component of a fall arrest system subjected to an impact load shall immediately removed from service and not used again for employee protection until it has been recertified as stated above.
Appendix C - Guide to Selecting Safe Anchorages for Fall Protection Systems

a. The strength of a personal fall-arrest system depends on its subsystems and components, as well as how the system is attached to the anchorage point. Such attachment shall not significantly reduce the strength of the system, including the structural members such as beams, column, or any rigid structures.

b. All components and sub-components of the selected fall-attest system shall be compatible with each other and constructed of stainless steel, galvanized steel, or other materials with a corrosive resistant finish. All surfaces shall be smooth to prevent damage to interfacing parts of the system.

c. When planning and selecting a point of anchor location, take into consideration the accessibility and ease of securing to it.

d. Select the point of anchor as high as possible. This will minimize the freefall distance and total fall distance and will prevent any contact with an obstruction of the ground below.

e. The point of anchorage shall be located in such a way to minimize swinging the worker (pendulum-like motion) that can occur during a fall. The farther away in a horizontal direction a worker moves from a fixed tie off point, the greater is the swinging angle if a fall should occur. If any obstruction exists in the path of the swing fall, the force generated by such a fall is the same as the force in a vertical fall. The maximum angle of swing away from the point of anchor should not be more than 30 degrees.

f. Always specify the number of authorized users that are allowed to attach to a specific anchorage point.

g. The diameter of the anchorage eye, tieback, or eyebolt shall be compatible to the snap hook or carabiner attachment. If an eyebolt is selected as a point of anchor, it should be rated along its axis. Eyebolt strength is greatly reduced if the force is applied at an angle to the eyebolt axis.

h. When tying off to a beam or column, do not attach the anchorage connection to a hole in the beam unless evaluated by a PE, because the forces generated by a fall may weaken the beam structure. Do not drill a hole for tying off. This attachment will compromise the structural integrity of the beam. If anchorage connectors are not available, the most favorable way to tie off is to wrap an anchor strap around the beam or column or use a designed beam clamp.

i. Do not tie a knot in the anchorage connection.

j. Take into consideration the impact of shear forces and the bending motion at the supports and also the distribution of forces beyond the supports onto other structural members.

k. When selecting the point of anchor in a column, take into consideration the impact of fall forces due to axial loading and bending stresses.
Appendix D - Fall Protection Post Job Submittals

a) The qualified person/contract designer and the installation contractor shall ensure that documentation of anchorage certification and annual recertification requirements are provided to UNC prior to the system being put into use.

b) Detailed user instructions for the fall arrest system must be printed and provided to UNC. User instructions shall include at least the following:
   a. manufacturer’s name, address, and telephone number
   b. manufacturer’s user instructions for part and model number e) statement of manufacturer’s intended use and purpose
   c. description of proper methods and limitations on use
   d. printed information or illustrations of fixed equipment markings
   e. description of detailed inspection/recertification procedures for fall arrest system
   f. criteria for failing inspections and determining unusable equipment
   g. procedures for maintenance and repair requirements (who is authorized to make adjustments and repair to equipment).
   h. Appropriate warnings regarding altering, misusing, and limitations of equipment

(c) Submit reduced shop drawings illustrating the fall protection system to be affixed at all roof accesses. m) Submit manufacturer warranty information and documentation that the system was installed in accordance with manufacturer’s instructions.
Appendix E - Definitions

Active fall protection systems are made up of components and systems that require some manipulation by the worker to make the protection effective.

Anchorage means a secure point of attachment for lifelines, lanyards or deceleration devices and at a minimum must meet the design loads outlined in the applicable OSHA regulations.

Body harness means straps which may be secured about the employee in a manner that will distribute the fall arrest forces over at least the thighs, pelvis, waist, chest and shoulders with means for attaching it to other components of a personal fall arrest system.

Competent Person is one who by way of training or expertise is knowledgeable of applicable standards, is capable of identifying workplace hazardous or dangerous conditions relating to the specific operation, is designated by the employer and has the authority to take corrective actions.

Engineering Controls are methods to reduce exposure to potential hazards either by isolating the hazard or by removing it from the work environment.

Guardrail system means a barrier erected to prevent employees from falling to lower levels and shall consist of a top rail, intermediate rail, toe board and posts and shall have a vertical height of 42" from upper surface of top rail to the floor. The anchoring of posts and framing of members for railings of all types shall be of such construction that the completed structure shall be capable of withstanding a load of at least 200 pounds applied in any direction at any point on the top rail, with a minimum of deflection.

Lanyard means a flexible line of rope, wire rope, or strap which generally has a connector at each end for connecting the body belt or body harness to a deceleration device, lifeline, or anchorage.

Lifeline means a component consisting of a flexible line for connection to an anchorage at one end to hang vertically (vertical lifeline), or for connection to anchorages at both ends to stretch horizontally (horizontal lifeline), and which serves as a means for connecting other components of a personal fall arrest system to the anchorage.

Low-slope roof means a roof having a slope less than or equal to 4 in 12 (vertical to horizontal).

Opening means a gap or void measuring 12 inches or more in its least dimension, in any floor, platform, pavement, or yard, through which persons may fall; such as a hatch, stair, or ladder opening, pit, or manhole.

Parapet Wall is a low wall along the edge of a roof or balcony.

Passive fall protection systems consist of components and systems that do not require any action on the worker’s part.

Personal fall arrest system means a system used to arrest an employee in a fall from a working level. It consists of an anchorage, connectors, body harness and may include a lanyard, deceleration device, lifeline, or suitable combinations of these. The use of a body belt for fall arrest is prohibited.
Positioning device system means a body harness system rigged to allow an employee to be supported on an elevated vertical surface, such as a wall, and work with both hands free while leaning.

Qualified Person is one with a recognized degree or professional certificate and extensive knowledge and experience in the subject field who is capable of design, analysis, evaluation and specifications in the subject work, project, or product.

Registered Professional Engineer is one who is licensed and has professional experience in the practice of design and installation of permanent fall protection systems and is familiar with all applicable codes and standards.

Rated Load is the combined weight of the employee, tools, equipment, materials that the device is designed to support.

Rope grab means a deceleration device, which travels on a lifeline and automatically, by friction, engages the lifeline and locks so as to arrest the fall of an employee. A rope grab usually employs the principle of inertial locking, cam/level locking, or both.

Roof means the exterior surface on the top of a building. This does not include floors or formwork, which, because a building has not been completed, temporarily becomes the top surface of a building.

Safety monitoring system means a safety system in which a competent person is responsible for recognizing and warning employees of fall hazards.

Self-retracting lifeline/lanyard means a deceleration device containing a drum-wound line which can be slowly extracted from, or retracted onto, the drum under slight tension during normal employee movement, and which, after onset of a fall, automatically locks the drum and arrests the fall.

Steep roof means a roof having a slope greater than 4 in 12 (vertical to horizontal).

Unprotected sides/edges means any side or edge (except at entrances to points of access) of a walking/working surface, e.g., floor, roof, ramp, or runway where there is no wall or guardrail system at least 42 inches high.

Walking/working surface means any surface, whether horizontal or vertical on which an employee walks or works, including, but not limited to, floors, roofs, ramps, bridges, runways, formwork and concrete reinforcing steel but not including ladders, vehicles, or trailers, on which employees must be located in order to perform their job duties.

Warning line system means a barrier erected on a roof to warn employees that they are approaching an unprotected roof side or edge, and which designates an area in which roofing work may take place without the use of guardrail, or safety net systems to protect employees in the area.
C-10 - Interior Design

General Notes

**Furniture Procurement:** All furniture purchases made on behalf of UNC should leverage UNC approved and State of NC contracted rates.

**Materials Selection:** In addition to meeting the necessary performance criteria, selection shall consider materials that require minimal maintenance, can accommodate future adaptation, can significantly reduce its environmental impact during its lifetime and have recycled content where appropriate for use. Sustainable materials are preferred in keeping with UNC’s Sustainability Policies, however suitability, availability, cost effectiveness and adequate competition shall also be considered when selecting materials for use.

Designers and consultants should confirm the minimum performance characteristics of interior design elements and finishes for each application. Particularly in laboratory, medical, or athletic settings, there may be additional requirements that need to be met other than those noted below.

**Code Compliance:** Interior design elements must comply with current ADA standards as well as all other applicable codes and university requirements. It is the responsibility of the designer and consultants to seek clarification when needed and ensure these requirements are met.

**Design Review:** Design of public spaces for students and visitors must be reviewed by UNC Facilities Services Interior Design during the design process and prior to construction.

**Asbestos & Lead Paint:** Precautions should be taken to avoid interactions with asbestos and lead paint, which may be found in some University buildings. Due diligence to discover hazardous materials should be initiated at the commencement of all projects to ensure remediation prior to construction or installation of new finish materials.

**Historic Objects:** Various pieces of fine and decorative art are located in and around buildings on the UNC campus. These objects (including, but not limited to, paintings, sculpture, and antique furniture) are designated as “Historic Property” and must never be moved or altered without prior consultation with the Historic Collection Curator in the UNC Facilities Services group. The team planning and coordinating any design project should note the presence of historic objects early in the planning phase so that arrangements can be made for safe removal of the items.

**Warranties:** Manufacturers’ specifications and installation guidelines must be followed to ensure valid warranty on all products.
C-10.1 – Interior Partitions

Non-load Bearing Partitions

Framing
Metal stud framing shall be consistent with design loads required for the use of the space, height of walls and the support of wall mounted items (including, but not limited to cabinets, shelving, TV monitors). Wood stud framing is not allowed.

The tops of walls shall be diagonally braced to the structure if they do not extend to the bottom of the structural deck.

Wall framing shall be braced with steel studs or wood blocking or 20-gauge sheet metal where wall mounted objects are located.

In renovation applications, metal studs that are damaged or that have lost structural integrity due to penetration by mechanical or electrical trades, shall be replaced.

Gypsum Board
Gypsum board shall be a minimum 5/8 inch thick for single layer applications in all typically occupied spaces. Water-resistant gypsum board (5/8 inch thick) shall be employed in high-moisture areas. Gypsum board shall be installed with a minimal number of joints. Provide moisture- and mold-resistant gypsum board on the interior side of exterior walls. Provide impact-rated gypsum board in high traffic areas such as corridors, lobbies, and fire stairs.

Plaster
Many of the walls on campus have a plaster finish. In renovation projects, it is preferred to patch plaster with a plaster material compatible with the existing material. When existing plaster ceilings are penetrated directly for mechanical or electrical work, the plaster shall be patched tightly in order to maintain the existing fire and acoustical protection. Repaired plaster walls and ceilings shall maintain the original fire-rating integrity.

Glazing
Glazing for interior partitions shall have a minimum thickness of one-fourth inch (1/4”). Glazing in interior partitions which are seven feet (7'-0") or less above the finished floor shall be tempered glass.

Sound Attenuation
Walls shall have sound insulation that is continuous from floor to top of wall.

*The following chart illustrates minimum STC and NRC requirements for space types including classrooms and offices:*

--- RESERVED FOR FUTURE STC CHART --
Operable Partitions
Provide manual or electric operation folding panel partitions, as required to meet project requirements. Partitions shall be factory finished, supported from overhead track and include all hardware, seals, track and rollers as needed to close the specified opening. Partition finishes shall be Class A rated when tested in accordance with ASTM E84. Ensure structural coordination with UNC Facilities Architectural Design.

Demountable Partitions
Demountable and movable partitions shall be considered for use in areas susceptible to future partition rearrangement and substitution. Partitions shall be specified as non-progressive allowing the removal of individual panels from any location without disturbing adjoining units. Partitions are point accessible meaning instant access of panels allows for electrical, telephone and communication lines to be installed quickly and easily. Furniture support capability is optional.

*Engineering Memorandum 10-2018 “Powered Modular Partition Walls and Powered Office Furnishings”* provides UNC Facilities Services requirements for powered partitions.

Submit certification attesting that partition system has a Class A (under 25) Flame Spread Rating in conformance with ASTM E84.
C-10.2 – Furniture, Fixtures and Equipment (FF&E)

Provide interdisciplinary coordination and integrate all fixed and movable furnishings with the space design to interior finishes and all building systems (HVAC, Plumbing, Fire Protection, Communications, Electrical, Data, Architecture, A/V etc.). Outlets, data ports, switches, thermostats, A/V controls etc. must be fully accessible. Accommodate sprinkler heads, fire extinguishers, ADA, etc., clearances. Coordinate with the appropriate discipline and capture in plans and specifications all power, data, tele-comm, lighting, etc. required to support furniture, fixtures and equipment providing a fully functional space for the end user. Refer to UNC Electrical and Communications Guidelines for more information.

Performance Criteria

1. Casegoods
   
   Standard office casegoods are laminate faced and edged.

   When wood casegoods are approved for use by UNC Facility Services Interior Design, wood shall be FSC certified and exterior veneer shall be Grade A. This criteria shall also apply to section C-14.

2. Systems Furniture
   

   For panel-based systems, electrical components are pre-wired to a wiring harness, UL listed, a coordinated product of the systems furniture provided by the systems furniture manufacturer. The maximum for power wiring in conduit in UNC Buildings on campus is six conductors (3 hots, 1 from each phase, and 3 neutral) plus one equipment ground, sized #12 on a 20-amp breaker. UNC does not allow more conductors in a conduit, as this would require de-rating of the conductor’s ampacity in accordance with the National Electric Code. Preference for furniture manufacturers to provide wiring that matches UNC’s standard for power wiring – 3 hots, 3 neutrals and 1 equipment ground unless otherwise noted. A single circuit shall not serve more than 4 cubicles under any circumstances. Cables and electrical shall be routed from one panel to another by means of a lay-in installation in a continuous and unobstructed clearance.

3. Ergonomic Task Chair
   
   Task chairs shall be a high-performance, long-use ergonomic chair that meets or exceeds all ANSI – BIFMA standards. When specifying, consider the following features:
   - Fully adjustable arms
   - Mesh back
   - Pneumatic height adjustment
   - Adjustable lumbar
   - Separate seat and back
   - Synchronized Tilt or 3-point pivot mechanism
   - Greenguard, SCS, or BIFMA FES certified
   - Industry standard warranty or better on parts
   - Weight limits above ANSI-BIFMA are occasionally required based on project specific needs.
4. **Guest Seating**
   Bariatric seating shall be included in any waiting room or reception area. Consider seat width, arms/no arms when specifying seating.

5. **Textiles**
   Wool textiles shall not be used. Seating textiles should be a minimum 50,000 double rubs with a soil resistant finish.

6. **Fixed Tables and Seating**
   Design shall comply with the current versions of the North Carolina State Building Code and the Americans with Disabilities Act Accessibility Guidelines (ADAAG). [http://www.ada.gov/publicat.htm](http://www.ada.gov/publicat.htm). In classrooms and auditoriums where a tablet arm is provided for fixed seating, a fixed table or tablet arm on a pedestal shall be provided at all wheelchair seat locations.
C-10.3 – Interior Accessories

Window Treatments

1. Blinds
   Specification or purchase of window blinds should comply with NCDOA: [https://ncadmin.nc.gov/870a](https://ncadmin.nc.gov/870a) guidelines at a minimum.

   The University standard for new construction and non-historic window coverings is 1-inch horizontal aluminum blinds, contract grade and warranty, equal to Levolor, Hunter Douglas or Bali. Color: white. Vertical blinds shall not be permitted.

   Consider 2”, 2.5” or faux/wooden/FR composite blinds for use in historic buildings on campus to maintain the exterior consistent visual aesthetic while meeting NFPA and life safety code requirements.

2. Curtains and Drapes
   No draperies except for special circumstances and approved locations by UNC Facilities Services Interior Design. Textiles used shall comply with NFPA-701.

3. Roller Shades
   Roller shades shall be contract grade roller shade with industry standard warranty. Shade cloth shall be selected from manufacturer’s standard offering light-filtering cloth with an openness factor of 1 to 3 percent, anti-microbial 'No Growth' per ASTM G21, passes flammability requirements in accordance with NFPA 701 small and large-scale vertical burn. For motorized shades, electrical requirements NFPA Article 100 listed and labeled in accordance with UL 325 or other testing agency acceptable to authorities having jurisdiction, marked for intended use, and tested as a system. Individual testing of components is not acceptable in lieu of system testing.

   Motorized shades must be coordinated with UNC Facilities Services, Electrical Engineering.

   Classrooms/Conference: Shade cloth with 1% openness at classroom or conference spaces unless blackout material is required due to the specific nature of the room activities.
C-10.4 – Casework

Standards and tolerances for the quality and fit of Architectural Wood Casework and related interior finishes shall comply with the ANSI/AWI 0641 - Architectural Wood Casework Standard including wood veneer-faced architectural cabinets, plastic-laminate-clad architectural cabinets, and cabinet and drawer hardware as specified under CSI Master Format Division 6. Please Note: the “economy standard” as defined in ANSI/AWI 0641, subsection 3.4, Aesthetic, shall not be utilized for product unless specifically approved by the UNC Interior Design.

This standard establishes structural and aesthetic tolerances for each of the applications referenced above, ensuring that the final product is of the utmost quality with regards to visual appeal and structural integrity. Also refer to section C-12 for Performance Criteria.

Casework should be reviewed with end users to ensure suitability to work performed in addition to review for ADA compliance.

**Casework Installation**
Casework installation should comply with AWI Installation Guidelines, Casework Wall Anchorage

**Countertops**
Specify solid surface countertops in high traffic areas. Where plastic laminate is used, specify image-match PVC edge.

**Lab Casework**
Countertops shall be smooth, clean exposed tops and edges in uniform plane, free of defects with minimum joints, flush with face of base cabinets (no overhang). The following notes apply:

1. **Phenolic resin shall be used at a minimum in lab spaces.**

2. **High pressure laminates with self-edges are not allowed.**

3. **Materials should be impervious to chemicals used.**
   Design Team shall coordinate a list of known chemicals for the intended space with the Facilities Planning Project Manager and EHS during the design programming and planning phase.

4. **See Laboratory Design Guidelines for more information.**
C-10.5 – Interior Finishes

Specify manufacturer’s standard offerings. In unique instances where a custom solution is designed because there is no standard offering, product and application must be reviewed and approved by UNC Facilities Services Interior Design.

Wall Coverings
Wall coverings may only be used when additional acoustic, cleanability or impact resistance is required by project scope and other finish materials do not have appropriate performance characteristics for the application. Wallcovering must be approved for select use by UNC Facilities Services. Wallcovering with a mercury-, cadmium-, lead-, and chromium-free base shall be specified, and wallcoverings protected with bactericides and mildew inhibitors against microbiological and mildew growth.

Wall and Corner Protection
Rigid vinyl wallcovering or wall panel systems shall be considered where high-impact resistance wall surfaces are needed (i.e., classrooms, service corridors, loading dock areas, corridors and elevator lobbies with cart traffic, etc.). Resilient corner guards shall be used in high traffic areas. Stainless steel corner guards shall be used in high-abuse spaces and where forklifts are used (i.e., cleanrooms, warehouses, loading bay areas, etc.). Wall and corner protection shall comply with ASTM standards for fire, chemical, stain, fungal and bacterial resistance.

Interior Painting
Paints and coatings shall be VOC free
Interior paint sheen as follows:
- Gypsum Board - Walls: Flat, Eggshell or Satin
- Gypsum Board - Ceilings: Flat (typical), or Eggshell (wet locations)
- CMU: Semi-gloss
- Metal Doors and Frames: Semi-gloss

Tile
Tile selection and installation shall comply with the Tile Council of North America, Inc. (TCNA) Guidelines, ANSI Standards and local codes.

Floor tile shall be porcelain with thru-body color. Floor grout and grout applications in wet areas to be epoxy. White and light color grout shall not be used for floor applications.

Carpet
1. Carpet Tile
   Specify carpet tile with a minimum 3.0 Heavy TARR rating. High traffic and heavy-use areas should be constructed with a type 6.6 nylon fiber. No fill pieces shall terminate in doorways. Solution dyed carpet fibers are preferred. Recyclable carpet is preferred.

   Where carpet tile is the first type of flooring to approach from exterior entrances, walk off carpeting material shall be used and integrated into the existing carpet material for a minimum of 6 linear feet from entrance.

   No carpet tile shall be specified on a floor below grade level unless it is a modular product that is not glued to the subfloor and can be easily removed and dried in a flooding event.
2. **Broadloom Carpet**

   Broadloom carpet must be approved by UNC Facilities Services Interior Design and shall only be specified for specific applications (i.e. auditorium risers, area rug, etc.). Broadloom carpet is not permitted in most instances.

**Resilient Wall Base and Transitions**

   Specify rubber base with field-cut wrapped inside/outside corners. Do not use preformed corners. New construction should use 4” cove base unless matching existing.

**Resilient Flooring**

1. **Luxury Vinyl Tile (LVT)**

   LVT shall conform to ASTM F1700 Class III printed film with a minimum wear layer thickness 0.50 mm, however wear layer and product thickness shall be appropriate to space use, maintenance and foot traffic expected. Both Type A smooth and Type B embossed, with a factory protective finish that enhances cleanability and durability, can be specified.

2. **Vinyl Composition Tile (VCT)**

   Vinyl composition tile must be approved for use by UNC Facilities Services Interior Design and UNC Facilities Maintenance and Construction. Due to high life cycle costs associated with long term stripping, buffing, waxing policies, there must be a valid performance justification for use of vinyl composition tile other than initial cost.

   Specialty flooring such as anti-static or epoxy may be required depending on the application and should be confirmed with campus partners.

**Raised Access Flooring Systems**

   Raised Access flooring systems, as a basis of design, shall consist of 24" square steel encapsulated wood core panels that are removable and interchangeable and provide easy access to the plenum area beneath the floor panels.

   Raise the system above the sub floor to a height sufficient to allow wiring, bus duct, and adequate air flow to all air outlets. Provide for at least 33% growth. Support the under-structure system in such a way as to provide a floor that is rigid, level, and free of vibration.

   The system shall have electrical continuity between the top of the floor panels and the base plates. The system shall have a Class 1-A fire rating when tested in accordance with ASTM-84-79.

   The system shall have available accessories as follows: Cable cut outs with grommets, ramps, steps, handrails, fascia molding, plenum dividers, cove base, perforated air flow panels with adjustable air flow dampers and panel lifting devices.

**Ceiling Finishes**

   Ceiling systems shall allow easy access to critical points of utilities: junction boxes, valves, exchangeable air filters, etc. Access doors to utilities shall be provided in gypsum ceilings and indicated in the construction documents. Confirm building standard acoustical ceiling tile prior to specification.
C-10.6 – Building Signage

The architectural construction documents shall incorporate the approved permanent room numbering / system utilized for all interior room identification signs. All University buildings are a “smoke free environment.” All entrances to buildings shall incorporate ‘No Smoking’ signage.

Interior signs which must be installed prior to Beneficial Occupancy include:

- Room Number Signs
- Toilet Room Signs
- Mechanical and Electrical Room signs.
- Stair and Elevator Signs
- Tactile Exit Signs

Note: Temporary signs are not acceptable.

As the signage program is developed consider fabricating the signage in-house. Consult the UNC sign shop for present in-stock standard signage systems/styles, and coordinate with the Project Manager for this determination. If signage is performed in-house, include line item in budget. Room numbering is a requirement of the fire alarm system and NFPA. It must be included as a life safety element.

Accessibility

The Designer is expected to provide a design that will comply with the current versions of the North Carolina State Building Code and the Americans with Disabilities Act Accessibility Guidelines (ADAAG). http://www.ada.gov/publicat.htm. The University requires some elements that exceed these codes and standards: **Interior and exterior signs identifying permanent rooms and spaces shall have both the name and number in raised letters and Braille that complies with the current accessibility codes.**

C-10.7 – Interior Electrical Products and Lighting

General

Products shall be UL listed and meet all applicable codes as well as UNC electrical requirements. Use of products containing proprietary electrical components is not permitted. Connectrac or similar products should be avoided in path-of-travel locations.

Halogen lamps are not permitted. Lamp color temperature to be coordinated with UNC Electrical Engineers and match buildings existing lamp color temperatures where applicable. LED lighting should be used where possible for energy efficiency. Refer to UNC Electrical Guidelines and Engineering Memorandum 10-2018 “Powered Modular Partition Walls and Powered Office Furnishings” for more information.

C-10.8 – Audio/Visual

Some campus partners will require A/V implementation as part of a project while others will not. The level of A/V coordination required should be confirmed during initial project phases to ensure scope is determined appropriately.
C-11 – DOORS, HARDWARE, AND ACCESS SECURITY

General
All doors, hardware, closers, etc., shall provide means for easy access and use by the physically handicapped.

Interior Doors
Except in special situations, the minimum door opening is 36”. Use flush doors wherever practical. Transparent finished wood doors shall be satin finished where practical. Seal tops and edges with Water-Lox or equivalent immediately after trimming.

For non-fire rated doors, use only solid-core wood doors similar and equal to Weyerhaeuser, Code DSC-1.

Fire rated doors which are required to be B-label should be metal, in order to minimize the weight which, the hinges and closers must carry. However, if B-label wood doors are specified, they shall have hinges and door closers installed using through-bolt hardware. Hardware, otherwise capable of handling the unusual weight.

On labeled fire doors, all closers shall be UL listed non-hold open type.

Doors which open to corridors, and which contain glass, shall use either 1/4” UL fire-rated tempered glass or 1/4” wire glass set in rated metal frames with wire strands running diagonally.

Provide automatic door openers as required in the Accessibility Section IV - D.

Whenever possible, avoid fire shutter doors. If fire shutter doors are required, they shall be motor operated Up and Down. Provide access to the controls and all reset features from floor level. The test and reset connections to the fire alarm system should be key operated.

Exterior Doors
All exterior doors shall have a minimum of 36” opening and 7'0” height.

Double doors generally should not be used because of the problems involved in securing these doors. Where double doors are required, provide a keyed removable mullion such as Von Duprin #5754.

All exterior doors and jambs should be hollow metal (steel) or aluminum and glass (storefront systems). Wood and frameless glass exterior doors present a severe maintenance problem and should be avoided. Steel doors shall be a minimum of 16-gauge steel; jambs shall be a minimum of 14 gauge. Aluminum doors in storefront systems shall be medium or wide stile; narrow stile doors are not acceptable.

At each accessible entrance to a building equip at least one door with an automatic door operator. Refer to accessibility Section IV - D for additional requirements.

Completely protect all exterior automatic door operator activators provided at accessible entrances from the weather. This shall include not only the use of weatherproof electrical boxes and enclosures, but also must contain a weatherproof activator (rubber seal or push button) or housing which will prevent water from entering around the switch and prevent sticking during freezing weather.
Access Doors
As a basis of design, design shall specify access doors equal to: *Milcor Style 'K' or 'DW'.*

Windows - Wood and Metal
Construct window sections to enable cleaning of outside glass surfaces from inside the building (in-swing, removable, or pivoted) except for windows accessible from the ground and windows no higher than forty feet (40') above grade. Equip window sections with concealed locks and removable keys.

For fire department access and emergency escape certain buildings and windows are required to be operable from within, without special use of a key.

Turn all keys over to Facilities Services with a minimum of one key per each 30 windows. Provide double-glazed windows with vacuum seal and 1/4" minimum, clear, polished glass.

Accessibility
The Designer is expected to provide a design that will comply with the current versions of the North Carolina State Building Code and the Americans with Disabilities Act Accessibility Guidelines (ADAAG). [http://www.ada.gov/publicat.htm](http://www.ada.gov/publicat.htm). The University requires some elements that exceed these codes and standards:

1. All lever hardware shall have an end return.
2. Automatic door opener shall be hardwired. The location of activators (push plates) and stub outs for the automatic door openers shall be shown and dimensioned on the architectural drawings. Activators shall be mounted 36" above the adjacent grade or floor and be 48" minimum from any portion of the door in the open position. The push plate shall be 4-1/2” diameter minimum. Door activator shall be provided at the following locations:
   a. Main Entrance doors into the building. Where the building has main entrances on different levels, they shall be provided at each level. These locations shall also be stub out for a proximity reader.
   b. Entrance doors into the primary multi-fixture toilet rooms on levels served by the main entrances mentioned above.
   c. Additional locations may be requested on a project by project basis no later than the Design Development Phase.
   d. Where vestibules are provided, the opener shall activate the doors on each side of the vestibule. An activator shall be located in the vestibule.
3. In addition, stub outs for future automatic door openers (conduit supplied to ceiling above and to boxes at future activator locations) shall be provided in the following locations:
   a. Entrance doors to all other multi-fixture toilet rooms on all floors.
   b. Entrance doors of common use bathrooms in dormitories, accessible dorm room entrance doors and toilet room doors in an accessible suite.
Door Hardware – Basis of Design & Preferred Brands
* Indicates Preferred Brands

1. **Hinges**
   To be no smaller than 4 ½ x 4 ½ No less than three per door leaf
   Ball Bearing hinges to be used on all exterior doors that are not store-front.
   a) McKinney*
   b) Stanley
   c) Ives

2. **Continuous Hinges**
   a) Markar*
   b) Select
   c) Ives

3. **Keying System and Cylinders**
   For new construction and complete building renovations furnish removable-core, large-format Schlage “Primus” cylinders in a keyway specified by the Access Control Shop unique to UNC-CH. All locks shall be furnished with permanent cores with 2 key blanks per core when ordering for permanent cores. In partial renovations to existing building the keyway for additional cylinders will match the existing keyway.

   In new or renovation construction, cylinder shells are to be installed by the hardware installation sub-contractor.

   **The Access Control shop will furnish temporary removable core cylinders in consultation with the general contractor and the end user for use during construction or renovation.**
   Permanent cylinder cores with two (2) keys per cylinder will be delivered to the Access Control shop zero bitted for keying and installation for the end user upon acceptance of the building by the University and DOI.

   For construction and major renovation in residence halls and student family housing facilities, furnish Schlage “Everest SFIC” 7-pin format interchangeable cores. All locks shall be furnished with 3 keys per core. Housing Support Lock shop will provide information on keyway and keying to be used. Permanent cores and keys will be delivered to the Housing Support Lock shop.

4. **Door Closers**
   To be equal to LCN 4000 and 4100 series. No floor closers to be used.
   a) LCN *
   b) Norton
   c) Dorma

5. **Mortise Locks**
   Trim to be equal to Corbin-Russwin ML 2000 series. Provide Corbin-Russwin ML 2000 series as owner preferred alternate.
   a) Corbin-Russwin
b) Schlage
   c) Best

6. **Cylindrical Locks and Latch Sets**
   Equal to Schlage AL series with removable core Primus cores X SAT X 626
   a) Corbin-Russwin
   b) Schlage*
   c) Best

7. **Silencers, Stops and Flush bolts**
   a) Rockwood
   b) Glynn-Johnson
   c) Ives

8. **Kick plates, Armor plates, Door edges and Misc.**
   a) Rockwood
   b) Don-Jo
   c) Ives

9. **Weather-stripping, Seals and Thresholds**
   a) Pemko
   b) Zero
   c) National Guard

10. **Push/Pulls**
    a) Rockwood
    b) Glynn-Johnson
    c) Ives

11. **Exit Devices**
    To be equal to Von Duprin 99 series. No concealed or vertical rod units to be used.
    a) Von Duprin*
    b) Corbin Russwin
    c) Sargent

12. **Overhead Stops/holders**
    a) Glynn-Johnson*
    b) ABH
    c) Rixon
    NOTE: Holders and Stops will be listed for fire alarm use

13. **Automatic/Accessible Door Operators**
    To be equal to LCN 4630/4640
    a) LCN*
    b) Horton
    c) Beasom
14. **Electronics**
   
a) Von Duprin*
b) HES
c) Locknetics

15. **Classroom Intruder**
All classroom hardware shall require interior locking capability to be used in an emergency lockdown situation.

Keying for all projects will be done by the university Access Control shop in coordination with the end user’s needs. All lock cylinders in new construction and total building renovations to be removable-core, large-format, *Schlage “Primus.”*

**Building Card Access System**
If the scope of this project includes Card Access the following guidelines shall apply.

The Access Control shop will purchase material used for card access to maintain continuity with existing and future card reader projects on the UNC-CH campus. The Access Control shop will then supply the contractor and other University departments with material as needed to complete the work on the project. Here are listed the responsibilities of the general contractor and the subcontractors:

1. **General Contractor**
The general contractor shall furnish, install and paint one 8’ X 4’ X ¾” exterior grade sheet of plywood as instructed by the Access Control shop in the designated card access control room. It is the responsibility of the general contractor or his representative to coordinate the work of all subcontractors and communicate any scheduling dates, delays, problems or needs to the proper University personnel.

2. **Electrical Subcontractor**
The electrical subcontractor shall furnish and install all necessary conduit, 2 X 2 Panduit and two-gang boxes in all locations as designated by the project plans and instructions of the general contractor. This subcontractor shall also furnish and install one 12” X 12” junction box with one two-inch nipple and in a separate location 110 volt power on a dedicated circuit terminating on the plywood mounted by the general contractor in the designated access control room as instructed. This contractor shall then pull and label all necessary wire furnished by the University Access Control shop from the access control room to all card reader locations as indicated without splices. If any locations are designated for future installation of card readers the contractor shall install boxes, conduit and labeled pull tape in the wall and install a cover plate as directed by the plans and the general contractor.

Each new construction project and/or complete building renovation shall include the installation of a Traka key control cabinet in a designated mechanical space for Facilities Services. The cabinet and ancillary equipment shall be supplied, installed and maintained by the Access Control shop. The Contractor shall provide:

A. Dedicated circuit for Traka cabinet
B. Raceway with wire or pull tape for card access
C. Lan/data for Traka cabinet and card access readers

OneCard System

Except for Medical School and Housing, most buildings at the University of North Carolina at Chapel Hill employ the OneCard card access system, using a Diebold A-1000 access reader system. Requirements for the design of this system are project specific.

The designer will work with the Project Manager to determine project scope and cost early in the design process. The project cost will include the equipment and work provided by UNC.

The following outlines responsibilities of owner/contractor work as it applies to the Diebold system:

1. The building contractor will furnish and install all door hardware, electrical exit devices, automatic door operators, ADA push plates & power supplies for all door hardware, unless otherwise specified.

2. The building contractor will furnish and install all raceways, boxes, 24 volt wiring & associated components required for the OneCard System.

3. The building contractor will install new fire-retardant plywood on the wall of the OneCard closet. The size of the closet(s) will depend on the size of the system.

4. UNC Electronics shop will purchase, install, and make all terminations to the OneCard equipment including card readers, proximity readers, A-100 controllers, A-1000 controllers with Wiegand adaptors, Altronix ULX400, power supply for door strikes, Proximity reader power supplies, terminal server, control cabinet and relays, and associated components.
C-12 - ROOM NUMBERING GUIDELINES

General
In order to allow for future space management and asset tracking needs, building room numbers should follow these guidelines:

(1) Each facility’s room numbering system shall be structured so that the numbers flow through the building in a consistent and comprehensible pattern. The patterns shall be clear to the users of the facility, not causing confusion for individuals attempting to locate spaces
   (a) All new construction shall follow these guidelines as written.
   (b) During renovations, all re-numbering of renovated rooms shall be consistent with the existing numbering in adjacent spaces, making sure to not duplicate existing number that may be outside the scope of work. When the existing numbering is not internally consistent or is confusing, the rules here are to be used as reasonable to define the best solution.
   (c) When buildings connect or join, the floors should line up and starting numbers should be the same in both/all buildings.
   (d) For numbering, cubicles and other soft-partition or partition-less divisions of space are treated as rooms and called rooms in these guidelines.
   (e) Open Office spaces, where multiple desks are located, shall be considered as one room with many workstations.

(2) Most room numbers will be 4 characters long, with special conditions as below.
   (a) Buildings with more than 10 stories will use 5 digit long numbers on floors 10 and above.
   (b) Rooms within a suite of rooms are designated with an alphabetic extension in the last position.
   (c) No dashes or other punctuation will be used in room numbers.

(3) The first digit, or two, of a room number indicates the floor on which the room is located.
   (a) Floor number 1 shall be the lowest most level entered at grade or one half-flight above grade.
   (b) If a new building is being significantly connected to an existing structure, the existing structure’s floor numbering will be followed.
   (c) Buildings which are significantly connected shall be numbered as though each building were a separate wing or corridor. See section 5 for definitions of wings and corridors.
   (d) Floors below level 1 will be designated as follows:
      (i) G – First level below 1, if there is a direct exterior entrance.
      (ii) B – First level below G or 1 with no exterior entrance, or partially unexcavated.
      (iii) S – Level below B.
      (iv) SS – Level below $S$

(4) The digit after the floor designation in the room number will indicate the wing or corridor.
   (a) In a building with only one dividing corridor, room numbers should flow in an ascending order beginning in the southwest corner of the building. The digit after the floor designation will be a zero, 0.
   (b) Any single corridor or wing directly serving more than 10000 square feet of usable space should be divided using the wing and corridor numbering concepts below.
(c) For buildings with a cross, star or “Y” configuration the Corridor or Wing section of the room number, as above, will be used to identify the wing of the building.
   (i) The southwest-most wing will use a 1 as the corridor or wing digit.
   (ii) Corridor or wing numbers will be assigned clockwise in increasing order, starting in the southwest-most wing.
   (iii) Rooms in the “central core” for each floor, not on a wing hallway, will use a 0 as the corridor or wing digit.

(5) The digits after the wing or corridor designation in the room number will indicate the room.
(a) Room numbers should be assigned so that odd numbers are on one side of a corridor and even numbered rooms on the other, when possible.
(b) The first room numbers on a wing or floor will end in a 1 or a 2.
   (i) Room numbers 1000, 2000, 1100, and 1200 are not standard room numbers.
   (ii) Use 1001 or 1002, 2001 or 2002, 1101 or 1102, 1201 or 1202, etc as the first room number of a wing or floor.
(c) Room numbers across a corridor from each other should be in matched order. Example: 125 is across from 124 and/or 126.
(d) To the greatest extent possible, without creating other inconsistencies, rooms with the same digits in the last two positions should be located in the same position in the building. Thus, 1105, 2105, 3105, 4105, etc., occur in a vertical stack.
(e) Skip numbers as appropriate in order to reserve numbers for future use.
   (i) A room number value should be skipped for each 60 square feet of room space or 2% of usable space on the corridor or wing, whichever is greater.
   (ii) When numbers are reserved for future room divisions, the room numbers on both sides will increment as appropriate so rooms across from each other have matched order numbers, even and odd.
   (iii) Explanation: Most buildings undergo renovation many times; and when, as is often the case, larger spaces are divided into smaller areas, new room numbers will be needed. Having numbers in reserve will avoid the need to renumber an entire level.
(f) One room must have only one number regardless of the number of doors opening into it.
(g) Rooms that are part of a suite, where all are entered from a main corridor or lobby by the same primary door, share the same room number with a suffix letter.
   (i) The lobby or main area of a suite is designated by the numbers with no suffix (1301, 5002, 3031, etc.).
   (ii) Rooms within a suite are numbered with the entrance room number, plus an alpha suffix (1301A, 1301B, 1301C, etc.), beginning with the room to the immediately left of the main entrance and proceeding in a clockwise direction.
   (iii) The letters O and I are not used in suite lettering.
   (iv) Letters should be skipped for large rooms in a suite, following the above rules for room numbering.

(6) Corridors and other required egress-ways will be numbered on plans and for space measurement. These numbers are not normally posted for use.
(a) Corridors will be numbered following the above standards with the first one or two digits indicating floor and the second or third indicating the wing or corridor, with a 0 for the last digit. I.E. 1000, 1100, 1200, etc...
(b) Vestibules and airlocks shall follow the corridor numbering system and be treated as suites. I.E. 1000 for the main corridor, and 1000A for a vestibule.

(7) Stairways will be designated by the corridor number that they serve.
   (a) The first digit(s) shall indicate the floor number of the stair landing or access door.
   (b) The second digit will match the corridor primarily served.
   (c) Stairwells can be numbered as suites off the corridor, like vestibules above, or they can be numbered in sequence with the rooms on the floor.
   (d) The same stairwell will have multiple identifiers in the first two numbers based on the floor being discussed. The last numbers should match across all floors of a building.

(8) Final, approved, room numbers must be on the final drawings prior to construction.

(9) Room numbers shall be approved by FTG Plan Room, Space Management Staff.
C-20 - PLUMBING AND MECHANICAL SYSTEMS

PREFACE

Instructions to the Engineer
The designer is required to incorporate this design guideline into the design document and to enforce during construction. Underlined text has extra emphasis.

If a design guideline variance is requested, contact the appropriate Engineering Services reviewer.

The designer is recommended to read the design guideline in entirety, underline text which the designer has questions or wishes a variance, and then review the underlined sections with the Reviewer.

Applicability
These design guidelines apply to:
1. Formal and informal construction and repair performed by outside contractors and University shops, and
2. Mechanical and plumbing systems located in or on the building that are maintained by Facilities Services. Occasionally, such systems are located exterior to the building such as plumbing backflow protection.

These design guidelines do not apply mechanical equipment located within the building that is maintained by Energy Services such as:
1. Chilled water utility piping up to and including the chilled water bridge, or
2. Steam utility piping up to and including the steam meter. The building main steam condensate receiver and condensate piping from the main receiver back to the Cogen plant. The building steam PRV station and relief valve are maintained by Facilities Services.
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I. GENERAL REQUIREMENTS

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3. Steam System
4. BSL3 Design Guidelines
5. Laboratory Design Guideline
6. Non-Potable Water Design Guideline
7. Environmental Chambers Design Guideline

B. Architectural and Engineering Coordination
1. Architectural and all MEP designers must coordinate and protect the service area around equipment. It is emphasized that equipment above ceilings and elsewhere must have access for replacement without the need to remove unrelated conduits, pipes, ducts, cable trays, etc.
2. The A&E shall coordinate the location of ceiling mounted devices such as lights, diffusers, life-safety devices, etc. with above ceiling access requirements. Upon request, the A&E shall provide coordination drawings.
3. The Architect, the Plumbing Engineer and the Mechanical Engineer should review the section “Section IV Specialty Equipment”
4. Suspended Ceilings: Suspended ceilings tiles more than 2’ x 2’ are generally prohibited with the following exceptions:
   a. Downward opening ceiling tiles are provided and can be easily removed and reinstalled by a single individual.
   b. All components requiring access, including junction boxes, balance damper handles, terminals, are located away from this area
5. Building Materials Storage for new buildings and major renovations.
   a. MEP drawings shall designate and mark out storage space for ladders.
   b. MEP drawings shall designate and mark out storage for spare parts.
   c. Designated storage space shall be marked out on the floor with paint striping or solid paint.
   d. Buildings shall designate dedicated storage rooms for spare ceiling tiles, light bulbs, ballasts and supplies for maintenance and repair of building finishes.
   e. Storage shall not interfere with required egress paths or electrical panel working spaces.
   f. The Engineer must bring these requirements to the attention of the architect.
   g. Refer to the architectural design guidelines for additional requirements.
6. Flooding of electrical equipment:
   a. Any equipment containing water or cooling condensate shall not be installed above electrical panels and equipment.
   b. Chilled water pipe shall not be installed above electrical panels and equipment.
   c. Other pipes should not be installed above electrical panels.
   d. Server rooms, electrical rooms, telecom, and other sensitive rooms.
      i. Bathrooms should not be located above these spaces.
      ii. Care should be taken with routing piping in floors above these spaces.

C. Design Requirements
1. Pipe and duct systems:
   a. Schematic drawings: For large or complex projects or when requested by UNC, the designer shall provide as part of the drawing package schematic level drawings of the mechanical pipe. These drawings will schematically show system layouts on single drawing sheets and will show at least the following level of detail: major equipment with equipment ID’s, major equipment design flow rates or entire floor design flow rates, major system accessories, such balance valves and main strainers, expansion tanks, air / dirt separators, etc., major control devices and sensors, pipe main sizes, and
system gauges, for example, the pressure gauge at the top hydronic systems. Indicate in the drawing notes the sizing criteria and any diversity factors used for sizing pipes and any assumptions used. Provide any critical system information that will be useful when the system is modified in the future such as excess capacity, system redundancy, etc.

b. Pressure loss calculations: Upon request, the designer shall furnish detailed pressure loss calculations for the longest equivalent run in the piping or duct system at design conditions. Diversity factors and other assumptions shall be clearly identified.

c. Piping larger than 2" dia., shown in mechanical rooms, shall be shown double lined to reflect the insulated diameter of the pipe.

2. Renovations:
   a. In the area of renovation, the design documents shall show all existing equipment and components that will remain. The documents must show terminals that serve the area of renovation even if they are located outside of the area of renovation.
   b. When existing systems will be modified, Engineering Services may require showing on the drawing existing system components that will remain even if they are outside the area of renovation.
   c. AHU zoning maps: Upon request from Engineering Services, the designer shall provide schematic level floor plans showing the region of the building served by each HVAC system. This will be necessary in existing buildings with numerous AHU’s serving multiple floors.
   d. For existing equipment that will remain and will be rebalanced, provide existing and new schedules. The new schedules will become the master schedule.
   e. HVAC load, supply, and outside air calculations:
      i. Provide revised load calculations to the areas served.
      ii. Provide revised supply and outside air calculations to the areas served.
      iii. Recalculation of supply air is especially important for constant volume systems.
   f. Indicate the location and equipment ID of equipment that is part of the HVAC system serving the space. That way the entire construction team can easily locate equipment remote to the primary area of the renovation.

3. Equipment Schedules:
   a. When redundant equipment is provided, redundancy levels shall be indicated on the equipment schedules and indicate the level of surplus capacity.
   b. Schedules are required for control valves and VFD’s.

4. Redundancy requirements:
   a. For labs, provide n+1 redundancy for plumbing and mechanical equipment. For other buildings, the need for redundant equipment must be discussed with Engineering Services.
   b. For critical spaces, such as freezer rooms and body coolers, redundant cooling systems will often be required.
   c. When one of the redundant equipment is being repaired or replaced, the remaining equipment shall be designed to remain operational.

5. HVAC:
   a. Space pressurization: For the doorways with pressure differentials, provide flow direction arrows and CFM values must on the duct plan drawings. Provide a note to the TAB contractor that the flow arrows and flowrates are for conveying pressure relationships and that measurement, adjusting and balancing of transfer air is not required.
   b. Schematic drawings: Upon request by UNC, the designer shall provide schematic duct drawings for each system and identify major components and provide enough information to determine design flow, redundant equipment, diversity factors, etc. This will be typically provided for all complex projects. Indicate the duct sizing criteria used and require the contractor to adhere to the sizing criteria. For example, maximum friction loss, maximum duct velocity, etc.
c. Air Handling Units: Provide ½” x 1’ scale plan and elevation drawing of AHU’s. For very large AHU’s, smaller scales may be used. Show all specified features including AHU doors, windows, magnehelic gauges, filters, coils, UV lights, fans, dampers, minimum doors widths and heights, minimum or maximum AHU geometries, etc. Show pipe and duct layouts. Show all room conflicts including the elevation of overhead structures.

6. Engineering Notebook: For large or complex projects or when requested by UNC, provide during design and with the as-builds a digital engineering notebook containing information requested by the University such as specific calculations.

D. Manufacturer’s Installation Instructions
   1. Equipment and components shall be installed in accordance with the manufacturer’s installation instructions including all “optional” and “recommended” installation instructions. Optional and recommended requirements must be incorporated into the project documents. Omission of optional or recommended installation instructions must be approved by Engineering Services.
   2. The manufacturer’s installation instructions shall be available on the job site at the time of inspection and start-up.

E. Submittals
   1. Submittals shall include a copy of the relevant written specifications. For each specification section and subsection, the submittal shall indicate either “complies” or “deviates” and with explanation. The specification shall precede the product information.
   2. Submittals shall contain the manufacturer’s installation instructions.
   3. (Note to the Construction Manager: Plumbing and Mechanical Submittals must be provided to Engineering Services at the time of review.)
   4. Provide an exploded view parts drawings with part numbers with the equipment submittals.

F. Training
   1. The contractor shall provide on-site training to University staff prior to occupancy or acceptance.
   2. For capital projects, contractor shall provide additional classroom or factory training for new Building Automation System, environmental cold rooms, lab air compressors (>50 hp), vacuum pumps (>30 hp), non-potable water treatment systems, high purity water systems, etc. The designer shall specify the appropriate training required through coordination with UNC Engineering Services.
   3. The contractor shall submit training schedules, training syllabus, and resumes of the person(s) giving the training to the University for review and final approval.
   4. The designer shall provide a complete list of all required training in the general or commissioning sections of the mechanical and plumbing design documents.
   5. Training shall not be scheduled until the installation is complete and verified by UNC Engineering Services. Requests for training must be provided to UNC’s training coordinator at least two weeks prior to the event. Requests must include a detailed syllabus, times, names and affiliation of instructors, and a specific meeting location (e.g., room number).
   6. At the completion of each training agenda, attendance records shall be distributed to the University.

G. Equipment O&M manuals
   1. Provide hard copies of the wiring diagrams within the O&M manuals and at the equipment.
   2. Provide an exploded view parts drawings with part numbers within the O&M manual.
   3. Provide a detailed and complete wiring diagram.

H. Turn-over documents
   1. Projects shall turn over digital copies of approved submittals including TAB reports, final approved fire, and sprinkler as-builds, controls as-builds, and approved equipment and other approved submittals.

I. Procedures during Construction
   1. General
a. New equipment installed under the project scope of work shall be cleaned and in new condition at the time of acceptance. Reused equipment shall only be used if specified and approved and shall be cleaned and in some cases, rebuilt.
b. Cleaning solutions or anything other than water shall not be discharged to the storm sewer system.
c. Spare parts shall be turned over to the owner via the UNC construction manager.
d. The contractor shall be responsible for maintenance until the O&M manuals are delivered and approved by Building Services and training is complete.
e. Warranty: Contractors standard 1-year warranty starts at the beneficial occupancy of the area accepted.

2. Requirements for operating HVAC equipment during construction
   a. Building must be fully enclosed, including installation of all doors, windows, etc.
   b. If construction is still generating dust, use 100% outside air when possible and when conditions for freezing coils do not exist. If return air is to be used then all exhaust and return ducts/grilles shall be covered with temporary filter media, minimum MERV 8, to prevent dust infiltration into the ducting.
   c. All chilled water piping shall be insulated.
   d. Pump and fans shafts shall receive final alignment prior to operation. Laser alignment shall be provided for pumps, and reports shall be furnished prior to operation.
   e. Supply and outside air connections of ductwork to AHUs shall be complete.
   f. All manual dampers, fire dampers and combination fire/smoke dampers shall be open.
   g. All main supply ductwork shall be insulated.
   h. All safety circuits and basic control functions shall be active and fully functional. If the equipment may operate without a fully functional BAS, then means to prevent damage to ducting due to closed dampers and means to prevent damage to freezing coils shall be provided. Blow-out doors may be used to protect ducting. Until TAB activities commence, fans and pumps shall operate at no more than 70% of estimated design capacity.
   i. Conditioning (cooling & dehumidifying) of the building shall remain once started.
   j. Final approval of UNC is required prior to starting AHUs for temporary operation.
   k. Cover outside air intakes with 1” roll filter media.
   l. The contractor shall perform all required preventative maintenance on mechanical equipment operated during construction and provide documentation in the operation and maintenance manuals of preventative maintenance activities completed during this period.
   m. At the end of the construction period and prior to occupancy, clean the inside of AHUs and replace prefilters one month old. Final filters shall be replaced if
   n. AHU UV lights shall be operational, and filters shall be installed.

3. Cleaning and treating the domestic water system
   a. For all fixtures with aerators, remove the aerator before flushing. After flushing, rinse the aerators and reinstall.
   b. Operate booster pumps to achieve maximum pipe velocity and flushing effectiveness.
   c. With all aerators removed, let the water run through the fixtures for 10 minutes at the highest flow rate.
   d. Forming a protective layer on the brass in the system: Turn on the cold water for all faucets in the building, such that some water flows out for 3 days at low flow. Any flow rate from 2 drips per second to a small “trickle” from each fixture is adequate. Very high flow rates should be avoided because they waste water and, if taken to an extreme, may prevent formation of a protective layer.
   e. Notify the EHS Occupational and Environmental Hygiene Manager when building flushing begins and are complete. Provide the building and the site contact information.
   f. Overflow Pipes: Extend all equipment overflow or blow-down lines to a floor sink or floor drain connected to the sanitary sewer system.
g. For below grade domestic pipe, the designer shall specify cleaning and disinfecting compliant with AWWA and OWASA.

4. Cleaning and treating the hydronic piping
   a. Specify flushing and cleaning for piping systems before they are put into service. Do not utilize building pumps for circulating cleaning fluid to maintain design water velocities for the duration of the test. The building pumps may be used if the seats and seals are replaced prior to building turn-over. Used seats and seals will be returned to UNC HVAC Services. Flush system at 4 fps minimum velocity.
   
   b. For new pipe systems, specify a closed-loop cleaning procedure. The basis of design is Chem-Aqua TB 3-001. Passivate new systems for a minimum of 5 days. Notify HVAC Services prior to flushing. Piping shall be drained and filled as quickly as possible to avoid damage to the passivation layer and subsequent formation of rust. Provide startup pump strainers or temporary pumps during flush and cleaning process. Once the pipe is exposed to water, water shall remain in the piping except for flushing procedures and pipe rework. Air will cause rapid corrosion and rusty water.
   
   c. For modifications to existing pipe systems, the UNC Construction Manager shall place and fund a work order for HVAC Services to test and treat the loop. The contractor shall minimize the quantity of wet pipe that is exposed to air.

   d. Bypass all coils and all heat exchangers during the initial cleaning and flushing process. This to ensure high velocities in piping and to avoid trapping sediments in coils and HX. Prior to completion, flush the coils and heat exchangers and blow-down strainers.

   e. Coordination with UNC Shops
      i. A minimum of 5 working-days’ notice is required for assistance from UNC Shops.
      ii. For large projects, a third party should be considered to monitor of the cleaning and flushing process. The monitor shall act as the owner’s representative.
      iii. UNC Construction Management, HVAC Services and Engineering Services shall be invited to test the water prior to treatment and shall be invited to inspect the system prior to flushing and cleaning. The chemical shall be approved by HVAC Services. Water samples taken at the end of flushing shall be approved by HVAC Services.

5. Protection of the building drainage system: The contractor shall protect all drains from debris entering the drains. Having drains clogged with nuts, bolts, welding debris has been a problem in the past.

J. Testing and Verification

1. General
   a. Should the University or the Designer have any reasonable doubt as to the proper functioning of any equipment installed under this Contract, at any time during the guarantee period; the University and/or Designer has the right to perform any test deemed practical to determine whether such equipment is functioning properly and performing at specified capacity.
   
   b. Specify factory certified start-up and inspection for vacuum pumps, air compressors, pumps, AHUs, fans, boilers, VFDs and water heaters.
   
   c. Provide a complete list of all required factory certified start-up and inspection in the general or commissioning sections of the mechanical and plumbing design documents.

   d. Air and Water Balance (TAB)
      i. Air and water systems shall be tested including all ducts and fire dampers.
      ii. The balancing shall be performed by an independent, certified AABC or NEBB TAB firm.
      iii. At least one AABC or NEBB certified balance specialist with a minimum of 2 years’ experience shall be at the site to perform daily TAB activities.
      iv. TAB activities shall be reviewed by a certified TAB supervisor or Professional.
v. Testing and balancing of air systems shall be performed in complete accordance with the latest version of AABC National Standards for Total System Balance, or NEBB Procedural Standards for TAB Environmental Systems.

vi. Balance reports shall be sealed as accurate by a professional engineer licensed in the State of North Carolina.

vii. The designer shall review and approve the qualifications of the balance specialist and the means and methods of testing.

viii. Air quantities shall be balanced to no greater than +/- 5% of design values for research buildings or critical spaces and +/- 10% for other buildings.

ix. Balance devices shall be equipped with tags, labels and markings recording the following: design flowrate, final setting position, pressure drop when equipped with flow orifices, date of final setting, and TAB Company name. Duct balance damper handles shall be marked with survey tape.

K. New buildings:
   1. ME room requirements
      a. Minimum size: must be able to remove all equipment and skids without the need to dismantle unrelated equipment and systems.
      b. Provide laydown areas around large equipment components adequate for performing repair and replacement.
   2. Provide an office for technicians
   3. Provide a room for MEP stock storage
   4. Owner Project Requirements
   5. Abandoned mechanical and plumbing equipment in the work area shall be removed. This applies to components above the ceiling such as abandoned pneumatic tubes, humidifiers, ducting, conduit, etc. This also applies to equipment in mechanical areas. Consult with Engineering Services if unsure. Specify “return to owner” or to the return to the specific shop. For equipment that is reusable or can be used for spare parts should be considered for return to Building Services.

II. COMMON WORK REQUIREMENTS:
   A. Applicability:
      1. This section applies to both Plumbing and Mechanical trades. The plumbing and mechanical Engineers shall coordinate these requirements with other divisions.
   B. Access
      1. Minimum Clearance Requirements:
         a. Interference with elements of permanent construction:
            i. Clearances around equipment such as skids, pumps, AHU, air terminals, reheat coils, air valves, tanks, PRV’s, Heaters, backflow devices, etc. shall be sufficient to allow inspection, service, repair or replacement without the need to remove unrelated elements of permanent construction such as conduits, pipes, ducts, cable trays, etc.
            ii. Drawing Requirements: Designers shall indicate, on the plans, minimum clear maintenance access for all major equipment including air handlers, terminal units, air valves, fan coils, heat exchangers, boilers, chillers, air compressors, pumps, motors, fans, control valves greater than 3”, etc. This will be indicated with a light, dashed line, or crosshatch, or within detail drawings.
            iii. Clear path: Assure there is an adequate pathway for replacing equipment without requiring removal of permanent walls.
b. **Suspended ceilings:**
   i. All MEP components shall be installed a minimum of 2" or two times the ceiling tile thickness above the top of suspended ceilings systems. (Note: The intent is to allow for ease of ceiling tile removal. Jamming ceilings up against cable trays, ducts, etc. is prohibited.)

c. **Service clearances:** Provide service and replacement clearances as specified throughout this design guideline or as “recommended” by manufacturer’s installation instructions.
   i. Control valves: For valves 3 inches and larger, provide access above the valve of the assembly height plus 12 inches.

2. **Elevation requirements**
   a. **Equipment requiring maintenance must be installed below 13’ elevation above the finished floor.** This applies to pumps, fans, control valves and other controls, coils, terminal units, balance dampers, etc. When exceptions to this requirement must be made, the following requirements shall be followed:
      i. When mounted above 13’ and requiring access from a ladder
         01. Isolation valves located above 13’ elevation require chain operators.
         02. Other equipment mounted over 13’ requires written permission from the Facilities Safety Officer. Engineering Services shall be notified.
      ii. For equipment mounted over 15’ elevation, the project will provide an access platform, fixed ladder, extension ladder or scissors lift.
         03. Extension ladders require adequate floor space for a 1:4 slope and may require a ladder holdoff for resting the ladder upon.
         04. Fixed ladders over 20’ require an intermediate platform.
         05. Fixed ladders over 24’ require a fall arrest system.
   b. **Access platforms:**
      i. Detailed elevation and plan drawings shall be provided for all required access platforms. Large equipment such as high plume fans and double stacked AHU’s shall have approved access platforms that provide safe access to all components that may require inspection, repair, replacement, servicing, or removal.
      ii. Alternating stair treads are prohibited.

3. **Access doors**
   a. All serviceable equipment (smoke dampers, fire dampers, control dampers, duct smoke detectors, fans, valves, coils, terminal units, pumps, filters, isolation valves, clean-outs, junctions, etc.) installed behind an inaccessible finished surface requires the installation of suitable access doors. Ensure that access is not blocked by conduit, wire trays, ductwork, etc. Access doors shall be labeled indicating the equipment housed within.
   b. Refer to “HVAC Air Distribution” for additional requirements for duct access doors.

C. **Means for Equipment Replacement:**
   1. Provide a means for lifting and removing heavy motors and pumps when the following is met:
      a. Equipment over 150 pounds which may not be reached with a portable engine hoist. Portable engine hoists extend up to 8’ elevation and are rated for 150 to 500 pounds depending upon the lift height and required extension of the boom.
      b. Equipment over 8 feet elevation above the floor and more than 70 lbs.
   2. Means for lifting and removal may include monorails, jib-crane, and 5000 lb. rated eyehooks and structure.
   3. When attachment points are over 13’ elevation, lifting chains or other structure must be extending to below 13’ elevation.

D. **Sound:**
   1. Specify maximum sound requirements for all equipment that may create nuisance sounds levels.
E. Motor Requirements

1. General requirements
   a. Insulation shall be a minimum of NEMA class F with Class B temperature rise.
   b. Motor service-factors shall be a minimum of 1.15 in an ambient temperature of 40 °C maximum.
   c. Motors ½ hp and larger shall be served by three phase electrical service. Provide single phase protection for multiphase motors. For motors ½ hp and larger, provide 480 VAC power when available.
   d. Enclosures for motors shall have hinged covers. Bolt on covers are not acceptable.
   e. For frames 284 or larger, bearings shall be capable of lubrication. Extend grease lines to an accessible location. For frames 140T - 280T, bearings shall be capable of lubrication or equipped with double shields. Fractional horsepower motors may have sealed bearings.
   f. Base plates for motors shall be constructed to NEMA standards and shall have a minimum of 2 belt tensioning bolts.
   g. Terminations for motors 5 hp or greater shall made with split bolts wrapped with a layer of glass tape and then black electrical tape. (Note: proprietary connectors present servicing challenges.)
   h. Specify that all motors conform to the latest IEEE or NEMA standards relating to characteristics, dimensions, tolerances, temperature rise, insulation, and ratings for noise and vibration.

2. For motors 1 hp and larger
   a. The following manufactures are approved: Baldor Super-E EM/XE (general purpose family) with cast iron frames. TECO/Westinghouse ASHH or Max-PE, WEG W22, or Toshiba. In cases of shipping delays, severe duty and IEEE 841 motors shall be considered.
   b. Motor frames and end-bells shall be cast iron for motors 1 hp and larger. Rolled steel frames and aluminum end bells are not acceptable.
   c. Specify premium efficiency motors, as defined by NEMA MG-1, for all motors 1 hp and larger.
   d. Belt drives shall be equipped with fixed pitch sheaves.

3. For motors equipped with VFDs
   a. Motors shall meet the requirements of NEMA MG-1, part 31 “Definite Purpose Inverter-Fed Motors”.
   b. Provide solid shaft grounding rings (Aegis SGR or equal). Soft carbon brushes shall not be accepted. Split grounding rings shall not be accepted.

F. Variable Frequency Drives

1. Location
   a. VFDs shall not be installed within or fed from MCCs. VFDs shall be fed from electrical panels.
   b. VFD’s shall be mounted to stands or walls. VFDs shall not be mounted inside or directly to AHU casings.
   c. VFDs shall be located as close as feasible to the motor controlled and in accordance with manufacturer’s installation instructions.
   d. Show the location of VFDs on the drawings.
   e. When possible, VFDs should not be located outdoors. When necessary and approved by UNC Engineering Services, outdoor installations may be considered, but should be covered and protected from rain to allow for maintenance during adverse weather and should be protected from direct sun exposure.
   f. For any VFD located out of site of the equipment served, provide a disconnect within sight of the equipment served. Disconnections shall be equipped with auxiliary contactors and wired to the VFD enable circuit. When the disconnects are in the open position, the VFD’s must be disabled through the safety circuit. (note: This eliminates the possibility of a hard start when the disconnect is closed.)

2. Approved brands and labeling requirements
a. Only the following brands are approved: ABB, Danfoss, and Schneider. No other manufacturers will be accepted.
b. VFDs shall bear the original and approved manufacturer’s label and shall not be re-branded.
c. It is preferred that the entire project provide VFDs of one brand. This is typically accomplished through specification of an owner preferred alternate brand.

3. Harmonic Mitigation
   a. Provide an IEEE 519-2014 (or most recent version) analysis. For typical buildings, the total harmonic distortion shall not exceed 5%. For buildings with sensitive research or medical equipment, the total harmonic distortion shall not exceed 3% on both normal and emergency power. The VFD manufacturer shall provide mitigation as part of the VFD package. (The designer may specify the harmonic mitigation method).
   b. The method of mitigation must be provided to the owner for approval (either through submittal or design review).
   c. Specify a dV/dT filter if the motor is greater than 50 hp.

4. Features
   a. Bypass circuit: Bypass circuits are required when it improves system operational reliability and when the motor will not be overloaded at synchronous speed. Bypass circuits are not typically provided for fan arrays.
      i. Bypass circuits shall operate independently from the VFD drive module, i.e. the bypass shall provide motor functionality with the drive module removed. The bypass shall have a power supply separate from the VFD. The bypass shall automatically respond to the BAS start and stop commands when operating in bypass.
      ii. Bypass package shall include a main input circuit breaker, disconnect, or fused disconnect.
      iii. Bypass shall include a service switch or line isolation contactor to disconnect power to the drive, but not the bypass.
      iv. Drive and bypass package shall be UL listed and have a labeled, short circuit current rating (SCCR) of 100,000 amps.
      v. Start, stop, speed reference, and safeties to the drive are hard wired. Provide a LonTalk or BACnet compatible transceiver, whichever is compatible with the building for BAS diagnostics.

5. Redundancy
   a. Provide one VFD to serve each motor. Serving multiple motors from a single VFD should be avoided or discussed with Engineering Services.

6. Miscellaneous
   a. VFDs must go into fail safe mode during generator testing.
   b. Provide a schedule /s for VFDs indicating equipment ID, equipment served, location, HP, minimum rated output amps, volts, phase, UL enclosure type, bypass (if equipped), input disconnect means (circuit breaker or fused disconnect), etc.
   c. Micro-drives can only be considered for motors 1 hp and lower. A minimum of 3% input impedance or harmonic mitigation is still required but is not usually a feature of micro-drives.

7. VFD to Motor Wiring:
   a. General:
      i. Shall be specified in section 23.
   b. Intent: The intent of the VFD to Motor Wiring standard is:
      i. Load side wiring shall be shielded.
      ii. Load side wiring shall resist corona discharge.
      iii. Low impedance grounding shall be provided for conducting high frequency ground currents that commonly occur in load-side VFD wiring.
iv. Load side wiring shall not induce currents in instrumentation wiring.

v. Special inspections are required for load-side wiring.

vi. Two grounding systems shall be provided.

c. Acceptable load-side wiring:
   i. Individual conductors
   ii. Approved VFD cable
   iii. See below for requirements

d. Conductor insulation
   i. The use of THHN wire is prohibited.

e. Shielding
   i. The power conductors and primary ground conductors shall be encased in a continuous electrical shield.
   ii. The ends of the shielding system shall be grounded to the VFD ground bar and the motor conduit box.
   iii. Shielding shall be provided by either metallic raceway or shielded VFD cable.
   iv. When utilizing metallic raceways as the shield, continuous shield continuity shall be provided between the terminations at each end. To maintain continuous continuity, raceway components shall be connected with grounding bushings, grounding straps or other wiring techniques.

v. Bonding of primary ground conductors to the shield system is prohibited except at the VFD ground bar and motor. Ground conductors shall not be bonded to load-side junction boxes.

f. Grounding
   i. Two separate grounds shall be provided.
      1. The primary ground is shielded (as described above) and is installed between the VFD ground bar and the motor ground termination. The shield is bonded to the ground at both ends.
      2. A secondary ground is required and will be installed to bond the motor frame or skid framing to the building ground system such as the ground bar within a panel or building steel. When using the skid as the ground termination, the motor frame shall be bonded to the skid. The secondary ground system may daisy chain between multiple motors and skids.

   ii. The minimum size of the primary grounding conductors shall be the same size as the power conductors. For 25 hp and larger, the ground conductors shall be a minimum of 200% of the load conductors, i.e. two full size ground conductors or equivalent. For 40 hp and larger, the ground conductors shall be a minimum of 300% of the load conductors, i.e. three full size ground conductors or equivalent.

   iii. The primary ground conductors must not have intermediate connections to the shield system such as at junction boxes. (Note: if in doubt to what this means, inquire with Engineering Services)

g. VFD Cable:
   i. Cable shall have low capacitance and impedance design.
   ii. VFD cables shall be terminated per the manufacturer’s installation instructions.
   iii. Cables shall meet or exceed 600V UL 1277 Type TC-ER, 1000V UL 2277 Type WTTC, IEEE 1202.
   iv. VFD cable conductors shall be XHHW-2 or RHW-2 circuit conductors rated at 90 ºC wet/dry.
   v. Cables with armor such as stainless-steel braid, may be installed outside of a raceway, but cables installed in air plenums shall be enclosed in raceway or shall be plenum rated.
   vi. Basis of Design: Less than 40 hp - Belden Classic VFD Cable. Greater than 40 hp- Belden Symmetrical Classic VFD cable. Other brands may be considered.
vii. VFD cable ground wires, drain wires, shielding and armor shall only be grounded at the VFD and the motor. Any of the above ground system must NOT be bonded to disconnects and will be isolated from disconnects with cable insulation, shrink wrap, or other approved means. (note - do not bond ground system to the shield system except at the ends)

viii. Cables shall be equipped with a PVC or equivalent jacket.

ix. VFD conductors shall be constructed from fine, tinned copper strands.

x. Cables with 2 AWG and smaller conductors shall be equipped with a braided armor and copper foil shield. Cables larger than 2 AWG shall have a minimum of copper foil shielding.

xi. Specify round cable geometry for liquid tight connections.

h. Inspections:
   i. Each contractor installing VFD to motor wiring shall schedule and conduct a special inspection for the (Engineer, Owner or CxA) to inspect a minimum of one, complete VFD to motor wiring installation.
   ii. The inspector will select the specific installation to be inspected.
   iii. The contractor shall make visible for inspection the terminations at the VFD, at the motor, at any intermediate junction boxes and the terminations of the secondary ground system. The contractor shall open devices as needed to complete the inspection.
   iv. For large projects, inspections shall be completed by the Engineer or the third part CxA.

8. Startup, training, and warranties
   a. Factory Start-up: Specify a factory certified start-up and certification. (The factory certified start-up extends the warranty for ABB brand drives). The VFD manufacturer shall provide a factory certified technical representative to inspect the contractor's installation, to test and start-up the VFD's and to provide a certification letter. The factory representative shall review the project requirements for VFDs (specifications and drawings) and shall document in the certification letter if the project requirements are fully met or shall identify any requirements that are not met. The certification letter shall describe and document the actual start-up, training, and certification effort.
   b. Training: A representative of the VFD manufacturer shall provide on-site training. For large projects, provide factory training in addition to on-site training. The owner has the option to or not to attend training.
   c. Warranty: The VFD and bypass warranty shall be 24 months minimum from the date of startup and shall cover parts, travel, labor, and shipping required for repair. The manufacturer shall provide factory direct warranty and support service.
   d. Accessories: Provide all required cables and copies of software required for adjustment of all user adjustable parameters. Provide one Installation and Operations Manual and wiring schematic per VFD at the time of training.

G. Controls furnished by the original equipment manufacturer (OEM controls)
   1. BAS Controls: The Building Automation Controls vendor typically provides controls for HVAC components and for monitoring other equipment controlled by OEM controls.
   2. OEM Controls:
      a. OEM controls are typically provided for domestic booster systems, air compressors, vacuum pumps, water purification systems, DX (direct expansion) refrigeration equipment including packaged DX AHU’s and DX split and mini-split systems, proprietary energy efficiency equipment, and other proprietary and novel equipment.
      b. The BAS controls may monitor and provide a start-stop or other controls signal to OEM controls. In such cases, a BACnet interface may be required. Consult with Engineering Services.
      c. OEM controls shall be the standard or premium offering and shall not be value engineered. Engineering Services and the Director of Building Services have complete authority to determine the
required components of the controls system which may include optional touch-screen control interfaces, optional safeties, and redundant controls.

d. Provide a back-up copy of the programming software, ladder logic and database for all controls.

e. The OEM shall provide three controls manuals and two complete sets of cables or other communication devices for interfacing with the controls.

f. The OEM shall provide as part of the equipment submittal a detailed and complete written equipment sequence of operations in English text. This written sequence of operations shall be reviewed and approved by the Engineer and Engineering Services. The written sequence of operations shall be of adequate detail to fully understand the operation of all sensors, actuators, and controlled devices with reasonable detail to allow for thorough equipment commissioning, complete troubleshooting, and repair by University staff. Ladder logic diagrams and other controls diagrams may be provided by do not qualify as a written sequences of operations.

g. The OEM shall provide as part of the equipment submittal a detailed and complete wiring diagram.

h. OEM controls shall be warranted for a period of 4 years for parts, labor, travel, and shipping. Warranties shall cover component failures and failures to perform the approved sequence of operations.

i. For large equipment, Engineering Services may choose to specify and provide BAS controls logic for equipment typically controlled by OEM controls. The Director of Building Services and Engineering Services shall both approve this controls approach. In such cases, the Engineer should discuss with the UNC Project Manager any impacts upon their responsibilities, fees, or project delays.

j. The OEM shall provide spare copies of the control program. Exception: if the OEM states in writing that the controls program is proprietary and not provide to any customers.

H. Electrical Requirements

1. The division 23 engineer shall coordinate compliance with these requirements with the division 26 engineer.

2. Division 23 and 26 coordination: The division 26 Engineer shall specify 120 VAC controls circuits for powering division 23 control panels. 120 VAC circuits shall terminate in locations near the control panels served. The division 26 designer shall show the 120 VAC termination point on the electrical drawings. The division 23 controls contractor shall provide necessary step-down transformers and shall field route low voltage power from the 120 VAC termination point to the equipment served. The division 23 and division 26 engineers shall coordinate these requirements.

3. Controls panels shall not contain wiring more than 24 volts. An exception is that terminations more than 24 volts shall be segregated, covered, and/or provide with finger-safe terminals.

4. Roof Mounted Equipment
   a. For equipment located on roofs or locations prone to lightning strikes provide:
      i. Disconnect switches shall be heavy-duty safety switches equipped with integrated, factory wired and UL-listed surge protection devices. For 30 amp and higher, Eaton DH heavy duty safety switches and SP1 and CVX surge protection devices are approved.
   ii. Lightning grounding rods

5. Disconnecting means furnished integrally with equipment shall be properly sized and fused or protected by a breaker.

6. Starters
   a. For starters located adjacent to the motor served, provide combination starters with a magnetic starter and integral disconnect
   b. Specify with integral control transformers, solid state thermal overload protection, 120-volt coils, low voltage protection, indicating pilot lights (neon or LED type), hand-off-automatic switches and all necessary auxiliary contacts. Starters shall be UL508 listed for the available short circuit current. All starters, including skid mounted starters, shall be NEMA rated. IEC rated starters are not acceptable. Specify phase loss protection and adjustable overloads.
7. Design Document Requirements
   a. Equipment schedules shall indicate electrical power requirements.

I. Painting and Identification
   1. Exterior equipment.
      a. Equipment, ducting, and piping installed on the exterior of the building shall blend in with the building. Specify appropriate paint colors and coordinate with the architect.
      b. Equipment mounted exterior to buildings and in highly visible to students and staff may require approval by the Building and Grounds Committee. Discuss aesthetic impacts of equipment with the UNC Project Manager.
   2. Equipment Identification
      a. Equipment for each building shall receive a unique equipment ID. Equipment ID’s shall start with an alphabetic abbreviation of the equipment type followed by a consecutive number system starting with "1". When the equipment is on numerous floors, indicate the floor in the numbering system. For example, for VAV air terminals on a 9-story building, floor one will be VAV-101, VAV-102, VAV-103, ... For floor nine, VAV-901, VAV-902, VAV-903, ...
      b. Equipment shall be clearly identified with engraved phenolic plates securely fastened to the equipment with sheet metal screws. Specify phenolic plates with tag and letter colors in compliance with the SCO electrical design guidelines. Indicate the equip ID number. When appropriate, such as for exhaust fans, indicate at the fan/s and the equipment served or system served, panel number, and breaker number.
      c. Concealed equipment: All equipment requiring periodic maintenance or testing located in concealed spaces shall be clearly identified on an adjacent finished surface to identify the location of equipment. For equipment mounted above ceilings, provide an ID label on the ceiling below the equipment. Typical concealed equipment includes air terminals, air valves, PRVs, mixing valves, duct and pipe differential pressure sensors, steam traps, fire smoke dampers, etc. Labels shall be clear or white with 0.375" high black letters affixed to the ceiling.
   3. Pipe and Duct Identification:
      a. Identify piping and ducting with the labels listed below. At each label, identify the direction of flow.
      b. Identification shall be provided no further than 30 feet apart at major changes in direction, at each valve or equipment, and on both sides of penetrations.
      c. Label pipe and ducts with text of a size and color that is easily readable from floor level. For pipe, text height should be roughly 1/3 to ½ the actual diameter of the pipe including the insulation. For duct, text should be at least 2” in height.
      d. Completely paint piping systems or utilize colored PVC jackets in mechanical rooms with the applicable colors listed below.
      e. When accessible, identify exhaust duct at each floor level and at roof level with the exhaust fan ID and device served or exhaust system name.

Table 1: System labels and colors

<table>
<thead>
<tr>
<th>System</th>
<th>Pipe and duct labels</th>
<th>Jacket color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ductwork</td>
<td>supply, exhaust, return, outside air</td>
<td>N.A.</td>
</tr>
<tr>
<td>Chilled Water</td>
<td>CWS/CWR</td>
<td>dark blue / light blue</td>
</tr>
<tr>
<td>Process Chilled Water</td>
<td>PCWS / PCWR</td>
<td>dark green / light green</td>
</tr>
<tr>
<td>Heating Hot Water</td>
<td>HWS / HWR</td>
<td>orange / yellow</td>
</tr>
<tr>
<td>Steam, Low Pressure (0-15 psi)</td>
<td>LPS</td>
<td>dark red</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th></th>
<th>MPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam, Medium Pressure (16 - 75 psi)</td>
<td>dark red</td>
</tr>
<tr>
<td>Steam, High Pressure (&gt; 75psi)</td>
<td>HPS</td>
</tr>
<tr>
<td>Steam Condensate Return</td>
<td>MPSC, MPSC, HPSC</td>
</tr>
<tr>
<td>Domestic Cold Water</td>
<td>DCW</td>
</tr>
<tr>
<td>Domestic Hot Water</td>
<td>DHW</td>
</tr>
<tr>
<td>Domestic Hot Water (RECIR)</td>
<td>DHWR</td>
</tr>
<tr>
<td>Non-potable Water</td>
<td>NPW</td>
</tr>
<tr>
<td>Purified water</td>
<td>RO / RODI / DI</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>NG</td>
</tr>
<tr>
<td>Vacuum</td>
<td>VAC</td>
</tr>
<tr>
<td>Compressed Air</td>
<td>AIR</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>N</td>
</tr>
<tr>
<td>Helium</td>
<td>He</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>H</td>
</tr>
</tbody>
</table>

Notes:

1. "R-O" is RUST-OLEUM color

4. Valve identification
   a. Control valve identification:
      i. Control valves shall be tagged with vinyl or other approved tags that will last the life of the valve.
      ii. Mark the tags with the following: equipment or branch served, design gpm, installed CV, fail position (FC, FO, FLP), installation date, and installer’s name/company. When applicable, provide other key information such as measured differential pressure or valve characteristic.

b. Balance Damper Identification:
   i. Balance dampers shall be identified and labeled.
   ii. For ease of locating the balance dampers, orange survey ribbon shall be hung from unexposed balance dampers such as when above ceilings or in chases.
   iii. Balance damper shall be labeled with the following information on a vinyl tag, permanent adhesive label, or other approved means: design flowrate, final set position, date, balancers name/company.

c. Balance valves identification:
   i. Balance valves shall be tagged with vinyl or other approved tags that will last the life of the valve.
   ii. Mark the tags with the following: equipment or branch served, design gpm, final set position (if applicable), final measured differential pressure, date, and TAB contractor name.
   iii. The following should also be notated on the tag: balance valve brand and model, measured pressure drop at design flow, when applicable, installed cartridge or orifice size.

d. Isolation Valve Identification
   i. Isolation valves shall be clearly identified in the design drawings on both the pipe layout drawings and the pipe schematic drawings.

e. Other specific labeling requirements:
i. Expansion and hydropneumatics tanks: Identify the final set pressure on the tank. This may be done with a vinyl maintenance tag or other permanent means.

J. Insulation and Vapor Barriers

1. Pipe and Duct General Requirements
   a. Thickness: Insulation at accessories and fittings shall be at least the same thickness as the adjoining insulation.
   b. Continuity: Insulation at hangers, sleeves and penetrations shall be continuous with adjoining insulation.
   c. Components that require access: Pipe and duct accessories that require access for periodic inspection, maintenance, repair, or replacement and that are insulated shall be easy identifiable or labeled with a maintenance tag. At these locations, insulation shall be easily removable and re-installable without damage to the insulation. On major projects, accessories should be insulated with form-fitting, clam-shell insulation shells or removable insulation wraps.
   d. Thermal and vapor barriers:
      i. Insulation shall provide an adequate thermal and vapor barrier to prevent condensation under all operation conditions including start-up.
      ii. Insulation shall be provided on surfaces that may give off excess heat such as heating hot water converters, air separators, valve bodies, etc.
   e. Equipment labels: Equipment labels shall be visible. Insulate around equipment labels or affix equipment labels exterior to the insulation.
   f. Insulation damage: The Contractor shall replace all insulation that absorbs water during the construction period. (Note: this especially applies to fiberglass and calcium silicate insulation.)

2. Piping
   a. Insulation
      i. Fiberglass insulation shall not be used on chilled water piping or other surfaces below 55 °F.
      ii. Insulate the body of the roof drains and piping a minimum of 10 ft. into the building.
      iii. Insulate cooling condensate drains. Insulate sanitary sewer drains exposed to air that are primarily conducting cooling condensate.
      iv. Insulation should be per Table 2 below:
   b. Insulation Jackets
      i. Corrugated aluminum jacketing or PVC jacketing is required on insulated piping at the following locations: in mechanical rooms from floor level to 8 ft. above finish floor, inside of AHUs, exterior to the building, at any location prone to damage.

Table 2: Approved Insulation types

<table>
<thead>
<tr>
<th>Service</th>
<th>approved insulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCW / DHW</td>
<td>fiberglass or elastomeric</td>
</tr>
<tr>
<td>interior roof leaders and overflow piping</td>
<td>fiberglass or elastomeric</td>
</tr>
<tr>
<td>(note 2)</td>
<td></td>
</tr>
<tr>
<td>chilled water &gt; 40 °F (note 1)</td>
<td>Polysisocyanurate foam (nominal 2 lb./ft³), Phenolic Foam, elastomeric, or cellular glass (see requirements below)</td>
</tr>
<tr>
<td>HHW</td>
<td>fiberglass, cellular glass, or calcium silicate</td>
</tr>
<tr>
<td>LPS and MPS</td>
<td>fiberglass, cellular glass, or calcium silicate</td>
</tr>
<tr>
<td>HPS</td>
<td>cellular glass or calcium silicate</td>
</tr>
</tbody>
</table>
3. **Ductwork**
   a. The interior of ducts shall be smooth to avoid trapping dust and shall be a cleanable surface.
   b. **Duct Liner:** Lined duct are generally not permitted. The use of sound attenuation liner shall be approved by Engineering Services.
   c. Specify rigid insulation for ductwork installed in mechanical rooms from floor level to 8 ft. AFF. Ductwork installed in mechanical rooms shall be with 8 oz. canvas lagging, minimum or PVC.
   d. Externally insulate all exposed supply, return and outside air ducts with rigid fiberglass insulation.
   e. Provide continuous insulation on supply duct at joints and throughout duct system from cooling coil to supply air grilles. Insulate all equipment including reheat coils, diffuser necks, fire dampers, and flexible connections.
   f. Insulate the following duct systems in entirety:
      i. **Outdoor air duct**
      ii. **Supply duct**
      iii. **Supply diffusers including the neck and back of the housing**
      iv. **Return ducts in areas that noise may be a problem such as large rectangular ducts within ceiling plenums of occupied areas and exposed rectangular duct in occupied areas.**
      v. **Return duct in mechanical rooms where the duct may take abuse.**
      vi. **HVAC plenums and unit housings not pre-insulated at factory.**
   g. Insulate each ductwork system with one of the following:
      i. **Rigid Fiberglass:** 2" minimum thickness.
      ii. **Flexible Fiberglass**
      iii. **Cellular Glass**
      iv. **Flexible Closed Cell Insulation (elastomeric)**

K. **Pipe and Fittings**
1. **Grooved Pipe Requirements**
   a. Approved uses:
      i. **Grooved piping is approved for use on equipment skids, AHU coil connections, and pump installations or for the following:**
      ii. **When fittings are accessible for inspection and future replacement, the following uses are allowed only when approved by Engineering Services:**
         01. Installed in mechanical rooms and other easily accessible areas, or
         02. For limited work where there are issues with obtaining hot work permits.
         03. For limited work that requires very short outages.
         04. For limited work where access limitations greatly impact the ability to perform welding, brazing, or soldering.
   b. **25-year warranty:** The warranty shall cover the following:
      i. Reasonable labor, material, and costs to repair or replace failed warranted product and any part of the mechanical system damaged because of the failure of the warranted product.
ii. Reasonable labor, material, and costs to repair or replace parts of the building (such as finishes, furniture, cabinetry, MEP equipment, etc.) damaged as a direct result of the failure of the warranted product.

c. Inspection Services: The manufacturer shall provide inspection services and provide a report. The manufacturer shall visually inspect 100% of all fittings prior to insulation. The report shall state the quantity of fittings of each size and type that are installed, the number that meet the visual inspection criteria, the number that did not initially meet the visual inspection criteria, and detail corrective actions taken for fittings that did not initially pass. Any fittings that could not be inspected due to access or other issues must be individually noted and brought to the Engineer’s attention. Fittings that pass shall be marked with a permanent means. Fittings that fail shall be temporarily marked with ribbon or other means.

d. Contractor training: The manufacturer shall provide training and certification for each installer of grooved fittings for the Project. The contractor shall maintain a training record and make it available upon request. Only installers receiving training and certification specific to the Project may install grooved fittings on the Project.

e. Approved brands: Victaulic. (no other approved brands). Specify as an owner preferred brand alternate. The base scope will be welded, brazed, or soldered.

2. Copper and steel press-fitting requirements

   a. Approved uses:
      i. Press-fittings may be used when approved by Engineering Services, and
      ii. Typically, only used on small projects or limited scope of large projects, and
      iii. Is allowed for work where there are issues with obtaining hot work permits, or
      iv. Is allowed for work that requires very short outages, or
      v. Is allowed when there are access limitations that greatly impact the ability to perform welding, brazing, or soldering.

   b. Approved Brands: Viega. (no other approved brands). Specify as an owner preferred brand alternate or change-order. The base scope will be welded, brazed, or soldered.

3. PEX-A

   a. May be used on cold and cool water systems.
   b. Requires approval of Engineering Services on heated systems. Will not be approved for high-rises.
   c. Shall have a 25-year warranty
   d. Pipe and fittings shall be stored indoors. Pipe and materials shall not be stored or installed in direct sunlight.
   e. Fittings and pipe shall be provided by the same manufacture.
   g. 25-year warranty: The warranty shall cover the following:
      i. Reasonable labor, material, and costs to repair or replace failed warranted product and any part of the mechanical system damaged because of the failure of the warranted product.
      ii. Reasonable labor, material, and costs to repair or replace parts of the building (such as finishes, furniture, cabinetry, MEP equipment, etc.) damaged as a direct result of the failure of the warranted product.
   h. Contractor training: The manufacturer shall provide training and certification for each installer of PEX-A for the Project. The contractor shall maintain a training record and make it available upon request. Only installers receiving training and certification specific to the Project may install PEX-A on the Project.
   i. For large projects, provide the owner one set of installation tools complete for the sizes provided on the project.

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L. **Meters and gauges**
   1. Hydronic pressure gauges exposed to vibrations or condensation shall be liquid filled.
   2. When providing pressure measurement on each side of equipment, specify a single gauge connected to both sides and equipped with isolation valves for measuring either side independently with the same gauge.

III. **PLUMBING SYSTEMS**

   A. **General**
   1. Every mechanical room shall have a minimum of one hose bib. For large mechanical rooms, provide at least two hose bibs.
   2. Piping dead legs are prohibited. During renovations, dead end piping should be removed to within six inches of mains (or what is appropriate).

   B. **Plumbing Fixtures**
   1. **General**
      a. Lead-free: Any pipe, fitting, or plumbing fixture intended to convey or dispense water for human consumption shall be certified to NSF-61 Annex G or NSF372.
      b. Pipe layout: Domestic water services intended for human consumptions such as serving food areas, breakroom sinks, and water fountains so that the water supply has a high rate of turn-over to assure high water quality. This may be accomplished by serving a bathroom group downstream of the services intended for human consumption.
   2. **Water Closets and Urinals:**
      a. Specify the following Owner preferred brand alternate for flush valves and electronic actuators: Shall be Sloan, Zurn, and American Standard. (Note: coordinate this requirement with the architect.)
      b. Automatic flush valves shall be wired or hydro-generated and equipped with side-mounted operators. Battery powered operators are prohibited. Manual flush valves are preferred in situations where automatic are unnecessary.
      c. **Water closets**
         i. Flush valves shall be rated for 1.6 gpf in older buildings that may have pitted or poorly sloped drain pipes. 1.28 gpf are acceptable for new buildings especially if there is adequate diversity to keep the main drain flushed clean. (Notes: Dual-flush valves and low flow valves are prohibited due to maintainability. Dual-flush valves require increased maintenance. Low flow from toilets may result in increased sanitary sewer clogs due to pitted or improperly sloped drainpipes.)
         ii. The flush valve and china shall have a MAPP rating of 1000 or greater.
      d. Urinals: China and flush valves shall be rated for 0.125 gpf.
   3. **Faucets:** Specify low-flow lavatories with faucet aerators.
   4. **Bar Sinks:** Sink drains shall be a minimum of 1 ½”. (Note: do not specify bar sinks or any sink with smaller drains which tend to not drain well.)
   5. **Showers:** Specify low-flow showers with single handle that enables off/on and temperature adjustment. Consider the basis of design as Delta Low flow shower head or equivalent with 1.4 GPM at 45 psi, 1.5 gpm at 80 psi, single spray function, with large water droplets with a full spray pattern (H2O Kinetic technology or equivalent).
   6. **Floor sinks and Drains**
      a. Within a 2' radius of floor sinks and drains, slope the floor downward 1/8" per foot towards the drains. (note - this is especially important for floor sinks)
b. Floor sinks and floor drains shall be slightly recessed below the floor. The contractor shall reinstall any floor sinks which is higher than the surrounding floor surface. Prior to the pouring of concrete floors, floor sinks and drains shall be secured and anchored into place.

c. For new construction, provide recessed floor sinks or hub drains for each source of equipment condensate. Verify the elevation of floor sinks and secure prior to pouring.

d. Provide floor sinks in areas prone to flooding and for the collection of condensate.

e. Provide floor drains which require removal of the cover with a "special tool" or by qualified staff.

f. Floor sinks for exterior stairwells, if required, shall be a minimum of 4" with a minimum 12" x 12" x 6" drain well with grate-type cover.

g. Provide trap primers for floor sinks and drains.

7. Mop Sinks
   a. Provide one mop sink per floor.
   b. Flooring in the vicinity of the mop sink shall be waterproof. Sealed concrete is preferred.
   c. Protect walls from water damage with a splash guard from the mop sink to 12” above the faucet and 6” horizontally past the mop sink.
   d. Mop sinks shall be located near the front of janitor rooms to avoid being blocked by items being stored.
   e. Mop sinks shall be centrally located on the floor plan for convenient access and service to the entire floor.
   f. For very small buildings with a single mop sink, locate the mop sink on the ground floor in a central location or near the elevator.
   g. Provide a smooth drain grate mounted nearly flush to the mop sink to facilitate cleaning.
   h. Mop sinks shall be solid construction. Hollow fiberglass construction is prohibited.

8. Water Coolers
   a. Condensing unit: Condensing units should be accessible from the front of water cooler and in same enclosure. Remote mounted condensing units are prohibited. Shall not be recessed into areas with poor room airflow. Shall be installed with the manufacturer’s recommended clearances for air flow.
   b. Bubbler bounce: To assure adequate and stable water supply pressure, shall be installed with a minimum of ½” piping and piped so that the actuation of flush valves does not influence the bubbler height.
   c. Specify electric water coolers equipped with bottle filling stations and equipped with water filters.
   d. Specify as the basis of design Elkay EZH20 LZSTL8WSLK for the bi-level and EZH2O LZS8WSLK for the single bottle filling units. The equivalent Halsey Taylor model is approved.

9. Sinks: For areas using large quantities of bleach, such as BSL3, BSL2+ labs, HIV labs, etc., sinks and drains shall be compatible with bleach. Stainless steel is not acceptable for frequent use with bleach.

10. Mixing valves: Mixing valves shall be installed below ceilings.

C. Isolation Valves
   1. Provide isolation valves on piping branches.
   2. Separate piping services for similar spaces: For each specialty lab and for each bathroom of a bathroom group, pipe separately from other similar rooms to allow for plumbing repairs without affecting adjacent spaces.
   3. Restricted access: For spaces with restricted access, the isolation valves should be located outside the room.
   4. Gate valve installation: When installed in horizontal pipes, only install with the stem horizontal.
   5. Butterfly valves: Shall be lug-style capable of removing the piping on either side without impacting the functionality of the valve.

D. Plumbing accessories
   1. Dielectric unions are prohibited. Specify dielectric flanges or IPT to copper sweat dielectric transition fittings (Victaulic series 647 or equivalent).
E. **Backflow prevention:**

1. Service entrance domestic backflow protection
   a. Provide **dual**, parallel backflow devices (RPZ) to protect the building domestic supply.
   b. At a minimum, back flow devices shall meet OWASA guidelines.
   c. **Backflow devices capable of dumping water (RPZs):**
      i. Install in a location that may not flood the building such as an exterior hotbox or heated, above grade room that only opens to the exterior.
      ii. In unusual cases, when RPZs are in a room that opens to the interior, RPZs must relieve to a funnel drain connected directly to the exterior. The funnel drain must not be equipped with a backwater valve. Provide an exterior concrete gutter or other means to conduct relief water 4' to 10' away from the building foundation and coordinate with University landscape architect. Provide a recessed floor sink. Slope the floor towards the drain. Provide a concrete curb or trench drain at the interior door. Walls shall masonry or concrete to be capable of withstanding the splashing of water. Seal the floor and the walls to an elevation of 6". Seal the room airtight with respect to the rest of the building and provide a door sweep to prevent a negatively pressurized building from drawing exterior air through the relief drain.
   d. Backflow devices requiring maintenance shall be less than 5' above the floor.
   e. Backflow valves shall not corrode, and the bodies must be constructed of bronze, stainless steel, epoxy coated cast iron, etc.

F. **Pressure reducing valves**

1. The use of pressure reducing valves should be minimized. For example, do not equip every floor of a boosted building with PRV's.

G. **Water Conservation**

1. **Domestic water shall not be used as a primary cooling source.**
2. Use of domestic water for back-up cooling should be monitored by the BAS with a flow switch and a make-up water meter.
3. When domestic or reclaim water is used for back-up cooling, approval from Engineering Services is required.
4. For numerous equipment requires a means of chilled water backup (such as many cold rooms in a single building), consider a single domestic branch pipe serving this equipment with a single switch over valve and monitor flow with the BAS.
5. Vacuum pumps shall be utilized for sources of vacuum. Domestic water shall not be utilized to create an aspirated vacuum.

H. **Plumbing Equipment**

1. **General**
   a. Also refer to the sections “O&M Manuals” and “Controls Furnished by the Original Equipment Manufacturer (OEM controls)” in section I – “General Requirements” of this design guideline.
   b. Provide isolation valves on both sides of all equipment that requires periodic replacement such as PRVs, meters, pumps, coils, tanks, heat exchangers, etc.

2. **Vacuum Pumps**
   a. Vacuum pump style and features shall be selected to provide minimal water usage.
   b. Liquid ring vacuum pumps shall be equipped recirculating sealant water.

3. **Air Compressors and Air Dryers**
   a. Provide 25-micron filters and pressure regulators with isolation valves on each side.
   b. Locate in an accessible location and not located behind the equipment.
   c. Provide two-foot clearance on all sides.
   d. Provide washable condenser filters.
   e. Screw compressors are required for large size building compressed air systems. Scroll are required for medium sized compressed air systems.
f. For lab air systems, provide an exterior service connection for connecting to adjacent buildings. When possible, pipe to the adjacent building.
g. For large compressed air systems, air compressor receiver tanks shall provide a total minimum capacity of 4 cft per scfm of compressor capacity. Provide N+1 receiver tanks with a set of isolation valves for each.
h. Desiccant Dryers:
   i. Provide a wet and dry storage tank on each side of the air dryers.
   ii. For desiccant dryer final filters, provide audible alarms, alarm signal to the BAS, and a 4" differential pressure gauge. Alarms shall be powered by 120 VAC, not battery powered.

   a. In closed loop systems equipped with DI beds, provide a resistivity meter in the return piping.
   b. Provide pressure gauges and sample ports on both sides of each filter and component.
   c. For large systems, RO pretreatment is required. Provide a single, centralized RO system with redundant features.
   d. Design centralized systems to produce Type 4 (200 KOhm) water. Users will provide and maintain point of use polishing systems. In special circumstances, Type 3 water system may be considered although this substantially increases the maintenance costs for the Facilities Services. Type 3 water systems will normally involve RO followed by EDI or DI serving a tank. The building occupants will provide and maintain all components designed to produce water of higher purity than type 3.

5. Sump Pumps
   a. Elevator shafts:
      i. Elevator shafts shall be provided with sumps and sump pumps piped to the sanitary sewer.
      ii. For hydraulic elevators, sump pumps shall be equipped with oil-minder features.
   b. Monitor the alarm status with the BAS. At a minimum provide alarms for high-level, component failure, and oil detector if required. The controls shall be installed within a MEP room.
   c. For large sumps, provide top mounted suction pumps.
   d. Submerged pumps:
      i. For submersible sump pumps mounted in sumps exceeding 7 feet in depth, lifting rails and hardware shall be stainless steel.
      ii. Provide means for lifting the entire assembly out of the sump and provide adequate lay down space for maintenance procedures.
      iii. All pump components in a chemical waste pump system shall be corrosion-proof. Typically provide stainless steel pump bases, mounting yokes, check valves and gate valves.

6. Domestic Booster Pumps
   a. Each boosted system shall be equipped with a hydrodynamic storage tank.
   b. There is a preference for nonproprietary motors; split coupling that allows for seal replacement without removing the motor, stainless steel baseplate and stand, flanged pipe connections, lug style butterfly valves, type 304L stainless steel piping, reversible headers.
   c. Provide a touch-screen interface with graphics, trending, and alarm functionality.
   d. Provide nonproprietary controllers and controls hardware. Provide a 5-year controls warranty.
   e. Provide discharge pressure demand controls. Controls shall comply with AHRAE 90.1.
   f. Provide stainless steel pressure transducers.
   g. Specify the following owner approved brand alternates: Hyfab and SynchroFlo.
   h. Provide a minimum of 5 years of free, factory technical support.
   i. Expansion and hydropneumatics tanks: Specify the set pressure in the equipment schedule. Specify for the TAB contractor, CxA or mechanical contractor to mark the final set pressure on the tank. This may be done with long-life maintenance adhesive label, vinyl maintenance tag or other permanent and legible means.
7. Pressure reducing valves: Avoid excessive use of PRV’s. Install isolation valves on each side of PRV’s.
8. Ice Machine Hookups: At the location of each ice machine (owner or contractor furnished) provide isolation valves, 25 micron in-line filters, braided stainless flex connectors on the supply water, and when required, a pressure regulators. Coordinate with the architect to locate the filter and isolation valve in an easily accessible location, such as on the wall beside the ice machine, but not behind the ice machine. Having good access to the isolation valve and filter is critical to the service person.
9. Cage and rack washers and bulk cleaning equipment: Drain piping and fittings shall meet chemical waste requirements and shall be corrosion proof. Cast iron pipe and fittings are prohibited. (note: the neutralizer for extreme pH cleaners sometimes runs out and the piping system fails). Consider Orion PVDF or similar. Pipe the drain to the chemical waste pipe system. If a chemical waste pipe system does not exist, provide chemical resistant drain piping to a point where adequate dilution will occur to protect the building drain system piping.

IV. SPECIALTY EQUIPMENT

A. Electric snow-melt system
   1. The snow-melt system shall be connected to the BAS and equipped with a replaceable moisture / temperature sensor and remote on/off.

B. Ice Machines
   1. Provide one foot of clearance in the rear and two feet of clearance on each side. Show this service clearance on the design drawings even if the equipment is owner furnished.
   2. Specify washable condenser filters.
   3. The following brands are approved: Hoshizaki, Follett, or Manitowoc.
   4. Refer to the plumbing design guidelines for requirements for ice machine hook-ups.

C. Critical lab freezers
   1. This applies to -80°F freezers.
   2. For each designated freezer space, provide both 120 (NEMA 5-20R) and 208 VAC receptacles.
   3. For buildings with more than 10 freezers, specify an additional space for temporary rental freezers.
   4. Freezers shall be fed from a panel backed up by the emergency generator.

D. Autoclaves, Sterilizer, Cage washers, and Glassware washers
   1. Cage washers and autoclaves shall be equipped with optional water conservation features whether owner or contractor furnished.
   2. Refer to the plumbing requirements for cage and rack washers.
   3. Leaks shall not be capable of escaping the autoclave room. Slope the floor to a floor sink. When it is not possible to slope the floor, other measures are required such drain pans, curbs at doors, epoxy floors and coving. Drain pans shall stainless steel.

E. Fume Hoods
   1. The sides of fume hood must be at least 1 foot from room corners. (Note: this is to reduce turbulence at the constrained side of the fume hood which can impact the final face velocity setting and energy efficiency.
   2. Provide laminar flow diffusers for any diffuser within 10’ of fume hoods.
   3. Install intake screens to prevent wipes from sucking into the exhaust system which tends to foul air valves.
   4. Occupancy sensor must have an indicator light which indicates the occupancy mode.
   5. If there is a chance that the lab supply air may fail and impact opening of doors, specify a “failure mode” in which exhaust terminals reset to a reduce flow rate to allow for exiting. For such situations, specify that the CxA perform commissioning testing to determine the appropriate reduced exhaust flow rates to allow for safe exiting.
V. MECHANICAL PIPING SYSTEMS AND EQUIPMENT

A. Installation requirements
1. Pipe layout: To prevent the build-up of sludge within coils, all pipe branches serving coils shall NOT connect to the bottom of horizontal mains. Connecting to the sides or tops of the horizontal mains is acceptable. Provide detail drawings capturing this requirement.
2. Pressure gauges: Provide a combination pressure and vacuum gauge at the highest point in the system and show on the riser schematic drawings.
3. When coils hook-ups utilize combination isolation valves and strainers, provide additional isolation valves where the coil run-out branches from the main.
4. Provide a line-sized, bypass around all coil and HX hookups which allows for full flow flushing of the branch piping. Equip with full-port isolation valves.

B. Piping Accessories:
1. Valves
   a. Gate valves: Shall be installed with stems in the horizontal position.
   b. Butterfly valves shall be fully lugged and equipped with resilient EPDM seats. For Hot water applications, seats shall be peroxide-cured EPDM. Disks shall be stainless steel or corrosion proof materials. Basis of design: Siemens Resilient Seat Butterfly Valve.
2. Gauges
   a. For heat exchangers, install hydronic pressure gauges to allow for measurement of the differential pressure across the tubes and across the strainer. Install isolation valves on each sensing line. Hydronic pressure gauges are not required across reheat coils or coils under 60 kBTU.
3. Air vents:
   a. Provide manual vents at high points.
   b. The use of automatic air vents is not permitted except at the air / dirt separators.
   c. Provide an air vent at the top of all upward flowing risers. Provide an air vent at the end of long horizontal runs. Show these on the riser diagrams.
4. Drains
   a. Provide a dirt leg and blow down valve at the bottom of all accessible risers and at the end of horizontal runs. Show this on the riser diagrams.
   b. Drain and dirt leg valves shall be full port, line-size for pipe up to 1" and a minimum of 1" for larger pipe. The outlet of drain valves shall be equipped with hose threads and a full pressure rated cap with chain.
   c. Each closed loop must be equipped with a main drain and piped to a sanitary sewer drain to permit flushing.
5. Pressure relief
   a. For heating hot water systems, the pressure relief pipe shall be piped and drain at a visible location such as to the side of the floor drain.
6. Dielectric unions:
   a. Dielectric unions are prohibited. (Note: These are prone to leaking due to expansion and contraction and subsequent damage to the union seat.) Specify dielectric flanges, nipples or IPT to copper sweat dielectric transition fittings ( Victaulic series 647 or equivalent).
7. Flexible connectors
   a. Spherical, elastomeric pipe vibration isolation fittings shall not be installed in locations where connector failure could flood the building. In such locations, braided steel vibrations isolation connectors may be used. Braided steel vibration connectors shall never be installed in tension or compression.
8. Air / Dirt Separators
a. Air and dirt separators shall be the high efficiency, coalescing type. Spirotherm, B&G – CRS, Armstrong DAS and Thrush Aar-O-vent are approved. Separators shall be at least the size of the pipe served. Separator media shall be corrosion proof. Provide an oversized blow-down valve.

9. Chemical feeders
   a. All closed loops shall be equipped with bypass chemical feeders equipped with integral filter socks.
   b. Basis of design: Neptune model FTF-5150DB. The feeder shall have a minimum of 3.5” opening, shall have a threaded and sealed closure, and shall be rated for a minimum of 300 psi and 200 °F, shall be corrosion proof, closure seals and seal housings shall be designed for long-term reuse, shall be equipped with legs to elevate the feeder off the floor, and the filter bag shall be fully supported by a corrosion-proof filter basket. (This is necessary to standardize filters for campus and ensure the treatment tablets fit into the feeder opening).
   c. The pot feeder with integral filter must be installed across the pump or supply and return lines (one line on suction side of pump and the other line on discharge side).

10. Make-up meters and flow switches
    a. Provide a totalizing water meter for the make-up water for all closed loops. Basis of design: Assured Automation WM-NLC. The optional pulse output is required for large systems and shall be monitored by the BAS.
    b. As an alternate to the optional pulse output, provide a make-up flow switch (e.g., McDonnell & Miller FS5-3/4 or equal) and connect output to the BAS. Flow shall trigger an alarm.

11. Flow balance valves
    a. For hydronic flow balancing, specify the B&G Circuit Setter Plus or Circuit Setter Flo-Setter II or equivalent. Balance valves shall be designed for clog-free operation.
    b. Flow balance valves shall be equipped with differential pressure measurements ports. Flow measurement curves or charts shall be provided with the O&M documentation.
    c. Automatic (autoflow) balance valves are prohibited.
    d. Combination balancing/shutoff valves shall be independent and using the shut off function shall not affect the system balance when the valve is reopened.
    e. Butterfly valves are not acceptable valves for flow balancing.
    f. In most cases, balance valve should be set to a minimum of 1.0 gpm to avoid plugging of piping and small orifices.

C. Closed loops design requirements
1. Heating hot water coils shall be sized for 160 °F supply temperature and 130 °F return temperature.
2. Freeze Protection
   a. For systems prone to freezing specify a minimum of 28% inhibited propylene glycol solution. (glycol solutions below 25% accelerate microbial growth)
   b. Provide an automatic glycol make-up tank system for all glycol loops. Provide a make-up water meter and alarm contacts for BAS monitoring. Basis of design:
      i. Large systems: Advantage Controls Model DAGF-1B Glycol Feed System with standard 55 gallon poly tank and stand, .3.3 GPM @ 100 psi positive displacement pump (or sized as required), digital controls, low level switch with audible and dry contact alarms, pressure relief valve, NEMA 4X enclosure with viewing window, digital pressure sensor and standard pressure gauge, budget price 2019: $3,796.
3. Provide a strainer and analog water totalizing meter for makeup water supplies. See the “piping accessories” section for make-up meter requirements.
4. Specify a quarterly pasteurization sequence to open control valves to flush coils. For the heating hot water system, heat the system 170 °F and flush each pipe branch and coil by full opening the controls valves for a
D. **Pumps**

1. **General**
   a. Approved pump brands are B&G, Taco, and Armstrong.
   b. Pumps 5 hp and larger shall be base-mounted, flexible coupled or split coupled vertical inline.
   c. Pump mechanical seals shall have ceramic stationary seats.
   d. A single pressure gauge with isolation valves to provide suction pressure, discharge pressure, and differential pressure shall be installed on all pumps.
   e. 24” service clearances shall be provided on all sides of pumps.
   f. Isolation valves shall be provided on the inlet and outlet of pumps.
   g. Pumps shall be serviceable without removing the volute from piping connections.

2. **Alignment for Flexible Coupled Pumps**
   a. For pumps 10 hp and larger, a factory certified technician shall field align flexible coupled pumps three times: prior to the connection of the piping, after the pump is fully installed, and after start-up.
   b. Align pump and motor in the vertical angular, horizontal angular, vertical parallel and horizontal parallel. Alignment shall be within the recommended values specified by the pump manufacturer (not the coupler manufacturer) but not over 0.002” parallel and 0.005” angular per radius-inch.
   c. All results of the alignment procedure and the pump manufacturer’s alignment specifications shall be submitted for review and approval.

3. **Pump efficiency**
   a. Specify on the pump schedules the minimum pumping efficiency at the design condition and for pumps over 5 hp, the minimum pump PLEV efficiency based on the AHRI Standard 550/590 “IPLV” load profile, 30% fixed head or calculated minimum control head.
   b. The pump efficiency at 100%, 75%, 50% and 25% of flow rate and the associated system differential pressures shall be submitted for review.

E. **Heat Exchangers**

1. Provide a means to isolate the heat exchanger for inspection, maintenance and replacement while keeping the primary loop pump operating. Typically, two heat exchangers or bi-pass piping is provided. Provide two heat exchangers for large systems that require uninterrupted service. Piping shall be configured so that the redundant heat exchanger may remain in service while one heat exchanger is being repaired or replaced.

2. **Steam fired, Shell and tube heat exchangers**
   a. Clearance shall be provided to pull the tubes from shell and tube heat exchangers without the need to remove the shell from the piping. The clearance shall be marked on the piping drawings. Provide an additional 12” pull clearance.
   b. Steam shall not impinge upon the tubes. The end of the shell should have an area without tubes for the steam to enter. (commentary: condensate in the steam can quickly damage tubes.)
   c. Return water shall enter in the lower tube port.
   d. Specify low leakage head gaskets such as by Flexitaulic ZG or equivalent.

3. **Plate and Frame Heat Exchangers:** Provide line-sized connections for back flushing.

4. **Process cooling**
   a. Buildings equipped with closed loop chilled water piping separate from the campus chilled water system, shall not be cross connected with the campus chilled water system. (Note: The building closed loops are treated with nitrate-based chemicals which are not compatible with the campus chilled water loop treatment chemicals.)
   b. If there is any chance of campus chilled water entering a building cooling loop, for example if an emergency bypass is installed around a heat exchanger, then the process loop needs to be treated with non-nitrate chemicals such as phosphates. This is a very unusual situation. In such cases,
provide a placard which reads, “Do not treat with nitrate-based chemicals. Treatment chemicals must be compatible with the campus chilled water loop”.

F. **Boilers**
   1. The following minimum access clearance shall be provided: 24 inches on all sides and 36 inches on the burner side.
   2. Specify IRI approved gas trains on all boilers.
   3. Specify boiler controls to provide heating hot water year around.
   4. Specify factory certified start-up and inspection

G. **Building Steam Systems**
   1. **General**
      a. This section covers steam piping between the building steam meter and the main building condensate receiver.
      b. When available, steam will be used to produce heating hot water and domestic hot water. Coils for heating air will be served by heating hot water (not steam).
   2. **Construction Inspections**
      a. Piping shall be inspected prior to insulation by the Engineer. Engineering Services shall be invited to all pre-insulation piping inspections. Proper pipe slope and weld quality shall be verified.
   3. **Piping**
      a. Steam and condensate piping shall slope in the direction of flow. Under no exceptions will the pipe be installed with dips or back-sloping with one exception: steam pipe serving control valves shall slope back to the drip or main.
      b. Steam and condensate piping 2 inches and smaller shall be schedule 80.
      c. Steam piping and accessories shall be compliant with ASME Standard B31.9 Building Piping systems.
   4. **Piping accessories**
      a. Isolation valves, strainers, blow down valves and other components after the building steam PRV shall be a minimum of 150 # class.
      b. Strainers: Strainers in horizontal steam piping shall be installed pointing to the 3:30 position (slightly down from horizontal). Strainers in condensate piping shall be pointed down (6:00 position).
   5. **Main PRV’s**
      a. Each building steam service shall be equipped with a stream PRV and safety relief valve. Deviations require approval by both Facilities Engineering Services and Energy Services Cogen.
      b. The basis of design for steam PRV’s is the Spence type-E main valve with type D pilot.
      c. Steam PRV’s shall be a minimum of 250 # class.
      d. Drip pan elbows are prohibited. Pipe steam vent drains to a building sanitary drain.
   6. **Insulation**
      a. F&T, bucket traps, isolation valves, steam control valves, strainers and PRV’s shall be insulated in accordance with manufacturer instructions with removable, insulation jackets meeting the following requirements: Jackets shall be removable, preformed thermal jackets by Thermaxx or equivalent with a minimum 5-year warranty for materials and labor, silicone jackets, jacket edges sewn with Kevlar thread (not stapled), jacket secured with Velcro or equivalent and/or straps. Specify damp and wet location jackets when required. Provide resilient tags on the jacket exteriors identifying the device and when specified, device ID’s.
   7. **Control valve installation**
a. Provide drip legs before control valves to protect control valve seats from wiredraw. For short pipe runs serving control valves, the run-out may come off the top of a main and the drip leg may be omitted. Slope steam supply piping back towards the drip or main from the control valve to the.

8. Traps and trap assemblies
   a. For coils supplied with modulated steam, locate steam traps a minimum of 12 inches below the coil condensate outlet. Exception: When shorter distances are required, the Engineer shall thoroughly review and approve the selection of the trap and orifice sized based on the actual installed gravity head.
   b. Trap assemblies shall be equipped with a dirt pocket and blow down valve, two isolation valves, a strainer with blow down valve, two unions, and trap test valve. The Engineer shall provide a trap installation detail drawing for approval.
   c. Dirt pocket blow down valves shall be installed on the side of the dirt leg, 2" up from the bottom. Provide piping to direct the blow-down towards an impervious surface (usually downward) and in such a way that building materials will not be damaged during blow-down.
   d. Test valves shall be installed on a Tee immediately downstream of the trap. Specify ½” ball valves with locking handles and hand-tight caps on the discharge pipe. Direct towards the floor in a visible location.
   e. When the use of test valves is not possible such as when traps are installed above ceilings, provide steam condensate site glasses
   f. Excessively oversized and undersized traps must be avoided.
   g. Specify F&T traps downstream of modulated coils or heat exchangers. Specify Barnes and Jones, Armstrong or Spirax Sarco pressure balanced bellows or F&T traps for drips less than 75 psi.

9. Condensate
   a. Steam condensate from equipment served by modulating steam control valves shall drain by gravity and shall not be lifted.
   b. Contaminated steam condensate shall direct to a cooling vessel and then drain to sanitary sewer. Uncontaminated steam condensate shall return to the condensate receiver.

10. Flash Tanks
    a. Vented flash tank shall be provided to cool condensate prior to entering the condensate receiver

11. Condensate receivers:
    a. Condensate receivers shall be the elevated style. Standard elevation receivers may be accepted only when there is not substantial pipe elevation to provide gravity condensate drains.
    b. To provide longer equipment service life, there is a preference for 1750 rpm motors over 3600 rpm motors.

VI. HVAC SYSTEMS
A. General Requirements
1. UNC-CH standard HVAC system is centralized, variable volume air handling units with hot and chilled water coils and serving VAV terminal units with hot water reheat coils.
2. HVAC systems should be of heavy commercial/industrial quality and designed to provide reliable service for 40 years or more.
3. HVAC systems should be centralized and should minimize maintenance needs and maximize reliability.
4. HVAC coils should be sized with excess capacity to maintain proper temperature and humidity levels with potential future increases in cooling load and coil fouling. Design for up to 20% increase in outside and supply airflow.
5. The HVAC systems shall provide reliable positive pressurization to the building.
6. Ductwork shall be externally insulated. Duct liner anywhere in the system is not permitted unless approved by Engineering Services during design development.
7. Return air shall be fully ducted unless approved by Engineering Services during the design development phase.
8. The use of non-centralized fan powered devices such as fan powered terminal units and fan coil units are typically prohibited in occupied spaces. Institutional grade fan coils may be considered for renovations under limited circumstance and when served by outside air makeup units.
9. Design HVAC systems which provide air change effectiveness greater than or equal to 0.9, as calculated by ASHRAE 129-1997.
10. HVAC equipment shall be shown to scale on the drawings. HVAC ductwork shall be shown as “double lined” unless duct diameters are less than 10”.
11. HVAC systems serving animal holding areas and spaces requiring uninterrupted HVAC, shall have a minimum of two manifolded AHUs with isolation dampers so that the HVAC will continue to operate at design capacity during AHU maintenance.
12. Pressure relief: Specify pressure relief doors when fans are capable of rupturing ducts and equipment casings.
13. Cooling equipment larger than 30,000 BTU must be floor mounted.
14. Recirculation of air from break rooms, mechanical rooms and print/copy rooms is not permitted.

B. Spaces with special considerations
   1. Server and IT Rooms
      a. Provide independent cooling separate from the central HVAC system.
      b. Sources of water leaks must not be located over server and IT equipment.
      c. Floor mounted fan coils are provided for cooling. Mount fan coils low on a wall as the first choice or mount outside of the room. All possibilities of leaking water onto the telecom equipment must be eliminated. When provided in the telecom room, provide an auxiliary drain pan with auxiliary float switch. Chilled water piping should stub through the wall and directly into the fan coil valve enclosure. Any leaks or dripping shall be contained within the fan coil enclosure and/or drain pans.
   2. Freezer rooms: In addition to providing outside air from the central HVAC system, provide independent cooling equipment. Independent cooling shall be floor-mounted vertical, up-flow fan coils, chilled beams, or radiant panels. Fan coils over 1.5 tons are prohibited from being located above ceilings.
   3. For any spaces with a considerably different thermal loading schedules than most of the building, provide an independent HVAC system. This typically applies to spaces with high process loads or spaces with substantially different occupancy schedules.

C. HVAC Zoning
   1. When serving multiple rooms on a single zone:
      a. HVAC zones should not exceed 700 square feet.
      b. Rooms shall have similar exterior exposures.
      c. Rooms shall have similar schedules and loading characteristics.
      d. If the project does not follow zoning design guidelines, future changes to the zoning layout will be at the customers expense.

D. Design Conditions
   1. Indoor Summer Conditions: 75 °F, 50% RH max.
   2. Indoor Winter Conditions: 70 °F, 30% RH min.
   3. Mechanical Room Conditions: 50-83 °F, 50% RH max.
   4. HVAC systems with high outside air percentages and serving spaces that have critical cooling needs must have capacity above typical ASHRAE design conditions

E. Heat Transfer Coils
   1. General Requirements
      a. Air handlers providing ventilation air shall be designed with a preheat coil, regardless of outside air percentage or the calculated mixed air temperature.
b. Coils shall completely fill unit casing. Do not overlap coils unless required for piping connections.
c. Tube thickness:
   i. For AHU's more than 6000 cfm, coils tubes shall have a minimum thickness of 0.035 inches, and tube bends shall have a minimum thickness of 0.049.
   ii. For fan coils, blower coils, and small AHU’s, specify a minimum of 0.025” thick tube walls.
d. Coils shall be leak testing at 315 psig minimum.
e. The maximum air velocity shall not exceed 500 feet per minute.
f. Headers shall be constructed of copper, brass, or other corrosion proof materials. Steel headers are prohibited.
g. Tube turbulators are prohibited.
h. Evaporative cooling (spray coils) are prohibited.
i. Tube velocity at design conditions shall be a minimum of 2 feet per second at design conditions.

2. Chilled Water Coils (requirements in addition to General Requirements)
   a. Chilled water coils should be designed for 45 °F supply temperature and a minimum of 59 °F return temperature. Cooling coils that have peak demand during the winter shall be sized for 50 °F supply water and a minimum of 62 °F return temperature.
   b. Mechanical schedules for cooling coils shall indicate the following: chilled water velocity in the coil tubes at design conditions, required tube wall and fin thickness, maximum face velocity, special construction requirements, design supply and minimum return temperature, maximum fin spacing and number of rows.
   c. Coil casings, frames, supports, attachment hardware and intermediate troughs shall be stainless steel. For custom AHUs, fasteners attached to stainless components shall be 400 series stainless steel or equivalent performance and zinc plated fasteners are prohibited.
   d. The coil maximum face velocity shall not exceed 450 feet per minute. (note - this is to minimize fan energy and to provide future surplus capacity).
   e. Coils shall have a maximum of eight rows at 10 fins per inch. 11 fins per inch is acceptable when necessary, and 12 fins per inch and higher is prohibited.
   f. Tube velocity at design conditions shall be between 4 and 6 feet per second at design conditions.
   g. For AHU’s, copper tubes shall have a minimum thickness of 0.035 inches and aluminum fins shall have a minimum thickness of 0.0095 inches. Tubes shall be constructed of copper or stainless steel. Fins shall be constructed of aluminum or equivalent.
   h. Coils are sized for 45 °F CWS and 14 °F minimum temperature differential.

3. Steam Coils
   a. UNC’s standard is for heating hot water coils, and steam to air coils should be avoided. Steam coils exposed to air temperatures below 40°F must be a tube within a tube design or other design specifically to avoid freezing.

F. Cooling Condensate and Drain Pans
   1. Drain pans and support framework within the cooling section shall be stainless steel and comply with ASHRAE IAQ standards.
   2. Drain pans shall be stainless steel and intermediate troughs shall be stainless steel. Plastic drain pans may be considered for fan coils. Drain pans shall be sloped and pitched to allow proper drainage. Drain pans for AHU’s should be a minimum of 16 gauge.
   3. Drain pans shall extend at least 6" downstream of the cooling coils, but typically much further.
   4. Drains pans should not be installed above suspended ceilings and shall not be installed above fixed ceilings. Where this is unavoidable, approval from Engineering Services is required and auxiliary drain pans shall be provided and shall be equipped with auxiliary float switches. Auxiliary drain pans shall not interfere with service access to the unit. Equipment shall always be replaceable without the need to remove elements of permanent construction.
5. AHU’s over occupied areas and capable of leaking into occupied areas shall be equipped with an auxiliary drain pan capturing leakage from the entire unit and equipped with a float switch.

6. For walk-in AHUs, drain pans should be protected with aluminum grating.

7. Cooling condensate pumps should be avoided. Provide gravity drains when feasible.

G. **Cooling Condensate Traps**
   
   1. Water shall not stand in drain pans even with loaded filters. The drain lines shall be 1" dia. minimum. Materials of construction shall be copper or schedule 80 CPVC.
   
   2. Condensate shall flow to a sanitary sewer and shall not flow to a storm sewer system including draining on roofs and building grounds. (note - chemicals are periodically used for cleaning the coils).
   
   3. Provide a plugged tee for rodding straight into the drain pan and provide two plugged tees at the bottom of the trap for cleaning. Provide a union on both sides of traps.
   
   4. Slope drain lines ¼” per foot.
   
   5. The total trap height shall be a minimum of 1.5 times the maximum negative differential expected at the drain connection to the AHU plus 1”. The trap weir shall be a minimum of maximum negative differential pressure plus 1” below the AHU outlet.
   
   6. Specify on the coil schedule the minimum height above the trap over-flow (dimension A) and below the trap overflow (dimension B). For draw through AHUs, the "A" dimension shall be at least local maximum static pressure plus 1”, and the B dimension shall be at least ½ the local maximum static pressure.
   
   7. For AHUs base rails heights shall be specified and shall be adequate to allow for trap installation.

H. **Humidifiers**
   
   1. Applicability: Provide humidification for labs, DLAM, and other specialty spaces to provide a minimum of 30% RH or as required by the user.
   
   2. Style: When available for larger applications, humidifiers shall be panel style with horizontal supply and condensate headers serving vertical, dispersion tube. Dispersion tubes shall be insulated.
   
   3. Humidifiers will be supplied by campus steam which will be injected into the HVAC systems.
   
   4. Humidifier installation location:
      
      a. **Humidifiers shall not trip the duct smoke detectors.** In most cases, humidifiers shall be installed after the AHU supply duct smoke detector.
      
      b. **Access to humidifier components that require periodic inspection, testing, repair, or replacement shall be convenient.** Provide portable stairs (roll-around style) or permanent stairs and access platforms for overhead steam humidifiers. Mark on the plans a storage location for portable stairs.
      
      c. If necessary, humidifiers may be mounted within the AHU but must not wet the fans and must not operate when the cooling is operating.
   
   5. Steam and condensate separation chambers shall be provided and shall be installed on the inlet side of the steam control valves.
   
   6. Control Valve: The humidifier steam control valves shall be carefully sized to avoid excessive oversizing and loss of controllability. The humidifier steam control valves shall be tuned including setting the upper limit of the control valve actuator to limit the humidification capacity.
   
   7. Installation features:
      
      a. For duct mounted humidifiers, specify welded stainless-steel ductwork from the humidifier downstream for 2 times the absorption distance of the humidifier. Provide a minimum of 3” deep; double sloped, stainless steel, drain pan integral to the duct extending the entire length of the humidifier section. Provide a drain with valve and pipe to a conspicuous location.
      
      b. Provide a minimum of 10” x 10” sweat-free windows for viewing humidifier operation.
VII. HVAC AIR DISTRIBUTION

A. General Requirements
   1. Location of Air Intakes: Air intakes shall be located to prevent the intake of pollutants, nuisance odors or debris such as automobile and generator exhaust, building exhaust and landscape debris. Intake openings shall be protected with ½” x ½” corrosion resistant hardware cloth installed inside the louver and when necessary, painted to match.
   2. Sound Attenuation: Incorporate necessary attenuation strategies to minimize noise in occupied spaces. ASHRAE’s noise guidelines are the maximum acceptable noise levels.

B. HVAC Ducts
   1. SMACNA: All ductwork shall conform to SMACNA HVAC duct construction standards, metal, and flexible, latest edition.
   2. Insulation:
      a. Internally lined duct is not permitted.
      b. Exhaust or relief ducting installed in unconditioned, ventilated attics and spaces must be insulated if there is a chance of condensation forming on the exterior of the duct.
   3. Duct Pressure Class: When fan total static pressure could exceed 4” w.c., ducts from the AHU to the fire dampers shall be rated for 6” w.c. pressure class.
   4. Flexible ducts:
      a. Bends in the flex duct shall be no less than one duct diameter centerline radius.
      b. Flex ducts shall extend a few inches past sheet metal prior to bending.
      c. Provide hard elbows or three straight duct diameters at diffuser connections.
      d. Flex ducts shall be supported at least every 5 feet.
      e. Flex ducts shall sag less than ½” per foot.
      f. Flex ducts shall be installed fully extended and not in the compressed state (including pinched between other building components).
      g. The hanger material in contact with flexible ducting shall be a minimum of 1.5” wide.
      h. Should not be more than 6’ in length.
   5. Outside air:
      a. Outside air ducts shall be sized for 100% outside air economizer operation.
      b. A separate minimum OA damper is required when the minimum OA flow less is than 25% of supply air flow. The minimum OA damper shall be located above the maximum OA damper.
   6. Pressure drop:
      a. Duct fittings shall not have excessive pressure drops. Consider specifying the maximum allowable pressure drop at critical duct fittings.
      b. Ducts at the intake and discharge of fans shall be arranged to avoid fan system effect.
      c. Angles of divergence of duct fittings shall be less than 30 degrees.
      d. Duct aspect ratios should be less than 4 to 1.
   7. Ductwork Leakage Test
      a. Duct Leakage Testing: 100% leakage testing shall be provided for all ducts rated 4” w.c. or greater. For laboratories, provide 100% leakage testing of 2” w.c. or greater ducting.
      b. Duct Seal Class: Provide SMACNA Seal Class A on all metal duct 2” w.c. or greater. In no case shall the ductwork sealant be less than SMACNA Seal Class B.
      c. Testing shall be completed before the installation of duct insulation. If ducts are insulated prior to leakage testing and leaks are found, the contractor to responsible to remove the insulation from the entire section of the leaking duct, repair the leaks and replace the insulation.
      d. Perform the field leakage tests and inspections according to SMACNA’s “HVAC Air Duct Leakage Test Manual” and prepare test reports.
      e. Do not pressurize systems above maximum design operating pressure.
f. Provide the designer, UNC Engineering Services and UNC Building Services at least seven days’ advance notice of testing.

g. Maximum Allowable Leakage: Maximum leakage shall be 1% of total cfm delivered by the air moving device(s).

h. Remake leaking joints and retest at contractor’s expense until leakage is equal to or less than maximum allowable.

i. For large duct systems, specify a maximum external static pressure that the duct installer must not exceed. If the ESP is exceeded, then high pressure drop fittings must be replaced.

8. Exterior Ducting: Assure water will not pond on horizontal surfaces. Round or oval duct is generally preferred.

9. Clothes dryers: For clothes dryers, provide smooth aluminum or stainless-steel exhaust duct with long radius elbows.

C. Dampers

1. Duct splitter dampers are prohibited.

2. Remote manual balance damper operators should be avoided (they tend to prematurely fail). In areas of hard ceilings, provide accessible manual balance dampers.

D. Fire and Smoke Dampers:

1. A safe means of maintenance access shall be provided for all duct damper actuators and damper access doors.

2. A clear line of site shall be provided for inspection of all damper actuators and fusible links.

3. For conditions with limited access to smoke damper actuators, dampers shall be selected with actuators on the inside of the duct, on the bottom of the duct or on the accessible side of the duct.

4. For access to fusible links, on ducts larger than 14”, provide access doors of a minimum of 144 sin.

E. Duct Access Doors

1. Specify ultra-low leakage doors. (Nailor Industries Model 0800 Type M1 Double Flange Frame for rectangular duct and Model 0895 for round duct, or equivalent). Knock-over tab frames are not permitted. Maximum leakage must not exceed British Standard DW144 Class A, B, and C.

2. Provide a schedule on the drawings specifying the maximum leakage of access doors as follows:

<table>
<thead>
<tr>
<th>duct size</th>
<th>Minimum Door Size</th>
<th>Maximum Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 18”</td>
<td>12” x 6”</td>
<td>0.064 cfm</td>
</tr>
<tr>
<td>18” to 28”</td>
<td>18” x 10”</td>
<td>0.133 cfm</td>
</tr>
<tr>
<td>&gt; 28”</td>
<td>21” x 14”</td>
<td>0.206 cfm</td>
</tr>
</tbody>
</table>

b. Access doors shall be shown on the drawings.

c. For access doors on reachable by ladder, provide a safety chain attaching the door to the duct.
d. Provide grab handles for doors 18\" x 10\" and larger when there is a positive pressure greater than 3\" w.c.
e. Specify gaskets designed for extra long-life.
f. Note: A lower cost alternate to the Nailor Model 0800 is the Ductmate Sandwich Access Doors, but this may require an adjustment to the maximum leakage. For most projects, the Nailor Model 0800 shall be provided.

F. HVAC Filtration
1. Specify 2\" MERV 8 pre-filters and 12\" primary filters ahead of the first coil. Final filters shall be MERV 11 with the exception that labs shall be MERV 14. In walk-in AHUs, filters shall be front-loading. When space is limited or for small AHU's, 6\" or 4\" primary filters may be specified. Small package units may utilize 2\" or 4\" pleated filters as necessary for unit sizing.
2. The filter bank shall be equipped with high quality gaskets and blank-off panels to prevent the by-pass of air around filters.
3. Filters shall be standard sizes, either 2' x 2' or 1' x 2'. Filter face velocities shall be 500 fpm or less.
4. Provide a minimum of MERV 8 filtration upstream of air-flow measurement stations and energy recovery coils.
5. Furnish adequate sets of pre-filters and final filters for all AHUs, so that a complete spare set is provided at the time of project turn-over. Prior to start-up of AHUs, filters shall be installed. For projects of especially long duration, in addition to the initial set and spare set, the contractor shall replace pre-filters every three months or when they become loaded, whichever is less. In addition, pre-filters shall be replaced within one month of turn-over.
6. Primary filters shall be Viledon MV8S, AAF VariCel VXL or equivalent. 12\" primary filters shall be constructed with a minimum of 170 sft of media area per 2' x 2' filter.

G. Outside Air Intakes
1. Louvers must be selected carefully to avoid rain entrainment. Louvers shall be sized to accommodate future increases in design airflow with a minimum of 20% increase for typical occupancies and 30% increase for labs. Entrained moisture must be captured and drained to an appropriate location. Rain must not reach the AHU or filter bank. (Note: rain entrainment is an issue at several outside air intakes)
2. Outside air intakes should minimize the entrainment of snow into the AHU. For 100% outside air handlers, especially for critical applications, snow must not reach the filter bank and trigger a high suction pressure alarm.
3. Moisture from unexpected entrained rain and snow must drain to an appropriate location such as the exterior or a floor drain.

VIII. HVAC EQUIPMENT
A. General Requirements
1. Lightening protection: For equipment mounted outdoors and equipped with on-board controls:
   a. Disconnect device: specify a heavy-duty disconnect switch with integral surge protection devices. Basis of design: Eaton SP1 and CVX series with integrated SPD and viewing window.
   b. Provide loss of phase and brown-out protection.
B. Modular and built-up Air Handling Units and Energy Recovery Units
1. Related Documents
   a. HVAC Air Distribution/HVAC Filtration
   b. HVAC Equipment/Fans
   c. Design Requirements within the General Requirements of this document.
2. Access clearances
   a. Clearance for pulling coils shall be provided. (Note: Show on the plan drawing the coil pull area and denote with a cross hatch. The coil pull will normally be the length of the coil plus 6 inches and the
width of the coil plus 12 inches (or more) on both sides. When walls obstruct coil pull, access openings within walls.

b. Provide a means and a pathway for installing and replacing the air handler modules without major demolition of other systems including building walls.

c. AHU’s may be set with one side close to a wall, but 24” clearance shall be provided where equipment and components requiring access are located.

3. Casings
   a. Casings shall be double wall, insulated sandwich panel construction. Outer wall shall be at minimum 0.040” Aluminum, 22 gauge stainless or galvanized steel. Inner walls shall be .040” aluminum, 22-gauge 304 stainless steel or 22-gauge galvanized steel.
   b. Insulation shall be a minimum of 2” polyurethane for walls, floors, and roof having a “U” factor of no more than .066. Fiberglass insulation and insulation utilizing CFC or HCFC blowing agents is not permitted. 3” wall thickness is required for AHU over 30,000 cfm or when installed on the exterior of the building.
   c. Floor construction: The floor shall be a minimum of 3/16” checker plate aluminum or stainless steel for walk-in custom equipment and 18 gauge minimum for semi-custom and modular AHU’s.
   d. Penetrations shall be insulated, sealed, and sandwiched between metal with equivalent materials to the casing construction.
   e. Lab quality AHU’s panel connections shall use aluminum extrusions with a phenolic resin thermal break for no through metal construction. Intersecting extrusions shall be continuously welded to form an airtight seal.
   f. Major components shall be supported from the unit framework, not the casing.
   g. Units shall be specified to require external connection to all coils, drains, motor power, and ducts. All piping connections shall extend 3” through the panel casing and terminate with either flanges or threaded connections as applicable.

4. Leakage and deflection requirements
   a. Modular AHU’s leakage shall be less than 0.5 cfm per sft at +/- 5” w.c. or less than 1/2% of design airflow at 1.25 times operating static pressure. For specialty applications utilizing modular AHUs and when welded modules are utilized, leakage shall be less than 0.232 cfm per sft at +/- 8” w.c.
      (alternate approach: Specify AHRAE-111 class 6 casing air leakage rate for modular AHU’s.)
   b. Specify air handling units to withstand a minimum of 8” w.c. positive or negative internal pressure, or the fan shut off pressure whichever is greater.
   c. For AHUs greater than 40,000 cfm and all custom AHU’s:
      i. All units shall be factory tested for leakage and deflection at the contractor’s expense. The owner has the option to witness all factory testing.
      ii. All units shall be field tested for leakage at the contractor’s expense. The owner has the option to witness all field testing.
      iii. The casing shall have a maximum casing leakage of 0.5% of design cfm t +/- 10” w.c.
      iv. The casing shall have a maximum deflection anywhere on the casing of L/240 at +/-10” w.c.
      v. Floors shall be fully welded construction.
   d. All pipe and conduit penetrations shall be sealed airtight. After wire is pulled conduit shall be sealed so that air cannot be transferred into or out of the unit.

5. Base rails
   a. For AHUs greater than 20,000 cfm: base rails shall be structural steel or aluminum.
   b. For wet environments and greater than 20,000 cfm, base rails shall be structural aluminum.

6. Doors and Panels
   a. Access doors shall be provided for each section.
b. Doors shall be wide enough to remove replaceable unit components and to allow entry. Minimum door size shall be 24" W x 60" H unless unit height limits the door height. In special circumstances, doors may be a minimum of 16" width. Doors for fan sections of large AHU’s should be extra wide (roughly 30” minimum).

c. **Consideration must be taken to allow for access around UV lights**, humidifiers, and other features which block the door opening. When entry is blocked by UV lights, UV section doors shall be extra wide.

d. Door construction shall match unit casing.

e. Doors shall be perimeter, airtight, with replaceable, ¾" x 5/16" minimum sized, resilient gaskets. Specify automotive style bulb gaskets for custom AHU.

f. All doors shall be installed to open against the greater air pressure. If this is not possibly, equip doors with safety chains and/or latches and warning stickers.

g. Test ports shall be provided in all doors.

h. For custom AHU door closure hardware shall be metal or high strength plastic with three spare handles. For modular AHUs, high strength plastic handles are acceptable.

i. Windows shall be provided in all doors of walk in AHUs. For all other AHUs, windows shall be provided for inspection of UV lights, the fan section, and humidifiers.

7. **Drain Pans**

a. When installed over occupied spaces, an auxiliary drain pan with float switch shall be provided under the entire AHU. An alternative is to install a 2” high metal angle around the AHU and caulk liquid-tight.

8. **Electrical Requirements**

a. Power conductors inside the AHU shall be enclosed within conduit including motor wiring.

b. Pre-wired lights shall be provided in each section for all walk-in units with a single on/off switch. Equip switch with an illuminated indicator which indicates when the lights are on. All 120V items shall be wired to a junction box.

c. **Conduit shall be sealed so that air cannot migrate out of the AHU.**

d. Provide one VFD per fan motor.

9. **Maintenance Requirements**

a. When equipped with motors 20 hp or greater (15 hp for fan walls), an integral rail and hoist or other permanent lifting means shall be provided for motor removal.

10. **Gauges**

a. Differential pressure gauges shall be provided across each filter section, cooling coils, and fans.

b. Pressure gauges shall be sized to provide measurement in 1/10 in. w.c. or less increments.

c. Specify the full scale of pressure gauges. Pressure gauges should be exposed to pressures no greater than 50% to 67% of full scale.

d. Mount pressure gauges on to the exterior of air handler and specify copper tubing. Gauges shall not be mounted in the AHU casing walls.

e. Gauges shall be equipped with on-off-vent valves for measurement of both static pressure at each probe and differential pressure across the probes.

11. **UV Lights**

a. **Specify ultraviolet (UV) lights on the downstream side of chilled water coils. Adequate access shall be provided for bulb replacement.**

b. **UV lamps shall be non-proprietary and available from multiple manufacturers.** Submittals must provide a list of alternate bulb manufacturers (two minimum) with equivalent cross-reference lamp model numbers. Bulbs shall have a coating to contain mercury upon accidental bulb breakage.

c. UV lights shall provide 360-degree UV coverage for increased air treatment

d. Fixtures shall be corrosion proof.
e. Safety switches and safety stickers shall be provided on all access doors immediately on both sides of the cooling coil.

f. Ballast shall be installed on the exterior of the AHU. Ballast shall have a 5-year warranty.

g. The minimum intensity striking any point on a plane representing the surface of the coil or component shall not be less than 50 microwatts per square centimeter and average radiation shall be a minimum of 150 microwatts per square centimeter.

12. Outside air intake
   a. Where space limitations result in inadequate mixing, provide blenders, or direct the outside air and return air dampers at one another.
   b. Outside air ducting shall be sized for full economizer operation.
   c. Provide a separate minimum outside air and economizer damper when the minimum outside airflow is less than 25% of the economizer airflow.

13. Field Service and Equipment Startup
   a. A factory-authorized service representative shall inspect the equipment installation, including piping and electrical connections prior to unit startup. A factory-authorized service representative shall perform startup service.

14. Service features:
   a. For energy recovery units required to operate without interruption, provide a bypass around the coil and filter for providing filter and coil maintenance.
   b. For manifolded AHU’s serving spaces that require continuous supply air, provide means to isolate each AHU for individual servicing and provide adequate redundancy to allow for servicing without compromising system performance.

15. Schedule requirements:
   a. For documentation purposes, optional features and some design guideline requirements must be identified on the schedule including: Coil selection parameters including required tube velocity range, maximum face velocity (air), maximum number of rows and maximum fins per inch, chilled water supply and minimum chilled water leaving temperatures, and maximum water pressure drop; fan wheel minimum diameter, maximum design speed, wheel class, and wheel maximum operation speed (first critical speed).
   b. The schedule must note if the specified cooling discharge temperature includes fan heat.

C. Air Terminals / Air Valves
   1. VAV terminal units shall be ARI certified. The unit casing shall be a minimum of 22-gauge galvanized steel. The damper shall be heavy gauge steel with solid metal shaft rotating in a long-life, self-lubricating bearing. Unit shall be factory leak tested and sealed noting such.
   2. Fan powered VAV terminal units are allowed only with written approval from the University or when matching existing.
   3. Air terminals shall be sized to provide a minimum air flow ring signal pressure of 0.1-inch water column.
   4. For energy savings, the minimum cooling flow rates shall be 30% of maximum air flow unless the design requires otherwise.
   5. Air terminals shall be equipped with an access door or panel between the damper and reheat coil. Additionally, specify an access door after reheating coils.
   6. When internal liner is provided, provide liner which is resistant to mechanical damage, resistant to mold, shall not shed fibers.
   7. Prior to the installation of permanent ID tags, mark air terminals and air valves in a visible location with the equipment identification number using a thick black marker or equivalent and 2”, neat characters. Exception: does not apply for permanently exposed equipment.
8. The designer must coordinate the location of air terminals on the drawings so that safe ladder access is available without moving fixed and heavy furniture. Also coordinate with lights, sprinkler heads, life-safety devices, etc.,
9. On the design documents, provide a division of work detail for control wiring. Identify the transition point from the electrical contractor to the mechanical or controls contractor.

Air terminal schedules shall indicate the electrical requirements.

D. **Reheat coils**
1. To facilitate flushing long runs of new steel pipe and to avoid flushing through the coils, provide a bypass valve between the supply and the return before the coil isolation valves.
2. Size reheat coils for 160 °F supply temperature and 135 °F return temperature.
3. To avoid damage to the synthetic gaskets and seats, components that contain these shall not be equipped with copper sweat connections and shall be equipped with NPT connections.
4. Balance valve should be set to a minimum of 0.5 gpm to keep the coil and components flushed of sediments.
5. Dielectric unions are prohibited at reheat coils and on hot water systems. Refer to the requirements in the accessories sub-section of the piping section.

E. **Fan Coils**
1. Fan coils shall be institutional grade or higher quality and meet the following:
   a. Coiling coil casings shall be stainless steel.
   b. Coils shall have a minimum of 0.025” tube wall thickness. (This is normally an optional upgrade.)
   c. Drain pans shall be stainless steel or other corrosion proof materials.
   d. Equip with 2” filter racks. (This is an upgrade from the standard 1”.)
   e. Fiberglass insulation is prohibited in fan coils equipped with cooling coils and in such cases shall be closed cell insulation.
2. When installed above ceilings, specify an auxiliary pan with auxiliary float switch.
3. Fan coil units and blower coils are not permitted to serve occupied spaces except for (and when approved) renovation projects, housing projects, and equipment rooms. In all cases, a means to adequately dehumidify all portions of the building shall be provided.
4. Fan coils shall not be located above ceilings.

F. **Server room AHUs**
1. For below floor plenums, specify plenum fans. Fan speed shall be modulated to control the plenum static pressure.
2. Individual fans shall each be equipped with its own VFD and motor.

G. **Fans**
1. Fan maximum operating speed: the fan shall be capable of operating at speeds that will provide the following airflow:
   a. Buildings serving administrative and classroom functions: 120% of the design airflow.
   b. Buildings serving laboratories, research, health care functions: 130% of the design airflow.
   c. Specify the minimum fan wheel diameter, fan class and maximum design RPM on the schedule.
2. **Belt Driven Fans**
   a. All belt driven fans shall have a minimum shaft size of 1-1/8”.
   b. Fan shaft bearings shall be capable of relubrication when available.
   c. Each fan shall have the sheaves aligned by contractor prior to start up.
   d. A spare set of belts for each belt driven fan shall be turned over to University at the end of project.
   e. Adjustable motor bases shall be NEMA rated and equipped with a minimum of two belt tensioning bolts.
3. **Bearings**
   a. When necessary, extend bearing grease lines to an accessible location so that bearings may be lubricated with the fan operating. This requirement is necessary when equipment must operate
continuously and bearing lubrication points are not easily accessible without turning the equipment off.

b. Specify long life bearings. Except for small fans, specify L10 at 80,000 hours. For custom AHUs and major fans and when available, specify L10 200,000 hours. This requirement does not apply to motor bearings.

4. Vibration: Fans shall be factory balanced to BV-3 vibration or higher.

5. Flexible connections: Flexible connections shall be stretched tight and without major wrinkles that will contribute to affects upon the fan performance.

6. Ducts: Ducts shall be aligned within +/- 3/8" tolerance with fan inlets and outlets.

7. Access doors: When available as an option, specify hinged access doors (avoid bolt on access panels when possible).

8. System effect: Designs shall minimize the fan system effect due to poor inlet and outlet conditions. On the outlet side of fans, provide 2.5 straight duct diameters for conditions up to 2500 fpm, and 1 additional duct diameter for each additional 1000 fpm.

9. Materials: Fiberglass fan wheels and housings are prohibited. If there is a case where non-metallic is necessary, discuss this with Engineering Services.

10. Airfoil fans should be used whenever possible to improve efficiency. Forward curve fans should only be used on small fans with low external static pressure.

11. When equipping AHUs with multiple fans, specify backdraft dampers.

12. Fan array preferences:
   a. Specify n+1 fans.
   b. Size wheels to allow motors to operate close to 60 hz plus or minus 20 % maximum.
   c. Size fan wheels to allow for the use of 1850 RPM motors (if possible)
   d. Specify one VFD per motor and do not equip with a bypass circuit.
   e. Micro-drives are prohibited except motors 1 hp and lower and which may still require a minimum of 3% input impedance and harmonic mitigation. These features are not typically available in micro-drives.
   f. Drives shall not be mounted directly on the AHU.

13. Critical fans
   a. Fans shall be direct drive, arrangement four.
   b. Fan vibration velocity or balance shall be factory tested, certified. Documentation shall be provided in accordance with the requirements of ANSI S204-05 chapter 8. Specify the maximum, factory test vibration velocities for fan assemblies and/or balance grades for rotors in accordance with the latest version of ANSI Standard 204-05.
   d. All hardware used for the fan assemblies including the mounting to the structure shall be stainless steel.
   e. Extended bearing grease fittings shall be provided in an easily accessible location. Lube lines shall be constructed of Teflon tubes covered with braided stainless-steel jackets and equipped with relief fittings.
   f. The bearing life at the design operating speed shall be a minimum of L-10 at 200,000
   g. High plume lab exhaust fans
      06. The maximum fan assembly vibration velocity shall be 0.05 in/s.
      07. The maximum peak to peak vibration shall be 0.5 mil.
      08. The minimum material warranty shall be 7 years.
      09. The fan plenums intake plenums shall have a maximum duct velocity of 1500 fpm within three duct diameters of the fan intake.
10. Each fan shall be vibration tested before shipping, as an assembly, in accordance with AMCA 204-05. Each assembled fan shall be test run at the factory at the specified fan RPM. Vibration signatures shall be taken on each fan bearing in the horizontal, vertical, and axial directions. The maximum allowable fan vibration level shall be 0.08 in./sec. peak velocity, filter-in, at the fan RPM when the fan is rigidly mounted. If the fan is to be flexibility-mounted, the .08 becomes .10.

IX. BAS CONTROLS

1. Refer to the UNC Controls Standards.

2. The building automation system (BAS) is a BACnet or LON based open protocol system. Consult with UNC Engineering Services regarding which system to use. The UNC Controls Standards are prescriptive in nature. The designer is responsible for editing the controls standards to fit the project scope. The standardized schematic drawings must be edited with changes bubbled. The standardized specification shall be edited in Word format with track changes on for review. Provide the edited digital controls documents to UNC Engineering Services for review. Refer to UNC Controls Preface and Implementation Guidance document for more detailed instructions.

3. The BAS will be a stand-alone system, capable of operating the building by itself. The University requires the BAS to be connected to a central location called the Energy Management Control System (EMCS) located at the Giles F. Horney Building. The project will provide graphics, data trending, scheduling, etc. Refer to the UNC Chapel Hill controls Guidelines.

4. Monitor the following with the campus dial-in monitoring system which is monitored by Public Safety 24-7: lab freezers, environmental rooms, and lift station high level alarms.

5. BAS work room: For new buildings, provide a 12” X 10” enclosed, conditioned room for housing the BAS gateway server, BAS technician workstation and O&M documentation. Refer to the architectural design guidelines for specific requirements.

6. Additional controls requirements
   a. For demolition of existing pneumatic components on a pneumatic system that will remain, specify that all cut pneumatic tubes to be sealed w/ pneumatic plugs. Crimping and taping are prohibited.
   b. The designer must provide a controls valve schedule.

7. Controls Demolition:
   a. The controls contractor shall be responsible for demolition and removal of both digital and pneumatic controls panels, controllers, gateways, devices, conduit, and wiring made obsolete by their replacement with new components included in this project. Demolition of these components shall not be completed by the general contractor.
   b. The controls contractor shall be responsible for removal of points which are no longer used within the controls programming and controls graphics.
   c. Prior to demolition, a UNC controls representative shall be engaged (through the UNC construction manager) to come to the site to coordinate and approve removal of any digital and pneumatic controls panels, controllers, gateways, devices, conduit, and wiring. Demolition of these components shall not begin before approval is received from UNC. If a controls sub-contractor is used to complete the demolition, the subcontractor shall be in attendance with the UNC representative approving controls demolition on site. Any controls infrastructure which is still in use shall not be demolished.
   d. The controls contractor shall be responsible for replacing any digital and pneumatic controls panels, controllers, gateways, devices, conduit, and wiring which has been erroneously demolished which is still in use by UNC.
e. The controls contractor shall be responsible for Notifying UNC EMCS department (through the UNC construction manager) of any obsolete controls systems before they are removed from the UNC supervisor system.

f. A UNC controls representative shall be contacted (through the UNC construction manager) and allowed to inspect and take possession of any existing controls hardware such as controllers, field panels, valves, and sensors prior to controls demolition.

X. **REFRIGERATION EQUIPMENT**

1. Refrigerant isolation valves: Provide refrigerant ball valves at individual components to allow for replacement without the need of pumping the entire system down. This applies to environmental cold rooms, VRF systems or any condensing units that are not equipped with factory isolation valves.

2. Mini-split AC and heat pumps
   a. Approved brands: LG, Mitsubishi, or Trane. Specify LG as basis of design. (UNC stocks LG parts)
   b. Air-cooled condensing units must not be installed indoors. When installed inside, condensing units shall be water-cooled.

3. BAS Controls:
   a. For each mini-split air conditioner the BAS shall monitor the room temperature and equipment alarm output. The BAS shall provide graphics, trending, and an adjustable high room temperature alarm.
   b. For DX AHU, provide BAS monitoring of the following:
      i. General alarm contactor.
      ii. Specify Discharge Temperature Control for units serving multiple zones.
# C-22 – ELECTRICAL and LIGHTING

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I. ELECTRICAL

A. GENERAL

1. Description

This division provides information on basic materials and methods for providing and installing electrical service, distribution, lighting, special systems, communications and controls for new construction and rehabilitation projects at The University of North Carolina, Chapel Hill.

“Interested parties”, as used in the following guidelines include UNC Project Manager, Building Representative and UNC Facilities Services.

2. Applicable Codes, Regulations, and Standards

- The following codes (latest edition) shall apply:
  - National Electrical Code (NEC)
  - The NC State Building Code
  - Occupational Safety and Health Act of North Carolina (OSHANC)
  - Code of Federal Regulations (CFR) 1910.269
- The following standards (latest edition) apply:
  - North Carolina State Construction Office Electrical Guidelines:
  - Underwriters Laboratory (UL)
  - Illuminating Engineering Society of North America (IESNA)
  - National Fire Protection Association (NFPA)
  - National Electrical Manufacturers Association (NEMA)
  - American National Standards Institute (ANSI)
  - Institute of Electrical and Electronic Engineers (IEEE)

Local utility regulations governing connections and metering require an electrical inspection certificate from the State Electrical Inspector, State Construction Office prior to approval for final payment and before energizing any new transformers and electrical service. UNC Engineering Services shall be notified prior to energizing electrical distribution to allow inspection. Adjustable breakers shall be set per designer’s short circuit coordination study and testing completed as specified.

Where the above Applicable Codes, Regulations and Standards conflict with these guidelines; the more stringent of the two criteria shall prevail.

3. Equipment Identification

Prior to energizing, all equipment shall be properly identified with equipment identification, equipment controlled, panel and circuit feeding equipment, electrical ratings, and date of installation. All electrical distribution equipment, including motor disconnects and VFDs shall
have arc flash labeling containing incident energy and arc flash and shock boundaries provided by electrical designer to contractor.

4. Electrical Systems Training and Maintenance Manuals

No training will occur until UNC Engineering Services has approved installation is ready for training. The instruction time periods shall be approved by the Owner and conducted during normal working hours, Monday through Friday, at the job site. Owner’s facilities staff will be trained in proper maintenance and how to operate and make adjustments on all equipment. Training on specialized equipment shall be by manufacturer’s authorized representative. Maintenance manuals and copies of programmed inputs to software shall be provided prior to training. Maintenance manuals shall include project’s manufacturer’s shop drawings and program inputs for control systems, such as lighting dimming systems and emergency load shed programs. The Owner reserves the right to request replacement of any instructor who, in their opinion, does not demonstrate sufficient qualifications as an instructor. Final acceptance of the project will not be given until all specified training is completed.

Contractor shall provide the owner two copies of all red-lined drawings at beneficial occupancy or owner maintenance acceptance of project, whichever is first. One copy shall be placed in main electrical room and one copy in UNC Facilities Services plan room.

5. Acceptance Criteria

Prior to specified training, the Contractor shall conduct the specified operation acceptance test, with 7 days’ notice for witnessing by UNC Building and Engineering Services and the designer of record. Submittal copies of reports documenting all specified tests shall be specified and approved by designer and included in the maintenance manuals.

B. WIRE AND CABLE

- Interior branch circuits serving 120/208, multi-outlet receptacles shall not require greater than No. 10 wire to comply with maximum 3% branch circuit voltage drop. Panels shall be located to accommodate this requirement for maximum voltage drop and maximum wire size. Fully loaded multi-outlet receptacle circuits shall be assumed in sizing wiring for voltage drop on these circuits.
- For open office spaces, where systems furniture is not included in the contract, provide notation on drawings for contractor to coordinate exact locations and number of circuits with individual neutrals required at each location for furniture feeds for receptacles and telecommunication outlets with owner and furniture vendor.
- Furniture and pre-fabricated walls’ circuit wiring shall fully comply with these guidelines and SCO Electrical Guidelines. For example, wiring shall be specified with individual neutrals and green equipment grounding conductor in EMT conduit. Exception for furniture baseboard wiring, which is readily accessible, wiring with individual neutrals and green grounding conductor may be in flexible conduit. Proprietary wiring or conduit connectors are not to be allowed in or for connection to prefabricated walls or furniture. Connectors shall be conventional type for EMT or flexible conduit.
- All conductors, without exception, shall be copper. Aluminum is strictly prohibited.
- Size all neutral wires for 3 phase systems equal to or larger wire size than the phase
conductors. All single-phase circuits shall be provided with individual neutral. Utilizing multi-pole breakers for single-phase circuits sharing a neutral is not allowed.

- No more than three current carrying conductors allowed per conduit, except three single-phase branch circuit conductors, each with individual neutrals, shall be allowed in a conduit.
- MC, AC or “BX” cable is not allowed.
- Do not mix conductors of different voltages in the same raceway, pull box or junction box. Do not mix generator back-up circuits (NEC 700, 701 or 702) with normal circuits in same raceway or junction boxes. Exception: Where control wiring is a different voltage from power for the same system.

C. CONDUITS

Minimum conduit size is 3/4” (interior) and 1” (exterior) for premises wiring system. Exception: 1/2” flexible metal conduit not exceeding six feet may be used for fixture and small equipment drops.

Conduits shall not be run in building slab, unless agreed to by all interested parties and approved by UNC Engineering Services. Specify in bid documents that conduit is not to be run in building slab except where specifically indicated in drawings.

Conduit shall be routed in ceilings with a minimum of 18 inch spacing from terminal boxes’ maintenance access locations.

D. OUTLET, JUNCTION AND PULL BOXES

All outlet and switch boxes used for interior wiring shall be metallic and a minimum volume of 18 cubic inches. Exception: Special application such as moisture proof or hazardous location.

Provide sufficient duplex convenience outlets in mechanical and electrical rooms to enable maintenance to service equipment with plug-in lights and tools in accordance with 2014 NEC.

Provide duplex convenience outlets in all spaces, including corridors for housekeeping floor cleaners. Install corridor outlets on separate circuits from assigned adjacent spaces.

Freezer farms shall be provided with both 120V and 208V dedicated receptacles with generator backup at each location where a freezer could be located.

Do not install receptacle outlet boxes back to back. A minimum 6 inch spacing of receptacle outlet boxes serving opposite sides of a wall shall be maintained.

Junction and pull boxes above a suspended ceiling shall be located between three (3) and thirty-six (36) inches above the suspended ceiling for accessibility. Removal of duct or ceiling grid shall not be required to access pull or junction boxes. Note, pendant fixture boxes are not allowed more than six inches above ceiling grid. Specify contractor coordination shop drawings for congested corridor above ceiling spaces.

Junction boxes shall be labeled with circuits contained using panel and circuit identification.
E. WIRING DEVICES

All receptacles and fixed equipment shall have a permanent label indicating panel and circuit number. Do not use device as junction or feed-through. Pigtail the branch circuit wires to attach device.

Individual ground fault receptacles are required in lieu of ground fault breakers. Use of feed-through ground fault receptacles shall be determined by end-user. For stand-by GFCI receptacles, as in animal quarters, feed-through type is not allowed.

F. GENERATOR SYSTEMS AND TRANSFER SWITCHES

1. General

Modeling of generator exhaust emissions and personal exposure is required. Contact UNC-EHS for data sheet to be completed for project generator as early as possible in design phase, no later than Design Development Phase. UNC-EHS will provide this detailed information to an Environmental Engineering consulting firm in order to mathematically model both environmental emissions and personal exposures, including adjacent buildings and pedestrian pathways. Refer to UNC Emergency Generator Policy for requirements on permitting, locating and sizing generators at UNC-CH.

This modeling will be based on anticipated EPA Tier Level. EPA Tier Level shall at least meet the minimum Tier requirements in the year the generator is expected to be purchased, based on project bid schedule. A higher Tier level may be required based on modeling results. Space for future retrofits to reduce emissions shall be provided at generator location.

Generator should be sized for 50-75 percent of expected building load upon completion. Generator sizing should also take into consideration possible addition of adjacent building loads where existing generators need replacement. To prevent over-sizing for starting load and harmonics, specify stepped loading, variable frequency drives or reduced starting controls, and loads with lowest harmonics available or harmonic mitigation on high harmonic loads. Generator compatibility with elevators and large computer center’s UPS loads on generator shall be confirmed during design and final system testing.

A generator matrix identifying all generator loads by equipment ID and a load table with both running and starting demand shall be provided in DD drawings and updated in CD and bid document drawings.

Stepped loading and priority of load shedding shall be indicated on drawings. Identification of Emergency Life Safety distribution electrical equipment shall be labeled “Life Safety Loads Only” or equivalent. A separate feeder from generator and a dedicated transfer switch is required for each BL3 lab and animal quarters lab. Where load shedding is anticipated and multiple transfer switches are utilized, the designer should confirm appropriate transfer switch(es) for critical building loads, including redundant loads, with building occupants and facilities. Design intent for transfer switch loading shall be captured in narratives, during
maintenance training and commissioning final reports.

The University maintains and services all emergency and standby generators on campus. The Contractor shall provide any site specific and end user type training of the system. Additionally, where any specific computers, printers, cabling, software and/or license agreements are necessary for the University to have the capability to develop a database and/or modify any operating parameters for the buildings emergency and/or standby generator system without permission from outside distributors. A schedule of available manufacture certification training shall be provided. This training and certification shall recognize the University as a trained and licensed Generator System installers independent of local distributors and shall not be included in the price of the base bid. The authorized representative will coordinate and necessary proprietary agreements, training arrangements, costs, and specific support equipment needs with the owner.

Designer is responsible for incorporating all UNC and SCO applicable criteria in the bid documents and providing a complete performance specification.

2. **Manufacturer's Qualifications**

Firms regularly engaged in manufacture of generator systems of types, sizes, and electrical characteristics required, and whose products are Listed and Labeled by UL, Inc. All replacement repair parts shall be as produced or supplied by the same manufacturer as the generator system or transfer switch as applicable. Products of firms that do not maintain factory authorized service organization and spare parts stock within 2 days standard shipping are not acceptable for use on this project.

Manufacturers shall agree to make factory training/certification, product programs/software and/or operating systems, and continued product updates and/or Tech notes available to the University. Required software updates shall be made available at no cost. Software shall be capable of connecting to University network with remote control by University. Any licensing and/or proprietary agreements between the manufacturer/distributor and the University must be completed and in place prior to the manufacture and/or product being acceptable for installation.

Acceptable transfer switch manufacturers who have agreed to provide factory training/certification to UNC are ASCO, Onan, and Russell. Two preferred alternates shall be bid. These preferred alternates shall be 1) ASCO without http connectivity without bypass isolation and 2) ASCO with http connectivity, as described below (may also be bid without bypass isolation). Short circuit rating of ATS shall be indicated on plans.

Acceptable generator manufacturers who have agreed to the provide factory training/certification to UNC are CAT, Cummins and Kohler.

3. **Submittals**

A copy of all submittals will be provided for UNC Life Safety Review.

Submittals shall demonstrate compliance with technical requirements by reference to each
subsection of the specification. Where a submitted item does not comply fully with each and every requirement of the specifications, the submittal shall clearly indicate such deviations and may be subject to rejection. Identification requirements for non-complying features of items are very specific.

The submittal shall include, at a minimum, the manufacturer; model and catalog numbers, dimensions, construction materials, operating and performance characteristics, controls, finish any other pertinent information, and typical shop drawings.

- **Installer Certifications**: Copies of manufacturer signed certifications as required.
- **Product Data**: Submit (3) copies of any Manufacturer's technical product data, including specifications, installation instructions, and owner’s manuals.
- **Maintenance Data**: Submit (3) copies of any maintenance data and parts lists/manuals for the specific type of generator system installed, including any furnished specialties and accessories. Include recommended operator manuals, service manuals, recommended preventative maintenance, pertinent project specific wiring diagrams and controls manuals, any manuals of sequential operations, and any controller and diagnostic manuals and software as required in section 1.
- **Owner Training and Certification**: Provide the owner a current factory approved certification/ training schedule for the specific system installed.

4. **Packaged Engine Generator Requirements**

- Provide a 4-pole alternator, with drip-proof construction, revolving field type, protected and sized for maximum motor starting loads. Insulation shall be Class F per NEMA MG1-1.65. Rotor is dynamically balanced and permanently aligned to engine by flexible disc coupling.
- Voltage regulation shall be solid state temperature compensated with phase controlled sensing.
- Provide heavy duty ball bearings, permanently lubricated.
- The generator engine shall have sub-transient reactance of 12 % maximum.
- Two-thirds pitch stator winding and fully linked amortisseur winding shall be provided.
- Electronic fuel ignition control shall be provided.
- The governor shall be electronic, adjustable isochronous, with speed sensing.
- Provide permanent magnet excitation.

5. **Noise**

Control noise exposures in adjacent buildings below 60dB averaging for speech frequencies of 500, 1000, 2000 and 4000.

Noise levels 1 meter away from generator and 1 meter from ground shall be 82dBA or less. City Ordinances must be met when generator is located close to property boundary.

6. **Fuel oil tanks**

Any fuel transfer pump shall be approved by the UNC Life Safety Emergency Generator Shop.
Day Tanks should be avoided if possible. When necessary Day Tanks shall be approved by the UNC Life Safety Generator Shop.

Minimum capacity of sub-base fuel tank shall be 100 gallons or guaranteed volume to operate the system 68 hours at demand load, whichever is greater.

Install diesel fuel tanks above ground and in accordance with the UNC Spill Prevention Control and Countermeasures (SPCC) Plan Design Guidelines.

The Contractor shall fill fuel oil tanks immediately after installation using Ultra Low Sulfur Diesel (ULSD) with a sulfur content not to exceed 15 parts per million and refilled immediately with ULSD prior to acceptance of the building.

7. **Exhaust**

Locate exhaust above roof level, away from the air intake area of the building and adjacent buildings, trees, combustible materials and pedestrian traffic.

Generator exhaust must discharge vertically for maximum dispersion modeling. Rain cap shall fully open without impeding vertical discharge when generator is running. Provisions for maintenance and inspection access to Raincap/flap shall be provided, without using lifts or scaffolding.

8. **Outdoor Enclosure**

Adequate emergency lighting with battery backup shall also be installed in outdoor enclosures.

If generator breakers or other generator components requiring maintenance access are over 6-1/2 feet above grade, a platform is required such that all maintenance parts of generator are not over 6-1/2 feet above grade. Platform shall be a minimum of 4 feet deep. If platform is more than 2 feet above grade a rail is required.

9. **Interior Locations**

Generator Rooms, in buildings, shall have sealable floor drains to facilitate clean-up with a water supply within 50'. Transfer switches shall be located in dedicated electrical room in new or completely renovated buildings.

Generator Rooms shall have at least one 120VAC service receptacle.

Generator Rooms shall have two LAN Data Ports for Alarm Communication and Networking.

Floor openings between rooms adjacent to Generator Rooms shall have protective barriers to facilitate clean up (washing/mopping).

Foreign systems piping shall not be located above switch within the working space of switch up to structure (not just 6-1/2 feet above switch).
Louvers with gravity dampers shall be provided. Pneumatic/BAS controlled louvers are not allowed.

If other AHJs require controlled intake dampers, at least 20% of intake dampers shall be gravity fed to provide relief upon Pneumatic/BAS control failure.

No radiator exhaust Louvers shall be Pneumatic/BAS controlled.

10. **Engine-generator controls**

Contain the engine-generator controls in a shock mounted cabinet; use digital controls and metering where practical. Provide the following controls and metering:

- AC Voltmeter (2% accuracy) 3 1/2"
- AC Ammeter (2% accuracy) 3 1/2"
- Phase Selector Switch/Current Transformer each Phase
- Frequency Meter
- Running Time Meter
- Oil Pressure Gauge
- Water Temperature Gauge
- Battery Charging Ammeter
- Voltage Adjusting Rheostat
- Auto-Start-Stop Control
- Safety Shutdown and Alarm Light for:
  - High-water temperature
  - Low oil pressure
  - Engine over-speed
  - Engine over-crank
  - Auto-Off-Reset Switch
- Panel Lighting

11. **Remote annunciation**

Location of remote annunciator and/or data link shall be determined with the building occupant and Project Manager. Though not always necessary in every application, do not install in a Building Generator Room.

12. **Installation**

Location shall include one 120VAC emergency power outlet for maintenance use.

Generator feeders shall be continuous, without splicing from generator breaker lugs to breaker lugs feeding transfer switch.

G. **AUTOMATIC TRANSFER SWITCHES**

The automatic transfer switch shall be either 4-pole or 3-pole with overlapping neutral, solid state controlled, rated for all classes of loads, both inductive and non-inductive, and mechanically held on normal and emergency. Transfer switch shall have bypass isolation for all critical load unless
ASCO bid alternate without bypass isolation is accepted. Full-size neutral contactor shall be provided. Bypass isolation shall be provided in separate enclosure compartment from automatic transfer compartment, where this isolation is available for size of transfer switch specified. The need for closed transition transfer switch shall be determined during design with building representative and UNC Life Safety Shop.

1. **Components**

   In addition to SCO Electrical Guidelines, the following transfer switch controls shall be included:

   - Anti-single phasing protection shall detect regenerative voltage as a failed source condition.
   - Time delay on transfer from normal to emergency adjustable 0 to 120 seconds.
   - Time delay on stop - adjustable 0 to 8 minutes.
   - Under frequency - under voltage relay for emergency source.
   - Load shed feature shall be provided on transfer switches serving optional loads where connected load and future spare exceeds generator rating. Where provided, control shall provide for loads to automatically add back upon reduction of total generator load. UNC shall be provided software that allows UNC to change load priority.
   - Priority of optional load shedding shall be determined during design and indicated on plans.
   - Light-emitting diodes shall indicate time stamp logging.
   - No mechanical piping systems, i.e. steam or water piping, shall be located above NEC required working space to structure. Switch shall be located clear of any maintenance valve operations on steam or water piping. For new buildings and existing to extent possible, switches are to be located in dedicated electrical room.
   - Provide two LAN Data Ports in ATS Room for Alarm communication and Networking.

2. **Remote http connectivity with ASCO transfer switch without bypass isolation (Bid As Preferred Alternate)**

   Monitoring and control of power transfer switches in the Emergency or Standby Power Distribution System. Local Area Networks and Remote networks are supported with either single or multiple points of access, and web-enabled communications allow access to campus power systems from anywhere around the world.

   - Monitors and Controls Power Transfer Switches and Engine Generators.
   - Monitors Normal and Emergency Voltages and Frequency.
   - Indicates Transfer Switch Position and Source Availability.
   - Provides Transfer and Retransfer of Loads for System Testing.
   - View Normal and Emergency Voltage and Frequency Settings.
   - View Transfer Switch Time-Delay Settings.
   - Provides Transfer Switch Rating and Identification.
   - Automatic Paging Notifies Personnel, by E-mail or Pager, or Selected System Alarms.
   - View Current, Power and Power Factor with ASCO Power Managers Connected to the System.

H. **GENERATOR / TRANSFER SWITCH SYSTEM TESTING & CERTIFICATION**

1. **Database and Engine Inspection**

   The Contractor/Installer must 100% test all site-specific software functions and/or set
parameters for the system and provide a written test report or detailed check list. This documentation must include an engine diagnostics report, a hard copy of the completed program, and wiring diagrams.

a) The complete final configuration database (site-specific programming) for the system must be permanently stored on a computer disk or CD and archived by the manufacturer or authorized distributor. A disk or CD copy of that database must also be provided to the Owner when the system is commissioned.

b) The Manufacturer or authorized distributor must maintain software version (VER) records on the system installed. The system software shall be upgraded free of charge if a new VER is released for any reason during the warranty period. For any new VER to correct problems, free upgrade shall apply during the entire life of the system.

2. **Contractor/Installer Field Testing**

   Upon completion of the installation Contractor and the Manufacturer’s authorized representative together shall 100% test and instruct the Owner’s designated employees in the proper system operation and in all required periodic maintenance. Performance Testing shall include all permanent building loads with supplemental load bank to generator’s rating and in accordance with NFPA 110-2002, including cycle crank and performance tests. Operation of elevators and monitoring of any permanently installed UPS systems shall be provided during test.

   a) The owner shall be given advance notification in order to witness testing.

   b) Testing shall be performed using all installed generator loads supplemented with additional load to generator’s nameplate rating. Where more than one building is on a generator, all buildings’ loads will be utilized. The maintenance instruction shall include three (3) copies (minimum) of a written, bound summary of items covered for future reference.

   c) The documentation shall be part of the programming reports. The contractor shall keep history of all deficiencies determined. All deficiencies shall be corrected and retested. Once this has been accomplished, the contractor shall submit to the A/E all documentation of all problems and corrections and request the A/E to inspect and test the system.

I. **VARIABLE FREQUENCY DRIVES – REFER TO MECHANICAL DESIGN GUIDELINES**

J. **ALARM AND DETECTION SYSTEM CENTRAL ALARM RECEIVING SYSTEM**

The University has a Central Alarm Receiving System (CARS) located in the UNC Security Services Office capable of supervising fire, security, equipment or other system signals from any campus location. All fire, security, equipment signals shall transmit an alarm signal to this location by means of a digital communicator.

All security alarm systems and any special monitoring systems shall report to the CARS via a Digital Communicator. All fire detection and alarm systems shall report to the CARS via Radio Mesh Transceiver compatible with UNC monitoring station. Equip all communicators with a locking cabinet and battery backup system. The report shall contain both alarm and trouble conditions.
Fire detection and alarm systems shall report general alarm, system trouble, water flow and supervisory signal. Wire the communicator to the nearest building telephone closet using a four wire cable (2 pair, 22 gauge) in 3/4" conduit with ten feet (10') of excess at the closet end, terminated in the communicator, and identified at both ends. The University shall connect to telephone lines. For interconnections, notify the Facilities Services Life Safety Shop to program the central receiver and perform a joint acceptance test to ensure proper operation.

K. SERVICE AND DISTRIBUTION

UNC–CH and most electrical contractors today have adopted a safety policy of no energized electrical work that requires an energized work permit per NFPA 70E. Consequently, the designer shall specify electrical service and distribution to minimize occupant impact during planned and unplanned power outages, including University and Duke unplanned power outages, future planned electrical maintenance and repair work and future new construction work. In addition, design shall minimize arc flash hazards on future electrical troubleshooting and lock-out/tag-out. To achieve this goal, the following shall be specified:

- Main Service Switchgear rated 2000 amps and larger shall have separate enclosure section for main breaker that is connected to distribution section via conduit, versus open busbars connections between main and distribution sections in a single enclosure. An arc flash in distribution section could propagate to line side of main breaker in a main section of a single enclosure, which would make the whole gear “dangerous” arc flash risk.
- Arc resistant switchgear, maintenance reduction switches, insulated busses, barriers and current limiting breakers and fuses shall be considered to reduce arc flash hazard.
- Remote racking shall be provided for rack mounted breakers.
- Main normal service equipment rated less than 2000 amp shall have separate enclosure for main breaker from distribution (preferred) or internal barriers provided to prevent inadvertent contact with line side of main breaker in service equipment and reduce arc flash propagation from load side to line side of service equipment.
- Emergency and Standby distribution equipment shall be fed from fully coordinated generator breaker that is separate from distribution feeding emergency side of transfer switch.
- A separate main normal service breaker enclosure shall be provided ahead of fire pump combination controllers, to allow fire pump controller to be disconnected from service transformer without turning off power to building and reduce arc flash hazard during required preventive maintenance and future troubleshooting.
- Motor control centers (MCC) shall only be provided where there is significant number of contactor/starter controller motor loads to justify an MCC. Where motors are not within sight of MCC or starter controlled motors are few in number, individual combination disconnect/starters shall be considered for lower arc flash risk. MCCs shall not be utilized to server breaker fed loads, including VFDs and small panels. MCC shall not be excessively oversized for motor load served. Where used, MCC shall be constructed with barriers and insulation to reduce arc flash risk.
- Small 20 and 30-amp branch circuit breakers shall not be fed from the main service equipment or large distribution panels (typically over 800 amps).
• Penthouse distribution panels and MCCs shall be fed from the main service equipment on lower level floor versus other equipment in Penthouse.
• Breakers shall be fully coordinated in all loads with generator back-up, as these loads are considered critical.
• Normal breakers shall be fully coordinated to greatest extent possible, such that unplanned outages from system faults will be limited to smallest number of loads possible and to facilitate quick troubleshooting and repair.
• All feeder breakers rated 400 amps and larger shall be adjustable with LSI.
• Lighting and appliance panels shall have 225 amp main breakers to better coordinate with 20 and 30-amp branch breakers.
• The use of smaller 208/120 volt transformers is preferred to lower arc flash risk per IEEE 1584.
• Dedicated electrical distribution from the main service and generator and receptacle outlet redundancy shall be provided in BL3 labs, animal quarters and other critical spaces. The dedicated distribution shall not feed building loads outside the critical space. All distribution equipment shall be labeled for dedicated space only. Lighting and appliance panels shall be located in critical space, except no panels shall be located in animal quarters or BL3 lab space where dressing out for animals or lab is required.

Designers shall provide copy of short circuit study with CD drawings.

Following Shop drawing approval, Designers are responsible for arc flash studies per latest edition of NFPA 70E, incident energy method per IEEE 1584, at same time as short circuit coordination study. Arc flash studies shall include all electrical distribution equipment, equipment and motor disconnects, VFDs, transfer switches, and generator bus.

Designer shall provide paper and electronic copy or report to owner to review hazard levels and coordination choices in breaker settings prior to providing to contractor for labels and breaker settings. For generator back-up loads and most normal loads, coordination is highest priority, except where hazard level would result in dangerous incident energy exceeding 40cal/cm (or PPE4). Final report and electronic copy of input file required for software used in study to be provided prior to beneficial occupancy.

Contractor shall set breakers and apply arc flash labels as directed by designer, in accordance with arc flash study, prior to energizing of any electrical equipment. Breaker settings shall be provided in the maintenance manual. Manufacturer's secondary current breaker test equipment for new service and distribution equipment with breakers that utilize secondary current test equipment shall be specified to be provided with this equipment.

Service and distribution shall be sized for building demand with reasonable space for future growth. Contact UNC Electrical Distribution Systems for existing demand load on buildings being renovated or typical demand on similar buildings.

Lighting, mechanical and plug loads shall be fed from separate distribution breakers to allow separate energy analysis of these loads.

Provide normal and emergency service equipment with digital metering to measure the following on main breaker and main distribution breakers.
• Voltage: Phase to neutral and phase to phase.
• Amperage: (True RMS) - each phase and neutral. Fundamental and harmonics through 19th.
• Kilowatt Demand
• Power Factor

Sub metering of distribution breakers to provide separate load and energy usage analysis of building normal and emergency lighting, motor and receptacles loads shall be required. Data shall be connected to UNC energy management system.

Grounding riser and/or detail and layout plans shall be provided in bid documents that clearly indicates separate grounding bar in each electrical closet, telecom closet, generator room and main electrical room.

Grounding electrode conductors from step down transformer shall be routed back to main grounding bar via grounding bars in each electrical closet. Routing shall not be “piggy backed” on the telecom grounding bars.

All grounding conductors shall be labeled at each grounding bar as identified in grounding riser.

Ground system testing must be in accordance with IEEE Fall of Potential Method by qualified individuals. UNC Engineering Services must be given 7 day notice to observe test. Testing must be completed and accepted by Engineering Services before service conductors are connected to service (utility) transformer. Copy of test report is to be submitted to Engineering Services.

System ground test shall not exceed 5 ohms. Location of test well to be documented in as-built drawings and maintained accessible at end of project.

Mount one copy of the electrical riser diagram near the main normal and emergency main service equipment in the M.E. Rooms under clear protective material. For partial renovations an updated copy of the complete electrical riser shall be provided in plans and mounted in main switchgear room by contractor.

L. PANELS

Panels that could accept future plug-in or piggy-back style breakers shall not be accepted. All current carrying components shall be copper. Lighting and Appliance panels shall be provided with hinged covers. Where available, hinge covers are preferred for distribution panels as well.

Steam and water piping shall not be located above NEC dedicated space to structure over panel. Use of shield to protect panel from leaks is not allowed.

Do not install single phase panels in a three phase system. Panels shall only serve loads on floor where they are located, unless agreed to by UNC Engineering Services.

Panel boards serving power loads in office, computer facilities, and laboratories shall have full size neutral with neutral and grounding bars sized to accommodate individual neutrals and equipment grounding conductors.
Design distribution panel boards for laboratory spaces to allow for 66% growth (e.g. 40% space breaker slots). Other panel boards shall allow at least 50% growth (e.g. 34% spare breaker slots). In this regard, the spare breaker slots are very important. Use of 42 circuit panel boards is required.

Spare demand capacity of distribution and panel boards shall be not less than 25%.

Panel boards shall not be located inside laboratories. All 480/277 panels shall be located in closets, where not accessible to public. Subpanels rated 208/120 V, 225 amps and smaller may be installed in corridors where all interested parties agree exit egress can be maintained during maintenance and emergency troubleshooting operations on energized panel. Coordination of panel locations with corridor doors shall be considered early in design to maintain this egress. Where 120/208 subpanels are in corridors, they shall be served from transformers rated less than 125 KVA or other method provided to achieve arc flash boundary that does not preclude egress. Where flush or corridor panels are approved, a spare 1 in. conduit shall be stubbed out and capped for every three spaces or spare circuits remaining in panel. These spare conduits shall be stubbed out above ceiling in the space where the panel is located.

Upon completing the installation, the electrical contractor shall conduct an electrical load balance test. Panel phases shall be balanced within 10%. Copy of all test results shall be included in maintenance manuals.

M. TRANSFORMERS, DRY TYPE

1. General

Dry type transformers shall be NEMA TP-1 rated, tested per NEMA TP-2 and labeled per NEMA TP-3.

If a large amount of non-linear load is expected anticipated on transformer, then harmonic mitigating transformers may be specified. In buildings with sensitive electronic equipment and/or an anticipated large amount of non-linear load, other harmonic mitigation equipment may be considered. Acceptable method of mitigating harmonics shall be determined early in design with all interested parties.

Transformers 15KVA and larger shall have a minimum of 6-2.5% full capacity primary taps for 480V primaries.

2. Construction

Transformers shall be common core construction. Transformers utilizing more than one core, or Scott T-connections, are not acceptable. Transformer sizing shall be based on 80 deg. C rise, with transformer constructed with 220° C insulation. Ventilation shall be by natural convection. Supplemental fans are not allowed. Transformer inrush shall be coordinated not to exceed adjustable rating on breaker feeding transformer.
N. INTERIOR LIGHTING LUMINAIRES

Day lighting shall be incorporated to the greatest extent possible in all applications and combined with daylight and occupancy sensors to minimize the use of electric lighting and reduce building cooling load. Where fluorescent tubes are provided without dimmers, inboard/outboard systems should be incorporated to provide greater lighting flexibility. Minimum ambient lighting levels should be coupled with task lighting as needed.

Preference in choosing luminaire type shall be given to luminaire types with higher efficacy. Minimum efficacy typically available for a luminaire type shall be specified. Life cycle cost analysis (LCCA) for current and new lighting technologies shall be agreed to with Facilities Services prior to DD submittal. LEDs shall be considered in LCCA.

LEDs shall be bid as base bid or alternate where supported by LCCA or where simple payback is less than 10 years on projects not requiring LCCA. Where dimming and/or interior daylight harvesting is specified, the LCCA shall consider the complete lighting system, including luminaire type plus dimming controls.

Comply with Energy Efficient Lighting Guidance Document for New Construction and Retrofits: State of the North Carolina for LED lighting with additional UNC criteria: Mock ups and/or owner witness of LED installation with same luminaire is recommended due to difference in perception from other traditional lighting sources and to confirm quality of light specified is acceptable. Circuit loads should not exceed 50% for LED fixtures. Specified LED general illumination luminaires must have full photometric report in compliance with IESNA LM 79 and be used in designer’s layout design. In addition, LM 80 and TM21 end-of-life data is used for LCCA. Separate replacement of LED driver and lamps shall be possible. A minimum 5 year comprehensive warranty on LED lamp and driver is required. Where 2 or more manufacturers have 10-year warranty available for type of fixture specified, the 10-year warranty shall be specified. Recessed 2x4 and 2x2 fixtures shall be specified with 10-year warranty.

Electronic ballasts shall have input current Total Harmonic Distortion not exceeding 10%. Where available, ballasts that are rated for multiple lamp wattages shall be specified. LED drivers shall have Total Harmonic Distortion not exceeding 20%.

Use 277V for lighting where 480/277V is available, except track lighting is not required to be 277V. Do not mix 120V and 277V in a building for other general lighting applications for safety considerations. Do not install 120 volt track and 277 volt general lighting in same switch or junction boxes.

Luminaire enclosures shall be designed with acrylic or other UL approved plastics. Glass globes are not acceptable in any application. Do not use "egg-crate" louvers. Linear pendant hung luminaires shall be specified with slots/openings to allow air flow through the luminaire to reduce dust build-up that results in significant lumen depreciation. Linear fixtures shall be modular in design, such that fixtures are capable of being field-converted to individual 8 foot lengths or connected end-to-end, with manufacturer provided end caps and associated hardware.

General illumination luminaires shall be provided with integral disconnects, except where remote switch control is provided for a single luminaire. Integral disconnects must be reusable after
ballast replacement.

All fluorescent lamp types specified shall be available on State Contract. See https://ncdoa.s3.amazonaws.com/s3fs-public/documents/files/285b.pdf. **Extra Long Life T8** or compact fluorescent lamps are preferred and supported by LCCA.

Incandescent lighting is not allowed at UNC-CH unless special application approval is obtained from the UNC Energy Manager.

1. **Lighting Level Guidelines**

   Lighting designs shall conform to the recommendations of the Illuminating Engineering Society Lighting Handbook. Specific foot-candle level goals for spaces shall be agreed to by interested parties no later than Design Development submittal. Where needed, task lighting can be added to systems furniture.

2. **Interior Lighting Control**

   ASHRAE 90.1-2014 shall be utilized for lighting control design to greatest extent possible, including daylight harvesting controls as required by standard.

   Specify completion of lighting control commissioning in space and owner and occupant training prior to beneficial occupancy.

   Appropriate automatic cutoff for interior lighting per ASHRAE 90.1 shall be discussed during schematic design phase and agreed to by all interested parties no later than Design Development submittal. Wall mounted occupancy sensors shall not be blocked by furniture. Switch located occupancy sensors shall only be used in small single occupancy spaces.

   Provide for local occupant control in occupant accessible location for all spaces, including corridors and spaces controlled by occupancy sensors, that allows for occupant to turn off lights when leaving space.

   Vacancy sensors shall be used versus occupancy sensors. Infrared vacancy sensors shall be located where they cannot be block by furniture arrangement. Wall mounted sensors shall only be used in place of toggle switches in small single occupant spaces. Specify for manufacturer submittal to show sensor location and space coverage of sensors on layout plans.

   In lengthy open office areas, provide separate lighting control for every four or five workstations. Master control in suite areas should be considered for spaces with regular office hours.

   Where dimming is provided, dimming system shall be capable of interfacing with photocells, time clocks and occupancy sensors for additional automatic cut-off of lights.

   Dimming control of LEDs shall be confirmed by luminaire manufacturer as compatible and as providing desired low end of dimming without flicker and with load specified.
Provide local control capable of dimming or capable of reducing lighting levels by 1/2 and 2/3 in all building areas, except in corridors, MEP closets and other areas as agreed to with the Project Manager.

Designer shall consider using photocells and dimmable ballast in perimeter rooms to turn off lights when the available daylight augments the lighting level.

3. Lighting Fixture Applications

All applications where occupants use visual display terminals only use indirect lighting luminaires, indirect linear and/or pendant types with multiple switching or dimming capabilities. For example:

- General offices
- Classrooms
- Laboratories
- Lab benches
- Locate a fixture over the edge of each lab bench on each side of the aisle
- Use batwing or bilateral lenses for under-cabinet or shelf-hung luminaries

For all new construction and renovation projects that require lighting fixture replacement, use luminaires with T-8, compact fluorescent or LED lamps.

4. Lighting of Large Interior Areas

Use LED, metal halide or fluorescent lighting for all warehouses. For gymnasium, atriums and similar high ceiling applications where a lift would be required for maintenance, use LED luminaries. Design shall conform to the recommendations of the Illuminating Engineering Society of North America (IESNA) Lighting Handbook. Interior high lumen output LED luminaries replacing metal halide lights shall provide heat dissipation from enclosure through convection. Fans are not allowed.

5. Lighting Maintenance Considerations

The lighting design must address accessibility for re-lamping, cleaning and other maintenance procedures. Mounting heights of interior fixtures in stairways shall be at 8 feet and not over 12 feet in other spaces unless agreed to by UNC Engineering Services.

Fixture locations requiring scaffolding or rented lifts to maintain lamps and ballasts shall be avoided. In spaces with fixed seating, where ladders and lifts cannot be used, fluorescent or self-driven LED lamps that can be changed with a lamp pole from ground level shall be used. As an alternative, fixture lowering means or catwalk shall be provided for maintenance of fixtures. Provide same accessibility in atrium areas not accessible by lift and/or long throw asymmetric light fixtures, mounted in all locations accessible by a 20 foot ladder.

Spare parts shall include the following:
• 1% of each type of ballast or LED driver except for T8, T17 and compact fluorescent ballasts
• 2 of each type of LED light engine
• 10% of each type of specialty lamp, does not include T8, T17 or compact fluorescent lamps
• 10% of each type of occupancy sensor
• 2% relays and 1 extra circuit board for each type of lighting control panel
• Specialty non-metallic fixture lens covers – quantity determined per project

6. Exit and Egress Lights

Where a battery provides the emergency back-up, the luminaire shall be self-diagnostic. Centralized battery back-up versus individual battery back-up shall be agreed upon by UNC Engineering Services during the design. Where emergency generator back-up is available, battery back-up shall not be added, unless agreed to by UNC Engineering Services and UNC Electrical Maintenance. The transfer switch for emergency exit and egress lighting shall be separate from the emergency manifold fume hood and associated make-up air transfer switches.

O. CLASSROOMS FOR MULTIMEDIA PRESENTATIONS

The classroom lighting system must be versatile enough to provide an appropriate environment for today’s audio visual technologies as well as the traditional lecture in front of a chalkboard. At the same time, the design of the lighting system must be simple enough to allow rapid and intuitive adjustment of lighting levels to suit this variety of media. All multimedia classrooms, auditoriums and conference rooms shall have lighting systems that allow for various lighting levels and control glare with highlighting features necessary to present the material.

Make provisions for dimming to enhance the use of various projected materials. Use fluorescent dimming ballasts or LED in architectural dimming applications, capable of dimming to 1% of full light output. Ballast or driver and controls must be confirmed as compatible by manufacturer testing.

Provide separate controls for appropriate luminaires to eliminate over lighting of projection screens and to provide proper highlight illumination of marker boards and lecterns.

To provide simplicity of operation, eliminate standard 3-way and 4-way switching systems. Provide programmable multiple zone, multiple scene preset, or digitally addressable (best for future flexibility in changing zones) lighting controls in all multimedia rooms. Wireless controls must be approved by UNC ITS, such that they will not interfere with wireless data in buildings. Typically 802.11 protocols are reserved for wireless data and are not allowed for lighting controls.

CLASSROOMS FOR MULTIMEDIA PRESENTATIONS

All classrooms visual display terminals only use indirect lighting luminaires, indirect linear and/or pendant types with multiple switching or dimming capabilities. For example:

For all new construction and renovation projects, that require lighting fixture replacement, use luminaires with T-8 fluorescent lamps or LED.
P. EXTERIOR WALL MOUNTED BUILDING LIGHTING

When the need arises for mounting luminaires on an outside wall of a building, design the lighting system to ensure adequate lighting levels without creating glare or nuisance lighting into residential rooms or other areas. Mount these lights for ease of maintenance and connect to a power source in the building.

Wall mounted lighting shall be designed to be LED luminaires. Any exceptions, shall be approved by UNC Engineering Services. The fixture choice shall be a function of the campus area where lighting is to be located and compatibility to existing lighting in the surrounding areas in style, color and function. For areas being provided with new site lighting refer to Electrical Utilities Site Lighting Section of these guidelines for additional information.

Lighting should be designed to reduce light pollution to the night sky. Building wall mounted units should provide only down lighting. For more details on light pollution and light trespass, see the Illuminating Engineering Society of North America’s Recommended Practices for outdoor lighting (IESNA RP-33) or reference the presentation by the Northwest Energy Efficiency Alliance and the Lighting Design Lab.

Exterior exit and egress lighting shall be powered by the same type of emergency backup as provided for interior exit and egress lighting.

Q. TELECOMMUNICATIONS

Basic telecommunications requirements for all new structures include service entrance ducts, telecommunications rooms, a conduit riser system between floors, a floor cabling distribution system, and building horizontal and riser cabling. Qualified Communications Contractors shall be required to procure, terminate, test and provide documentation for telecommunications wiring as specified by the UNC-CH Telecommunications Office. For general design requirements refer to web site:

http://its.unc.edu/about-us/what-we-do/communication-technologies/communication-technologies-engineering/

The information found at the aforementioned web site is NOT intended to be a Telecommunications performance specification. Each project designer will be expected to write a performance specification for the Telecommunications work on each project.
C-23 - EHS EMERGENCY GENERATOR REQUIREMENTS

GENERAL

A. BACKGROUND
Emergency generators are required for many of the new building designs based upon the State Building codes that address ventilation for toxic and highly toxic materials, elevators as means of egress, high rise buildings, fire pumps and more. The primary environment, health and safety issues relate to noise and generator air emissions. Most of the generators on the UNC Campus are powered by diesel fuel. Diesel generators emit NOx, hydrocarbons, particulates, CO and SOx. Diesel exhaust is considered a respiratory irritant and a suspect carcinogen. In the near future, tightening of air emission regulations are expected for stationary diesel engines as they are for on-road diesels engines.

B. Generator Location
Sighting the generator must begin in the Building Programming phase. All parties concerned with the generator should provide tentative approval for the “best” location of the generator and stack along with at least 2 alternate locations for the generator, stack or both. Each generator installation must meet the requisite NFPA, electrical and NC building code requirements, the local City noise ordinance (when close to the property boundary) and the manufacturer’s specifications.

C. Additional Design Location Requirements
1. The design should accommodate the following additional requirements. If a specification cannot be met, an explanation shall be provided for further evaluation by the EHS Department.
2. The generator exhaust must discharge vertically for maximum dispersion modeling.
3. The rain cap shall fully open without impeding the vertical discharge while the generator is operating.
4. Ensure the exhaust is clear of trees, combustible materials and pedestrian traffic to avoid fires and burn hazards (discharge temperatures are over 1000 degrees F).
5. Noise levels 10 feet away from the generator and 5 feet from the ground shall be 85 dBA or less at all locations around the generator as installed.
6. Locate generator in area that is not subject to flooding.
7. In confined areas, provide for direct reading exposure monitoring for generator operators (NOx, CO, O2).
8. Provide for spill catchments for diesel tank storage filling operations. (overfills, drips etc.)
9. Position the exhaust point above roof level and away from air intakes.
10. Provide an above ground fuel tanks with integral secondary containment
11. Provide for sufficient equipment spatial clearances for maintenance and repair personnel to access all sides of the generator in confined buildings or vaults.
12. Exposure monitoring equipment may be required for generator maintenance personnel working on the generator in confined areas.
13. Plan for fueling accessibility and spill control during fueling
14. Guard the exhaust stack to prevent burns or fire hazards

D. Emissions Modeling
Based upon the “best” location, the architects/engineers will provide the EHS Office with the key information requested in the attached emergency generator form. The EHS Office will provide this detailed information on the generator to an Environmental Engineering consulting firm in order to
mathematically model both environmental emissions and personnel exposures around the generator. The Environmental Engineers will evaluate the emissions against:

1. **EPA standards for Ambient Air Quality**
   a) Proximity of receptors
   b) Passersby
   c) Open windows
   d) Building air intakes
   e) Confined spaces

2. **Recommended Personnel Exposure Limits**
   a) < 338 mg/m³ NO₂ 1-hour for intermittent (ex. emergency engine) sources. (RWDI: assume NO₂ is 34% of total NOx)
   b) < 188 mg/m³ NO₂ 1-hour for continuous (ex. peak generators) sources.
   c) < 0.02 mg/m³ respirable, Elemental Carbon (EC) (ACGIH Notice of Intended Changes) (assume 40% of total particulate matter is EC from www.dieselnet.com/standards/us/ohs.html)
   d) 3000:1 dilution or greater from the generator stack discharge- typically reduces the nuisance odors to non-detect levels for 50% of the population (from RWDI 2018).

E. **Approval**
When the modeling is completed, a confirmation letter from EHS Department will be provided to the UNC Design Coordinator if all of the criteria are met. If the generator emissions exceed allowable limits, the deficiencies will be noted. Correcting the deficiencies could involve relocating the generator and/or providing additional engineering controls. If the generator or exhaust point is relocated, the emissions must be remodeled. If engineering controls are selected, the anticipated reductions in generated pollutants can be applied directly to the modeled emissions.

F. **Additional Design Consideration**
1. While not mandatory, these concepts will aid in future reconfigurations of emergency power infrastructure supplied to the campus buildings.
2. Design building electrical distribution to provide automatic load shedding to isolate critical emergency equipment and allow for potential sharing of emergency power units. It is far cheaper to install this equipment when the building is built than performing a retrofit.
3. Combine buildings to share larger generators which are located further from the buildings. Emission controls for the redesigned, larger diesel engines are actively under development and more readily available for purchase.
4. Identify generators that will run with a variety of fuels including ultra low sulfur diesel (<5 PPM sulfur), biodiesel and diesel/water mixtures
5. Potential emission control technologies include water injection, timing adjustments, catalytic conversion, particulate traps etc. If the additional cost is within budget, consider purchasing control technology in confined areas where emissions are marginally acceptable. Modeling is a relatively crude tool and provides only a rough estimate of exposures.
6. Ensure that the new diesel engines to be purchase are adaptable to the emerging control technologies that may be required with new regulations.
7. At a minimum, specifications for new generators should comply with current EPA off-road diesel engine Tier 4 standards.
G. Comments for Designers on Selecting New Generators (8/13/03):
   1. UNC-Chapel Hill is located in Orange County, North Carolina, currently an attainment area for
      the air pollutant ozone. However, since diesel engines emit significant quantities of NOx, a
      precursor to the formation of ozone, more stringent regulations for engines may apply in the
      future. Also, EPA has been regulating off-road diesel engines since 1996. On January 1, 2014,
      EPA finalized Tier 4 emission reduction standards required for off-road engines.
   2. In most states, including NC, the regulations have been applied primarily to mobile sources.
      However, in California, they have adopted the EPA standards for stationary sources in 2003.
   3. Because emergency generators have a long service life, it is prudent for the University to
      prepare for future regulations of emergency/standby generators by procuring the latest engine
      technology. Careful genset specification and purchasing will reduce air pollution now and will
      enable the addition of less costly emission controls in the future.

H. Desirable emission features for new generators are as follows:
   1. New generators must meet at least the most stringent of the applicable EPA Tier 4 off-road
      diesel engine standards without the use of end of pipe exhaust treatment when burning #2 fuel
      oil.
   2. Emissions modeling will be based upon the generator specifications. Generators must not be
      substituted by the contractor after bidding without detailed review by EHS.
   3. The generator engine must be capable of running on the full spectrum of fuels from ultra-low
      sulfur, no sulfur fuel and biodiesel.
   4. Sufficient space should be provided around the generator for emissions equipment upgrades
      should they be required in the future.

EMERGENCY GENERATOR DATA SHEET
The following information should be included to expedite the processing of the application for a Certification of
Approval. If more than one emergency generator is being applied for, please fill out one of these data sheets for
each emergency generator or include the information contained below in a summary table.

A. Please provide a brief description of the intended use of the emergency generator.
B. Where will the generator be located? (e.g., indoors, outdoors in enclosure)
C. Identify the fuel being used (e.g., diesel oil, natural gas, etc.)
D. What is the unit rated for? (in kW)
E. Provide exhaust emission data and exhaust building/enclosure, then the exhaust flow rate (actual
   ft3/s) and temperature (Fahrenheit degrees) are required.
F. Provide the stack exit diameter (in feet)
G. Provide the stack height above the roof (in feet).
H. Provide the stack height above grade (in feet).
I. If the generator is located indoors, please provide the following:
   1. Building dimensions (including dimensions of all buildings within 5L of the generator (5L is 5
      times the lesser of the height or projected width of the buildings).
   2. Building elevation(s)
   3. Location of the exhaust stack
   4. Location of the property line
J. If the generator is located outdoors in an enclosure, please provide the following:
   1. Enclosure dimensions (length, width, height)
2. If the enclosure is within 15 feet of any other structures, include the dimensions of that structure as well
3. Location of exhaust stack
4. Location of property line
K. Provide the distance from the ventilation openings for combustion air intake/exhaust or the combustion exhaust stack (whichever is closer) to the nearest residential property line (if the residences are located on-site, then provide the distance to the nearest residential receptor).
L. If there are any sensitive receptors (e.g., hospital, school, nursing home, day care center) within 1,500 feet of the exhaust stack, please provide details of their location
M. Provide exhaust emission information, if available. Include equipment data sheet, if available
N. Is the required fuel readily available on campus?
O. Provide the maximum sulfur content of fuel to be burned
P. Provide sound performance data
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FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 SCOPE

A. This section of the specifications includes the furnishing, installation, and connection of the microprocessor controlled, addressable reporting fire alarm equipment required to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control panels, auxiliary control devices, annunciators, power supplies, and wiring as shown on the drawings and specified herein. It also includes the connections and appurtenances necessary to interconnect with the existing system as described above.

B. The University maintains and services all fire alarm equipment on campus. The Contractor shall provide any site specific and end user type training of the system. Additionally, where any specific computers, printers, cabling, software and/or license agreements are necessary for the University to have the capability to develop a database and/or modify any operating scenario for the buildings fire alarm system without permission from outside distributors, a schedule of available manufacture certification training shall be provided. This training and certification shall recognize the University as a trained and licensed Fire Alarm System installer independent of local distributors and shall not be included in the price of the base bid. The authorized representative will coordinate training arrangements, costs, and specific support equipment needs with the owner.

1.3 QUALITY ASSURANCE

A. **Manufacturer’s Qualifications:** Firms regularly engaged in manufacture of fire alarm systems of types, sizes, and electrical characteristics required, and whose products are Listed and Labeled by UL, Inc. All products, including initiating devices and notification appliances, shall be as produced or supplied by the same manufacture as the main fire alarm control panel. Products of firms that do not maintain factory authorized service organization and spare parts stock are not acceptable for use on this project.

Manufacturer’s shall agree to make factory training/certification, product programs and/or operating systems, and continued product updates and/or Tech notes available to the University. Any licensing and/or proprietary agreements between the manufacture/distributor and the University must be completed and in place prior to the manufacture and/or product being acceptable for installation.

B. **Installer’s Qualifications:** An experienced company who is an authorized representative of the FACP manufacturer for both installation and maintenance of all equipment is required
for installation of the FACP and connection of all circuits for any project. The Installer shall have a minimum of 5 years documented experience installing fire detection and alarm systems similar in size and scope to this project. The Installer technicians shall be individually certified NICET Level 2 and by the manufacturer of the equipment and trained and certified on the specific model being installed. The Installer shall have at least one technician on staff certified NICET Level 3. Certifications shall be current to latest release and must have occurred in the most recent 24 months. All connections to the FACP, system programming, and/or programming changes shall be accomplished only by the Installer technicians compliant with qualifications, and must be present for the 100% test, Engineer’s inspection, and Owner inspections.

C. **Codes and Standards:** The codes and standards listed below are utilized as design criteria for “minimal" system coverage. The University may require additions to these codes and standards based on historical consensus criteria for design and installation of fire alarm systems specific to facility applications within University type settings.

1. **NFPA Compliance:** Comply with current applicable requirements of NFPA-72, National Fire Alarm Code.

2. **NEC Compliance:** Comply with current applicable requirements of NFPA-70, National Electrical Code (NEC) standards pertaining to fire alarm systems.

3. **State Building Code Compliance:** Comply with applicable requirements of the North Carolina State Building Code.

4. **NC Department of Insurance:** Comply with current Office of State Fire Marshal Fire Detection and Alarm Systems, and Fire Sprinkler Systems.

5. **Testing Laboratory Compliance:** Comply with provisions of UL safety standards pertaining to fire alarm systems. Provide products and components, which are Listed and Labeled.

6. **FM Compliance:** Provide fire alarm systems and accessories, which are FM approved.

7. **Comply with Authority(ies) Having Jurisdiction (AHJ):**

   a) **NC State code requirement issues:** NC State Construction Office

   b) **City of Chapel Hill code requirement issues:** Chapel Hill Fire Marshall

   c) **University code requirement issues:** UNC Health & Safety Fire Marshall

   d) **University policy and system application requirements:** UNC Facilities Services Manager Life Safety Systems

D. **Assumption of Existing System Responsibility/Liability:** Any construction project additions
and/or renovations that will require changing the current programming of an existing fire
alarm system in any way shall require an official transfer of the entire FACP system
responsibility to that contractor. This also includes significantly impairing any active system to
accommodate phased construction projects where the FACP will either be: removed in its
entirety at the completion of the project and/or significantly modified and/or totally replaced
through a dual system coverage conversion type project. A signed letter transferring the
responsibility of the system, or part thereof, as well as an emergency contact list shall be
provided to the owner prior to the start of any construction. (See Attachment A).

1.4 SUBMITTALS - GENERAL

A. Submittals shall demonstrate compliance with technical requirements by reference to each
subsection of this specification. Where a submitted item does not comply fully with each and
every requirement of the specifications, the submittal shall clearly indicate such deviations
and may be subject to rejection. Identification requirements for non-complying features of
items are very specific.

1. **Installer Certifications:** Copies of manufacturer signed certifications and NICET
certifications as required in section 1.3.B above.

2. **Product Data:** Submit Manufacturer's technical product data, including specifications
and installation instructions, for all system components (i.e., boards, devices and/or
modules, duct mounted smoke detectors, flow switches, tamper switches, supervisory
switches, and/or other similar items which require mechanical installation.) that will
support the entire fire alarm system. Submit technical product data on any required
fire alarm system servicing and/or support equipment.

3. **Maintenance Data:** Submit maintenance data and parts lists for each type of fire alarm
equipment installed, including furnished specialties and accessories. Include this data,
product data, and shop drawings in maintenance manual.

4. **Standby Battery Sizing Calculations:** Battery calculations shall be sized considering the
University has its own Central Station and provides runner service. The University is
considered Proprietary and a contiguous campus. For those facilities off campus, they
shall be sized as a remote station.

5. **Owner Training and Certification:** Provide the owner a current factory approved
certification/training schedule for the specific system installed.

6. **Maintenance Contract:** Provide maintenance contract per Alternate E1 if agreed to by
all interested parties. Interested parties include: UNC Facilities Planning Project
Manager, the Building Representative, and the Life Safety & Access Controls
Superintendent.

7. **Network Interface Connection:** Provide interface equipment that would allow Ethernet
connections if available from manufacturer. Arrangements for two data drops at the
PART 2 - PRODUCTS

2.1 MANUFACTURER’S/MODELS

A. Manufacturer’s/Models: Subject to compliance with requirements in section 1.3.A above, the current manufacturers and corresponding panel models that are acceptable to be incorporated into the contract are limited to the following:

1. Edwards System Technology - (EST3, *EST3X),
2. Notifier; Div. of Pittway Corp. - (*NFS2-640, NFS2-3030),
3. Siemens, Inc. - (Fire Finder XLS)
4. Simplex – (4100ES)

*Only for small installations deemed appropriate by owner

Substitution request for other manufacturers must be made with proof of compliance with manufacturer qualifications in section 1.3, including manufacturer signed licensing and proprietary agreements, a minimum of 10 (or 14?) days before bid opening. Substitution requests after bid opening will not be considered.

PART 3 – SPECIFIC SYSTEM PERFORMANCE GUIDELINES

3.1 FIRE ALARM CONTROL PANEL (FACP)

A. FACP - Minimum Requirements:

1. The system shall be electrically supervised for open or (+/-) ground fault conditions in SLC, alarm circuits, and control circuits. Removal of any detection device, alarm appliance, plug-in relay, system module, or standby battery connection shall also result in a trouble signal. Fire alarm signal shall override trouble signals, but any pre-alarm trouble signal shall reappear when the panel is reset.

2. Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed.

3. Visually and audibly annunciate any trouble, supervisory or alarm condition on operator's terminals, panel display, and annunciators.

4. The FACP shall include a full featured operator interface control and annunciation panel.
that shall include a backlit, liquid crystal display, individual, color coded system status 
LED’s, and an alphanumeric keypad for the field programming and control of the fire 
alarm system.

5. The system must comply with UL 9th edition.

B. System Capacity and General Operation: The system shall have the following capacities and 
general operation modes:

1. Signal Line Circuits (SLC’s): Capacity for expansion up to at least 198 total addressable 
devices per SLC and up to at least 2048 total annunciation points per system. The 
number of SLC’s provided shall be as indicated on the Drawings, with a minimum of (1) 
one spare for future use.

2. Digitized Electronic Signals: Shall employ check digits or multiple polling. In general a 
single ground or open on any system signaling line circuit, initiating device circuit, or 
notification appliance circuit shall not cause system malfunction, loss of operating 
power or the ability to report an alarm.

3. System Response to an Alarm Condition: When a fire alarm condition is detected and 
reported by one of the system initiating devices or appliances, the following functions 
shall immediately occur:

a) The system alarm LED shall flash.

b) A local piezo-electric signal in the control panel shall sound.

c) The LCD display shall indicate all information associated with the fire alarm condition 
including: the type of alarm point, the initiating device address and the description 
of its physical location within the protected premises.

d) History logging of all information associated with the event, including time and date 
of occurrence.

e) Activate all system outputs, including program assigned via control-by-event 
equations, shall be executed by the particular point in alarm. Exact programming 
shall be provided by the Contractor to meet the Owners requirements.

f) Activate all fire alarm Notification Appliances in the building, sounding and flashing 
in synchronization continuously until manually silenced, or until the initiating device 
and control unit has been reset to normal condition.

g) Activate digital alarm communicator.

h) Deactivate door hold control relay such that all smoke doors are allowed to close.

i) Deactivate control relays allowing HVAC units to stop.
j) Activate elevator recall sequence if smoke is detected in any elevator lobby or in the elevator equipment room.

k) Release all doors, which may be secured by “fail secure” methods.

l) Transmission of all data to any remote annunciation panels.

4. **System Response to Trouble Conditions:**

   a) The system trouble LED(s) shall flash.

   b) A local piezo-electric signal in the control panel shall sound.

   c) The LCD display shall indicate all information associated with the trouble condition including: the type of device point, the device address and the description of its physical location within the protected premises.

   d) History logging of all information associated with the event, including time and date of occurrence.

   e) Activate digital alarm communicator.

   f) System AC power trouble signal shall not be sent unless maintained for 8 hours (or more).

   g) Provide adjustable time delay for all trouble signals prior to transmission.

   h) Transmission of all data to any remote annunciation panels.

   i) Disable 24 hour resound in FACP program.

5. **System Response to Supervisory Conditions (typically associated with sprinkler system monitored type devices only):**

   a) The system supervisory LED(s) shall flash.

   b) A local piezo-electric signal in the control panel shall sound.

   c) The LCD display shall indicate all information associated with the supervisory condition including: the type of device point, the device address and the description of its physical location within the protected premises.

   d) History logging of all information associated with the event, including time and date of occurrence.

   e) Activate digital alarm communicator.

   f) Transmission of all data to any remote annunciation panels.
C. **System Features:** The FACP shall be capable of providing the following features:

1. Upload/Download to PC Computer
2. Charger Rate Control
3. Drift Compensation
4. Automatic Day/Night Sensitivity Adjust
5. Device Blink Control
6. Pre-alarm Control Panel Indication
7. NFPA 72 Smoke Detector Sensitivity Test
8. Walk Test
9. System and Device Status and History Reports
10. Periodic Detector Test
11. Alarm Verification, by device, with tally
12. Printer and CRT Display Interface
13. Non-Alarm Module Reporting
14. Block Acknowledge
15. Smoke Detector Maintenance Alert - When any smoke detector approaches 80% of its alarm threshold due to gradual contamination.
16. Control-By-Time and Event

D. **Operator’s Terminal:** Provide an operator’s terminal, which allows the following minimum functions. In addition, the operator’s terminal shall support any other functions required for system control and/or operation:

1. Acknowledge (ACK/STEP) Switch
2. Signal Silence Switch
3. System Reset Switch
4. System Test Switch
5. Lamp Test Switch

E. **Remote Transmissions:** On board communicators shall be acceptable on the condition of total compatibility with the owners receiving station equipment, provides dual line capability one of which is capable of communications via LAN.

F. **Power Supply(ies):** The FACP power supply(ies) shall operate on 120 VAC, 60 Hz and shall be adequate to power all equipment and functions in full alarm continuously utilizing only 80% of the rated output. Signal circuits shall each be loaded no more than 80% of their rated output.
capacity. All modules and drivers must be able to withstand prolonged short circuits in the field wiring, either line-to-line or line-to-ground, without damage.

G. **Emergency Power Supply:** Components include batteries, charger, and automatic transfer circuitry.

1. **Batteries:** Shall be completely maintenance free, sealed lead acid type. Battery nominal life expectancy of 3 years, minimum, is required. Battery voltage and capacity shall be determined by the measured load calculations required by the FACP and related connected equipment.

2. **Battery Charger:** Solid state, fully automatic, variable-charging-rate type. Provide capacity for 150% of the connected system load while maintaining batteries at full charge. If batteries are fully discharged, the charger charges them completely within four hours. Charger output is supervised as part of system power supply supervision.

3. **Integral Automatic Transfer Switch:** Transfers the load to the battery without loss of signals or status indications when normal power fails.

H. **Serial Interface Board:** The FACP shall contain a serial interface board to provide an EIA-232 interface between the fire alarm control panel and the UL Listed Electronic Data Processing (EDP) peripherals. The serial interface board shall allow the use of multiple printers, CRT monitors, and other peripherals connected to the EIA-232 ports. In addition, the serial interface board shall provide one EIA-485 port for the serial connection to annunciation and control subsystem components; LED’s shall be provided to show operational status. All serial interface input/outputs shall be optically isolated to provide protection from surges and/or earth grounds.

I. **Network Interface Capability:** Provide interface equipment that would allow Ethernet connections if available from manufacturer. Arrangements for at least two data drops at the panel should be made.

J. **Enclosures:** The FACP shall be housed in a UL listed cabinet suitable for surface or semi-flush mounting. Cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer’s standard finish. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be hinged on either the right or left side (field selectable). Where multiple enclosures are required in the same area, the cabinets shall all be the same size and color. Cabinet doors must be electrically bonded to enclosure it serves.

K. **General Requirements:**

1. A copy of the final building floor plans with all device locations and assigned system addresses shall be permanently mounted at the location of the main FACP. All AV circuit EOL’s, riser cabinets, and Isolation Modules shall also be included on these drawings. A separate sheet shall be provided for each floor. Sheets shall be laminated. Provide legend for symbols.
2. All external modules required to be mounted at the main FACP location shall be housed in a UL listed cabinet suitable for surface or semi flush mounting. Cabinet and front shall be corrosion protected, given a rust resistant prime coat, and manufacturer’s standard finish. The door shall provide a key lock. For convenience, the door may be hinged on either the right or left side (field selectable). Where multiple enclosures are required in the same area, the cabinets shall all be the same size and color. Cabinet doors must be electrically bonded to enclosure it serves.

3. The system shall be new and furnished with a warranty (parts & labor) of at least one year from the date of final inspection and acceptance by the Owner. Equipment, initiating devices, and alarm appliances shall be arranged as described in the Drawings; annunciator zones shall be configured as described in the Drawings.

4. All system components shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load. Adhesives are not permitted to mount fire alarm system components to building surfaces or structure.

5. Loops shall be confined to one floor of coverage and shall not include any devices/modules located or serving other floor areas of coverage. Loop 1 shall be assigned to the lowest elevation level of the building. Loop numbers shall increment with elevation levels of the building floors. Device numbering starts the loop with address 001 and increments sequentially accordingly as electrically connected in the circuit to the return of the loop.

Note: With the written prior approval of UNC Life Safety Systems, multistory buildings with small footprints may be allowed more than one floor per loop.

6. The FACP must have an Alarm Silence switch, and be equipped with the Subsequent Alarm (alarm resound) feature. Any remote annunciators or graphic displays located away from the alarm area must also include an audible signal with alarm resound feature and must be silence-able from the main panel.

7. A supervised programmable "Hot Key" for defeating or bypassing all AV circuits, including sounder base units, must be provided in the FACP. The switch must indicate "Normal" or "Off Normal" position.

8. If the system design includes any type of door control features, a supervised programmable "Hot Key" for defeating or bypassing all door hold open circuits and fire shutter doors or smoke curtains must be provided in the FACP. The switch must indicate "Normal" or "Off Normal" position.

9. If the system design includes any elevator controlling equipment, a supervised programmable "Hot Key" for defeating or bypassing all elevator capture and shunt trip features must be provided in the FACP. The switch must indicate "Normal" or "Off
Normal" position.

10. If the system design includes AHU shutdown or smoke removal startup, silencing the alarm (without resetting) must not reverse them. A supervised programmable "Hot Key" for all AHU Shutdown Defeat modules must be provided in the FACP. The switch must indicate "Normal" or "Off Normal" position. In addition, provide supervised Hand-Off-Auto switch(es) at the FACP for any building smoke control equipment (pressurization, smoke purge or exhaust fans).

11. The coverage of each fire alarm loop as described in the Drawings shall be indicated on the FACP and any remote annunciator. This may be accomplished by engraved labels, framed directories, and/or graphic displays. Label tape or handwritten labels are not acceptable.

12. System shall provide printer data connection.

L. **Input Power Requirements:**

1. All fire alarm equipment 120 VAC supply power shall be fed from the facility “Emergency Power” circuit if available. Systems are to be provided with a separate and independent source of emergency power. Switching to emergency power during alarm shall not cause signal drop-out. Batteries must meet the appropriate NFPA capacity requirements, with a 25% safety factor. This requirement is in effect even if generator power is supplied to the Fire Alarm Control Panel.

   a) Provide an engraved label in the FACP identifying its 120 VAC power source. This label shall include panel board location, identification and circuit number.

   b) The AC power source shall be protected with surge arrester(s) such as the DITEK DTK-120SRD. Surge arresters shall have trouble contacts that can be monitored by the FACP.

      1. Provide Fire Alarm Monitor Module to supervise trouble contacts

      2. Provide 120V receptacles for printer use at the main panel. Provide printer data connection at the main panel.

M. **Wiring:**

1. **Style 6 Circuits Required:** Systems with one or more addressable sub-panels that (1) have an integral addressable loop controller, or (2) monitor multiple conventional initiation zones, shall comply with the NFPA 72 requirements for Style 6 circuits.

2. All wiring shall be color coded in accordance with the following scheme, which shall be maintained throughout the system, without color change in any wire run:

| Addressable Devices | Approved Manufacture Data |
Signal Line Circuit cable
Red jacket with Red(+)/Black(-)

Alarm Indicating Appliance Circuits
Blue (+)/Black (-)

Conventional Type Devices or Circuits connected directly to the FACP or to Monitored or Controlled Addressable Devices

Initiating Circuits, General*
Red (+)/White (-)

Initiating Circuits, Smoke Detectors Only*
Violet (+)/Gray (-)

AHU Shutdown Circuits
Yellow (+)/Brown (-)

Door Control Circuits
Orange

Elevator Capture Circuits
Brown

3. All wiring and cable must be in EMT, 3/4" minimum diameter, unless indicated otherwise on the Drawings or elsewhere in the Specifications. All fire alarm system raceway, couplings, and connectors must meet the performance and installation requirements of Section 16000 "RACEWAYS". Couplings shall be steel compression type and connectors shall be steel compression type with insulated throats.

4. All wiring shall be checked for grounds, opens, and shorts, prior to termination at panels and installation of detector heads. The minimum resistance to ground or between any two conductors shall be ten megohms (10 MW), as verified with a megger. Provide advance notice to the A/E of these tests.

3.2 RADIO ALARM TRANSMITTERS (RAT)

A. **Minimum Requirements:** Provide a Radio Alarm Transmitter (RAT) which is compliant with NFPA 72 Chapter 26.6 for One Way Radio Systems and fully compatible with the Owner’s Proprietary alarm receiving equipment or the listed central station as indicated on the Drawings. The RAT must be capable of interfacing with the FACP, and shall be listed for UL 864 Standard for Control Units and Accessories for Fire Alarm Systems and UL 681 Standard for Installation and Classification of Burglar and Holdup Alarm Systems.. The following signals, in order of precedence shall be reported as applicable:

1. Fire
2. Trouble
3. Water-flow
4. Supervisory

1. The DACT shall be capable of and equipped with:
a) 8-channel minimum,
b) Backup batteries with an automatic battery charging circuit,
c) Capable of performing a self test every 6 hours and generating a 6 hour communication test report to the receiving station equipment,
d) Any failure shall initiate a trouble condition, The "Trouble" signal for AC power loss must not be sent unless maintained for 1 hour or more to avoid nuisance transmissions due to momentary 120 VAC power outages or alarm verification cycles,
e) Radio Mesh Technology,
f) Any off-normal condition shall be reported to the RAT for transmission,

*Contact UNC Life Safety for recommended equipment that is compatible with the Owner’s Proprietary Alarm Receiving System.*

2. Any deviations from the RAT requirements above must be approved in writing by the UNC Life Safety Supervisor and UNC Life Safety Manager.

### 3.3 AUXILIARY POWER SUPPLY PANELS (APS)

**A. Auxiliary Power Supply(ies) - General:** Typical applications for usage of APS panels include but are not limited to: notification appliance circuits (NAC), door holders, control relays, and sounder base power extenders.

**B. APS - Minimum Requirements:** All APS(s) shall operate on 120 VAC, 60 Hz and shall have a continuous rating adequate to power all equipment and functions in full alarm continuously utilizing no more than 80% of the total rated ampere output capacity. All modules and drivers must be able to withstand prolonged short circuits in the field wiring, either line-to-line or line-to-ground, without damage. All APS’s shall be capable of providing the following general requirements, features, and functions when utilized as an integral part of the system:

1. Each APS utilized in the system shall be supervised **individually** by the FACP. This may be accomplished by:
   a) On board means of setting the FACP assigned address.
   b) Utilization of a system addressable monitor type module.

2. Each APS must capable of supervising all input/output circuitry with on board LED’s for specific fault indications. On board supervision includes:
   a) AC power failure,
   b) Battery fault,
   c) Ground fault,
d) Individual output circuit faults,
e) And any auxiliary power output circuits.

3. Shall provide multiple regulated and conditioned +24VDC output circuits.

4. Shall provide at least (1) one +24VDC auxiliary type output.

5. Shall be capable of being externally triggered or initiated by the FACP, via an addressable control module, for all required output activations.

6. Shall provide at least (1) Form “C” dry contact or other on board form of dry contact output that will change states during any fault condition detected, for connection to (1) one addressable monitoring device for individual APS, FACP supervision.

7. Output circuits shall have the capability of being selectively disabled, via on board switch configurations, during any AC power failures.

C. **Enclosures**: The APS shall be housed in a UL listed cabinet suitable for surface or semi-flush mounting. Cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish. The door shall provide a key lock. For convenience, the door may be hinged on either the right or left side (field selectable). Where multiple enclosures are required in the same area, the cabinets shall all be the same size and color. Cabinet doors must be electrically bonded to enclosure it serves.

### 3.4 ANNUNCIATION DEVICES

A. **Alarm Notification Appliances - General**: Both audible and visible alarm signals shall be provided. Visible signals must be the strobe (flash discharge) type, with white or clear lens.

1. All and each AV circuits shall have a supervised means to individually bypass.

2. All NAC devices shall have circuit and device designation identification labels.

3. In ADA designated locations, where placement of additional specialized AV devices are required, those device shall follow the action of the roomsounder base.

B. **Audible (Horns)**: Shall be located as shown on the Drawings; sounders located outdoors or indoor locations subject to moisture, shall be listed for use in wet locations. Electric sounders shall have the following specifications:

1. **Voltage**: Horns shall operate on 24 VDC nominal.

2. **Programming**: Horns shall be field selectable without the use of special tools, to provide slow whoop, continuous, three pulse temporal or interrupted tones. Evacuation signal shall be the ANSI 53.41 three-pulse temporal pattern. Animal
quarters and patient areas must be served by chimes. Animal quarters shall have means to bypass chimes with supervised override switch to facilitate testing of system.

3. **Mounting:** Ceiling mounted devices are not permitted without specific location approvals by the owner.

C. **Visual (Strobes):** Strobes shall be located as shown on the Drawings. Strobes indicated for use exterior to the building or indoor locations subject to moisture, shall be mounted at the indicated elevation and listed for use in wet locations.

1. **Voltage:** Strobe lights shall operate on 24 VDC nominal.

2. **Mounting:** Ceiling mounted devices are not permitted without specific location approvals by the owner.

D. **Audible/Visual Combination Devices:** Shall be located as shown on the Drawings and shall comply with all applicable requirements for both Audible and Visual.

E. **Sounder Bases:** Where indicated on the Drawings, provide bases with a built-in (local) sounder rated at 85dB minimum. Configure sounder bases such that sounders are activated under conditions as described or otherwise indicated on the Drawings. All areas that require the installation of Sounder Base Units shall be configured to function as follows:

1. **Voltage:** The sounder base power shall be supervised by the FACP.

2. **Programming:** All areas that require the installation of Sounder Base Unit Devices shall be programmed to perform the following sequence of operation:

   a) The sounder base initiating device shall report the 1st alarm condition to the FACP, which in turn shall sound that individual sounder base and any special ADA AV device additionally required in that area ONLY and be silence-able from the FACP.

   b) The 1st alarm received by the FACP shall initiate the DACT.

   c) All sounder bases shall sound on any general alarm condition initiated by any common area initiating device including: smoke detectors, thermal (heat) detectors, manual stations, water-flow, duct detectors, or by a 2nd or subsequent alarm from any other sounder base initiating device.

   d) Individual sounder bases must and be capable of alarm resound.

   e) The initiating device connected to the sounder base shall be supervised by the FACP.

F. **Bells:** Shall be 10" diameter vibrating type located as shown on the Drawings; bells located outdoors shall be listed for use in wet locations. Bells shall have the following specifications:

1. **Voltage:** Bells shall operate on 24 VDC nominal.

2. **Mounting:** Provide flush mounting devices. Bell mounting elevation shall be as described on the Drawings.
G. **Device Remote Annunciation:** Remote annunciator indicator lights (RAIL’s) shall be provided in locations where indicated on the Drawings. In addition, RAIL’s shall have the following features:

1. RAIL’s shall be provided with a key type switch for testing of the annunciated device. Testing device activation shall be accomplished through direct hardwiring to the device NOT through software activation, be program activated, or by any external logic controlling.

2. **Voltage:** RAIL’s shall operate on 24 VDC nominal.

3. **Mounting:** Device shall be mounted in/to the wall at the same height requirements per NFPA72 as A/V devices. Do not mount in ceiling tiles. Devices shall be located in the nearest corridor or public area and identified by an engraved affixed label.

H. **Alphanumeric Display Annunciators:** Shall be supervised and remotely located as specified on the Drawings.

1. Unit shall have a back-lit LCD display in clear English text.

2. The LCD annunciator shall display all alarm, trouble, and supervisory conditions in the system and provide duplicate “active” manual switching functions of the FACP, including: Acknowledging, Signal Silencing, System Reset, and Test/Drill.

3. The annunciator shall be in a lockable cabinet keyed the same as the FACP.

4. **Connections:** The annunciator shall connect to a two-wire EIA-485 interface. The two-wire connection shall be capable operation at distances of 6,000 feet. Provide interface to fiber optic cable systems and/or repeater units where such are indicated on the Drawings.

5. **System Capacity:** The system shall allow a minimum of four LCD annunciators. In addition to annunciation functions, each LCD annunciator shall be capable of the following software programmed system functions: Acknowledge, Signal Silence and Reset.

I. **Serially Connected LED Annunciator:** Annunciator shall communicate with the fire alarm control panel via an EIA-485 communications loop (four-wire) and shall individually announce all zones in the system. System zones shall be as indicated on the Drawings.

1. **Annunciator Indicators:** The annunciator shall provide a red Alarm LED per zone, yellow Trouble LED, and Supervisory Trouble LED per zone. The annunciator shall also have an "ON- LINE" LED, local piezo sounder, local acknowledge/lamp test switch, and custom zone/function identification labels. Annunciator switches may be used for System control such as, Global Acknowledge, Global Signal Silence, and Global System Reset. All annunciator switches and indicators shall be software programmable.
2. The annunciator shall be in a key lockable cabinet.

J. **LED Graphic Display Panel:** In high rise, complex, or higher square footage facilities, a Graphic Annunciator shall be installed. The University must approve the application and manufacturer of the annunciator.

1. **Annunciator Indicators:** The annunciator shall provide a red Alarm LED per zone, yellow Trouble LED, and Supervisory Trouble LED per zone. The annunciator shall also have an "ON- LINE" LED, local piezo sounder, local acknowledge/lamp test switch, and custom zone/function identification labels. Annunciator switches may be used for System control such as, Global Acknowledge, Global Signal Silence, and Global System Reset. All annunciator switches and indicators shall be software programmable.

2. Framed under glass graphic shall provide a LED lamp zone matrix/grid displaying each type of initiating device (manual stations, smoke detectors, thermal detectors, elevator lobby detectors, water flow, and supervisory) for each floor contained in the facility. The University must approve the specific floor labeling prior to construction. Floor references may vary per facility (i.e. Ground Floor may be referred to as 1st Floor).

3. The annunciator shall be in a key lockable cabinet.

### 3.5 EMERGENCY VOICE/ALARM COMMUNICATIONS

A. Where emergency voice communications systems are indicated on the Drawings, provide systems with the following characteristics and features:

1. One-way voice/alarm systems shall be dual channel, permitting the application of an evacuation signal to one or more zones simultaneously with manual voice paging to the other zones. Communication zones shall be capable of being selected in any combination.

2. Provide duplicate tone generators, pre-amps, and power amplifiers. Failure of any of these shall automatically result in the defective unit being promptly switched off-line and replaced with the backup so that operation as described elsewhere is uninterrupted.

3. Normal amplifier power shall be a minimum of 125% RMS of the full speaker load, per channel. For purposes of this calculation, use the amplifier’s continuous two-tone output rating and assume one watt per speaker. A copy of this calculation shall be included with the submittals.

4. Communications equipment shall be housed in the FACP and/or in adjacent cabinets(s) of matching appearance and size. All connections between the FACP and the voice communications panel shall be made via cables or harness assemblies, which have been prewired and tested by the system manufacturer.
5. Evacuation signal shall be a "three-pulse" temporal pattern complying with ANSI S3.41-1990.

6. Existing Wiring: Where existing wiring is reused provide a written guarantee that it is acceptable for use with the equipment provided under this contract. Existing wiring may be used only with the owner’s written permission.

3.6 INITIATING DEVICES

A. Non-Addressable Type Devices – General: In some cases, the use of non-addressable devices with an addressable monitor type module is acceptable. These areas shall be identified on the Drawing with the acceptable device type for the specific locations. Affected areas may include where:

1. Temperature Ratings: Non-addressable devices shall be utilized in unconditioned spaces where temperature and/or humidity ranges can exceed the manufactures recommended ratings of the electronic component circuitry for proper operation of addressable type devices. Acceptable substitutions with these non-addressable type devices may include:

   a) Thermal Detection Devices
   b) Manual Stations
   c) Tamper Switches
   d) Duct Smoke Detectors

2. Harsh Environments: Areas that is environmentally detrimental to addressable type devices. Acceptable substitutions with these conventional type devices may include:

   a) Explosion proof devices
   b) Flame detection devices

3. Mounting: When using non-addressable type devices monitored with an addressable monitor type modules. Mount addressable monitor type modules in nearest conditioned space and indicate its address on the outside of the enclosure by means of a label.

B. Addressable Type Devices – General: Unless otherwise indicated on the Drawings all initiating devices shall be individually addressable. Addressable devices shall comply with the following general requirements:

1. Address Setting: Addressable devices shall provide an address setting means inherent within the device. Devices, which are addressed by the FACP are also acceptable.

2. Device Identification: Addressable devices shall store an internal specific identifying
“type” code that the FACP shall use to identify the type of device.

3. **Temperature Ratings:** Addressable devices shall not be utilized in unconditioned spaces where temperature and/or humidity ranges can exceed the manufactures recommended ratings of the electronic component circuitry for proper operation.

4. **Operational Indications:** Addressable devices shall provide powered LED’s. LED’s shall flash under normal conditions, indicating that the device is operational and in regular communication with the FACP. LED’s shall be placed into steady illumination by the FACP to indicate that an alarm or off normal condition has been detected. The flashing mode operation of the detector LED’s shall be optional through the system field program. An output connection shall also be provided in the device base to connect an external/remote LED indication of an alarm or off normal condition in specific required locations.

5. **Device Mounting:** Unless otherwise specified all devices shall provide the following mounting criteria:

   a) All detectors shall be ceiling-mount.

   b) All other addressable devices, remote LED indicators, remote test switches, and isolation modules shall be wall-mount type.

C. **Addressable Manual Stations (Pull Stations):** Unless otherwise indicated on the Drawings all pull stations shall comply with the following additional requirements:

1. All pull stations shall have a dual-action mechanism requiring two actions to initiate an alarm condition.

2. All pull stations shall provide a clear visual indication when operated, and shall utilize a key type reset for restoral to normal operation. Pull stations that employ a glass break rod are not acceptable.

3. An LED shall be provided that shall flash under normal conditions, indicating that the control module is operational and is in regular communication with the control panel.

4. **Construction:** Pull stations shall be constructed of Lexan or other material suitable to the installation environment with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches or larger. Stations shall be suitable for surface mounting or semi flush mounting as shown on the plans.

5. In facilities that are fully sprinklered the University requires additional manual stations located at all exits from the building and at all exits per floor within the building (including rooms that only have outside entrances with no access into the facility such as outside mechanical, electrical, and sprinkler riser rooms etc.).

D. **Addressable Smoke Detectors:** Unless otherwise indicated on the Drawings all smoke
detectors shall comply with the following additional requirements:

1. All smoke detector sensitivity shall be set through the FACP and shall be capable of adjustment in the field through the field programming of the system. Sensitivity shall be capable of being automatically adjusted by the FACP program on a time-of-day basis. Devices shall be capable of reporting obscuration levels and maintenance alerts when any smoke/duct detector approaches 80% of its alarm threshold due to gradual contamination.

2. In facilities that are fully sprinklered the University requires additional smoke detection in telecommunication closets, electrical closets, and rooms that contain significant electronic equipment such as computer server rooms and audio and/or video projection rooms.

3. Must be the plug-in type, each having a separate base, to facilitate replacement and maintenance. When installed in a room, detectors shall be oriented so their alarm light is visible from the nearest door to the corridor.
   a) In areas where smoke detector placements are not easily visible a Remote Alarm Indicator Light (RAIL) must be provided, or in areas that will allow, a RED circle shall be painted on the floor directly below the detector with the device system address.

4. Spot type smoke detectors mounted within 12 feet of a walking surface shall have their built-in locking device activated.

5. Unless suitably protected against dust, paint, etc., detectors shall not be installed until the final construction clean-up has been completed. Contaminated detectors must be REPLACED by the Contractor at no additional cost to the Owner.

6. Identification of individual detectors is required. These device numbers, which must also be shown on the shop drawings, shall be permanently affixed to the detector base. Device labels may not be affixed to the device. Identification labels must be printed labels with black lettering on a white background. Handwritten labels or labels made from embossed tape are not acceptable. Device labels shall be legible from floor level. If this is not feasible, a suitable form of identification must be agreed upon by the owner.

7. Smoke detector guards, where indicated on the Drawings shall be Listed for use with the specific model of smoke detector being protected. All smoke detector guards are to have a separate base which must be very securely anchored to wall or ceiling. The cover must be readily removable by the Owner for periodic detector cleaning and servicing but, to prevent unauthorized entry, must be secured to the base by a lock or tamper resistant screws approved by the A/E. Metal guards must be 16 gauge or heavier steel.

8. Devices used for elevator capture are identified on the Drawings by the designation EL adjacent to the detector. Primary and/or alternate recall points are indicated on the drawings. Elevator capture or control signals must come from the FACP as relayed by
control modules. Use of detector auxiliary contacts for elevator capture is not acceptable or permitted.

E. **ALARM VERIFICATION FOR SMOKE DETECTORS**

1. The fire alarm system shall be equipped with logic method of verifying the presence of smoke.

2. Alarms from other than spot type smoke detectors must not be delayed by Alarm Verification. Alarm Verification is NOT to be applied to linear beam, duct smoke detectors, elevator lobby and machine room detectors, nor to any software configured "cross zoned" detection devices. When programming the system, activate the automatic drift compensation feature for all spot-type smoke detectors. Whether or not to activate the alarm verification feature for such detectors is to be determined by the design engineer/owner’s representative.

   NOTE: UNC Life Safety recommends Alarm Verification where applicable to help prevent nuisance alarms.

3. Systems with Alarm Verification must be permanently labeled to indicate that fact.

4. While a verification cycle is in progress, an alarm, which occurs on another zone, must not cause the verification cycle under way to be restarted or extended. It may have the same effect on the system as a verified alarm.

5. The equipment must be Listed for Alarm Verification purposes. It must either be installed at the factory, or field programmable and tested by the Manufacturer's authorized representative.

F. **Addressable Thermal Detectors (Heat):** Unless otherwise indicated on the Drawings all addressable heat detectors shall comply with the design criteria of the conditioned protected space.

G. **Addressable Duct Smoke Detectors:** Unless otherwise indicated on the Drawings all duct smoke detectors shall be the photoelectric type.

   1. **General:** The contractor shall mark the direction of airflow on the duct at each duct detector location. Provide duct access doors

      a) Air duct/plenum detectors must have device remote annunciation. See section 3.3.G above for guidelines pertaining to these specific devices.

      b) These detectors shall be installed in a manner that provides suitable access for required periodic cleaning and calibration.

   2. **Air Sampling Tubes:** The preferred method for providing support is to extend the intake tube through the far side of the duct, seal around the tube where it penetrates the duct wall, and plug the end with a rubber stopper. This facilitates visual inspection, intake tube cleaning, and injection of smoke or equivalent aerosol for testing the detector. Those over 36 inches long must be provided with center support.
3. **Outside Air Intakes, Lab Exhaust and Autoclave Exhaust:** Do not use duct detectors on outside air intakes, lab exhaust snorkels, autoclave exhaust and general DCM exhausts as this can lead to nuisance alarms and maintenance issues from moisture and debris.

**II. Air Sampling Detectors:**

1. Air Sampling Detectors shall intelligently interface with the FACP.
2. Air Sampling Detectors with multiple sampling ports shall be addressable per port.

### 3.7 MONITOR AND CONTROL DEVICES

**A. Addressable Dry Contact Monitor Modules:** Addressable Monitor Modules shall be provided to connect (1) one non-addressable device or to supervise a non-addressable IDC zone (either Style D or Style B) of conventional type alarm initiating devices (any Normally Open [N.O.] dry contact device) to one of the Fire Alarm Control Panel Signaling Line Circuit Loops. Monitor modules shall be installed as required by the system configuration. All required monitor modules shall be shown on the Drawings.

1. **Indication of Operation:** Unless otherwise indicated on the Drawings an LED shall be provided that shall flash under normal conditions, indicating that the Monitor Module is operational and in regular communication with the FACP.
2. **Mounting Requirements:** Shall be mounted at the same height requirement as Notification Appliance devices in a clearly visible location.
3. **Device Labeling:** Monitor Module and device supervised shall be labeled identically.

**B. Addressable Control Modules:** Addressable Control Modules shall be provided to supervise and control the operation of (1) one conventional Notification Appliance Circuit (NAC) of compatible, 24 VDC powered, polarized Audio/Visual (A/V) Notification Appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contract relay. The control module shall provide address-setting means using decimal switches and shall also store an internal identifying code that the control panel shall use to identify the type of device. An LED shall be provided that shall flash under normal conditions, indicating that the control module is operational and is in regular communication with the control panel. Control modules shall be rated for the load they control. (Inductive Loads require inductive rated modules.)

1. **Mounting Requirements:** Shall be mounted at the same height requirement as Notification Appliance devices in a clearly visible location.
2. **Configuration:** The control module NAC circuit may be wired for Style Y Class B with up to 1 Amp of inductive A/V signal, or 2 Amps of resistive A/V signal operation, or as a dry contact (Form C) relay. The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NAC’s may be energized at the same time on the same
pair of wires.

3. **Power Source**: Audio/visual power shall be provided by a separate supervised power loop from the main fire alarm control panel or from a supervised, UL listed remote power supply. A/V power sources and connections are not shown on the Drawings.

4. Supervision required: The connection between individual addressable modules and their contact type initiating device(s) must be supervised.

C. **Isolator Modules**: Isolator Modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC loop. The Isolator Module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC Loop.

1. **Operation**: Isolator Modules shall operate such that if a wire-to-wire short occurs, the Isolator Module shall automatically open-circuit (disconnect) the SLC loop. When the short circuit condition is corrected, the Isolator Module shall automatically reconnect the isolated section. The Isolator Module shall not require any address setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an Isolator Module after its normal operation.

2. To minimize the impact of a wiring fault on the system, isolation modules must be provided as follows:

   a) After each 20 devices/control points on any addressable circuit.

   b) For each circuit extending outside the building.

   c) In the FACP, at each end of the loop.

   d) On loops containing less than the 20 devices place an isolator at each end of the loop and one in the electrical center of the loop.

3. **Mounting**: The Isolator Module shall be wall mounted at the same height as A/V devices in a clearly viewable area in corridors. It shall provide a single LED that shall flash to indicate that the Isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

4. **Labeling**: Label each Isolator Module with loop information.

### 3.8 MISCELLANEOUS SYSTEM ITEMS

A. **Door Hold-Open Magnets**: Door hold open magnets shall be furnished with keepers, door chains, and other accessories as required to properly hold open doors as indicated on the Drawings. Holding force of the magnet shall be appropriate for the door to be held open.

Door hold open magnets shall operate in a fail-safe manner, *i.e.*, the door shall release in event of a failure of voltage to the device.
1. **Power Supply**: Door hold open magnets shall be configured to operate from a nominal 24 VDC system as supplied by the FACP or other power supply listed for the purpose. All hold open magnet supply sources, whether a part of the FACP or whether derived from a separate power supply, shall be supervised. Door hold open magnets which use step-down transformers, 120 VAC, or local relays are not acceptable. Magnets shall release on a power failure.

2. **Device box support**: Door hold open magnet device boxes shall be securely attached to the building structure by effective means. Boxes attached directly to only one metal stud or boxes supported by means of expansion type fasteners are not acceptable.

3. Wall mounted magnetic door holders and separate heavy-duty closers shall be used, instead of combination door control units. The electromagnets shall be controlled by the building’s smoke detection system FACP. Individual smoke detector auxiliary contacts shall not be used to release door holders.

B. **Rolling Fire or Smoke Doors**: Rolling Fire or Smoke Doors shall be motor operated. No manual reset doors are permitted.

1. **Remote Power Supplies**: Where remote power supplies are required, they shall meet the same requirements as those for the main fire alarm control panel, including the requirements for batteries and supervision.

2. **Keys and Locks**: All panels, terminal cabinets, and pull stations shall be keyed alike. Coordinate key/lock with the Owner’s requirements.

C. **Building Automatic Door Locking Systems Interface Requirements**:

1. Automatic door locks controlled by the system must be either fail-safe magnetic locks or fail-safe electro-mechanical with reverse bevel deadbolts.

2. All lock protected doors must immediately unlock upon fire alarm, loss of AC power, disablement of the fire alarm system (defined as loss of 24 VDC power) or upon manual operation of an unlocked supervised switch at a constantly attended location.

D. **Spare Parts Requirements**:

1. **Spare Parts**: Provide at least one spare of each type field device installed and the following spare parts with the system, each individually packaged and labeled. For multi-building projects, calculate separately for each building:

   - Fuses: 2 of each size used in system
   - Isolation Modules: 2% of installed quantity
Manual Stations 2% of installed quantity
Notification Devices 4% of installed quantity Spot Smoke Detectors, Bases 6% of installed quantity
Heat Detectors 6% of installed quantity
Monitor/Relay Modules 2% of installed quantity
Air Sampling Detectors 5 years of filters
Duct Smoke Detectors, Bases 6% of installed quantity

2. Increase decimal quantities of spare parts to the next higher whole number. For example if a system has 20 spot-type smoke detectors provide 2 spare detectors with bases.

PART 4  SYSTEM TESTING & CERTIFICATION

4.1 Contractor/Installer Testing and Certification

A. Upon successful completion of the Pre-final Inspection, per the NCDol checklist, and correction of all deficiencies, the manufacturer’s authorized representative shall issue a test report to: the A/E, the Facilities Services Life Safety Shop, and the UNC Health and Safety Officer detailing and certifying the test, including those requirements as specified in this document.

4.2 A/E Testing and Certification

A. **A/E System Inspection:** In an effort to expedite the inspection process for projects already seriously behind schedule, the A/E can request UNC Construction Management to schedule the Facilities Services Life Safety Shop Owner acceptance commissioning field inspection and test to be performed in conjunction with the A/E inspection. This is not recommended and has proven to produce lengthy punch- lists and numerous re-inspections by the Owner.

B. Once the A/E has inspected, tested and is satisfied the system is 100% operational, and has met all aspects of the A/E design, the A/E shall notify UNC Construction Management to schedule the Facilities Services Life Safety Shop owner acceptance commissioning inspection and test. At that time the A/E shall also and submit the following:

- A printout of the current installed site-specific database.
- Signed copy of the NFPA “Record of Completion” form per NFPA 72.
- Signed copy of the NCDol checklist.
- Current copy of as-built drawings with correct room numbers and device system addresses.
Room numbers must be installed.

- Copy of battery calculations.
- Copy of record for the Notification Appliance Circuit voltage measurements taken at the EOL devices during the A/E test. Take readings at the start of the test and every 15 minutes during NAC test. Test shall be 30 minutes minimum. Test shall be conducted with AC power off and under battery power only.

### 4.3 Owner Testing and Inspection

**A. Database and Drawing Inspection:** The Facilities Services Life Safety Shop will require all the above and a minimum of 3 days for review of the system databases and drawing review, prior to scheduling any on-site test.

1. Upon completion of the system databases and drawing review any discrepancies will be documented and forwarded to UNC Construction Management requiring action and corrections from the A/E’s system installer/programmer. When the required actions and corrections have been addressed and performed a corrected printout of the installed site-specific databases and drawings shall be forwarded to the Life Safety Shop for re-review. After review and satisfaction that the corrections have been made, then and only then, will the Life Safety Shop schedule their field inspection and test. The Life Safety Shop will notify UNC Construction Management of the scheduled date and time.

**B. Owner acceptance commissioning field inspection:** A 100% fully functional test of all aspects of the system will be conducted. Therefore, it is expected that the system shall be complete in all aspects. Each function and aspect of system will be tested along with each and every initiating device. Also, all other system functions shall be verified, including but not limited to (where applicable): elevator capture features, control of HVAC systems, door locks, pressurization fans, fire or smoke doors/dampers/shutters, sprinkler systems, etc. The trades’ personnel representing the various aspects must be present. The A/E representative does not have to attend but may attend if so desired. The fire alarm vendor’s technician who programmed the system must be present.

**NOTE:** If at any time, during the owner’s acceptance commissioning field inspection and test, it appears that the installation contractor has not performed a prior 100% performance test, the current test will be terminated and rescheduled.

1. Upon completion of the acceptance commissioning field inspection and test, the Facilities Services Life Safety Shop will forward a list of discrepancies in the form of a formal “Punch List” to UNC Construction Management for comment and/or inclusion in the A/E’s punch-list of items requiring action and/or corrections from the effected systems contractors/installers. Once the contractors/installers have corrected these items, the A/E shall notify UNC Construction Management and schedule a re-inspection by the Facilities Services Life Safety Shop. When the systems are verified to be satisfactory by the Life Safety Shop, the A/E shall be notified by UNC Construction Management to schedule an inspection and test with the Office of State Construction.
On or before the day of the Office of State Construction the following must be completed and/or provided to the Owner:

- Copy of current databases installed in the system on CD or USB drive (preferred).
- All drawings shall be posted.
- All spare parts and test equipment as described in the specification shall be turned over to the owner.
- All training requirements shall be met or scheduled.
- All required software on CD or USB drive shall be turned over to the owner.
- All certifications.
- A new signed and dated NFPA “Record of Completion” form per NFPA 72, signed by the contractor, the Designer/Engineer of Record and/or the Construction Management Representative.
- The FACP shall be turned on but not reporting to the UNC Central Alarm Receiving System (CARS).

4.4 System Acceptance

A. **Office of State Construction inspection:** The above items must be completed before the Office of State Construction inspection. Upon completion of Office of State Construction inspection any items or discrepancies must be corrected. When this obligation has been met the warranty shall begin on the day the A/E notifies the Office of State Construction and the Facilities Services Life Safety Shop to that effect.

1. Beneficial or partial occupancy acceptations shall require the system contractor/installer to remain responsible for the "live" system. A daytime and after hours contact list shall be provided to the Life Safety Shop which will include the names and phone numbers for three (3) responsible individuals until Final acceptance has been granted.

B. **UNC Central Alarm Receiving System (CARS) Activation:** The Life Safety Shop will activate the FACP account in the UNC Central Alarm Receiving System (CARS). In the event of malfunctions or excessive nuisance alarms, the Contractor must take prompt corrective action. The Owner may require a repeat of the Contractor's 100% system test, or other inspections. Continued improper performance during the warranty period shall be cause to require the Contractor to remove the system and replace it.

C. The contractor shall notify the supervisor of the Facilities Services Life Safety Shop prior to performing any work on the system after the final acceptance by the Office of State Construction.

**PART 5 SYSTEM DOCUMENTATION, TRAINING, & MAINTENANCE**

5.1 **System Documentation**

A. The Contractor/Installer shall provide the Owner with the following:
1. A current factory approved certification/ training schedule for the specific system installed.

2. **As-Built Drawings:** Submit: *(1)* Bound full size set *(2)* One 11”x17” set *(3)* Electronic copy in a format compatible with the most recent release of AutoCAD

   The As-Built Drawings should include scaled architectural floor plans depicting final device/module and equipment locations with corresponding system addresses, all circuiting, pathways, and terminal cabinet locations for the full building (or full floor for renovations). Include wiring and riser diagrams with actual field measured battery calculations for the main fire alarm panel and all individual circuits of the Notification Appliance Circuit panels (NAC’s).

   a) Electrical and Electronic circuit diagrams of all control panels, modules, annunciators, communications panels, riser panels, etc.

3. Three (3) copies of all software required, both for the installed fire alarm system and for any personal computer (PC) necessary to access the fire alarm system for trouble shooting, programming, modifications, monitoring, de-bugging, or similar functions.

4. Three (3) copies of the complete maintenance, installation, and programming manuals for the installed fire alarm system. If available a CD version is desired and acceptable. Also provide all technical literature on all major parts of the system, including control panels, batteries, detectors, manual stations, alarm indicating appliances, power supplies, and remote alarm transmission means.

5. Three (3) of each interconnection cables that are required to connect the fire alarm system to a PC.

6. Three (3) each of any proprietary programmers/software/tools needed to program, maintain and trouble shoot field devices, including but not limited to Air Sampling Detectors.

C. The Equipment Manufacturer’s shall provide the Owner: with the following:

1. Agreement to License and/or factory certification system training for the Facilities Service Life Safety Shop technicians to maintain and service the equipment installed under this contract.

2. Direct access and support for the Facilities Service Life Safety Shop technicians from the Manufacturer’s or Factory’s Technical Services.

5.2 **System Training and Maintenance**

A. During the design specification review process, the Design Manager, the Life Safety Supervisor and the Life Safety & Access Controls Manager will jointly review the proposed specifications
to determine if training is required for the proposed life safety system. Training requirements, scheduling, and purchasing of computers will be coordinated by the Life Safety & Access Controls Division directly with the installation equipment Contractor/Installer and the equipment Vendor/Factory. All cost involved with training travel (transportation, accommodations, meals, etc.) will not be assessed to the Contractor/Installer as part of the contract, but will be funded separately by UNC from allocated reserves.

B. The Equipment Manufacturer’s shall provide the Contractor/Installer and/or the Owner: with the following:

1. The schedule of available dates when classes are available to obtain License and/or factory certification system training for the Facilities Service Life Safety Shop technicians to maintain and service the equipment installed under this contract.

2. Training Content: Factory/Manufacture classes, training and testing shall provide what is necessary to certify and/or authorize attendees to program and service the fire alarm system installed for this project, including system hardware and software. Additionally, the training shall cover the following topics as a minimum:

   a) Preventative maintenance service techniques and schedules, including historical data trending of alarm and trouble records.

   b) Overall system concepts, capabilities, and functions. Training shall be in depth, so that the owner shall be able to add or delete devices to the system and to take any device out of service and return any device to service without need for Manufacturers approval.

   c) Explanation of all control functions, including training to program and operate the system software.

   d) Manuals, drawings, and technical documentation.

   e) The actual system software used to support the fire alarm system installed for this project shall be provided on CDs or USB drive (preferred), any required “software keys” and/or peripheral hardware to successfully operate the software on the technicians computers shall be provided to the Owner’s technicians upon successful completion of the training.

C. The Contractor/Installer shall provide the Owner: with the following:

1. The contractor shall submit a complete site specific system orientation training schedule including dates, times and location for approval by the owner and engineer. which shall include:

   a) Preventative maintenance and any special servicing and/or maintenance techniques, including methods and means of troubleshooting and replacement of
all field wiring and devices and, methods and procedures used for troubleshooting the main fire alarm control panel, including field peripheral devices as to programming, bussing systems, internal panel and unit wiring, circuitry and interconnections.
b) Overall system concepts, capabilities, and functions.

c) Explanation of all control functions, input or output.

d) Any device and/or equipment locations that are not easily found.

e) Any programming peculiarities that is inherent in the system.

2. The Contractor/Installer is responsible for ensuring that the manufacturer's authorized representative shall provide a schedule of the available manufacture certification training for attendance by the Owner's designated employees. The training will include the proper programming procedures, operation of the system, troubleshooting and maintenance aspects, and all required periodic maintenance.

   a) The authorized representative will coordinate training arrangements with the Owner's schedule.

   b) **Location:** On-site certification training is preferred and UNC will make available classroom space as needed by the manufacturer. If travel is required, the Life Safety & Access Controls Division will determine the personnel required to be trained.

3. The Contractor/Installer is responsible for ensuring the manufacturer provides the Owner with the following:

   a) Licenses and/or certifications to maintain and service the equipment installed under this contract.

   b) Direct access and support for the University Technicians to the Manufacturers Technical Services.

4. **Equipment:** The Contractor/Installer is responsible for providing a list of all required support equipment necessary to support the fire alarm system installed for this project. This list shall include computers (laptop or desktop), software, connecting cables, accessories and auxiliary equipment necessary to effectively operate the life safety system.

5. **Warranty Information:** Contractor shall provide warranty information to UNC Life Safety Shop Representative and UNC Construction Management Representative.

**PART 6  ALTERNATES AND ATTACHMENTS**

**6.1  ALTERNATES**

Alternate E1 - Submit a quote for a maintenance contract to provide all maintenance, test, and
repair described below and/or in accordance with NFPA-72, "Inspection, Testing, and Maintenance". Include also a quote of unscheduled maintenance/repair, including hourly rates including travel cost, for technicians trained on this equipment, and including an “on call” type response time within one (1) hour from time of notification 24-7, 365 days a year. Submittals that do not identify all post contract maintenance costs will not be accepted. Rates and costs shall be valid for the period of five (5) years after expiration of the warranty. Inspections and testing shall be performed as prescribed below. A preventive maintenance schedule shall be provided by the Contractor that shall describe the protocol for preventive maintenance. The schedule shall include:

a) Quarterly inspections of any radiant energy fire detectors, supervisory signal devices, and water-flow devices. Functional testing of entire system batteries and battery charging circuits.

b) Semiannual inspections of entire system batteries and battery charging circuits, transient suppressors, control unit trouble signals, emergency voice / alarm communications equipment, remote annunciators, initiating devices, interface equipment, alarm notification appliances, and the Radio Alarm Transmitter (RAT). Functional testing of entire system batteries and battery charging circuits, radiant energy fire detectors, water-flow devices and valve tamper switches. Systematic examination, adjustment and cleaning of all detectors, manual fire alarm stations, control panels, power supplies, relays, and water flow switches and all accessories of the fire alarm system.

c) Annual inspection and functional testing of all control equipment, entire system batteries and battery charging circuits, control unit trouble signals, emergency voice / alarm communications equipment, remote annunciators, initiating devices, interface equipment, special hazard equipment, alarm notification appliances, and the Radio Alarm Transmitter (RAT).
**Attachment A:**

Life Safety System Transfer of Responsibility

<table>
<thead>
<tr>
<th>BUILDING NAME</th>
<th>EFFECTIVE DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>The current status of the Life Safety System that serves this facility is in the following condition:</td>
<td></td>
</tr>
</tbody>
</table>

The following parties have acknowledged the condition and status of the Life Safety System in this facility and have accepted the transfer of responsibility of this system in its present condition with the understanding that the system will be returned to the University in the same or better condition. Programming changes must be made to the main systems database to support ongoing building construction and/or renovations. In buildings where occupancy must continue, the accepting contractor/vendor will be responsible for the main system and all issues that are a result of the constructed and/or renovated areas. Issues that occur outside the constructed and/or renovated areas that are a direct result from the constructed and/or renovated areas are also the responsibility of the accepting contractor/vendor. The University will be the 1st responders, will notify the contractor/vendor when appropriate, and will be responsible for all areas outside the constructed and/or renovated areas. Upon completion both parties will conduct a 100% test of the devices in the constructed and/or renovated areas and if required, will perform a 10% inspection on the rest of the building per NFPA72.

<table>
<thead>
<tr>
<th>Life Safety Shop Supervisor Releasing System</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vendor/Contractor Accepting System</td>
<td>Date</td>
</tr>
<tr>
<td>Life Safety Shop Supervisor Re-Accepting System</td>
<td>Date</td>
</tr>
</tbody>
</table>
EMERGENCY NOTIFICATION CONTACT LISTING
DAYTIME WORKING HOURS
Name: | Phone and or Pager #:
---|---
1. | 
2. | 
3. | 

NIGHTS, WEEKENDS, AND HOLIDAYS
Name: | Phone and or Pager #:
---|---
1. | 
2. | 
3. |
C-25 – FIRE SAFETY ELEMENTS

General

1. Fire lanes shall be provided for as described below.
2. Fire service sprinkler system features, standpipes, and fire alarm systems shall be provided for as described below.
3. Fire extinguishers shall be provided for as described below.
4. Key Boxes (Knox Boxes) shall be provided for as described below.

Fire Lanes and Access Roads
This section has been relocated, refer to Section: B-01 - Roadways, Driveways & Fire Lanes.

Sprinkler Systems, Standpipes and Alarm Systems
Fire department connection (FDC) locations shall be approved by the University Fire Marshal in consultation with the Chapel Hill Fire Department.

A. Buildings equipped with a fire sprinkler system or standpipe system must be equipped with Post Indicating Valves (PIVs).
B. FDC locations and PIVs shall be identified with a sign stating “FDC” or “PIV”, where appropriate, and must indicate the name of the building served by the connection or valve. All text shall be white on a red background. The “PIV” or “FDC” designation shall be no less than 8” in height.
C. FDCs shall be provided with at least 3 feet of space on all sides.
D. Directional signage shall be provided for FDC and PIV locations where the sign in section C is obscured from the fire lane or access road.
E. Fire alarm panels or equipment should not be co-located in spaces with other uses (e.g., housekeeping closets, communications closets).
F. Rooms containing the fire alarm panel shall be identified with a sign indicating “FACP”, with letters no less than 6” in height.
G. Where required by code, a Fire Command Center will be provided at a location approved by the University Fire Marshal and Chapel Hill Fire Department. This location will be constructed in accordance with Section 508 of the North Carolina Fire Prevention Code.

Fire Extinguishers
The purchase and installation of fire extinguishers shall be included as a part of the cost of each project.

A. Fire extinguishers installed within recessed or semi-recessed cabinets along a hallway or path of egress shall be provided with a sign visible from both directions along the path of egress.
B. Fire extinguishers shall be distributed in accordance with Section 906 of the North Carolina Fire Prevention Code. With respect to fire extinguishers, University buildings shall be considered at least an Ordinary hazard occupancy unless otherwise designated by the University Fire Marshal.
C. Given the requirement in Section IV.C above, fire extinguishers shall be required to be installed, even where not required explicitly by code due to the installation of quick- response sprinkler heads.
D. Fire extinguisher layout and distribution plans shall be submitted to the University Fire Marshal for review and approval prior to construction.
E. “Amerex” brand fire extinguishers are preferred for compatibility with existing University fire extinguisher maintenance programs.
Key Boxes (Knox Box)
Where access to or within a structure or an area is restricted because of secured openings or where immediate access is necessary for lifesaving or fire-fighting purposes, the University Fire Marshal is authorized to require a key box to be installed in an approved location.

A. The key box shall be a Knox Box and shall contain keys and or access cards to gain necessary access.
B. A Knox box shall be added to all new construction projects and will be installed with a tamper switch that will be hardwired to the fire alarm communicator to send a signal to monitoring station at UNC Police Department.
C. Approved Knox boxes are **model 3200 and model 4400**. The University Fire Marshal will determine which box is required for the building based on UNC Fire Safety SOP.
D. The operator of the building shall immediately notify the University Fire Marshal and provide new key where a lock is changed or rekeyed. They key to such lock shall be secured in the Knox box.
E. The purchase and installation of Knox boxes shall be included as a part of the cost of each project.
C-26 - FIRE PROTECTION SYSTEMS

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Preface
The designer is to review all design guidelines and use them to prepare their design and the contract documents for the Fire Protection Sprinkler Systems. This is document is not intended to conflict with any Code or NFPA Standard. If conflict is observed, the designer shall notify the Facility Planning Project Manager and if necessary, obtain a ruling from NC Office of State Construction.

The designer shall consider the following while preparing their design and the contract documents:

1. The designer shall determine the need for a fire pump prior to design development stage through the conduct of water flow tests. All testing must be coordinated with Orange Water and Sewer Authority (OWASA) and the University’s Life Safety Systems Department. Designer shall contact OWASA to determine the fee for water flow tests and coordinate payment to OWASA with the UNC-CH Project Manager. A formal request along with the fee must be submitted to OWASA prior to testing (see the OWASA website).

2. In all new construction and wherever possible in renovations, fire pumps shall be directly connected to both the service transformer and the emergency generator via a service entrance rated combination fire pump controller.

3. Specify that a schedule of fire protection valves shall be installed adjacent to the main fire alarm control panel for the building.

Design Guidelines

I. FIRE PROTECTION SPRINKLER SYSTEMS
Both the North Carolina State Construction Office and the University’s Life Safety Systems Department must review and approve shop drawings for fire protection sprinkler systems before such systems are installed.

UNC-CH’s Fire Sprinkler guidelines are available on the UNC Facilities website. If additional information is needed contact the Life Safety Dept: Manager Sherwood McLamb (sherwood.mclamb@fac.unc.edu). Supervisor David Sharpe (david.sharpe@fac.unc.edu).

A. GENERAL

1. Codes and Standards:
   - NFPA Compliance: Reference NFPA Standards (NC Code may list earlier but these permitted to be used)
   - NFPA 13-2013* Sprinkler Systems
   - NFPA 14-2013 Standpipe and Hose Systems
   - NFPA 15-2012 Water Spray Fixed Systems
   - NFPA 16-2015 Foam-Water Sprinkler Systems
   - NFPA 20-2013 Centrifugal Fire Pumps
   - NFPA 22-2013 Water Tanks for Private Fire Protection
   - NFPA 24-2013 Private Fire Service Mains
NFPA 25-2014  Insp., Testing, and Maintenance of Water-Based Fire
NFPA 72-2013  National Fire Alarm Code

(*Please contact AHJ prior to any use of NFPA 13R or 13D for design, in lieu of NFPA 13.)

SCO Compliance:  Comply with current applicable requirements of North Carolina State Construction Office.

2. **Plans and Specifications Content:**
   - Water supply test data (static pressure, residual pressure, and flow) taken.
   - Design density, remote area size, area per sprinkler, and hose demand.
   - Permitted pipe, valves, sprinkler heads, fittings, and other materials
   - Backflow prevention device requirements, location, and installation detail.
   - Building specific Post Indicator Valve location and installation detail.
   - Fire/booster pump requirements and installation detail, when pump used.
   - Sprinkler riser diagram, beginning where the sprinkler system contract does, showing all cutoff valves, inspector test valves, test connections, supervisory switches, and drains.

3. **Contractor's Shop Drawings and Hydraulic Calculations:**
   The specifying engineer (PE), if any, has primary responsibility for review and approval of sprinkler system shop drawings and calculations. Contractor must provide a minimum of 10 copies (more if required by engineer's specification). PE's review shall be to determine "substantial compliance" with this document and the project specification. After completing this review, the PE is to send one marked-up copy to the University's Life Safety Systems Department for review and approval and must include the hydraulic calculations. In addition, the PE is to send two (2) copies of the shop drawings, hydraulic calculations and materials/product data along with his/her review comments to SCO for review and approval.

4. **Contractor Qualifications and Responsibilities:**
   The contractor must be licensed by the North Carolina State Board of Examiners of Plumbing, Heating, and Fire Sprinkler Contractors and must submit evidence of Level III certification in "Inspections and testing of water-based fire protection systems" by NICET. Minimum of 5 years documented experience installing fire sprinkler systems similar in size and scope to this project.

   The contractor shall be required to furnish evidence of satisfactory performance on previous sprinkler system installations of equivalent size, type, and complexity.

   The contractor shall furnish all parts, materials, and labor required for a complete and operating system in accordance with all applicable requirements, even if each needed item is not specifically shown or described in the plans or specs.

   The contractor is also responsible for the inevitable adjustments in sprinkler locations, sprinkler quantity, and piping required for full compliance with the NC Building Code, NFPA standards, and the project plans and specifications.

   After the project is completed, Contractor's Material and Test Certificates must be submitted
to the UNC Construction Management Representative and the UNC Life Safety Shop Representative, in accordance with NFPA 13. The sprinkler system riser must not be connected until the underground piping has been tested, flushed, and certified per NFPA 24 and inspected and approved by OWASA.

If any conflict is observed between this document and the project plans, referenced Codes, or Standards, obtain a ruling from the AHJ before proceeding with purchase of materials, fabrication, or installation of the system. Failure to do so may cause the sprinkler contractor to be held liable for any cost or delay incurred as a result.

The Installer must be present for the 100% test, Engineer's inspection and the University's Life Safety Systems Department inspections and must submit evidence of Level II certification in "Inspection and Testing of Water-based Protection Systems" by NICET.

B. BASIC SYSTEM PARAMETERS

1. Hydraulic Calculations:
The actual water supply must be verified by test using a minimum 2 hydrants as close to the point of connection as possible, witnessed by the Designer, and the University's Life Safety Systems Department. The waterflow test results shall be adjusted in accordance with DOI criteria by reducing the flow (gpm) and the residual pressure (psi) by 10%. Calculations start at the gauge hydrant used in the test and must include the backflow preventer and all valves and fittings. Use the “1.4 Rule,” and include a 500gpm hose stream allowance if water supply permits. Limit water velocity to 25fps, except use 18fps for any segment with a vane type waterflow switch (to comply with UL listing).

2. Minimum Design Density:
Ordinary Hazard (Group 1) is the minimum system design normally accepted.

The minimum design density is to be 0.15gpm/SF for the hydraulically most remote 1500 SF. If there are open areas greater than 5,000 SF, or if combustible construction is used, the minimum design density shall be 0.12gpm/SF for the hydraulically most remote 3,000-SF. For dry systems, increase the area of application by 30%.

 EXCEPTION (1): When QR sprinklers are used and open spaces are relatively limited in size (e.g., dormitories, classroom-faculty office buildings), Chapter 11 of NFPA 13 is permitted to be used to reduce the system area of operation (and cost). Upon request, permission may also be granted to exceed the OH-1 area/sprinkler limit (130SF) if OH-1 density is still achieved.
 EXCEPTION (2): QR Extended Coverage sprinklers, currently listed only for Light Hazard applications, are permitted to be used in dormitories if density approximating OH-1 results.
 EXCEPTION (3): When NCDOI allows use of listed attic sprinklers, now listed only for Light Hazard. The minimum design in such spaces shall be the greater of 2,000SF or 5 sprinklers for wet systems, and 2,600SF or 7 sprinklers for dry systems.
NOTE: The Appendix of NFPA 13 includes suggested lists of "occupancies" categorized by fire hazard as being Light, Ordinary (Group 1), etc. It carefully qualifies the lists as applying only to "typical" facilities, stating that higher than normal fuel loading, or susceptibility to change, should be considered in classifying the present or potential hazard of each facility. The following facts justify using Ordinary Hazard (Group 1) as the minimum design density: (1) It provides a modest safety factor for changes in building use or occupancy, an important consideration for facilities expected to be in service 50-100 years or more (most public buildings). (2) It helps keep the hydraulic design basis for the system from becoming invalid due to deterioration in the public water supply, a common occurrence due to increasing demand or the build-up of scale in mains. (3) It makes rapid suppression of fire more probable, an important factor in limiting losses and, where plastic pipe is used, in preventing the system from being breached. (4) For residential and institutional facilities using QR sprinkler heads, it increases the probability of saving sleeping occupants in the room of origin. (5) A modest safety factor is also very prudent when the owner is self-insured or has insurance with high loss retention. All these factors apply to the State of NC, which is self-insured. It has high rise facilities in rural areas protected by volunteer fire departments that aren't able to provide the fire fighting resources of cities. Public buildings are often in use 100 years or more, with changes in their fire load common. Finally, anyone who has toured crowded State office buildings or typical college dorms in recent years will understand the fuel load is frequently more than "Light." These provide a strong, prudent basis for adopting Ordinary Hazard (Group 1) as the minimum system design normally accepted. Individual project circumstances may warrant an exception to this criterion.

3. **Extent of Sprinkler Coverage:**
   Ordinary electrical equipment rooms, telephone closets, housekeeping closets and similar spaces shall be fully sprinklered. Sprinkler protection is permitted to be omitted in main electrical switchgear and generator rooms, provided they have direct outside access for the fire department and are enclosed by 2-hour fire rated construction.

4. **System Zoning Requirements:**
   Each story must be a separate sprinkler zone with a dedicated cutoff valve, tamper switch, water flow switch, and an Inspector's Test valve piped to a drain capable of handling full flow without backup or splatter. All cutoff and test valves are to be located on the floor they serve, unless the Owner permits a different arrangement.

   NOTE: For buildings of more than 12 floors, consider two risers, separated from one another and located within stairways or otherwise protected from fire. Each riser would serve either: (1) Alternate floors, or (2) Roughly half of each floor. Where the floors are divided by smoke or fire partitions, we recommend option (2) if the sprinkler zone boundaries could reasonably correspond to smoke/fire partitions.

5. **Multiple Riser Designs:**
   Multiple riser designs that require the operation of more than one floor cutoff valve to isolate any portion of the system are not permitted.
NOTE: This assures non-ambiguous workflow alarm and enables a single valve to shut off water to any zone.

6. **Electrical Supervision:**

Electrical supervision per NFPA 72 is required for monitoring the position of all sprinkler cutoff valves beyond the water source valve, including the outside post indicator valves (PIV), water motor gong control valves and isolation valves for the backflow prevention device. Tamper switches for OS&Y valves shall be mounted to rigid frames secured by bolts through clamp bars. ("J"-hook mounting to the valve's frame is not permitted.)

- **EXCEPTION (1):** Valves are permitted to be secured by locks when located in prison yards, underground pits, or other environments unsuitable for supervisory switches. The Owner may permit additional exceptions based on the individual circumstances.

- **EXCEPTION (2):** Normally closed valves to test headers, rooftop hose connections, etc., are permitted to be provided with locks, in lieu of electrical supervision.

Separate pump houses and hot boxes shall be monitored for freezing. Dry pipe and preaction system air supply must also be monitored, for both low and high pressure, and a manual bleeder valve is to be provided for testing and adjusting air pressure supervisory switches.

NOTE: Low air pressure can cause the dry system to trip wet, requiring it to be drained, the dry pipe valve reset, and repressurized. High air pressure will retard system response to fire, since the air pressure will first have to bleed down to the trip point before water enters the system.

7. **Fire/Booster Pump, Water Supply, Throttling, and Metering:**

The water supply to the sprinkler system must provide at least 150% of pump rated capacity at a positive pressure and also meet the system demand at 20psi minimum. The water supply test shall have been performed within the most recent 12 months.

NOTE: A water supply of 200% of pump capacity is recommended whenever this can be reasonably achieved.

Per the NC Administrative Code, Title 15A, Subchapter 18C, an automatic pilot-operated throttling valve must be installed on the output side of the booster pump, to maintain required minimum pressure. Suction side control is not permitted, due to possible cavitations. Where permitted by SCO a low pressure shutoff sensing the suction pressure may be substituted if the water supply provides 200% of pump rated capacity at a minimum pressure of 40psi, and an acceptable means is provided to periodically test the calibration of this device in its installed location.

Provide a permanently installed meter for net pump performance testing without water streams. The meter outlet must discharge to a drain or to the suction tank, if provided, or (where permitted by NCDOI) to the suction side of the pump

An electrical disconnect rated at 6 time FLA shall be located between the power utility and the Fire Pump ATS/Controller.
The Fire Pump ATS and Fire Pump Controller shall be in separate rated and listed enclosures.

All sensing line Gauges shall be liquid filled.

C. MATERIALS AND COMPONENTS

1. Listing / Approval:
   All sprinkler system materials and components must be listed or approved, and installed in strict conformance to the conditions of their listing / approval.

2. Sprinkler Piping:

   a) Metal:
      Only steel pipe shall be used, with a Corrosion Resistance Ratio (CRR) of one (1) or greater. Schedule 5 pipe is not permitted, in any size. Schedule 10 steel pipe and the approximately equal "flow" products, sizes 1.5" and larger, are permitted to be used only with listed roll groove end fittings. All dry pipe, deluge, and preaction system pipe must be galvanized, including any fittings exposed to weather. Listed flexible stainless steel piping systems (e.g. FlexHead, Flex-Arm) are also permitted.

   b) Plastic:
      Listed CPVC sprinkler pipe is only permitted, with prior written approval by the University's Life Safety Systems Department, to be used in occupancies other than Institutional-Restrained, when all of the following criteria are met:

      - Pipe and fittings shall be post-chlorinated polyvinyl chloride, UL Listed and FM Approved for sprinkler system use, and fully compliant with ANSI/UL 1821-1994 and ANSI/UL 1887-1996.
      - Base resin, compound, finished pipe, and fittings shall meet all the ASTM criteria specified for Noveon BlazeMaster2000 CPVC, and must be produced in the USA or Canada by an ISO 9002 Certified facility.

      NOTE: The benchmark BlazeMaster product is produced under license by several different manufacturers in the USA and Canada. Any listed product meeting the same ASTM, ANSI/UL, and ISO criteria is also acceptable.

      - System shall be the wet pipe type with quick response sprinkler heads. It must be installed indoors (only), where the temperature will not exceed 150°F.
      - Except in corridors and stairs, pipe shall be run concealed or protected from fire exposure by one of the following methods: (a) 19/32" plywood, (b) 1/2" gypsum board, (c) prefabricated 20-gauge steel soffit system over mineral wool insulation, (d) plaster ceiling, (e) approved construction
providing a 15-minute fire rating.

NOTE: Protection from fire exposure is generally required because CPVC pipe is listed for Light Hazard applications only and we judge most State facilities to be predominantly Ordinary Hazard – Group 1. In corridors and stairs the fire hazard should always be "Light," hence no protection is needed. However, we recommend a 20-gauge steel soffit (alone) in corridors, for physical protection and aesthetic appearance.

- CPVC pipe shall not be threaded, grooved, or drilled.
- If stored outdoors the pipe must be protected from exposure to sunlight (UV) by an opaque covering.
- Where pipe penetrates rated wall, floors, or ceilings the fire stopping used must be labeled as being compatible with CPVC.

NOTE: Some fire stop sealants and wrap strips contain solvents or plasticizers that may damage CPVC. It is very important to use only fire stop materials certified to be compatible with this pipe.

- If pipe is to be painted, only water-based paints shall be used (no oil-based).

NOTE: Petroleum-base solvents and lubricants are not compatible with CPVC and may cause damage.

- For threaded connectors, use only Teflon tape. For the steel portions of the system, any pipe dope used must be labeled as being compatible with CPVC.

Each installer of CPVC sprinkler pipe must provide documentation supporting they have attended an authorized training class in how to properly use this material, within the previous two years. They are not permitted to do any CPVC installation work prior to such training, or if not trained within 2 years.

c) Fittings and Joints:
All fittings must be listed or approved for the specific pipe and type of system they are used on. For gasketed fittings, install only with the lubricant the manufacturer obtained listing with, since other lubricants may not provide suitable performance.

d) Metal:
The following joining methods are acceptable for steel pipe, to the extent permitted by listings, except that threading or cut groove fittings are accepted for use only on fully complying Schedule 40 and heavier pipe:

- Threading
- Shop Welding
- Cut Groove with Gasket Fitting
- Roll Groove with Gasket Fitting
- Full Back Design Clamp-on Fittings
- "U" Bolt Design Clamp-on Fittings (Only for pipe of 2.5" run size and smaller)
Plain end, hooker, press-on, key type or slip type metal fittings are not permitted.

All grooved metal products on a job (both fittings and couplings) must be products of the same manufacturer.

NOTE: Mixing different brands may cause problems due to variations in design dimensions and tolerances, which could cause leaks or even failure.

e) Plastic:
CPVC pipe and fittings shall be joined by solvent cementing, in accordance with the following criteria:

- Use only solvent cements which are specifically tested and listed for use with CPVC, and which have been approved by the pipe and fitting manufacturer(s). Apply them strictly in accordance with the manufacturer's instructions.
- Solvent cement must not be used beyond its shelf life, or if gelled or discolored.
- To prevent solvent cement from running and plugging sprinkler orifices, the sprinkler heads are not permitted to be installed until all solvent-welded CPVC pipe, fittings, and head adapters have been allowed to cure a minimum of 30 minutes.
- Torque values must be observed when joining threaded or flanged CPVC adapters.

Grooved coupling adapters must be joined only with flexible couplings (not rigid type), using standard Grade "E" EDPM compound to lubricate the gasket.

f) Valves:
An outside post indicator type control valve (PIV) must be provided for all systems. All indoor cutoff valves in the two (2) inch through eight (8) inch range shall be the butterfly type, with integral tamper switch and position indicator.

NOTE: We've had many field problems with frame-mounted tamper switches mounted on OS&Y valves using "J-bolts", often field-fabricated from threaded rod stock. Adjustment to obtain proper operation is often very difficult, and does not hold. Factory installed butterfly valve tamper switches have proven to be very reliable.

- EXCEPTION (1): Valves on each side of any fire pump are to be the OS&Y type. This does not apply to the fire pump bypass valves (kept normally open), which are permitted be either the butterfly or OS&Y type. CAUTION: Butterfly valves bolted to a check valve frame may create an interference problem in some cases. Check specs to assure non-interference, or provide a short section of pipe between them.
- EXCEPTION (2): All valves are permitted to be OS&Y type if their tamper switches are mounted with substantial, rigid frames (not "J-bolts"), so that adjustments hold.
g) **Sprinkler Heads:**

- For combustible attics, roof decks, or floors above crawl spaces, use sprinklers that provide good wetting of exposed combustible members. The acceptable options include listed attic sprinklers, or pendant heads installed upright.
- Use Dry pendant or sidewall sprinklers for protecting refrigerated storage.
- Quick Response (QR) sprinkler heads shall be used in all sleeping rooms and laboratories, except where institutional heads are needed for security reasons.
- The use of QR heads is encouraged in any other applications for which listed.
- The use of Listed/Approved Residential Sprinklers should be considered for all sleeping occupancies.

NOTE: Although OH-1 is the minimum design normally allowed, Light hazard listed QR heads may be permitted where spacing will provide (near) OH-1 density. Examples: (1) dormitory rooms, (2) sidewall heads used to avoid ornate ceiling impact and/or running exposed pipe in aesthetically sensitive areas.

Residential sprinklers are not to be used in dry systems, unless the spec permits, as water delay might permit too many of these more responsive heads to open.

h) **Backflow Prevention Devices:**

Provide a cutoff valve on both sides of the backflow prevention device in the water supply connection, for isolation (servicing). RPZ backflow prevention device shall be provided with cutoff valves as part of a complete factory assembly, shipped and provided to the project as a whole. Where a booster pump is installed the backflow assembly, required by water quality regulations to be on the suction side, must be located as far from pump intake as possible (at least 10 pipe diameters).

D. **SPECIAL SPRINKLER SYSTEMS**

1. **Preaction Systems:**

   Preaction valves shall be single interlocked, except for freezer facilities the double interlocked type must be used. Preaction Systems shall be installed per NFPA 13 and manufacturer’s specifications.

2. **Foam-Water Systems:**

   Closed head foam-water systems shall be the pre-primed, wet pipe type, except use pre-action type if subject to freezing. (Dry pipe designs not permitted.) Design for solid performance at low flow rate. Endurance shall be at least 20 minutes full flow to the specified design area. Foam concentrates from different manufacturers are not to be mixed. Replace the concentrate used during system inspections. Ceiling sprinklers are to be 286°F (141°C) rating. Provide a two-inch flushing connection at the far end of each cross main, with a conveniently accessible valve and piped to a suitable discharge location that permits the observation and sampling of foam.
NOTE: The flushing connections help assure a rich foam mixture upon initial flow. They also facilitate needed periodic renewal of the water-concentrate solution in the system piping.

3. Refrigerated Area Systems:
Dry systems for freezers must have a regenerative compressed air dryer that will maintain the system dew point at least 20°F below the lowest freezer operating temperature. For freezers with wet systems and dry pendant or dry sidewall heads, the connection between the sprinkler head and the wet pipe must extend at least 12 inches beyond the cooler and be provided with insulating wrap to prevent sweating.

NOTE: To preserve the freezer warranty, only the freezer manufacturer's representative should cut and seal the holes for sprinklers. This should be covered in the engineer's specification.

4. Freeze Protection of Systems:
Heat tracing is NOT acceptable for dry pipe or preaction valve freeze protection. A heated room or closet must be provided to protect these vital components.

NOTE: Antifreeze-primed systems are no longer permitted, due to environmental concerns.

E. INSTALLATION, TEST, AND CERTIFICATION

1. Locating Valves, Drains, and Inspector's Test Connections:
All sprinkler valves and controls must be located for safe and convenient access during emergencies and testing. Control valves shall not be located above ceilings.

NOTE: Inspector's Test Connections should be operable from floor level whenever possible. They're permitted to be locked if vandalism is a concern. Where control valves must be located more than 10 feet AFF, provision for access should be provided (e.g., permanent ladder/catwalk or, if the Owner permits, a chain-operated valve).

Identify each valve and control with a prominent engraved phenolic or stamped metal placard. Any such devices that are behind access doors or panels must also have their location made known by an appropriate placard on the means of access. A valve placard I.D. legend shall be posted at the main sprinkler riser denoting the locations of the identified valves.

2. Contractor's Inspection of System:
The contractor shall thoroughly inspect the completed system to assure compliance with this document, project plans and specs, and applicable Codes and Standards. IMPORTANT: This must include an operational test of each waterflow alarm switch and all system supervisory devices (valve tamper, hi-low air pressure, pump status, etc), in coordination with the fire alarm system contractor.

When a fire pump / booster pump is provided, its flow test will be witnessed by the specifying engineer, UNC Life Safety Shop Representative, SCO and/or the Owner. The contractor must
notify them 2 weeks before the pump test, to permit sufficient time to schedule an inspector to be there.

Pressure tests shall be done with all sprinkler heads installed. Where an existing sprinkler system is being expanded or renovated, the contractor is responsible for the integrity of all new piping plus existing piping within three feet of new or renovation work, and the owner is responsible for the integrity of the balance of the system, during the pressure test.

3. **Contractor’s Material and Test Certificates:**
Prior to final inspection by SCO, NCDOI, and the University's Life Safety Systems Department, the system installer is to submit NFPA-required Contractor’s Material and Test Certificate(s) for aboveground, and underground, piping. These documents should be witnessed and signed by the contractor, the Designer/Engineer of Record and/or the UNC Construction Management Representative. Send copies to the following:

- The Specifying Engineer (PE), if any
- SCO
- UNC Construction Management Representative
- UNC Life Safety Shop Representative

**EXCEPTION:** If the sprinkler contractor did not provide the underground piping, the responsible contractor must submit that certification. The sprinkler contractor is not to connect the riser until underground piping has been flushed, tested, and certified by the responsible contractor.

**NOTE:** For State of NC building projects, the owner is normally represented by the State Construction Office or by the facility's Construction Project Coordinator, as applicable. For private sector projects, the insurance carrier may be the "Representative of the Building Owner."

4. **Reference Information:**
For convenient reference, relevant NFPA test requirements are summarized below. See the applicable NFPA standard for additional details and the forms that must be used by the contractor(s) to document the results of these tests.

- **Underground Pipe Flushing and Test:** Underground pipe shall be thoroughly flushed before being connected to the sprinkler system. Perform hydrostatic pressure test in accordance with NFPA 13 or 24 (generally at 200psi for 2 hours), as applicable. Provide certification per 5.3 that the leakage limits described in detail by the relevant standard were not exceeded.
- **Interior Piping Test:** Hydrostatically test all interior piping and appurtenances in accordance with NFPA 13. This generally requires that the system hold 200psi for 2 hours without any water leakage. Record results and submit copies per 5.3.
- **Additional Air Test for Dry Pipe Systems:** Pump the system to 40psi and allow to stand for 24 hours. The air pressure must not leak down more than 1.5psi. Record results on the Contractor's
Material and Test Certificate per 5.3, above.

- Additional Operating Test for Dry Pipe Systems: All dry pipe systems must deliver sustained water flow to the inspector’s test connection within sixty (60) seconds. Record the actual time on Contractor's Material and Test Certificate.

F. INSTRUCTIONS TO DESIGNERS

This document is not intended to conflict with any Code or NFPA Standard. If conflict is observed, the designer shall notify the Facility Planning Project Manager and if necessary obtain a ruling from NC Office of State Construction.

- Insert this entire document at the back of the specification (as an Appendix). Require compliance by reference in the sprinkler system section (by title and revision date), or
- Reference this document in the text (by title and revision date), require compliance, and mandate that the contractor obtain a free copy from NCDOI (available on their website) for use on the project, or
- Incorporate all of the relevant portions of this document in the sprinkler specification. To facilitate that process, the electronic version of this document contains a separate, attached MS Word Section, comprised of all of the criteria herein, but with the following items deleted: DOI Letterhead, Introduction, all page headings, and fine print NOTES, the Instructions to Designers, Table of Contents, and Revision Record. This makes it very convenient for the engineer to cut and paste these criteria as part of the sprinkler system specification.

The designer and contractor are jointly responsible for coordination of system details with the other designers/trades, as needed. This includes suitable location (and access) for all cutoff valves, determination of which contractor provides alarm/supervisory switches, and coordination with the fire alarm designer on sprinkler system monitoring by the FACU:

- Waterflow alarm, by sprinkler system zone
- Supervision of each sprinkler cutoff valve
- Supervision of high-low air pressure (if used)
- Supervision of fire/booster pump (if present)
- Other sprinkler system supervisory signals (as applicable)

The NC Building Code requires that sprinkler system alarm and supervisory signals be monitored, and transmitted off-premises, by the building fire alarm system. The above signals are permitted to be grouped as follows when received at the remote supervising station: (1) Waterflow Alarm, (2) Sprinkler Supervisory Signal (System Status Abnormal)

Locate points which discharge to the outside of the building (This includes flow testing, system drain down points, and RPZ discharge,) so that any water hazards, erosion hazards, and/or ice hazards are not created by these discharge or drain-down flows.
C-30 – VERTICAL TRANSPORTATION

General
Elevators and Stairways on campus shall be designed in accordance with the current version of the North Carolina Building Code.

Accessibility
The Designer is expected to provide a design that will comply with the current versions of the North Carolina State Building Code and the Americans with Disabilities Act Accessibility Guidelines (ADAAG).

The University requires some elements that exceed these codes and standards. They are listed below:

1. Elevators shall be provided with a grab bar on at least one wall of the elevator cab.

2. Platform Wheelchair Lifts shall not require a key to operate.

3. Stair handrails shall have a bottom extension that extends 12” plus one tread width from the bottom nosing.

# C-32 - LABORATORY BUILDINGS

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I. INTRODUCTION

Purpose: UNC-Chapel Hill has a continuing need to modernize and upgrade its facilities. The resulting construction projects often have significant health and safety requirements due to regulatory oversight. Since these requirements can impact the design of a project, the Department of Environment, Health and Safety (EHS) prepared this EHS Laboratory Design Guide to aid the campus community with planning and design issues. EHS believes that the Guide, in conjunction with EHS’s plan review and consultation, improves design efficiency and minimizes changes. The main number for the UNC-EHS Office is (919) 962-5507.

Application: The Guide is a resource document for use by faculty, staff, and design professionals for use during use during the planning and early design phases of a project. The Guide applies to construction projects for all UNC-Chapel Hill facilities, including leased properties.

Format of Guide: The Guide is formatted to address laboratory design issues pertinent to General Laboratories (e.g.: chemical laboratories) in Section II through VII, with additional requirements for Radioactive Materials Laboratories and Biosafety Level 2 Laboratories presented in Sections VIII and IX respectively. Within the sections, specific design criteria are provided.

References: Please note that if any Design Guidelines are less stringent than the current NC Building Code, Mechanical Code, Fire Prevention Code etc., it should be brought to the attention of the EHS Department for discussion and revision as necessary. The Design Guidelines are not intended to preempt NC Code without State approval of Alternate Methods and Materials, where these Guidelines are found to be less stringent.

Design criteria are designated in the following ways:

Shall: Criterion is typically mandated by applicable regulation(s). The user of the Guide is required to include the design feature.

Must: Criterion is based on well-established consensus standards/guidelines. “Must” is used to reflect a UNC requirement, although not required by a regulation.

Should: Criterion is advisory in nature, based on good engineering and safety practices. It is the discretion of the user of the Guide to include the design feature.

Limitations of the Guide: The EHS Laboratory Design Guide is not "all inclusive." It does not cover all regulatory issues nor does it cover all design situations. It is important to note that use practices must be considered during the design process, as they can directly influence how the laboratory will be designed (e.g.. how hazardous materials are used impacts how they are stored, which is a design issue). In all cases, EHS should be consulted on questions regarding health, safety, and the environment.

II. GENERAL REQUIREMENTS FOR UNC-CHAPEL HILL LABORATORIES

1. Codes, Standards, and References

   i. Regulations:
1. Federal Code of Regulations ("CFR"), Title 29, Labor
2. NC Building Code
3. NC Fire Prevention Code
4. NC Mechanical Code
5. CDC Select Agents, Title 42, Part 73
8. NC Radiation Control Regulations

ii. Consensus Standards and References

1. American National Standard for Laboratory Ventilation (ANSI/AIHA Z9.5-)
3.
5. NC Radiation Protection Section
8. CDC-NIH Biosafety in Microbiological and Biomedical Laboratories, 5th (or latest) Edition
9. Guidelines for Research Involving Recombinant DNA Molecules (NIH Guidelines), April 2019 (or latest)

2. Scope

The primary objective in laboratory design is to provide a safe environment for laboratory personnel to conduct their work. Therefore, all health and safety hazards must be identified and carefully evaluated so that protective measures can be incorporated into the design. The basic laboratory design features listed in this section illustrate some of the basic health and safety elements to include in all new and remodeled laboratories at UNC. The subsections of Section 2.1 provide specific guidance on additional critical features of a general laboratory (e.g., fume hoods, hazardous materials storage, and compressed gases.) (Keep in mind, however, that no matter how well designed a laboratory is, improper usage of its facilities will always defeat the engineered safety features.)

3. Architectural Considerations

i. Walls/Doors/Security

The laboratory must be completely separated from outside areas (i.e., must be bound by four walls).
The laboratory shall have means of securing specifically regulated materials such as DEA Controlled Substances, CDC Select Agents and radioactive materials (i.e., lockable doors, lockable cabinets, etc.)

Having secured hazardous materials storage will keep unauthorized personnel from gaining access to them. These regulations apply specifically to laboratories containing radioactive materials, CDC Select Agents and DEA Controlled Substances; however, UNC-Chapel Hill EHS interprets this to include all laboratories (e.g., general chemistry and electronics).

Laboratories which may use CDC Select Agents shall have secured entry doors that upon illegal entry alarm to UNC Police and EHS.

Doors in H-occupancy laboratories shall have doors which swing in the direction of egress. Doors serving B-occupancy shall swing in the direction of egress if the occupant load is 50 or more. Where possible, all B-occupancy lab doors should swing out with hardware satisfying ADA requirements.

On the wall next to each door entry into the laboratory an 8.5 x 11 inch space must be provided for a standardized clear frame with the room number and hazard warning sheet insert (landscape orientation).

Each door into a laboratory room must have a view panel.

Inside the laboratory, on the wall adjacent to the door latch, provide 2 feet of clear space for light switches, telephone, thermostat and fire extinguisher.

Vents are prohibited in laboratory doors which open to egress/access corridors.

Laboratories which use hoods or other larger equipment should be equipped with doorways that have 48-inch openings. Each opening should accommodate a 36-inch active door leaf and a 12-inch inactive leaf.

ii. **Windows**

If the laboratory has windows that open, they must be fitted with insect screens.

iii. **Flooring**

The floor must be one piece, non-pervious and with covings to the wall. This can be achieved by use of glue, heat welded vinyl flooring, epoxy coated concrete slab, etc.

Floors should be coved up walls and cabinets to ensure spills cannot penetrate underneath floors/cabinets. Tiles and wooden planks are not appropriate because liquids can seep through the small gaps between them. These references apply specifically to laboratories containing biological and radioactive materials; however, UNC-Chapel Hill EHS interprets this to include all laboratories (e.g., general chemistry, electronics, etc.).
Floors in storage areas for corrosive liquids shall be of liquid tight construction.

iv. **Sinks**

Each laboratory must contain a sink for hand washing. Elbow or electronic sensing faucet controls are recommended particularly for biological agents and/or highly toxic chemicals.

Sink faucets and hose bibs that are intended for use with attached hoses must be equipped with back siphon prevention devices.

Laboratory sinks shall have lips that protect sink drains from spills.

Sink lips or berms should be $\geq 0.25$ inches and designed to completely separate the lab bench or fume hood work area from the sink drain.

v. **Chemical/Waste Storage**

Chemical storage shelves shall not be placed above laboratory sinks.

Chemical storage shelves shall be flush to a back wall and shall have a $\frac{1}{2}$ inch lip along the front edge.

Sufficient space or facilities (e.g., storage cabinets with partitions) shall be provided so that incompatible chemicals can be physically separated. This will be based on the chemical inventory and use projection provided by the Principal Investigator to the project and EHS. If the project scope cannot provide sufficient storage the user must develop a written management control plan to include as part of their local Chemical Hygiene Plan.

Materials, which in combination with other substances may cause a fire or explosion, or may liberate a flammable or poisonous gas, must be kept separate. Recommend that solvent storage not be located under the laboratory fume hood, as this is a location where fires are most likely to occur in laboratories.

Adequate space must be provided for the collection of waste materials.

All labs should be designed to conveniently and safely accommodate the temporary storage of biological, radiological, and chemical wastes based on laboratory use projections. Wastes are generally stored in the lab in which they are generated, not in centralized accumulation areas. Contact EHS if waste storage and space become design challenges.

vi. **Furniture Design and Location/Exit Paths**

All furniture must be sturdy. All work surfaces (e.g., bench tops and counters) must be impervious to the chemicals used.
For example, many microbiological manipulations involve concurrent use of chemical solvents such as formaldehyde, phenol, and ethanol as well as corrosives. The lab bench must be resistant to the chemical actions of these substances and disinfectants. Wooden bench tops are not appropriate because an unfinished wood surface can absorb liquids. Also, wood burns rapidly in the event of a fire. Fiberglass is inappropriate since it can degrade when strong disinfectants are applied. Fiberglass also releases toxic smoke when burned. These references apply specifically to laboratories containing biological and radioactive materials; however, UNC-Chapel Hill EHS interprets this to include all laboratories (e.g., general chemistry and electronics).

The lab shall have a minimum aisle clearance of at least 24 inches. Main aisles used for emergency egress must have a clearance width of at least 36 inches.

Lab benches and other furniture must be placed a minimum of 36 inches from an exit. Lab desks should be located near exit ways and in the path of fresh make up air.

vii. **Cleanability**

The laboratory must be designed so that it can be easily cleaned. Walls should be painted with washable, hard non-porous paints.

Spaces between benches, cabinets, and equipment must be accessible for cleaning.

Laboratory furniture must have smooth, non-porous surfaces so as to resist the absorption of liquids and the harsh effects of disinfectants. Furniture must not be positioned in such a manner that makes it difficult to clean spilled liquids or conduct routine maintenance. These references apply specifically to laboratories containing biological and radioactive materials; however, UNC-Chapel Hill EHS interprets this to include all laboratories (e.g., general chemistry and electronics).

viii. **Breakrooms**

The design of the laboratory building must incorporate adequate additional facilities for food storage/consumption and personal hygiene tasks outside of the rooms where chemical and biological materials are handled.

Break rooms should be sized based upon floor occupancy and must be dedicated as a break area and not serve other functions such as a copy center or equipment storage.

A minimum of 1 break room is required per floor unless separate desk space is provided for each occupant in office areas which are walled off and separately ventilated from the laboratory space.
ix. **General Ventilation Considerations (see also Section 2.2 for fume hood considerations)**

Air outlets (preferably non-aspirating diffusers) must not discharge into the face of a fume hood, BSC, an exhaust device or sensitive laboratory equipment. Within the frontal area of the fume hoods and BSC’s, the supply air velocities should be no more than 30% of the fume hood face velocity. Supply air velocities up to an elevation of 7’ and in the vicinities of the fume hoods and BSC, should not exceed 50% of the fume hood face velocity. (Refer to the section “Room air Velocities” in Chapter 6 of ASHRAE Lab Design Guideline, 2nd Edition.) The building DDC system should have spare capacity for building gas and vapor sensor inputs.

Sensor technology should be considered for emergency detection and alarm for highly hazardous gases or vapors.

Winter: 69-76 °F (at 35% RH); Summer: 73-79 °F (at 60% RH)

Consider providing chilled water line services to laboratories with significant heat loads.

Certain equipment may be specified to incorporate centrally produced chilled water and reduce water use and conditioned air.

Chilled water lines may be connected to portable fan coil units for spot cooling in rooms with high general heat loads.

Cabinetry or other structures or equipment must not block or reduce effectiveness of supply or exhaust air. Consider requiring CFM modeling and a minimum air mixing effectiveness.

Supply diffusers and room exhaust openings are located along laboratory ceilings. Storage of boxes near these openings may obstruct the circulation of air and supply or exhaust air functioning.

General laboratories must have a minimum of 6-air changes/hour.

OSHA requires a minimum of 6 AC/HR in chemical storage rooms. Since most laboratories store some quantities of chemicals, this regulation applies.

Laboratories should be equipped with an emergency exhaust button with reset capability located next to the exit door to provide up to 12 air exchanges per hour in the event of a chemical emergency (gas leak, volatile liquid spill, smoke, etc.) This has not been done on recent projects. Is this purge button required?

Laboratories must be maintained under negative pressure in relation to the corridor or other less hazardous areas.
Clean rooms requiring positive pressure should have entry vestibules (anterooms) provided with door-closing mechanisms so that both doors are not open at the same time.

Air exhausted from the general laboratory space (as distinguished from exhaust hoods) must not be recirculated unless one of the criteria listed in ANSI/AIHA Z9.5 are met. Exhaust air from hoods is never recirculated.

General laboratory and Hood exhaust systems which pass conditioned building air through heat recovery systems require maintenance at the filtration/heat exchange units. These units should be maintainable without physical entry into the exhaust system.

If bodily entry is required into the ventilation system, isolation valves/dampers must be provided for each section being entered. Also, Grade D air must be plumbed to the units to allow the use of supplied air respirator hoods or masks while working inside the ventilation system.

x. **Casework and countertop recommendations**

1. **Casework:**

   Type: Standard, floor mounted, closed-base type (may have access doors), should be used in all laboratories.

   Materials: Metal or Hardwood (such as oak or another approved equivalent) - should be used in:

   a. General research and teaching laboratories where humidity and temperature will be normal (standard for occupied rooms), where casework maintenance is not a compelling factor, and where flammable, corrosive, or toxic substances will not be absorbed into the surface.

   b. Plastic Laminate - Should be used in:

      (i) Miscellaneous storage and workrooms requiring base or wall storage facilities, and where the infusion of appropriate colors may be architecturally desirable.

      (ii) Only non-combustible and non-reactive laminates may be used where flammable or corrosive chemicals are to be stored or used.

   c. Millwork - Should not be considered for new construction. Variances may be considered on renovation projects on a case-by-case basis.

2. **Counter Tops:**

   Chemical Reaction and Abuse Resistance - for chemical resistance work surfaces, either of the following should be used:

   (i) Type 1 - Composition Stone -- with a chemical resistant resin finish.

   (ii) Type 2 - Natural Quarry Stone -- with a chemical resistant finish.

   (iii) Type 3 - Solid Resin -- for chemical resistant surfaces and in the bottom of general purpose general-purpose fume hoods
General Purpose - Areas where neither chemical nor physical abuse is expected and where no liquid services are to be used, such as 30" high desk and writing surfaces, instrument support surfaces, or storage areas may use either of the following:

(i) Type 4 - Wood Core -- A wood fiber or wood particleboard core with chemical resistant finish on all exposed surfaces.

(ii) Type 5 - Plastic Laminate -- Plastic Laminate surface with a wood particle core; may be self-edged or post-formed.

Radiation and Other Special Uses -- areas where radioactive materials or other special uses are approved should use the following:

(i) Type 6 - Stainless Steel -- Type 316 polished stainless steel countertop surfaces may be approved on a case-by-case basis.

Physical Abuse Resistance - areas where abrasive physical abuse is expected; Physics, Earth Sciences, Geology, or Paleontology laboratories shall use:

(i) Type 3 - Solid Resin -- with a chemical resistant surface, or

(ii) Type 7 - Composition Stone -- with a low gloss vinyl sealer.

Fume Hood Work Surfaces -- should be selected as follows:

(i) General Purpose Hoods - Type 3, Solid Resin (chemical resistant)

(ii) Radiation Hoods - Type 6 - (Type 316 Stainless Steel).

(iii) Perchloric Acid Hoods - Type 6 - (Type 316 Stainless Steel).

(iv) Special Purpose Hoods - Type 3, Solid Resin (chemical resistant)

Where these casework guidelines are not deemed suitable, alternates of equal or better quality and durability shall be discussed with the UNC Chapel Hill EHS Office.

xi. Engineering Considerations

a. Electrical

GFI protection shall be provided to electrical receptacles above counter tops and within 6 feet of sinks. Receptacles that are not readily accessible or receptacles for appliances occupying dedicated space, which are cord-and-plug connected in accordance with NEC Section 400-7A (6-8), are exempted.

Circuit breakers should be located outside the lab. All breakers must be clearly labeled as to equipment, lighting and outlets served.
In the event of an emergency, the laboratory may be unsafe to enter. Hence, the circuit breakers for key electrical appliances should be located outside the lab.

b. Plumbing

Valves for building gas supply lines should be located outside the lab.

The flexible connections should be used for connecting gas and other plumbed utilities to any freestanding device including, but not limited to; biosafety cabinets, incubators, and liquid nitrogen freezers. Flexible connections should be appropriate for the pressure requirements and should be constructed of material compatible with the transport gas. A shutoff valve should be located within sight of the connection and clearly marked.

Sink drains traps must be transparent (e.g., made of glass) and easy to inspect or have drain plugs to facilitate mercury spill control.

Lab wastewater lines shall be separate from domestic sewage and sampling points shall be installed in an easily accessible location outside the building.

The sampling point shall be installed at a location where all building lab wastes are discharged, before the lab waste line connects to the domestic waste line. The sampling point shall be designed so that it is perpendicular to the lab waste line, has a minimum 4-inch diameter, inch diameter has a cleanout screw on cap and is protected by a Christie Box. The sampling point should not be located in an area where water from irrigation or flow from stormwater runoff can accumulate.

All gas and utility supply lines shall be clearly marked along their entire length through the building. One suggested marking scheme is outlined in SEFA 7, 1994 as follows:

<table>
<thead>
<tr>
<th>Number</th>
<th>Service</th>
<th>Color</th>
<th>Code</th>
<th>Color of Letter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cold Water</td>
<td>Dark Green</td>
<td>CW</td>
<td>White</td>
</tr>
<tr>
<td>2</td>
<td>Hot Water</td>
<td>Red</td>
<td>HW</td>
<td>White</td>
</tr>
<tr>
<td>3</td>
<td>Steam</td>
<td>Black</td>
<td>STM</td>
<td>White</td>
</tr>
<tr>
<td>4</td>
<td>Air</td>
<td>Orange</td>
<td>Air</td>
<td>Black</td>
</tr>
<tr>
<td>5</td>
<td>Gas</td>
<td>Dark Blue</td>
<td>Gas</td>
<td>White</td>
</tr>
<tr>
<td>6</td>
<td>Vacuum</td>
<td>Yellow</td>
<td>Vac</td>
<td>Black</td>
</tr>
<tr>
<td>7</td>
<td>Distilled Water</td>
<td>White</td>
<td>DW</td>
<td>Black</td>
</tr>
<tr>
<td>8</td>
<td>Oxygen</td>
<td>Light Green</td>
<td>OXY</td>
<td>White</td>
</tr>
<tr>
<td>9</td>
<td>Hydrogen</td>
<td>Pink</td>
<td>H</td>
<td>Black</td>
</tr>
<tr>
<td>10</td>
<td>Nitrogen</td>
<td>Gray</td>
<td>N</td>
<td>Black</td>
</tr>
<tr>
<td>11</td>
<td>All Other Rare Gases</td>
<td>Light Blue</td>
<td>Chemical Symbol</td>
<td>Black</td>
</tr>
</tbody>
</table>
III. FUME HOODS

The requirements of this Guide apply to all UNC laboratory buildings, laboratory units, and laboratory work areas in which hazardous materials are used, handled, or stored.

1. Fume Hood Location

Fume hoods should be located away from activities or facilities, which produce air currents or turbulence. Locate away from high traffic areas, air supply diffusers, doors, and operable windows.

Fume hoods should not be located adjacent to a single means of access to an exit. Recommend that hoods be located more than 10 feet from any door or doorway.

Fume hoods must not have large equipment located in front.

Hoods should not be located in room corners, near windows or near very cold equipment.

Fume hood openings should not be located opposite workstations where personnel will spend much of their working day, such as desks or microscope benches.

Fume hoods should not face each other across narrow aisles.

An emergency eyewash/shower station shall be within 10 seconds of each fume hood.

Per 8 CCR 5162, the requirement for an eyewash/shower is triggered when an employee may be exposed to substances, which are “corrosive or severely irritating to the skin or which are toxic by skin absorption” during normal operations or foreseeable emergencies. Fume hoods are assumed to contain such substances; hence, UNC interprets this regulation to mean that emergency eyewash/shower station shall be within 10 seconds of fume hoods.

An ADA emergency eyewash/shower shall be within 10 seconds of an ADA fume hood (minimally one ADA hood per laboratory floor).

The location of at least one ADA hood per floor will enable disabled individuals to conduct their research without having to transport chemicals, etc. in elevators.

2. Approved Equipment

All fume hoods shall meet the requirements of NFPA 45, Standard on Fire Protection For Laboratories Using Chemicals, and ANSI/AIHA Z9.5.

3. Selection/Types

i. General: Consider the following factors when selecting fume hood:
1. Room size (length x width x height)
2. Number of room air changes
3. Lab heat load
4. Types of materials used
5. Linear feet of hood needed based on
6. Number of users/hoodusers/hoods
7. Frequency of use
8. % of time working at hood
9. Size of apparatus to be used in hood, etc.

ii. Constant Volume Hoods

These hoods permit a stable air balance between the ventilation supply and exhaust by incorporating a bypass feature. A restricted bypass is recommended to reduce the opportunity for hood leakage through the bypass caused by convection currents established when a heat source is used in a hood.

iii. Variable Air Volume (VAV) fume hoods

These hoods maintain constant face velocities by varying exhaust volumes in response to changes in sash position. Because only the amount of air needed to maintain the specified face velocity is pulled from the room, energy savings are possible when the sash is closed.

iv. Supply or auxiliary air hoods: These hoods are not permitted for new construction.

It is very difficult to keep the air supply and exhaust of supply hoods properly balanced. In addition, the supply air is intemperate, causing discomfort for those working in the hot or cold air stream. As a result, the supply vent is often either shut or blocked off, which eliminates any potential benefit of this type of hood. Finally, the presence and movement of the user’s body in the stream of supply air creates turbulence that degrades the performance of the hood.

v. Ductless Fume Hoods:

Portable, non-ducted fume hoods are generally not permitted; however, a portable hood may be used for limited applications (e.g., used inside of an existing hood for a special application, such as odor control or to enclose a microbalance). Such applications must be reviewed and approved by EHS on a case-by-case basis.

vi. Perchloric Acid Hoods:

Heated perchloric acid shall only be used in a laboratory hood specifically designed for its use and identified as "For Perchloric Acid Operations." (Exception: Hoods not specifically designed for use with perchloric acid shall be permitted to be used where the vapors are trapped and scrubbed before they are released into the hood.)

Perchloric acid hoods and exhaust duct work shall be constructed of materials that are acid resistant, non-reactive, and impervious to perchloric acid.
The exhaust fan should be acid resistant and spark resistant. The exhaust fan motor should not be located within the duct work. Drive belts should not be located within the duct work.

Ductwork for perchloric acid hoods and exhaust systems shall take the shortest and straightest path to the outside of the building and shall not be manifold with other exhaust systems. Horizontal runs shall be as short as possible, with no sharp turns or bends. The ductwork shall provide a positive drainage slope back into the hood. Duct shall consist of sealed sections. Flexible connectors shall not be used.

Sealants, gaskets, and lubricants used with perchloric acid hoods, duct work, and exhaust systems shall be acid resistant and non-reactive with perchloric acid.

A water spray system shall be provided for washing down the hood interior behind the baffle and the entire exhaust system. The hood work surface shall be watertight with a minimum depression of 13 mm (½ inch) at the front and sides. An integral trough shall be provided at the rear of the hood to collect wash-down water.

The hood surface should have an all-welded construction and have accessible rounded corners for cleaning ease.

The hood baffle shall be removable for inspection and cleaning.

Each perchloric acid hood must have an individually designated duct and exhaust system.

vii. Radioactive Material Use

1. Fume hoods intended for use with radioactive isotopes must be constructed of stainless steel or other materials that will not be corroded by the chemicals used in the hood.
2. The interior of all radioisotope hoods must have coved corners to facilitate decontamination.
3. The hood exhaust may require filtration by HEPA or Charcoal/HEPA filters. Where such is the likelihood, the hood must have a bag-out plenum for mounting such filters and fan capacity for proper operation of the hood with the filter installed. The most appropriate location for the plenum is near the exhaust port of the fume hood (i.e., proximal to the hood).
4. The cabinet on which the hood is installed shall be adequate to support shielding for the radioactive materials to be used therein.
5. In general, glove boxes with HEPA filtered exhausts shall be provided for operations involving unsealed radioactive material that emit alpha particles. Consult with the Radiation Safety Section of EHS for specific requirements.

viii. American with Disabilities Act (ADA) Hoods:

Must consult with UNC Chapel Hill’s ADA Compliance Office regarding the number lab hoods to install in facilities, which are accessible to and usable by individuals with
disabilities – recommend minimally one ADA hood per laboratory floor. These hoods must provide appropriate work surface heights, knee clearances, reach to controls, etc. to individuals in wheelchairs.

The location of at least one ADA hood per floor will enable disabled individuals to conduct their research without having to transport chemicals, etc. in elevators.

ix. **Glove Boxes:**

Glove boxes (positive and negative) must meet the type, design and construction of requirements ANSI/AIHA Z9.5

x. **Floor mounted (walk-in) Fume Hoods:**

These hoods must meet the type, design and construction requirements of ANSI/AIHA Z9.5

xi. **Special Purpose Hoods:**

These hoods include enclosures for operations for which other types of hoods are not suitable (e.g., enclosures for analytical balances, histology processing machines, special mixing stations, evaporation racks). These hoods must be designed per ANSI Z9.5 and the Industrial Ventilation manual.

4. **Labeling**

Laboratory hoods and special local exhaust ventilation systems (SLEV) shall be labeled to indicate intended use (e.g., “Perchloric Acid Hood”).

5. **Construction, Installation & Performance**

New hoods can be mounted above a chemical storage cabinet provided that the cabinet meets the International Fire Code requirements for construction.

Type 316 stainless steel should be used for all parts of the fume hood system ventilation duct as long as compatibility is maintained.

Fume hood interior surfaces shall be constructed of corrosion resistant, non-porous, noncombustible materials such as type 316 stainless steel. These materials shall have a flame spread index of 25 or less when tested in accordance with NFPA method 255, Standard Method of Test of Surface Burning Characteristics of Building Materials. New hoods must not contain asbestos materials. Hoods used for perchloric acid digestion shall have interiors constructed of stainless steel and be equipped with perforated spray pipes behind the top of the baffles for periodic wash downs.
Hood inserts are only permitted for radioactive iodination procedures specifically approved by the UNC Radiation Safety Officer.

Laboratory hoods shall be provided with a means of containing minor spills.

The means of containing minor spills might consist of a 6.4-mm (¼ in.) recess in the work surface, use of pans or trays, or creation of a recess by installing a curb across the front of the hood and sealing the joints between the work surface and the sides, back, and curb of the hood.

There must be a horizontal bottom airfoil inlet at the front of the hood.

Adjustable baffles with horizontal slots must be present in the fume hood interior at the back and top.

Before a new fume hood is put into operation, an adequate supply of makeup air must be provided to the lab.

6. Face Velocity

Average air velocity at the hood face must be between 100-120 linear feet per minute (LFM) with a minimum of 90 LFM at any measured point at a minimum vertical sash opening of 18 inches. For combination sashes, the face velocity with the vertical sash down and two panels open must be 100 fpm and must pass the ASHRAE 110 tests at constant volume when the sash is raised to the full open (setup) position.

7. Certification

The criteria for new fume hood installations at UNC-Chapel Hill are:

The average face velocity of the fume hood is between 100-120 fpm at an 18-in sash height or, for the combination sash, 100-120 fpm with the vertical sash closed and two horizontal sashes open.

All single-point velocity measurements are 90 fpm or greater at the specified minimum openings.

Fume hood containment is shown using the ASHRAE 110 smoke test and tracer gas tests in 3 test conditions:

i. Two horizontal sashes open (vertical sash lowered)
ii. Vertical sash at 18 inches
iii. The sash fully open.

Fume hoods with a vertical sash only must pass the ASHRAE 110 testing for the 18 inch and full open sash positions.
Where the required velocity can be obtained by partly closing the sash, the sash and/or jamb shall be marked to show the maximum opening at which the hood face velocity will meet the face velocity requirements.

An airflow indicator and alarm shall be provided and located so that it is visible from the front of the fume hood. In addition, a magnehelic gauge mounted on the front of the hood and connected to the hood throat shall be installed to monitor hood suction.

Hood alarms will sound locally.

Baffles shall be constructed so that they may not be adjusted to restrict the volume of air exhausted through the laboratory hood. Manual dampers shall be locked in position as soon as the system is balanced.

Fans should run continuously without local control from hood locations and independently of any time clocks unless specifically exempted by the UNC EHS Department.

For new installations or modifications of existing installations, controls for laboratory hood services (e.g., gas, air, and water) should be located external to the hood and within easy reach.

Shutoff valves for services, including gas, air, vacuum, and electricity shall be outside of the hood enclosure in a location where they will be readily accessible in the event of fire in the hood. The location of such a shut-off shall be legibly lettered in a related location on the exterior of the hood.

Each exhaust hood shall be permanently labeled with the unique identification number and the fan ID to which it is attached. Each fan on the roof shall be permanently labeled with its unique ID and a permanent listing of all room numbers, hoods and or general exhausts to which it is attached.

8. **Power and Electrical**

Chemical fume hood exhaust fans shall be connected to an emergency power system in the event of a power failure.

Emergency power circuits should be available for fan service so that fans will automatically restart in proper sequence upon restoration after a power outage.

Fume hood ventilating controls should be arranged so that shutting off the ventilation of one fume hood will not reduce the exhaust capacity or create an imbalance between exhaust and supply for any other hood connected to the same system.

In installations where services and controls are within the hood, additional electrical disconnects shall be located within 15m (50ft) of the hood and shall be accessible and clearly marked. (Exception: If electrical receptacles are located external to the hood, no
additional electrical disconnect shall be required).

Hood lighting shall be provided by UL-listed fixtures external to the hood or, if located within the hood interior, the fixtures shall meet the requirements of NFPA 70, (National Electrical Code) and NFPA 45.

The light fixtures must be of the fluorescent type and replaceable from outside the hood. Light fixtures must be displaced or covered by a transparent impact resistant vapor tight shield to prevent vapor contact.

9. **Sashes**

Sashes may be horizontal, vertical, or a combination, and must have the capability to close off the hood face substantially.

Sash panels (horizontal sliding) must be 12 to 14 inches in width. Sashes shall be made of safety glass.

Use laminated safety glass when internal temperature is anticipated to be less than 160 °F.

Use tempered safety glass when high internal temperatures are anticipated that will result in sash surface temperatures greater than 160 °F.

10. **Ducting**

Hood exhausts should be manifold together except for:

i. *Perchloric acid hoods*

ii. *Hoods with wash down equipment*

iii. *Hoods that could deposit highly hazardous residues on the ductwork*

iv. *Hoods requiring HEPA filtration or other special air cleaning*

v. *Situations where the mixing of exhausted materials may result in a fire, explosion, or chemical reaction hazard in the duct system*

Manifold fume hood exhaust ducts shall be joined inside a fire rated shaft or mechanical room, or outside of the building at the roofline.

Horizontal ducts must slope at least 1 inch per 10 feet downward in direction of airflow to a suitable drain or sump.

Ducts exhausting air from fume hoods should be constructed entirely of noncombustible material. Gaskets should be resistant to degradation by the chemicals involved and fire resistant.

Automatic fire dampers shall not be used in laboratory hood exhaust systems. Fire detection and alarm systems shall not be interlocked to automatically shut down
laboratory hood exhaust fans.

Duct linings shall have a flame spread index of 25 or less when tested in accordance with NFPA 255, Standard Method of Test of Surface Burning Characteristics of Building Materials. Test specimens shall be of the minimum thickness used in the construction of the duct or duct lining.

Duct linings are not recommended. If they are installed, then they must meet the above requirement. Air exhausted from laboratory work areas shall not pass un-ducted through other areas.

11. Exhaust

New exhaust fans should be oriented in an up-blast orientation.

Hood exhaust stacks shall extend at least 10 feet above the roof. Discharge shall be directed vertically upward.

If parapet walls are present, EHS recommends that stacks extend at least 2 feet above the top of a parapet wall or at least 10 feet above the roof, whichever is greater.

Note: The University Architect/Planning Office must be contacted if any building features, such as exhaust stacks, extend above the roofline.

Hood exhausts shall be located on the roof as far away from air intakes as possible to preclude re-circulation of laboratory hood emissions within a building. For toxic gas applications, the separation distance shall be at least 75 feet from any intake.

As future gas necessities are difficult to predict, EHS recommends at least 75 feet for all applications.

All building exhaust and air intakes must be modeled to demonstrate that the exhaust air (including generator exhaust) will not be recirculated within the building being constructed nor in nearby buildings. Wind tunnel modeling should be used for complex building and terrain interactions.

Discharge from exhaust stacks must have a velocity of at least 3,000 fpm. Achieving this velocity should not be done by the installation of a cone type reducer. The duct may be reduced, but the duct beyond the reduction should be of sufficient length to allow the air movement to return to a linear pattern.

Rain caps that divert the exhaust toward the roof are prohibited.

Fume hood exhaust is not required to be treated (e.g., filtered or scrubbed) except when one of the following substances is used with content greater than the percent specified by weight or volume:
Chemical CAS Reg # (Percent)

i. 2-Acetylaminofluorene 53963 (1.0)
ii. 4-Aminodiphenyl 92671 (0.1)
iii. Benzidine (and its salts) 92875 (0.1)
iv. 3', 3'-Dichlorobenzidine 91941 1.0
v. 4-Dimethylaminoazobenzene 60117 (1.0)
vi. alpha-Naphthylamine 134327 (1.0)
vii. beta-Naphthylamine 91598 (0.1)
viii. 4-Nitrophenyl 92933 (0.1)
ix. N-Nitrosodimethylamine 62759 (1.0)
x. beta-Propiolactone 57578 (1.0)
i. bis-Chloromethyl ether 542881 (0.1)
i. Methyl chloromethyl ether 107302 (0.1)
i. Ethyleneimine 151564 (1.0)
i. 1, 2-Dibromo-3-Chloropropane
xv. Asbestos
xvi. Vinyl Chloride
xvii. Acrylonitrile
xviii. Inorganic Arsenic
xix. Ethylene Dibromide
xx. Ethylene Oxide
xxi. Methylene Chloride

When used for radioisotope work. In this instance, the fume hood exhaust treatment system must be approved by the UNC Radiation Safety Officer prior to installation and use.

Air exhausted from laboratory hoods and other special local exhaust systems shall not be recirculated.

Exhaust fans shall be located outside the building housing the laboratory or in a separate room that is maintained at negative pressure to the rest of the building and provides direct access to outside for fan discharge ducts.

The minimum penthouse exhaust flow rate is 1 air change per hour.

12. Noise

System design must provide for control of exhaust system noise (combination of fan generated noise and air-generated noise) in the laboratory. Systems must be designed to achieve an acceptable Sound Pressure Level (SPL) frequency spectrum (room criterion) as described in the 1991 HVAC Applications Handbook.

The preferred method of exhaust noise control is with low static loss air valves and reduced exhaust fan speeds.

Noise attenuators may be used as a last resort if constructed of 304 stainless steel and no packing material is used.
13. Testing

Proper operation of fume hoods must be demonstrated by the contractor installing the fume hood prior to project closeout. The recommended containment performance test is ANSI/ASHRAE 110 with the acceptable criteria as specified in ANSI/AIHA Z9.5. ANSI/AIHA Z9.5, 5.6

IV. EMERGENCY EYEWASH AND SAFETY SHOWER EQUIPMENT

1. Codes, Standards, and References

   a) Regulations, Consensus Standards, and References Consensus Standards and References:

      i. American National Standards Institute (ANSI), Z358.1-2004
      ii. A Guide to Eyewash and Safety Shower Facilities, NCOSHA
      iii. National Fire Protection Association
      iv. Health Care Facilities, Handbook 99, Chapter 10-6, Emergency Shower

2. Scope

This Guide presents the minimum performance requirements for eyewash and shower equipment or the emergency treatment of the eyes or body of a person exposed to injurious materials. It covers the following types of equipment: emergency showers, eyewash equipment, and combination shower and eyewash or eye/face wash.

Plumbed eyewash shall be provided for all work areas where, during normal operations or foreseeable emergencies, the eyes of an employee may come into contact with a substance, which can cause corrosion, severe irritation, or is toxic by skin absorption. Drench hoses, sink faucets, or showers are not acceptable eyewash facilities. Plumbed eyewash shall be provided at all work areas where formaldehyde solutions in concentrations greater than or equal to 0.1% are handled.

NFPA 99 Chapter 10-6

An eyewash safety station should be installed within all acid washing areas. An eyewash safety station should be installed in N2 dispensing stations and film processing areas using chemical developers and fixers.

An emergency shower shall be provided for all work areas where, during normal operations or foreseeable emergencies, areas of the body may come into contact with a substance which is corrosive, severely irritating to the skin or is toxic by skin absorption.

A deluge shower shall be provided at all work areas where formaldehyde solutions in concentrations greater than or equal to 1% are handled.

NFPA 99 Chapter 10-6
A deluge shower should be installed within all acid washing areas. A deluge shower should be installed in N2 dispensing stations and film processing areas using chemical developers and fixers.

3. General Location

i. Where to Install

Emergency eyewash facilities and deluge showers shall be in unobstructed and accessible locations that require no more than 10 seconds for the injured person to reach along an unobstructed pathway (i.e., no doors without panic bars or which don't swing open when pushed). If both eyewash and shower are needed, they shall be located so that both can be used at the same time by one person.

ANSI Z358.1, 4.6.1 and 5.4.4

NFPA 99, Chapter 10-6

American with Disabilities Act (ADA) Emergency Eyewash/Showers: Install an emergency eyewash/shower so that a disabled person can access it within 10 seconds of an ADA fume hood (minimally one ADA hood per laboratory floor). These emergency eyewash/showers must provide appropriate accessibility (e.g., activation of controls and height of eyecups) to individuals in wheelchairs.

The location of at least one ADA hood per floor will enable disabled individuals to conduct their research without having to transport chemicals, etc. in elevators. Fume hoods are assumed to contain substances which are “corrosive or severely irritating to the skin or are toxic by skin absorption,” hence the need for emergency eyewash/shower stations.

ii. Signage

Emergency eyewash and shower locations shall be identified with a highly visible sign. The areas around the eyewash or shower shall be well lighted and highly visible.

ANSI Z358.1, 4.6

ANSI Z358.1, 5.4.5

iii. Prohibitions around Equipment

No obstructions, protrusions, or sharp objects shall be located within 16 inches from the center of the spray pattern of the emergency shower facility.

ANSI Z358.1, 4.6.5
Electrical apparatus, telephones, thermostats, or power outlets should not be located within 18 inches of either side of the emergency shower or emergency eyewash facility (i.e., a 36-inch clearance zone).

Prevent potential electrical hazards posed when the water generated by the activated emergency eyewash/safety shower is in proximity to live electrical equipment.

4. Eyewash Requirements

   i. **Flushing Rates**

      A means shall be provided to ensure that a controlled flow of flushing fluid is provided to both eyes simultaneously.

      ANSI Z358.1, 5.1.1

      Eyewash equipment shall be capable of delivering to the eyes not less than 0.4 gallons per minute of flushing fluid for 15 minutes.

5. Eyewash Positioning

   The eyewash unit shall be positioned with the water nozzles 33-45 inches from the floor and 6 inches minimum from the wall or nearest obstruction. The unit must be located at an operable sink.

   ANSI Z358.1, 5.4.1

6. Eyewash Activation

   The valve shall be designed so that the flushing fluid remains on without requiring the use of the operator’s hands. The valve shall be designed to remain activated until intentionally shut off.

   ANSI Z358.1, 5.2 (a) ANSI Z358.1, 5.1.5

7. Eyewash Equipment Protection

   Nozzles shall be protected from airborne contaminants. The removal of the nozzle protection shall not require a separate motion by the operator when activating the unit.

   ANSI Z358.1, 5.1.3

8. Deluge Shower Requirements
1. Deluge Shower Positioning

The emergency shower location must have a level surface beneath the shower head.

Having a level surface will prevent the users from tripping while trying to access and use the emergency shower.

Emergency shower heads shall be designed so that a flushing fluid column is provided that is not less than 82 inches and not more than 96 inches in height from the surface on which the user stands.

ANSI Z358.1, 4.1

The shower head should not be mounted flush or recessed within any constructed surfaces or partitions and the center of the spray pattern shall be located at least 16 inches from any obstruction.

ANSI Z358.1, 4.1

Recessing the shower head may limit access and/or affect spray pattern.

The spray pattern shall have a minimum diameter of 20 inches at 60 inches above the surface on which the user stands.

ANSI Z358.1, 4.1

2. Flushing Rates

Emergency shower heads shall be capable of delivering a minimum of 75.7 liters per minute (20 GPM) of flushing fluid.

ANSI Z358.1, 4.1

The shower should be attached to a flushing fluid supply from a 1-inch minimum iron pipe size (IPS).

Good Practice (based on ANSI manufacturer’s test procedures)

9. Equipment Activation

The valve shall be designed so that the flushing fluid remains on without requiring the use of the operator’s hands. The valve shall be designed to remain activated until intentionally shut off.

ANSI Z358.1, 4.2
The manual actuator, triangle pull, shall be located not more than 69 inches above the surface on which the user stands. The manual actuator shall be free from obstruction for 18 to 24 inches in all directions. The actuator shall not be mounted flush or recessed within any constructed surfaces or partitions.

ANSI Z358.1, 4.3

10. Design for Maintenance/Use

The water supply to showers and/or shower/eyewash combination units should be controlled by a shutoff valve which is visible and accessible to shower testing personnel in the event of leaking or failed shower head valves.

When floor drains are used, a means shall be provided to control odors from dry traps.

If floor drains are not provided, controls shall be provided to prevent or minimize flooding.

11. Testing

Proper operation of the equipment must be demonstrated by the contractor installing the emergency eyewash or shower equipment prior to project closeout and facility occupation.

By testing the equipment, UNC can be assured that it is working properly before the users begin their research.

12. Approved Equipment

All emergency showers and eyewash facilities shall meet the requirements of NFPA 99 Chapter 10, and ANSI Z358.1 and shall be installed in accordance with ANSI Z358.1.

NFPA 99, Chapter 10 ANSI Z358.1

V. COMPRESSED GAS CYLINDERS

1. Codes, Standards, and References

   i. NFPA 45, Chapter 8
   ii. NFPA 99, Chapter 4
   iii. NFPA 704, Chapter 2

2. Scope

The Guide applies to all UNC-Chapel Hill facilities, including leased properties. It covers the design of storage for compressed gas cylinders. Note that there are numerous
regulations governing the proper use of compressed gas cylinders; use is not addressed by the Guide, as it is a work practices issue, rather than design feature.

3. **Storage of Compressed Gas Cylinders – General Location**

Laboratory design shall include a storage area for cylinders of compressed gases where:

i. *They are protected from external heat sources such as flame impingement, intense radiant heat, electric arc, or high temperature steam lines.*

ii. *They are in a well-protected, well ventilated, dry location, at least 20 feet from highly combustible materials.*

NFPA 99, 4-3.1.1.2

Design features which are prohibited: Unventilated enclosures such as lockers and cupboards.

Work practice issues: Oxygen cylinders shall not be stored near highly combustible materials, especially oil or grease, or near any other substance likely to cause or accelerate fire

a) **Restraint Systems**

Laboratory design shall include restraints for the storage of cylinders greater than 26 inches tall; the restraint system shall include at least 2 restraints (made of noncombustible materials), which are located at one-third and two-thirds the height of the cylinder.

NFPA 45, 8-1.5

NFPA 99, 4-3.1.1.2.3

A restraint system of chains, metal straps, or storage racks provides a reliable method of securing gas cylinders. Chains or a metal strap at the bottom and top one third of each cylinder provides protection against tipping and falling. [Work Practice Note: When compressed gas cylinders in service, they shall be adequately secured by chains, metal straps, or other approved materials, to prevent cylinders from falling or being knocked over.]

The purchase and installation of compressed gas cylinder securing systems must be subject to review and approval of EHS.

Gas cylinder securing systems should be anchored to a permanent building member or fixture. Provisions shall be made for securing cylinders that are delivered to locations outside of the laboratory.
4. Storage of Compressed Gas Cylinders – Toxic and Highly Toxic Gases

Laboratory design shall incorporate storage capabilities of compressed gas cylinders of toxic and highly toxic gases per the following table. The number of lecture bottle cylinders [approximately 5 cm x 33 cm (2 in. x 13 in.)] shall be limited to 25. See Table 6-1. Also, review the International building and fire codes for other limitations.

Flammable or Oxidizing Gases Liquefied Flammable Gases with Health Hazard Rating of 3

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<thead>
<tr>
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<th>Sprinklered Space</th>
<th>Nonsprinklered Space</th>
<th>Sprinklered Space</th>
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<tbody>
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<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
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</table>

NFPA 45: Table 8-1

a) Storage Systems

Laboratory design shall include one of the following storage systems for toxic and highly toxic compressed gas cylinders:

i. ventilated gas cabinets/exhausted enclosures/ laboratory fume hoods; or

ii. separate ventilated gas storage rooms without other occupancy or use, which has explosion control.

When gas cabinets or exhausted enclosures are provided, they shall (be):

i. located in a room or area which has independent exhaust ventilation;

ii. operate at negative pressure in relation to the surrounding area;

iii. have self-closing limited access parts or noncombustible windows to provide access to equipment controls, with an average face velocity of at least 200 fpm and with a minimum of 150 fpm at any part of the access port or window;

iv. connected to an exhaust system;

v. have self-closing doors and is constructed of at least 0.097 inch (12 gauge) steel;

vi. internally sprinklered;

vii. anchored;

viii. contain no more than 3 cylinders per gas cabinet, except where cylinder contents are 1 pound (1-pound net or less, in which case gas cabinets may contain up to 100 cylinders.

When separate gas storage rooms are provided, they shall:

i. Operate at a negative pressure in relation to the surrounding area;

ii. Direct the exhaust ventilation to an exhaust system.

b) Treatment
Treatment systems for the exhaust of toxic and highly toxic gases must be reviewed and approved by EHS.

EHS reviews treatment systems to ensure they are compliant and are consistent.

c) Emergency Power

Emergency power shall be provided for exhaust ventilation, gas-detection systems, emergency alarm systems, and temperature control systems.

d) Detection System

A continuous gas detection system shall be provided to detect the presence of gas at or below the permissible exposure limit or ceiling limit. The detection system shall initiate a local alarm and transmit a signal to a constantly attended location. Activation of the monitoring system shall automatically close the shut-off valve on toxic and highly toxic gas supply lines to the system being monitored.

An approved supervised smoke detection system shall be provided in rooms or areas where highly toxic compressed gases are stored indoors.

e) Security

Storage areas shall be secured against unauthorized entry.

5. Storage of Compressed Gas Cylinders – Medical Gases

Enclosures such as 1-hour interior and exterior rooms (detailed below) must be provided for supply systems cylinder storage or manifold locations for oxidizing agents such as oxygen and nitrous oxide. Such enclosures must be constructed of an assembly of building materials with a fire-resistive rating of at least 1 hour and must not communicate directly with anesthetizing locations.

NFPA 99, Sections 4-3.1.1.2(a).2

Other nonflammable (inert) medical gases may be stored in the enclosure. Flammable gases shall not be stored with oxidizing agents. Storage of full or empty cylinders is permitted. Such enclosures shall serve no other purpose.

A 1-hour exterior room shall be a room or enclosure separated from the rest of the building by no less than 1-hour-rated fire-resistive construction. Openings between the room or enclosure and interior spaces shall be smoke-and draft-control assemblies having no less than a 1-hour fire-protection rating. Rooms shall have at least one exterior wall provided with at least two vents. Each vent shall not be less than 36 square inches in area. One vent shall be within 6 inches of the floor and one shall be within 6 inches of the ceiling. Containers of medical gases shall be provided with at least one fire sprinkler to provide container cooling in case of fire.
When an exterior wall cannot be provided for the room, automatic sprinklers shall be installed within the room. The room shall be exhausted through a duct to the exterior. Makeup air to the room shall be taken from the exterior. Both separate air streams shall be enclosed in a 1-hour-rated shaft enclosure from the room to the exterior. Approved mechanical ventilation shall be in accordance with the California Mechanical Code and provided at a minimum rate of 1 cubic foot per minute per square foot of the room area.

Medical gas system cabinets shall be in accordance with the following:

i. Operated at a negative pressure in relation to surrounding area,

ii. Provided with self-closing, limited-access ports or noncombustible windows to give access to equipment controls. The average velocity of ventilation at the face of access ports or windows shall not be less than 200 feet per minute, with a minimum of 150 feet per minute at any point of the access port or window,

iii. Connected to an exhaust system,

iv. Provided with a self-closing door,

v. Constructed of not less than 0.097-inch (12 gage) steel, and

vi. Internally sprinklered.

VI. FLAMMABLE LIQUID STORAGE CABINETS

1. Codes, Standards, and References

   1. NC Fire Prevention Code Section
   2. NFPA 30 Chapter 4

2. Scope

Flammable liquid storage cabinets are intended for the storage of flammable and combustible liquids. This Guide applies to all UNC-Chapel Hill facilities, including leased properties. It covers the design, construction, and installation of Flammable Liquid Storage Cabinets; the Guide does not address the proper use of Flammable Liquid Storage Cabinets.

3. Design

   1. Approval/Submittal

      Flammable Liquid Storage Cabinets must be UL listed and must meet NC Fire Prevention Code requirements.

   2. Cabinet Capability

      Where flammable liquid storage cabinets are required, they shall be designed such that they do not exceed 120 gallons for the combined total quantity of all liquids (i.e., Classes 1, 2, and 3).
NFPA 30, Chapter 4-3.1

NFPA 30 Chapter 4-3.1 still contains the limit (Check most recent NC Fire Protection Code)

One or more Flammable Liquid Storage Cabinets are required for laboratories which store, use, or handle more than 10 gallons of flammable or combustible liquids.

3. Labeling

Flammable Liquid Storage Cabinets shall be conspicuously labeled in red letters on contrasting background "FLAMMABLE - KEEP FIRE AWAY."

NFPA 30, Chapter 4-3.5

When flammable or combustible liquids present multiple hazards, the laboratory design shall address the storage requirements for each hazard.

For example, acetic acid is a corrosive and flammable material.

Therefore, if stored in a flammable cabinet with other flammable materials, it must be segregated through the use of separate barriers (e.g., secondary containment). Incompatible material shall not be stored within the same cabinet.

4. Construction

1. Materials (NFPA 30, Section 4-3.3(b))

New Flammable Liquid Storage Cabinets must be constructed of steel. Good Practice per UNC-Chapel Hill EHS

Wood cabinets are not UL listed or EHS approved.

Flammable Liquid Storage Cabinets shall be constructed as follows:

a. Minimum wall thickness of 0.044 inches (18 gauge).

b. Double walled construction with a minimum air gap of 1- 1/2-inches between the walls including the door, top, bottom, and sides.

c. Tight-fitting joints welded or riveted.

d. Liquid-tight bottom with a door sill of at least 2 inches.

e. Three-point latch on doors.

2. Doors
Cabinet doors shall be self-closing and self-latching.

3. Venting (NFPA 30, Chapter 4-3.4 and NFPA 99, Chapter 10-7.2.3)

Flammable Liquid Storage Cabinets are not required to be vented except for odor control of malodorous materials. Vent openings shall be sealed with the bungs supplied with the cabinet or with bungs specified by the manufacturer of the cabinet. If vented, cabinet should be vented from the bottom with make-up air supplied to the top. It shall be vented outdoors to an approved location or through a flame arrester to a fume hood exhaust system. Construction of the venting duct should be equal to the rating of the cabinet.

4. Location

Flammable Liquid Storage Cabinets shall NOT be located near exit doorways, stairways, or in a location that would impede egress. Flammable Liquid Storage Cabinets must NOT be wall mounted. Wall mounted cabinets are not UL Listed or Fire Marshal Approved.

5. Laboratory design must ensure that Flammable Liquid Storage Cabinets are NOT located near an open flame or other ignition source.

6. Good Practice per UNC-Chapel Hill EHS

7. An open flame or other ignition source could start a fire or cause an explosion if an accident or natural disaster brought the ignition source and flammable liquids or vapors together.

VII. HAZARDOUS MATERIALS STORAGE AND HANDLING

1. Standards

NC Building Mechanical and Fire Prevention Codes

2. Scope

This design guide applies to the storage of hazardous materials. As noted in the introduction, the use of hazardous materials has direct bearing on the design of the laboratory; hence the research operations should be well understood in the planning phases when designing the laboratory’s hazardous materials storage.

3. Requirements

Laboratory design shall include spill control and secondary containment for the storage of hazardous materials liquids in accordance with the requirements of the NC Building Code, NC Fire Prevention Code and NFPA 45.

Notes: Design must allow for substances which, when mixed, react violently, or evolve toxic vapors or gasses, or which in combination become hazardous by reason of toxicity, oxidizing power, flammability, explosibility, or other properties, to be
separated from each other in storage by distance, by partition, or otherwise, so as to preclude accidental contact between them.

Explosion control shall be provided for storage of non-exempt quantities of the following materials:

1. Highly toxic flammable or toxic flammable gases when not stored in gas cabinets, exhausted enclosures or gas rooms.
2. Combustible dusts.
3. Class 4 oxidizers.
4. Unclassified detonable and Class 1 organic peroxides.
5. Pyrophoric gases.
6. Class 3 and 4 unstable (reactive) materials.
7. Class 2 and 3 water-reactive solids and liquids.

When the hazardous materials stored in a control area are not in excess of the amounts specified in the International Building and Fire codes, such storage shall conform to the Building Code requirements for Group B Occupancy. (See Building and Fire Codes)

When the hazardous materials stored in a control area exceed the amounts specified such storage shall conform to the Building Code requirements for Group H, Occupancy.

When the hazardous materials stored in laboratories and similar areas used for scientific experimentation or research are not in excess of the table below and are not otherwise classified as Group B Occupancies, shall conform to the Building Code requirements for Group H.

4. Procedures

Permitting and reporting procedures

1. NC Building Code Chemical Inventory Report Procedure

As noted in this and other sections, the quantity of hazardous chemicals planned for use and storage within a project area has a direct impact on how the project is designed. The project architect is responsible for ensuring the necessary data is collected from the future building occupants and is assessed by a qualified individual (firm) before the Design Development Drawings are submitted to the State Department of Insurance (DOI). This review must be completed using standard Microsoft software (or other approved by the EHS Department). The end result of the procedure is a summarized report showing the quantities of hazard classes planned for designated control areas as compared to the NC Building Limits. For unassigned spaces, the assumptions made for these areas must be specified. A copy of the final report and all supporting information must be provided to the EHS Office on a Read Only optical disk as a permanent record of this analysis.
2. Hazardous Waste Generator "permit" for "off campus" facilities

Projects within five campus sites are covered by the University’s existing Hazardous Waste Generator permits (Horace Williams Airport, Cogen, HMF, Main Campus and Marine Sciences). Projects that are outside of these 5 areas must contact the Environmental Section of the UNC-Chapel Hill EHS Department for guidance and assistance.

3. City Water Quality Control

All projects must be reviewed by the UNC Facilities Department if a new connection is made to the sanitary sewer. The University holds a comprehensive permit for the main campus. Sewer connections cannot be made until the building permit documentation has been submitted to the UNC Facilities Department.

4. Decommissioning of Existing Facilities

Prior to completion of construction documents, contact the UNC-EHS Environmental Office to coordinate the preparation of a decommissioning plan.

Chemical removal and cleaning of surfaces must be completed before demolition can begin. Decontamination of concealed areas such as pipes, and under cabinets etc. must be coordinated with demolition activity.

All chemical waste and contaminated debris must be assessed by the UNC-EHS for hazard determination.

The Environmental Office will assist in identifying appropriate waste handling methods.

Hazardous waste must be managed according to all State and Federal regulations. All hazardous waste manifests must be signed by the Hazardous Waste Manager and shipped to UNC approved waste facilities.

VIII. ADDITIONAL REQUIREMENTS FOR LABORATORIES USING RADIOACTIVE MATERIALS, RADIATION PRODUCING MACHINES, OR LASERS

1. Codes, Standards, and References

1. Regulations:

   a. NC Radiation Control Regulations (150A NCAC 115)
   b. NC Radioactive Material License,
   d. UNC-Chapel Hill Radiation Safety Manual (STIPULATED IN LICENSE)
2. University Policies:

Policies of the Administrative Panel on Radiological Safety

3. Recommendations:

NC Radiation Protection Section


“Structural Shielding Design for Medical X-ray Imaging Facilities”, NCRP, Report No. 147


Guide for the Preparation of Application for Medical Use Programs, (Proposed Revision 2 to Regulatory Guide 10.8, USNRC (NRC 10.8)

Guide for the Preparation of Applications for Type A Licenses of Broad Scope, 2nd Proposed Revision 2 to Regulatory Guide 10.5, Revision 2, USNRC (NRC10.5)


"Recommendations for the Safe Use Of LASERS," American National Standards Institute. (ANSI Z136.1)
2. Scope

All radioactive materials used at UNC-Chapel Hill are governed by the terms and conditions of the UNC-Chapel Hill Radioactive Materials Licenses, issued by the Department of Environment and Natural Resources, Division of Environmental Health, Radiation Protection Section. All radiation producing devices are registered with the State of NC, Radiation Protection Section, Electronic Products Branch.

3. Decommissioning of Existing Facilities Prior to Demolition or Renovation

Contact the Radiation Safety Section of EHS as early as possible (at least 120 days) before the planned initiation of construction. A plan for decommissioning must be prepared following the UNC EHS Guidelines for decommissioning. The laboratory must be cleared of all radioactive sources/contamination before demolition, renovation or construction can begin.

4. Design Features for Radiological Labs

1. Approval Process

Proposals for new facilities must be submitted to the Radiation Safety Section of EHS for review. New facilities may require the multiple approvals prior to construction.

NC Radioactive Material License

UNC-Chapel Hill Radiation Safety Manual

2. Architectural Considerations

Benches in laboratories must be capable of supporting weight of necessary shielding (e.g. lead).

NBS Handbook 92

IAEA, Safe Handling of Radionuclides

When work involves gamma emitters (especially gamma irradiators) the floors and coatings must be able to support the gamma shielding.

NBS Handbook 92

IAEA, Safe Handling of Radionuclides
When applicable, lead shielding must be incorporated in the structure. Based on the proposed type and quantities of radioactive materials, the Radiation Safety Section of EHS will determine the need for the shielding.

Note that for x-ray producing machines, shielding calculations will be performed by the Radiation Safety Section of EHS. Shielding design is to be in accordance with all applicable State Regulations and NCRP and ANSI standards. Designs must be submitted to the State through the Radiation Safety Section of EHS. During construction the shielding must be completed, the effectiveness of the installed shielding and protective design features shall be evaluated by the Radiation Safety Section of EHS and required reports submitted to and accepted by the State prior to operation of the radiation producing machine.

NC Radiation Control Regulations

National Council on Radiation Protection, Report No. 49, 147 NC Radioactive Material License

3. Security

Areas where radioactive materials or other radiation sources are used or stored shall be provided with adequate security (e.g., locks) to prevent removal or use by unauthorized personnel.

NC Radiation Control Regulations

UNC-Chapel Hill Radiation Safety Manual

High radiation areas or very high radiation areas (as defined in 15 A NCAC 11.0104) shall be equipped with means to prevent inadvertent access and restrict access to only authorized personnel. Means to reduce exposure levels in the area may be required via an interlock device. In some applications, means to monitor the radiation levels in the areas shall be provided.

NC Radiation Control Regulations

High radiation areas or very high radiation areas (as defined in 15 A NCAC 11.0104) shall be equipped with a control device that energizes a conspicuous visible or audible signal so that an individual entering the area and the operator of the device are made aware of the entry.

NC Radiation Control Regulations

4. Waste Storage

Adequate space must be available for radioactive wastes generated by projects
within the lab. Most radioisotope projects will need about 15 sq. ft. of floor space for containers and shields within a lockable area.

UNC-Chapel Hill Radiation Safety Manual

5. Ventilation Considerations

Ventilation requirements for the laboratories utilizing radioactive materials are dependent upon the types of materials used. Facilities that use radioactive gases shall be equipped with ventilation to adequately maintain concentrations to below allowable occupational exposure levels and to not permit escape of the gas to adjacent non-use areas such that concentrations exceed those allowed for uncontrolled areas. These range from no special requirements to those requiring separate exhaust systems equipped with "panic button" shut down switches. The Radiation Safety Program will review the proposed uses and make specific recommendations appropriate for each facility.

10 CFR 20: Appendix B

UNC-Chapel Hill Radiation Safety Manual

Depending on the type and quantities of radioactive materials or the location of the facility, fume hoods used with volatile radioactive materials have specific design requirements. These are detailed in the Fume Hoods Section of this Design Guide.

5. Laser Radiation Items

Class 3b and 4 Laser facilities must be equipped with adequate shielding (e.g. thermal curtains using materials approved by the University's Fire Marshal, window glass that does not transmit direct laser radiation or the specula or diffuse reflections of the laser radiation (shutters or filters)). Portals and viewing windows must be designed to prevent any exposure above the permissible threshold limit value.

ANSI Z136.1

CRC Handbook of Laboratory Safety, 4th Ed.

Class III3b and Class IV4 laser facilities must be in rooms secured by locks. Class IV laser installations must be provided with interlocked warnings that indicate the status of the laser prior to entering the facility.

ANSI Z136.1

Electrical outlets need to be positioned is such a manner that leakage of water coolant will not lead to risks of electrocution.
5. Laser Ventilation Considerations

Appropriate ventilation to remove laser generated airborne contaminants must be provided for Class 3b and 4 lasers.

ANSI Z136.1

Gas cabinets and adequate ventilation must be provided to mitigate the hazards associated with excimer laser gases or other lasers using toxic gases.

ANSI Z136.1

IX. BIOSAFETY LEVEL 2 LABORATORIES

1. Codes, Standards, and References

OSHA Blood borne Pathogens Standard

Biosafety in Microbiological and Biomedical Laboratories, 5th ed. (or latest), CDC-NIH

National Fire Protection Association (NFPA) Standard 45, Fire Protection for Laboratories

The Centers for Disease Control and Prevention (CDC) and the National Institutes of Health (NIH).

Primary Containment for Biohazards: Selection, Installation and Use of Biological Safety Cabinets the Centers for Disease Control and Prevention (CDC) and the National Institutes of Health (NIH).

NIH Guidelines for Research Involving Recombinant or Synthetuc DNA Molecules, April 2019.

National Sanitation Foundation (NSF) International Standard 49

2. Scope

All the biological research conducted at UNC-Chapel Hill involves low to moderate risk etiological agents as defined by the NIH. Section 1 of this Guide, General Requirements for UNC Laboratories, covers all design requirements for Biosafety Level 1 laboratory work areas. This section focuses primarily on the biosafety considerations for a Biosafety Level 2 laboratory. Please see Biosafety Level 3 guidelines for BSL3 laboratories.

3. Ventilation Considerations for Biosafety Level 2 Laboratories
Air pressure in laboratories and animal care rooms should be negative in relation to the corridor or adjacent non-laboratory areas.

Potentially harmful aerosols can escape from the containment of the laboratory room unless the room air pressure is negative to adjacent non-laboratory areas. As a general rule, air should flow from low hazard to high hazard areas.

Tissue culture rooms should be negative with respect to adjoining areas.

An autoclave should be provided with a canopy hood with slotted exhaust or other suitable means of local exhaust. In addition, autoclave rooms should have a minimum of 10 air changes per hour.

Unpleasant heat and odors will linger in the room unless provided with effective local exhaust and adequate frequency of air changes.

4. Biological Safety Cabinets and Other Containment Considerations

1. Approval/Type

All cabinets must be NSF listed, UL approved, and installed in accordance with the manufacturer’s requirements.

Cabinets, which when used and installed properly, will provide both product, environment and personnel protection.

For Biosafety Level 2 applications involving toxic chemicals or radionuclides, a Class II- B type cabinet must be installed.

Class II-B cabinets do not recirculate exhaust air and are appropriate for such uses. The exact type of BSC should be specified early in the design process.

2. Location

Biological safety cabinets (BSCs) must be located away from doors and other high traffic areas.

Currents of air can disrupt and degrade the protective capability of the cabinet. All attempts should be made to neutralize any interference.

A biosafety cabinet should not be installed directly opposite of another biosafety cabinet if spatial considerations allow otherwise.

Laminar airflow is greatly hindered by the operation of a biosafety cabinet located directly opposite of another biosafety cabinet or autoclave.

3. Natural Gas
Open flames are not to be used in Biosafety Cabinets.

4. Restraints

When initially installed or reinstalled, biosafety cabinets must be provided with an appropriate means of seismic stabilization.

5. Testing

Biological safety cabinets are to be certified as part of the building contract.

Remote HEPA Filtration Units in ductwork Remote HEPA filters must have provisions for testing and decontamination, with test ports before and after the HEPA, isolation dampers, and decontamination ports according to the drawing.

6. Autoclaves

Laboratory designs must include an autoclave for sterilizing media, lab instruments, and medical waste as necessary. An autoclave is required since heat and pressure can kill potentially infectious spores that resist other disinfectants. The autoclave need not be in the actual lab room; however, should be available on the floor.

An autoclave is required since heat and pressure can kill potentially infectious spores that resist other disinfectants. The autoclave need not be in the actual lab room, however, should be available on the floor.
**Biohazardous Materials**: Infectious agents, the products of infectious agents, or the components of infectious agents presenting a risk of injury or illness.

**Biosafety Level**: Biosafety levels consist of laboratory practices and techniques, safety equipment, and a laboratory facility appropriate for the operations performed and the hazard posed by the particular biohazardous material. The Centers for Disease Control (CDC) and the National Institute of Health (NIH) define the four biosafety levels in the publication, Biosafety in Microbiological and Biomedical Laboratories.

**Biosafety Cabinet**: A ventilated cabinet which serves as a primary containment device for operations involving biohazard materials. The three classes of biosafety cabinets are described below:

- **Class I Biosafety Cabinet**: The Class I biosafety cabinet is an open-fronted negatively pressured ventilated cabinet with a minimum inward average face velocity at the work opening of at least 75 feet per minute. The exhaust air from the cabinet is filtered by a HEPA filter and discharged without recirculation.

- **Class II Biosafety Cabinet**: The Class II biosafety cabinet is an open-fronted, ventilated cabinet. Exhaust air is filtered with a high efficiency particulate air filter (HEPA). This cabinet provides HEPA-filtered downward airflow within the workspace. Class II Cabinets are further classified as type A1, A2, B1, and B2.
  - Class II, type A1: Biosafety cabinets may have positive pressure contaminated internal ducts and exhaust HEPA-filtered air back into the laboratory. The cabinet shall provide a minimum inward average face velocity of 75 feet per minute at the work opening. The cabinet recirculates 70% exhaust and 30% to the lab.
  - Class II, type A2: Cabinets have all biologically contaminated internal ducts or plenums under negative pressure or surrounded by negative pressure ducts or plenums, exhaust HEPA filtered air through external ducts to space outside the laboratory, and have HEPA filtered down flow air that is a portion of the mixed down flow and inflow air from a common exhaust plenum. Recirculate 70% exhaust and 30% to lab.
  - Class II, type B1: Cabinets have all biologically contaminated internal ducts or plenums under negative pressure or surrounded by negative pressure ducts or plenums, exhaust HEPA filtered air through external ducts to space outside the laboratory, and have HEPA filtered down flow air composed largely of unrecirculated inflow air.
  - Class II, type B2: Class II type B2 cabinets (also known as "total exhaust" cabinets) have all biologically contaminated internal ducts or plenums under negative pressure or surrounded by negative pressure ducts or plenums, exhaust HEPA filtered air through external ducts to space outside the laboratory, and have HEPA filtered down flow air drawn from the laboratory or outside air. There is no re-circulated air.

- **Class III Biosafety Cabinet**: The Class III biosafety cabinet is a totally enclosed, negative
pressure, ventilated cabinet of gas-tight construction. Operations within the Class III cabinet are conducted through protective gloves. Supply air is drawn into the cabinet through high-efficiency particulate air filters. Exhaust air is filtered by two high efficiency particulate air filters placed in series or by high efficiency particulate air filtration and incineration, and incineration and discharged to the outdoor environment without recirculation.

**Boiling Point:** The temperature at which the vapor pressure of a liquid equals the surrounding atmospheric pressure. For purposes of defining the boiling point, atmospheric pressure shall be considered to be 14.7 PSIA (760 mm Hg).

**Carcinogen:** A substance is considered to be a carcinogen if:

- It has been evaluated by the International Agency for Research on Cancer (IARC) Monographs and found to be a carcinogen or potential carcinogen; or
- It is listed as a carcinogen or potential carcinogen in the Sixth Annual Report on Carcinogens published by the National Toxicology Program (NTP) or,
- It is regulated by Fed/OSHA as a carcinogen

**Combustible Liquid:** A combustible liquid shall be defined as any liquid that has a closed-cup flash point at or above 100°F (37.8°C).

- Class II Liquid. Any liquid that has a flash point at or above 100°F (37.8°C) and below 140°F (60°C).
- Class IIIA Liquid. Any liquid that has a flash point at or above 140°F (60°C) but below 200°F (93°C).
- Class IIIB Liquid. Any liquid that has a flash point at or above 200°F (93°C).

**Compressed Gas:**

- A gas or mixture of gases having a pressure exceeding 40 PSIA at 70°F in a container, or
- A gas or mixture of gases having a pressure exceeding 104 PSIA in a container at 130°F, regardless of the pressure at 70°F, or

A liquid or mixture of liquids having a vapor pressure exceeding 40 PSIA at 100°F

**Containment:** The combination of personal practices, procedures, safety equipment, laboratory design, and engineering features to minimize the exposure of workers to hazardous or potentially hazardous agents.

**Control Area:** A building or portion of a building within which the exempted amounts of hazardous materials are allowed to be stored, dispensed, used or handled.

**Corrosive:** A substance that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact. For example, a substance is considered to be corrosive if, when tested on the intact skin of albino rabbits by the method described by the U.S. Department of Transportation in Appendix A to 49 CFR Part 173, it destroys or changes irreversibly the structure of the tissue in 4 hours. This term does not refer to action on inanimate surfaces.

**Decontamination:** Removal or destruction of infectious agents; removal or neutralization of toxic agents.
**Emergency shower:** A unit that enables a user to have flushing fluid cascading over the entire body.

**Explosive:** A substance that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

**Eyewash:** A device used to irrigate and flush the eyes.

**Flammable Anesthetic Gas:** A compressed gas which is flammable and administered as an anesthetic including cyclopropane, divinyl ether, ethyl chloride, ethyl ether and ethylene.

**Flammable Liquid:** Any liquid that has a closed-cup flash point below 100°F (37.8°C).

**Class I Liquid:** Any liquid that has a closed-cup flash point below 100°F (37.8°C) and a Reid vapor pressure not exceeding 40 PSIA at 100°F (37.8°C).

- Class IA liquids shall include those liquids that have flash points below 73°F (22.8°C) and boiling points below 100°F (37.8°C).
- Class IB liquids shall include those liquids that have flash points below 73°F (22.8°C) and boiling points at or above 100°F (37.8°C).
- Class IC liquids shall include those liquids that have flash points at or above 73°F (22.8°C), but below 100°F (37.8°C).

**Flash Point:** The minimum temperature of a liquid at which sufficient vapor is given off to form an ignitable mixture with air, near the surface of the liquid or within the vessel used.

**Fume Hood:** A device enclosed on three sides, as well as the top and bottom, with an adjustable sash or fixed partial enclosure on the remaining side. They are designed, constructed and maintained so as to draw air inward by means of mechanical ventilation, and so that any operation involving hazardous materials within the enclosure does not require the insertion of any portion of a person's body other than the hands and arms into the work area. (Note: Laboratory fume hoods prevent toxic, flammable, or noxious vapors from entering the laboratory, present a physical barrier from chemical reactions, and serve to contain accidental spills.)

**Hazardous Material:** A material for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term “health hazard” includes materials which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents that act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes. The term “physical hazard” includes materials for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, cryogenic, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive), or water-reactive or water reactive.

**Hazard Warning:** Any words, pictures, symbols, or combination thereof appearing on a label or other appropriate form of warning that convey the health and physical hazards of the substance(s) present.

Highly Toxic: A substance is considered to be highly toxic if:
A substance that has a median lethal dose (LD50) of 50 milligrams or less per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.

A substance that has a median lethal dose (LD50) of 200 milligrams or less per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between 2 and 3 kilograms each.

A substance that has a median lethal dose (LD50) in air of 200 parts per million by volume or less of gas or vapor, or 2 milligrams per liter or less of mist, fume, or dust, when administered by continuous inhalation for 1 hour (or less if death occurs within 1 hour) to albino rats weighing between 200 and 300 grams each.

**HIV/HBV Research/Production Facility:** A laboratory producing or using research laboratory scale amounts of HIV or HBV. Research laboratories may produce high concentrations of HIV or HBV but not in the volume found in production facilities.

**Irritant:** A substance, which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact. A substance is a skin irritant if, when tested on the intact skin of albino rabbits by the methods of 16 CFR 1500.41 for 24 hours exposure or by other appropriate techniques, it results in an empirical score of 5 or more. Substance is an eye irritant if so determined under the procedure listed in 16 CFR 1500.42 or other appropriate techniques.

**NIH:** National Institute of Health

**Nonflammable Medical Gas:** A compressed gas, such as oxygen or nitrous oxide, which is nonflammable and used for therapeutic purposes.

**Organic Peroxide:** An organic compound that contains the bivalent -O-O- structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an organic radical.

**Oxidizer:** A substance, other than a blasting agent or explosive, that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

**Pyrophoric:** A substance that will ignite spontaneously in air at a temperature of 1300 F (54.40 C) or below.

**Risk Levels:**

**LOW RISK:** Risk level of agents and/or operations having minimal effect on personnel, other animal or plants under ordinary use. This classification is restricted to all etiologic agents designated as Biosafety Level 1 by the CDC.

**MODERATE RISK:** Risk level of agents/or operations requiring special conditions for control or containment because of (a) known pathogenicity to personnel, other animals or plants; (b) concentration; or (c) genetic alteration (synergistic effect) with other

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materials. This classification includes all etiologic agents designated as Class 2 or 3 by the CDC (Biosafety level 2 or 3) and oncogenic viruses specified as moderate risk by the National Cancer Institute (NCI).

**HIGH RISK:** Risk level of agents and/or operations requiring additional control measures beyond those for moderate risk. This classification includes all etiologic agents designated Class 4 by the CDC and oncogenic viruses classified as high risk by the NCI.

**Sensitizer:** A substance that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the substance.

**Toxic:** A substance is considered to be toxic if:

- A substance that has a median lethal dose (LD50) of more than 50 milligrams per kilogram but not more than 500 milligrams per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.
- A substance that has a median lethal dose (LD50) of more than 1000 milligrams per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each.
- A substance that has a median lethal dose (LD50) in air of more than 200 parts per million but not more than 2000 parts per million by volume of gas or vapor, or more than 2 milligrams per liter but not more than 20 milligrams per liter of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

**Unstable (reactive):** A substance which in the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions or shocks, pressure or temperature.

**Vapor Pressure:** The pressure, measured in PSIA, exerted by a liquid.

**Water-reactive:** A substance that reacts with water to release a gas that is either flammable or presents a health hazard.
C-33 - HIGH CONTAINMENT LABORATORIES (BSL-2, BSL-2+, & BSL-3)

<table>
<thead>
<tr>
<th></th>
<th>General Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>The purpose of this Guideline is to establish the criteria for Design and Construction of Level 3 Biological Safety Laboratories (High Containment Laboratory) at UNC-Chapel Hill. In addition to these criteria, any High Containment Laboratory shall conform to the latest edition of Biosafety in Microbiologic and Biomedical Laboratories (BMBL) and National Institute Health (NIH) Design Requirements Manual (DRM) in effect at the start of construction.</td>
</tr>
<tr>
<td>B</td>
<td>A high containment laboratory shall be designed to allow it to perform independently of other building systems. This is to allow normal building maintenance to occur without disruption to lab operations. Additionally, systems critical to lab operation shall be redundant. Reliability, longevity, and low maintenance shall be the primary building system goals.</td>
</tr>
<tr>
<td>C</td>
<td>At project close out a verification statement signed by all members of the Design Team will be submitted to the University stating that any high containment laboratory included in the project scope meets the requirements stated in IA. In addition, a Risk Assessment shall be completed prior to opening and after any modifications to a lab,</td>
</tr>
<tr>
<td>D</td>
<td>All building system equipment (HVAC, plumbing, controls) that will require regular maintenance shall be accessible to maintenance personnel without having to enter the laboratory space and shall not have the potential for exposure to pathogens/agents. External services shall have emergency shut off external to lab.</td>
</tr>
<tr>
<td>E</td>
<td>All mechanical, electrical, IT (including cables in telecom closet) and security equipment serving the high containment laboratory/suite shall be specifically labeled throughout the building.</td>
</tr>
<tr>
<td>F</td>
<td>All building system equipment shall at minimum be installed according to the manufacturer’s recommended installation instructions.</td>
</tr>
<tr>
<td>G</td>
<td>A laboratory system description shall be provided for all laboratories/suites. This document shall be updated anytime a laboratory is modified. The system description shall include the follow sections; General Description, Subsystems and Major Equipment, Operations and Maintenance, Periodic Testing, Drawings and Tables, and Attachments. UNC has adopted this format for system descriptions documents. This will be a living document that supports the operations and maintenance of the laboratories/suites for the life of the laboratories/suites.</td>
</tr>
</tbody>
</table>
The close out process (e.g., delivery of laboratory system description, operations & maintenance manual, commissioning report, test and balance report, and training of building operations staff) will be completed within 30 days of the final acceptance of the modified laboratory, prior to the re-introduction of the agent into the lab space.

## Architectural

### A Containment Zones (Refer to Figures 1 and 2): Containment zones shall be identified on plans.

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<table>
<thead>
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<tbody>
<tr>
<td>1</td>
<td>Primary Containment Zone (PCZ): The PCZ has live agent present. All air is HEPA filtered by Biological Safety Cabinet (BSC) prior to exhaust either by direct ducting or room exhaust. The PCZ is within the Secondary Zone.</td>
</tr>
<tr>
<td>2</td>
<td>Secondary Containment Zone (SCZ): A SCZ may have live agent present... All air is exhausted to the outside and is HEPA filtered.</td>
</tr>
<tr>
<td>3</td>
<td>Tertiary Containment Zone (TCZ): A TCZ never has live agent present. All air is exhausted via HEPA filtered room exhaust or to a higher containment zone. Examples of Tertiary zones include but are not limited to Anterooms, changing rooms and showers, etc.</td>
</tr>
</tbody>
</table>

### B The laboratory shall be separated from areas that are open to unrestricted traffic flow within the building.

### C Access through two (2) self-closing doors to reach the inner laboratory is the minimum requirement. The outer door shall be a self-locking security door.

### D A clothing change room (anteroom) shall be included in the passageway between the two self-closing doors. Adequate space for a hands-free sink, pass-through autoclave, and shelves for protective equipment and lockers shall be provided. The anteroom should have shower in\shower out capability.

### E The shower and hand washing sinks should have the capability to be plumbed for effluent decontamination.
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<thead>
<tr>
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<tbody>
<tr>
<td>F</td>
<td>The entry doors shall be designed to accommodate moving large equipment into and out of the laboratory.</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>Air pressure status shall be visible both from the hallway and the anteroom to provide assurance upon entry that all rooms are under negative pressure.</td>
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<tr>
<td>H</td>
<td>Each lab in SCZ shall have a hands-free or automatically operated sink available for hand washing.</td>
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<tr>
<td>I</td>
<td>All laboratory surfaces (walls, floors, ceilings) shall be designed to be easily cleaned and decontaminated.</td>
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</tr>
<tr>
<td></td>
<td>1</td>
<td>Bench tops shall be impervious to water and be chemical and heat resistant. Cabinets shall not be constructed of wood.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Floors shall be monolithic/seamless or with welded seams and coved up the wall 4 inches. The floors shall be continuous under permanent casework.</td>
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<tr>
<td></td>
<td>3</td>
<td>Ceilings shall be monolithic (no removable tiles).</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Walls and ceilings shall be painted with durable glossy acrylic or epoxy paint with adequate coverage to provide a “no pinholes evident” finish.</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>All laboratory furniture must be capable of supporting anticipated loads and uses and, shall be made of non-porous material (including chairs). Adequate spacing shall be provided between benches, cabinets and equipment to allow for cleaning and decontamination.</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>All penetrations (including electrical and plumbing) into the laboratory shall be sealed per the DRM sealant table. All penetrations and junction boxes within the lab shall be sealed.</td>
</tr>
<tr>
<td>J</td>
<td>No outside windows are recommended to be present in the laboratory.</td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>All high containment laboratory doors shall have full length door stops and the doors provided with adjustable door sweeps.</td>
<td></td>
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</tbody>
</table>
### L
All refrigerators, freezers, animal caging systems and incubators used to store high containment laboratory agents shall be located within the inner laboratory (SCZ) and equipped with a locking mechanism. Freezers shall be monitored 24/7 and page out if they fail.

### M
Ceiling access doors are not recommended. If required, ceiling access doors in the laboratory shall have gas-tight gaskets and piano hinges.

### N
A pass-through autoclave with a functioning door interlock shall be available in the laboratory.

1. Autoclaves shall be large enough to accommodate large equipment.
2. Steam isolation shut off valve shall be outside of the lab.
3. An autoclave shall have a built-in effluent decontamination cycle.
4. The drain for the autoclave shall be in the SCZ (lab) side of the lab.
5. Any autoclave steam relief valve discharge and condensate drain shall discharge to the SCZ (lab) side of a pass-through autoclave and not the anteroom or exit areas.
6. A bioseal shall be used to create a seal between the autoclave and the SCZ (lab) wall between the lab and anteroom.
7. Access for autoclave repair shall be outside of the SCZ.
8. A canopy hood over the autoclave is required to contain heat and steam from the anteroom side of the autoclave.
9. Clean side autoclave doors shall not open directly onto a public corridor

### O
A Class II Type A or Type B Biological Safety Cabinet (BSC) shall be available in the laboratory/suite.

1. BSCs shall be installed so that the room supply and exhaust air does not interfere with proper operation. Additionally, BSCs shall be located away from doors, high traffic laboratory areas and not directly across from each other.
2. Cabinets must comply with, be installed and certified in accordance with latest version of NSF/ANSI 49.
3. If a cabinet is ducted the internal supply fan in the biosafety cabinet and remote exhaust fans shall be interlocked so that the supply fan in the cabinet shuts off whenever the exhaust fan fails.

4. Class II Type A thimble ducted cabinets are not allowed.

P. Vacuum lines shall be independent of the building vacuum. Local vacuum lines must be protected with HEPA filters.

Q. An eyewash station shall be in each laboratory.

R. Provide space near the lab or in the building for storing critical spare parts such as belts and motors as well as tools such as a ladder.

S. The space above a lab shall be sealed such that a leak does not flood into the lab. Thresholds shall be provided on doors to keep minor floods from entering or exiting the anteroom or lab.

III. Electrical

A. Cast electrical boxes are recommended for outlets.

B. All components of the HVAC system (supply and exhaust), alarms, emergency lighting and laboratory outlets for essential equipment (Biological Safety Cabinets, freezers, autoclave, etc.) shall be on a backup power system. All high containment laboratory equipment and controls on backup power shall be supplied backup power through a closed transition transfer switch.

C. All components will have labeling to identify what panel and breaker is used, see Facilities Lab Maintenance Notification Procedure for labeling standards.

D. Backup power to the lab and associated systems shall be on dedicated circuits from the generator. These shall be in compliance with Article 700 of the NEC.

E. Light fixtures shall be surface mounted and designed to maintain gas tight requirements.

F. At least one light fixture in the inner lab and one in the anteroom shall be equipped with battery backup. Battery location cannot be within the light fixture.

G. BAS controllers and BSCs shall have UPS with a run time of at least 120 seconds. The UPS provided for the BAS controller and the A2 BSC’s must divert back to normal power if the UPS fails.
<table>
<thead>
<tr>
<th>H</th>
<th>Electrical panels serving high containment laboratories shall be located in locked electrical or mechanical rooms. Circuit breakers shall not be located within the SCZ (lab).</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>VFDs shall be selected and programmed to ride through (maintain microprocessor power) momentary power interruptions (such as open transitions during generator tests) of up to 3 seconds (???) and catch motors on the fly spinning down after an interruption.</td>
</tr>
<tr>
<td>IV</td>
<td><strong>HVAC\BAS Controls</strong></td>
</tr>
<tr>
<td>A</td>
<td>The laboratory shall be designed to have directional airflow from the hallway, through the TRZ into the SCZ.</td>
</tr>
<tr>
<td>B</td>
<td>The dedicated supply and dedicated exhaust system for the laboratory shall be completely separate from other building HVAC systems.</td>
</tr>
<tr>
<td>C</td>
<td>The air supply and exhaust systems must be interlocked to prevent reversal of the directional airflow and positive pressurization of containment area in the event of an exhaust system failure.</td>
</tr>
<tr>
<td>D</td>
<td>The pressure relationship of SCZ, TCZ, and corridor shall be actively controlled by laboratory grade supply and lab exhaust terminal valves. Blade damper style terminal boxes are not permitted.</td>
</tr>
<tr>
<td>E</td>
<td>The brand, generation, and software tools for the high containment laboratory BAS shall be the same as that used throughout the building.</td>
</tr>
<tr>
<td>F</td>
<td>Digital readout /visual monitoring devices that indicate directional airflow are required in the laboratory. These air pressure monitoring (APM) devices shall have audible alarms to indicate HVAC system failure. The devices shall be equivalent to Tek-Air Systems Iso-Tek Space Pressurization Monitor (SPM-2200) or Paragon SP-3000. The range of the room APM shall be from 0.25 to -0.25 INWC. There shall be a strobe light in main lab for APM alarms.</td>
</tr>
<tr>
<td>G</td>
<td>The APM shall have a dry set of contacts for alarming and analog outputs to enable remote monitoring via the Building Automation System (BAS) and UNC Police.</td>
</tr>
<tr>
<td>H</td>
<td>The exhaust system shall be designed with redundant 100% capacity exhaust fans, N+1. Exhaust systems shall be designed to allow fans to operate simultaneously. Failure of the either fan will cause the other fan to increase in speed to maintain design air flow in minimum time to maintain lab pressurization.</td>
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<tr>
<td>I</td>
<td>All general exhaust fans shall have dedicated variable frequency drives (VFD) with manual bypass capability to enable fan operation even when the VFD fails.</td>
</tr>
<tr>
<td>J</td>
<td>Each ducted BSC may require a redundant exhaust fan depending on design.</td>
</tr>
<tr>
<td>K</td>
<td>BSC controllers should be provided with one digital output. The BSC digital output will be for an alarm input to the BAS. (Refer to Table 1)</td>
</tr>
<tr>
<td>L</td>
<td>All exhaust ductwork shall be welded stainless steel, gas tight to allow for decontamination. Round ducts are recommended. Leakage tests of the ductwork should be done as part of the commissioning process. All welds, gaskets, penetrations or seals on exterior surfaces of ducts shall be able to sustain air pressure for 20 minutes and be free of soap bubbles at 4 inches WG and the gas leak rate should not exceed $2 \times 10^{-8}$ cubic feet per minute (CFM). (reference ductwork leakage testing in the Mechanical and Plumbing section of the UNC guidelines)</td>
</tr>
<tr>
<td>M</td>
<td>Consideration shall be made for uninterrupted straight lengths of ductwork to enable accurate airflow measurements.</td>
</tr>
<tr>
<td>N</td>
<td>Manual, accessible, gas-tight isolation dampers are required in the air supply and exhaust ducts for the laboratory.</td>
</tr>
<tr>
<td>O</td>
<td>A switch labeled “Emergency Supply Air Shutdown,” which will de-energize the air handler via a safety circuit (not BAS logic), shall be located in the anteroom and in the main lab.</td>
</tr>
<tr>
<td>P</td>
<td>Environmental room sensors (e.g. T-stat) shall not have local user adjustment features. The associated room air supply terminal unit shall be provided with a discharge air sensor, which along with the room sensor shall be used in a cascade loop to limit space temperature swings.</td>
</tr>
<tr>
<td>Q</td>
<td>Any high containment laboratory room housing an autoclave, served by an HVAC system that is capable of humidification, or housing any other device using steam shall have a room humidity sensor. Humidity Sensors shall be installed in the exhaust duct; not the lab.</td>
</tr>
<tr>
<td>R</td>
<td>The supply duct shall include sensors and logic to shut down the humidifiers upon a loss of humidity control.</td>
</tr>
<tr>
<td>S</td>
<td>The supply side of the air distribution system shall be designed with redundant full capacity fans. If both fans are in a common air handling unit they will be partitioned to allow servicing without loss of supply air.</td>
</tr>
</tbody>
</table>
All exhaust air from the laboratory shall be HEPA filtered. HEPA filters shall be located as close as possible to the containment barrier penetration. HEPA filters shall be rated for 99.99 efficiency at 0.3 microns. These filters shall include provisions for bag-in/bag-out filter replacement. HEPA filters shall be located with consideration to replacement and testing procedures. Consideration shall be given to provide redundant filter banks in case of unplanned laboratory shutdowns. HEPA filters should be zoned so that shutdowns can be coordinated.

**1** Test ports and isolation dampers shall be installed on both sides of the filter to allow for filter testing and decontamination.

**2** Valved ports with magnahelic gauges shall be installed to measure pressure drop across the filter and fans. These shall be separate gauges for the filter and fan sections.

**3** Clearance should be maintained around the filter housing to allow for filter changes.

**4** Polydisperse Dioctyl Phthalate (DOP) filter test is required to insure that HEPA filters or the areas around the filter do not leak. There should be 10 duct diameters upstream of the HEPA filter for good mixing.

**5** All exhaust discharge shall be vertical. The stack should be at least 10 feet above the roof surface or have a stack with a smaller diameter trailing end to produce higher velocity flow to avoid re-entrainment by the building, and should be increased in elevation when necessary to avoid the influence of surrounding structures. The discharge must be a minimum of 25 feet from the intake.

All HVAC equipment failures, including exhaust and supply fans, shall alarm through the building automation system to the Energy Management Control System (EMCS) shop. APM alarms shall be sent to the UNC Police and EMCS. Refer to Figures 1 & 2 and Table 1 for alarms and notification.

The BAS shall include a Local Control Station (LCS), with all graphics and controls hosted locally such that full BAS functionality including 1 minute sample rate trending exists in the building when internet connectivity to the outside is lost.

A second (redundant) fully functional LCS with a documented manual change over process is required if LCS serves a gateway/server function.
<table>
<thead>
<tr>
<th>W</th>
<th>The BAS network for the High Containment Laboratory shall be physically separate from the other parts of the building BAS network such that network problems in one area do not affect the other areas and problems may be isolated.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>Building automation systems shall maintain operational set points during all loss of power events and return to normal operations.</td>
</tr>
<tr>
<td>Y</td>
<td>For each High Containment Laboratory, any general room exhaust, BSC, and any autoclave hood exhaust flow shall be measured by the BAS. Total room exhaust shall be summed and the total room exhausts flow tracked by the room supply flow to ensure proper room CFM offset and pressurization control. Both the supply and exhaust air terminals shall be under the same controller. Refer to UNC HVAC standards for lab control requirements.</td>
</tr>
<tr>
<td>Z</td>
<td>HVAC control panels are best located in locked electrical or mechanical rooms. If a panel must be located in a public space, it must be locked.</td>
</tr>
<tr>
<td>ZA</td>
<td>System shall include a hard wired interlock to shut down the supply air ventilation system in the event that status of the exhaust fans is lost.</td>
</tr>
<tr>
<td>ZB</td>
<td>For suites of labs, a master status panel (refer to architectural section) is required to be visible from the anteroom to the suite for visual status of all air pressure monitors.</td>
</tr>
</tbody>
</table>
### Plumbing

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>An eye wash shall be available in the inner laboratory. An “Eyewash” sign must be posted near the eyewash.</td>
</tr>
<tr>
<td>B</td>
<td>Provide exterior access to isolation, mixing and other valves for domestic hot and cold water supply cutoff.</td>
</tr>
<tr>
<td>C</td>
<td>Water service to the laboratory shall be protected by backflow prevention devices to prevent contamination of areas exterior to the High Containment Laboratory. Backflow prevention devices shall be installed outside of the lab and in an accessible location.</td>
</tr>
<tr>
<td>D</td>
<td>Provide redundant reduced pressure backflow prevention specific to High Containment Laboratory to prevent contamination of non-High Containment Laboratory piping.</td>
</tr>
<tr>
<td>E</td>
<td>An emergency shower is required in the TCZ (anteroom).</td>
</tr>
<tr>
<td>F</td>
<td>Trap Primers are prohibited. All traps shall be extra deep (&gt;6 inches).</td>
</tr>
<tr>
<td>G</td>
<td>Natural gas cannot be plumbed into the laboratory.</td>
</tr>
<tr>
<td>H</td>
<td>All piping for effluent shall be double walled pipe.</td>
</tr>
<tr>
<td>I</td>
<td>If compressed gas will be needed for experiments, it is recommended that piping should be run into the SCZ from a manifold in a gas cabinet outside the SCZ.</td>
</tr>
<tr>
<td>J</td>
<td>The effluent decontamination process is determined by the science of the laboratory. A location for effluent decontamination shall be designated and designed.</td>
</tr>
<tr>
<td>K</td>
<td>The agent and chemicals used for decontamination in the laboratory must be taken into consideration when selecting construction materials.</td>
</tr>
</tbody>
</table>

### Security\Life Safety

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A strobe light fire alarm and a fire alarm pull station are required in the laboratory. The strobe light shall be visible in all locations of the laboratory.</td>
</tr>
<tr>
<td>Section</td>
<td>Requirement</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td><strong>B</strong></td>
<td>The laboratory shall be secured by electronic locks and/or combination locks, accessible only by authorized personnel.</td>
</tr>
<tr>
<td><strong>C</strong></td>
<td>A keycard access system shall be required for tracking entry into the lab.</td>
</tr>
<tr>
<td><strong>D</strong></td>
<td>A telephone that functions during power outages shall be available in the inner lab and anteroom for emergency purposes.</td>
</tr>
<tr>
<td><strong>E</strong></td>
<td>The anteroom and inner laboratory doors should be electronically interlocked to prevent both from being opened at the same time.</td>
</tr>
</tbody>
</table>
| **F**   | **Additional Life Safety Requirements for Select Agent Labs**  
A minimum of three security barriers where each security barrier adds to the delay in reaching secured areas where select agents and toxins are used or stored. One of the security barriers must be monitored in such a way as to detect intentional and unintentional circumventing of established access control measures under all conditions (day/night, severe weather, etc.) The final barrier must limit access to the select agent or toxin to personnel approved by the HHS Secretary or Administrator, following a security risk assessment by the Attorney General. |
|   | 1. Provide and install a keycard swipe recorder outside the main laboratory door and inside the main laboratory door to record entry and exit from the lab. |
|   | 2. Provide and install a keycard access on the door leading from anteroom to the laboratory proper. |
|   | 3. All keycard use shall record the time and date of entry or exit and the name of keycard owner. |
| **G**   | A Knox-box, accessible by emergency responders, shall be installed at the entrance to the main door of the lab for holding keycard to the secure lab/suite. Based on security requirements a Knox-box may also be required in the stairwell. |
| **H**   | In the event of a fire alarm, the combination and electronic locks on the laboratory's main door will continue to function and keep the laboratory secure (i.e., fire alarm secure). |
| **I**   | Video surveillance shall monitor hallway entrance to the select agent laboratory. The most recent forty five days of video shall be stored on a digital recorder with removable media. |
### VII Commissioning

#### A
The High Containment Laboratory and all supporting systems shall be commissioned by an independent commissioning provider. A commissioning plan shall be submitted for approval by Facilities Services and The Environment Health and Safety Department. During the commissioning process; the system description will be verified and validated.

### VIII Exception Process

If during the design and construction phase the requirements of this document cannot be met, it is required that a written explanation is provided documenting why and what alternative approach was agreed to. This document will require the signoff of the Department of Environment, Health and Safety, Facilities Services, and all members of the Design team.
# UNC-Chapel Hill BL3 Lab Alarming Standards

<table>
<thead>
<tr>
<th>Item</th>
<th>Condition</th>
<th>NFS</th>
<th>Audible</th>
<th>SMCS</th>
<th>Alarm Limite</th>
<th>Alarm Text</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Barometric Pressure&lt;br&gt;too High</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>Differential Pressure $&gt; 0.003$ in H2O (read out)</td>
<td>Audible Room xx BL3 Secondary Containment Zone High Pressure</td>
<td>Provide visual alarm after condition eams for 30 seconds. Provide 60 second delay prior to initiating alarm unless E&amp;MS and NFS overlap. Test verify delay and high limit.</td>
</tr>
<tr>
<td>2</td>
<td>Barometric Pressure&lt;br&gt;too Low</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>Differential Pressure $&lt; -0.003$ in H2O (read out)</td>
<td>Audible Room xx BL3 Secondary Containment Zone Low Pressure</td>
<td>Provide 60 second delay prior to initiating alarm. Test verify delay and low limit.</td>
</tr>
<tr>
<td>3</td>
<td>Barometric Pressure&lt;br&gt;too High</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>Differential Pressure $&gt; 0.003$ in H2O (read out)</td>
<td>Audible Room xx BL3 Secondary Containment Zone High Pressure</td>
<td>Provide visual alarm after condition eams for 30 seconds. Provide 60 second delay prior to initiating alarm unless E&amp;MS and NFS overlap. Test verify delay and high limit.</td>
</tr>
<tr>
<td>4</td>
<td>Barometric Pressure&lt;br&gt;too Low</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>Differential Pressure $&lt; -0.003$ in H2O (read out)</td>
<td>Audible Room xx BL3 Secondary Containment Zone Low Pressure</td>
<td>Provide 60 second delay prior to initiating alarm. Test verify delay and low limit.</td>
</tr>
<tr>
<td>5</td>
<td>Dust Cabinet Fan&lt;br&gt;Failure</td>
<td>x</td>
<td></td>
<td></td>
<td>Dust Cabinet Fan&lt;br&gt;Failure</td>
<td>Dust Cabinet Fan&lt;br&gt;Failure</td>
<td>Provide audible alarm at cabinet. Provide 15 second delay on alarm.</td>
</tr>
<tr>
<td>6</td>
<td>Dust Cabinet&lt;br&gt;Thermal Limits&lt;br&gt;x</td>
<td></td>
<td></td>
<td></td>
<td>Temperature&lt;br&gt;outside of limits</td>
<td>Dust Cabinet&lt;br&gt;Thermal Limits&lt;br&gt;outside of limits</td>
<td>Check dust cabinet and thermal limits. Check for leaks.</td>
</tr>
<tr>
<td>7</td>
<td>Dust Cabinet&lt;br&gt;Primary Fan&lt;br&gt;Failure</td>
<td>x</td>
<td></td>
<td></td>
<td>Pressure switch x CT indicates fan failure</td>
<td>Dust Cabinet&lt;br&gt;Primary Fan&lt;br&gt;Failure</td>
<td>Check primary fan. Check for leaks.</td>
</tr>
<tr>
<td>8</td>
<td>Dust Cabinet&lt;br&gt;Backup Fan&lt;br&gt;Failure</td>
<td>x</td>
<td></td>
<td></td>
<td>Pressure switch x CT indicates fan failure</td>
<td>Dust Cabinet&lt;br&gt;Backup Fan&lt;br&gt;Failure</td>
<td>Check backup fan. Check for leaks.</td>
</tr>
<tr>
<td>9</td>
<td>Room Temperature&lt;br&gt;outside of&lt;br&gt;limits</td>
<td>x</td>
<td></td>
<td></td>
<td>Temperature&lt;br&gt;outside of limits</td>
<td>Room Temperature&lt;br&gt;outside of limits</td>
<td>Check room temperature limits.</td>
</tr>
<tr>
<td>10</td>
<td>General Exhaust&lt;br&gt;Airflow&lt;br&gt;Failure</td>
<td>x</td>
<td></td>
<td></td>
<td>Flow rate&lt;br&gt;outside of limits</td>
<td>General Exhaust&lt;br&gt;Airflow&lt;br&gt;Failure</td>
<td>Check general exhaust airflow.</td>
</tr>
<tr>
<td>11</td>
<td>General Exhaust&lt;br&gt;Primary Fan&lt;br&gt;Failure</td>
<td>x</td>
<td></td>
<td></td>
<td>Pressure switch x CT indicates fan failure</td>
<td>General Exhaust&lt;br&gt;Primary Fan&lt;br&gt;Failure</td>
<td>Check primary fan. Check for leaks.</td>
</tr>
<tr>
<td>12</td>
<td>General Exhaust&lt;br&gt;Backup Fan&lt;br&gt;Failure</td>
<td>x</td>
<td></td>
<td></td>
<td>Pressure switch x CT indicates fan failure</td>
<td>General Exhaust&lt;br&gt;Backup Fan&lt;br&gt;Failure</td>
<td>Check backup fan. Check for leaks.</td>
</tr>
<tr>
<td>13</td>
<td>Supply Air&lt;br&gt;Low&lt;br&gt;Static Pressure&lt;br&gt;Failure</td>
<td>x</td>
<td></td>
<td></td>
<td>Static Pressure&lt;br&gt;below specified limits</td>
<td>Supply Air&lt;br&gt;Low&lt;br&gt;Static Pressure&lt;br&gt;Failure</td>
<td>Check supply air pressure.</td>
</tr>
<tr>
<td>14</td>
<td>Air Handler&lt;br&gt;Primary Supply Fan&lt;br&gt;Failure</td>
<td>x</td>
<td></td>
<td></td>
<td>Pressure switch x CT indicates fan failure</td>
<td>Air Handler&lt;br&gt;Primary Supply Fan&lt;br&gt;Failure</td>
<td>Check primary supply airflow. Check for leaks.</td>
</tr>
<tr>
<td>15</td>
<td>Air Handler&lt;br&gt;Backup Supply Fan&lt;br&gt;Failure</td>
<td>x</td>
<td></td>
<td></td>
<td>Pressure switch x CT indicates fan failure</td>
<td>Air Handler&lt;br&gt;Backup Supply Fan&lt;br&gt;Failure</td>
<td>Check backup supply airflow. Check for leaks.</td>
</tr>
<tr>
<td>16</td>
<td>Air Handler&lt;br&gt;Backpressure&lt;br&gt;Failure</td>
<td>x</td>
<td></td>
<td></td>
<td>Pressure switch x CT indicates backpressure</td>
<td>Air Handler&lt;br&gt;Backpressure&lt;br&gt;Failure</td>
<td>Check backpressure limits.</td>
</tr>
<tr>
<td>17</td>
<td>Air Handler&lt;br&gt;Over Temperature&lt;br&gt;Failure</td>
<td>x</td>
<td></td>
<td></td>
<td>Temperature&lt;br&gt;outside of limits</td>
<td>Air Handler&lt;br&gt;Over Temperature&lt;br&gt;Failure</td>
<td>Check temperature limits.</td>
</tr>
<tr>
<td>18</td>
<td>Door Access&lt;br&gt;Unauthorized&lt;br&gt;Access Attempt</td>
<td>x</td>
<td></td>
<td></td>
<td>Unauthorized&lt;br&gt;Access Attempt</td>
<td>Door Access&lt;br&gt;Unauthorized&lt;br&gt;Access Attempt</td>
<td>Provide 60 second delay prior to initiating alarm. Test verify delay.</td>
</tr>
<tr>
<td>19</td>
<td>Door Access&lt;br&gt;Door Left Open Too Long</td>
<td>x</td>
<td></td>
<td></td>
<td>Door&lt;br&gt;left open too long</td>
<td>Door Access&lt;br&gt;Door Left Open Too Long</td>
<td>Provide 60 second delay prior to initiating alarm. Test verify delay.</td>
</tr>
<tr>
<td>20</td>
<td>Unitized Box&lt;br&gt;Failure</td>
<td>x</td>
<td></td>
<td></td>
<td>Unitized&lt;br&gt;Box&lt;br&gt;Failure</td>
<td>Unitized Box&lt;br&gt;Failure</td>
<td>Check unitized box system.</td>
</tr>
</tbody>
</table>

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This section design guidelines for includes Environmental Chambers, in the form of: Walk-In Coolers, Freezers, Warm Rooms, and Incubators.

General Requirements

Condenser Cooling
Provide a process heat exchanger utilizing the campus chilled water system as primary cooling and provide single pass domestic water backup on the process side of the heat exchanger. Design the exchanger to serve all environmental chambers in the building. Provide single point change over for entire building. The domestic water backup supply shall include backflow prevention, as required by North Carolina Building Codes, and a pressure reducing valve. The domestic water return shall be discharged to a floor drain and shall utilize a modulating control valve to maintain return water temperatures at a maximum of 75 degF (resetable). Failure of the utility chilled water system will result in rising process chilled water temperatures necessitating use of the domestic water backup and alarming the UNC Energy Management Control System.

General Notes
Refer to Building Automation Design Guidelines for sequence of operation.

Noise levels inside the chamber may not exceed 80 dBA.

Specify environmental cold rooms furnished as a complete functional unit.

1. Assembly: All metal and other materials shall be shaped and sized as required with all angles sharp and true. All surfaces shall be finished smooth. Punching and shearing shall be neatly done. Permanent connections shall be riveted or bolted. All exposed welds shall be ground smooth and flush with adjacent surfaces. Welded connections in stainless steel shall be polished to match adjacent stainless steel.

2. Panel Construction: The room shall be constructed of prefabricated metal skinned urethane panels, with exterior surfaces constructed WHITE STUCCO GALVALUME, interior surfaces of stainless steel. The panels shall be constructed of high quality components with 100 percent of each panel exclusive of its metal supports as being comprised of urethane insulation. Panels shall have tongue and groove construction with vinyl stripping fitted on the exterior and interior of each panel to provide moisture and vapor tight gasketing. Each of the rooms corners shall be performed 90 degree angles. All construction shall comply with Factory Mutual Standard 4880 for insulated wall construction. Contractor shall furnish filler panels of matching metal to extend from the exterior of the chamber walls to the building walls and lay-in ceiling. Insulation in the panels shall be a minimum of 4 inch thick rigid, poured in place, urethane foam. Foam core of panels shall be Underwriters Laboratories certified as having a flame spread of 25 or lower when tested in accordance with ASTM E-84-76. Panels shall be approved by Factory Mutual as a Class-1 building type. They shall not use CFC, HCFC or HFC blowing agents. Insulation shall remain stable at an operating temperature range of –67 to 94 degrees C (non-humidified). Panels – including floor panels - must be constructed not using any wood materials and must be all metal panel and structural support.

3. Floor: The floor panels shall be clad in the interior with stainless steel and the exterior with GALVANIZED and utilize 4” thick urethane insulation. The floor panels shall be able to withstand loading to 600 pounds per square foot.

4. Door: The door shall be fitted flush with a minimum free span of 36 inches wide and 78 inches high with the same material finish and insulation as adjacent walls. Anti condensate heater wiring shall be concealed behind the (removable) metal edge of the door jamb on all four sides. Heaters shall be
connected to a temperature control to provide sufficient heat to prevent the formation of condensation and frost at various temperature and humidity conditions. The door shall utilize a minimum of two hinges of the spring loaded self closing type with plated steel pins and Delrin cam type bearings. Designer shall consider preference to have cam action rather than spring action. Hinges and latches shall be suitable high strength steel and not “pot metal.” The door latch shall be designed to open the door easily by breaking the force of the magnetic door gasket. The door shall be able to be opened with an easily accessible pull handle. The latch shall have a cylinder lock, keyed to match existing lockset, (PK 625 KEY number) and include provisions for padlocking. The latch shall also include an inside safety release handle. Door interior/exterior materials shall be equal to adjacent panel construction.

5. Observation Window: Provide a manufacturer’s standard, heated observation window. The window shall consist of three panes of glass with sealed vapor spaces between them. Window shall be 14” x 24”

6. Pressure Relief Port: Pressure relief ports shall be utilized for all chambers operating at -10 degrees C or lower.

7. Chamber Size: The exterior size of the chamber shall be at least as large as possible fitting in the free area of the building location. The Contractor shall verify the free space available after the completion of the site preparation by the University and General Contractor.

8. Painted Finish: Finish shall be factory applied baked on enamel/polyester. Paint shall be chemical resistant and odorless. Paint shall be sprayed on and not applied with a roller or a brush to achieve a uniform texture and appearance. Paint thickness shall be a minimum of 1 mil. Color shall be white.

Chamber Accessories

Electrical Receptacles: Receptacles shall be corrosion resistant track type. (must be Hospital grade and have gasketed covers) Receptacles shall be 8 inches above bench surface and shall be on 12 inch centers along the entire length of the bench. Receptacles shall be fed by TWO separate 20 amp, 120 volt circuits each feeding every other receptacle, with two circuits per side of enclosure, connecting to panel indicated on the drawings.

1. Sleeves/Pass-throughs Ports: Sleeves for service piping, refrigerant lines, cables and drain water lines shall be cylindrical in cross section, formed of 1/8 inch or 3/16 inch PVC and sealed to chamber from both ends with silicone sealant. The void between the service line and the sleeve inside and out shall be sealed with a sealant that remains flexible. Caps shall be provided to seal pass-throughs used for equipment line passage when not in use. Provide flange on both sides of pass-through for cap to slide onto.

2. Ceiling Grid: Lay in ceiling grid shall be provided on a 2 foot by 2 foot perforated Lexan lay in ceiling grid supported by 1.5 inch by 1.5 inch anodized aluminum tees to form a positive pressure plenum at the chamber roof with return air duct or plenum below the ceiling grid to the chamber floor area.

Submittals

The designer shall coordinate design with UNC Refrigeration Shops. Designer shall provide one set of submittals to UNC Refrigeration Shop during preconstruction and incorporate the Shops’ comments prior to returning submittals to the contractor.
Environmental Controls and Instruments

Control Console
Provide a control console incorporating a key locked door (pk 625 keyed) with a clear acrylic for viewing and protecting the settable controls. The console shall be mounted on the chamber exterior adjacent to the door if possible. The console shall include all instruments, controls, switches, pilot lights, alarm contacts and recorders including the process alarm card. This card shall provide several useful features including; the independent selection of 0-15 minute delay of each alarm action, maintained SPDT contacts for connection to remote alarm panels, defrost timer with time or temperature termination, evaporator fan delay, RH disable during defrost and user adjustable audible alarm silence timer. The control panel as an assembled unit will be labeled/listed by a certified National Testing Laboratory such as ETL, UL or MET, etc. Each control panel will provide:

1. Single point electrical connection with lockable overcurrent protection and disconnection means.
2. Automatic main power overcurrent protection and independent overcurrent protection for fans, heaters control circuits, steam heaters dryers and receptacles.
3. All control and switch functions clearly labeled with non-fading polycarbonate labels and thus no stamping of silkscreen markings that wear off. Panel labels shall be logically organized for ease of operation.
4. Removable laminate covered side panels for protection of main control panel housing. Access panels shall be color coordinated with building color scheme and shall be replaceable if damaged.
5. Durable non painted brushed stainless steel fronts for impact resistance and durability. These panels shall be lockable and hinged for convenient access when servicing the control panel.
6. Lockable acrylic view window to prevent unauthorized to control and alarm set points.
7. Anodized aluminum interior construction with offset mounting rails to produce a natural cooling plenum behind the control panel for heat dissipation.
8. Low power level switching and indication for longevity of switches and indicators.
10. Central wiring location and grouping for efficient trouble shooting.
11. Plug-in components where feasible.
12. Specify control panel mounting height of 72” maximum to top of panel. Mount on the latch side of the door to prevent damage from door openings.

Temperature Controller
Temperature controller shall be through a solid-state microprocessor based digital controller with RTD sensing. Sensitivity of the sensor will not be less than .01° C over the entire range of the chamber. The sensor shall be located to detect the average temperature of the chamber (and not directly in the air flow path of the evaporator discharge nor should they be mounted in the return air plenum). The control components shall control the capacity of the fully proportional refrigeration/conditioning system and shall be designed to meet the performance criteria of the chamber specified in the Project Outline. The chamber’s set point shall be set through the digital control and LED readout in degrees Centigrade (°C). The controller shall simultaneously display both the chamber set point and the actual chamber temperature. If the controller is a programmed controller contractor shall furnish any software needed to perform maintenance or repair with the chamber.
High/Low Temperature Safety Alarms
Provide the necessary sensing devices and circuits to takeover control, initiate corrective action and activate an audible and visual signal device in the event of deviation of more than 2°C from the main operating temperature set point and adjustable to match the main controller’s range. The signal shall be unbroken until the chamber is restored to the set temperature or until silenced by an operator. Separate alarms for high and low operating temperatures shall be provided. The alarm setpoint shall be digital and shall be in °C. Provide independent maintained dry contacts for connection to the building alarm system for each alarm point. The contacts shall switch either on a loss of chamber power or an alarm condition. Each alarm shall have an adjustable 0–60-minute delay before alarm action will occur. The alarm switching power shall be low voltage and low current to prolong the life of the alarm contacts. The remote alarm contacts shall be brought out to a removable connector for ease of hook-up to the remote alarm system. The remote alarm contacts shall be plug-in replaceable and shall have both NC and NO contacts available.

Defrost Control
On chambers operating below 7°C, provide a defrost control system settable for a minimum of 6 defrost operations in a 24-hour period. The defrost control shall be time initiated and time or temperature terminated. The defrost system shall have the capability to accept an input from a chamber temperature sensor that will automatically disable the defrost system when the chamber is operated higher than 7°C. The defrost system duration shall be adjustable from 2-30 minutes in one-minute increments. The defrost system shall provide for an adjustable fan delay at the end of the defrost cycle to allow for precooling of the evaporator coil after the defrost period. This precooling action shall prevent the warm air in and around the evaporator coil from being introduced to the working area of the chamber at the termination of the defrost cycle. This fan delay action shall only occur at the termination of a defrost cycle and not each time the refrigeration system is started. A manual defrost timer bypass shall be provided to defeat the defrost action when not required. A defrost test switch shall be provided which will initiate a defrost cycle on demand. This switch shall allow for additional defrost operations as required and shall facilitate a service mechanic in the check-out and service of the defrost system. Provide a pilot light on the control panel which shall remain illuminated during the duration of the defrost cycle. This pilot light shall be labeled “DEFROST”.

Recorder
Provide a solid state temperature recorder with a switch selectable 8 hour-24 hour-7 day chart movement. The recorder shall utilize a 10 or 12” circular chart (12” chart recorder is preferred) and shall be mounted in the control panel and furnished with 90 day supply of charts. Chambers provided with relative humidity control shall be provided with a second pen for the recording of relative humidity levels within the chamber. The temperature channel shall be calibrated to a minimum of 10% above and below the operating range (not start-up set point) of the chamber and the hygrometer shall be calibrated over the range of 10% to 98%. Recorder accuracy shall be +/- 1% of full scale.

Humidity Control
Refrigerated dehumidification is preferred though the following manner is acceptable.

1. Provide refrigerated dehumidification integrated into the pressurized supply air plenum. Electric reheat dehumidification will NOT be accepted. Capable of maintaining chamber relative humidity at 60% when operated at 4°C with accuracy of +/- 1%. Humidification during high temperature operation shall not be required. The system shall control humidity through a microprocessor based digital controller with readout in percent RH. The RH sensor shall be a variable capacitance sensor or a hygroscopic plastic foil sensor, temperature compensated and calibrated over the entire range of the chamber. The sensor shall be located within the chambers airflow to provide maximum sensitivity and
fast response to changes within the chamber. Wet bulb/dry bulb, lithium chloride, gold grid, bulk
resistance or similar sensors shall not be acceptable.

Refrigeration

Condensing Unit General
Unit and all system components shall be designed for operation on 134A Refrigerant for coolers designed
for 0-10degC and 404A for operating below 0 degC. Unit shall be designed for operation on building electrical
power. A single 120 volt power supply shall supply power to the control console, the chamber receptacles,
lighting.

Locate condensing units behind or beside the chamber in a chase or mechanical room providing
sufficient access on all sides, to facilitate maintenance. DO NOT LOCATE CONDENSING UNITS ON TOP OF
CHAMBER. The preferred location is 28” above the floor unless there is room for maintenance and repair and
approved by UNC’s Refrigeration Shop.

Compressor/Condensing Unit
The compressor/condensing unit shall be water cooled and shall be appropriately sized for the
specified operating range. The compressor/condensing unit shall provide safe operation in its specified
location remote from the chamber. All components of the condensing unit shall be designed for the greater of
300PSIG working pressure or 150% of maximum operating pressure. The semi-hermetic compressor unit shall
have a minimum of a high/low pressure safety control, receiver with fusible plug, low oil pressure safety,
liquid line dryer with sight glass, crankcase pressure regulator, accumulator, vibration eliminators and thermal
protection. Cycling solenoids shall not be acceptable for capacity control but shall be furnished to provide for
pump-down only.

A fully proportional modulating refrigerant valve on the hot gas line shall be used for capacity control

The condensing unit shall be designed for continuous operation to maximize compressor life, eliminate on/off
cycling and minimize RF interference. False loading of the compressor to cause continued operation will
NOT be allowed. Unit shall be provided with a modulating water flow valve to regulate head pressure. Provide
cleanable shell and tube heat exchanger.

Provide service lighting and 120V receptacle for service and repair of condensing unit outlet located on the
same level and within 10 ft of the condensing unit.

The compressor/condensing unit shall be linked to a matching evaporator designed to maintain the
specified operating conditions. The condensing unit shall have a single point electrical connection point
and shall be connected to an appropriate disconnect switch provided by the Chamber contractor.

Evaporator/Horizontal Ceiling Plenum
The chamber shall be provided with a custom stainless steel ceiling plenum with internal motor driven blowers
and copper coils. Modified stainless steel unit coolers or commercial evaporators shall not be acceptable. The
ceiling plenum shall contain evaporator coil, copper tube/ copper fins with stainless steel end plates to prevent
corrosion, an insulated condensate drain pan and dehumidification inlet/outlet. The plenum shall force
conditioned air continuously across the ceiling and down over the work surface through a perforated prismatic
Lexan ceiling grid system. Drainage during operation and during defrost shall be collected in the insulated drain pan and run through a trapped ¾" copper drain line to the casework within the chamber or to a specified drain point outside of the chamber within 10'. The drain piping shall be easily removable from the drain pan for pan access. All metal surfaces and hardware shall be stainless steel to resist corrosion. Air returns shall be equipped with removable, cleanable mesh air filters to protect the evaporator coil surface. The exposed surfaces of the ceiling plenum shall be 304 stainless steel with No. 3 finish. All access shall be through the drain pan allowing all walls to remain free of disturbance during access. Fans shall be direct drive centrifugal blowers with forward curved blades.

1. **Sub Assembly Quality Control:** The above mentioned sub-assemblies: condensing unit, evaporator, and plenums, shall be evacuated to <500 microns and held for > 5 hours prior to pre-charging with 150 PSIG of dry nitrogen. The unit shall be tagged with the dry nitrogen charge pressure, ambient temperature, date and the testing technician’s initials. Units shall be shipped with the test charge in tact and pressures evaluated after installation. Upon start-up, unit shall be evacuated of nitrogen and charged with the proper refrigerant charge. Evacuation shall be witnessed by UNC Refrigeration Shop.

2. **Chamber Dehumidification:** Chamber shall be equipped with dehumidification capabilities which utilize a refrigerated dehumidification coil designed as an integral part of the evaporator plenum. This dedicated coil will be housed inside of the evaporator plenum for condensate removal to a double wall stainless steel drain pan system. The dehumidification coils will be provided with specific valving to obtain the temperatures necessary to maintain the required humidity levels for the chamber. The control shall be through a separate solid-state microprocessor based digital controller mounted on the control panel. Dehumidification by desiccant or refrigeration and reheat shall not be acceptable.

**Refrigerant Piping**
Piping shall consist of Type “ACR” hard copper tubing and fittings. Joints shall be made with a high pressure silver bearing solder with a silver content of =>15 %, (Harris Stay-Silv 15 or equivalent). 95-5 solder or stabrite will not be acceptable. Refrigerant piping shall be sized in accordance with the ASHRAE Handbook, (1998 Refrigeration Volume, Chapter 2). Suction line shall be insulated with closed cell pipe insulation. Insulation shall have a flame spread rating of less than 25 and a smoke density rating of less than 50 as certified by ASTM E-84 tunnel testing. Adhesives used in the application of pipe insulation shall be designed for use with that product and maintain fire ratings. All penetrations in the insulation shall be sealed to maintain a moisture tight barrier. Insulation shall be sealed to the tubing at termination points.

**Performance**

**Temperature Fluctuation**
Room temperature swing during normal operation with the door remaining closed shall be less than ½° C.

**Temperature Range**
All chambers shall be designed to operate AND PERFORM AS ABOVE at any setting between 0 to 10° C.

**Uniformity**
Room temperature shall remain uniform within +/-2 degree C. for 24 hours and tested with a multi port recorder with at least 12 sensors over the entire range of operation (0-10 degrees C.) Specify that test
results are to be submitted to the University.

**Capacity**
The refrigeration system and all related components shall be capable of maintaining the temperature within the specified limits without operation at full capacity more than 80 percent of the time.

**Humidity Control**
The chamber shall be designed to be capable of lowering the relative humidity to 65% during low temperature operation. Humidification during high temperature operation is not required.

**Training:**
The manufacturer shall provide 1-day (8-HRS) of on-site training for the preventive maintenance, calibration, repair and operation of the chambers. The manufacturer shall also include at least one seat in their factory training school for each chamber supplied to the university at no charge. To be used as university workload permits.

**Warranty**
The room enclosure and its fixtures and components shall be guaranteed for a period of five years one year unconditionally and four for parts. The compressor and refrigeration circuit shall be guaranteed for a period of five years one year unconditionally and four years for parts. Repair and/or replacement of warranty components shall be performed at no cost to the Owner. The manufacturer must have factory trained service technicians on call to respond to emergency service 24-7, 365 days a year, with a maximum response time of 4 hrs.
C-40 – COMMISSIONING (NON-MEP)

Commissioning and Building Performance Verification
Building commissioning is required for projects as defined in GS 143-135. Refer to NC SCO Building Commissioning Guideline for requirements for commissioning. During the warranty phase of the project, the building’s energy performance must also be verified per GS 143-135. Refer to NC SCO Building Performance Guideline for energy performance verification requirements.

Refer to NC State Construction Manual for requirements for how commissioning interfaces with other aspects of the design and construction process.

The UNC Chapel Hill campus has a commissioning group tasked with analyzing and implementing the current state guidelines. Designers, commissioning agents, contractors and other professionals are to contact UNC Facilities Planning for current information on the process.

NC SCO Building Commissioning Guideline:  

NC SCO Building Performance Guideline:  

NC State Construction Manual:  

Building Envelope Considerations
The building envelope including the roof and windows and wall structures should be tested for water leakage by using pressure hoses on the outside and inspectors on the inside of the building.

The final building structure should be tested for air leaks by pressurizing the building and measuring the leakage rate. The observed air leakage shall not exceed the design infiltration rate used in sizing the HVAC and humidity control systems.

Special Considerations for Historic and Old Buildings
An engineering assessment is required during the project programming phase to determine the projected impacts of renovation activities on moisture control within the structure. This assessment should include considerations of below grade, at grade and above grade differences, the tightness of the envelope and the deterioration of or lack of moisture and vapor barriers and retarders. Goals shall be set in coordination with Facilities Planning to establish reasonable measures for improving or maintaining building tightness.

Prior to Beneficial Occupancy the Commissioning Agent shall provide satisfactory evidence to Facilities Planning that the prescribed goals for envelope tightness have been met.