Purpose: The University of California Berkeley Real Estate Division created the Campus Design Standards to guide design and construction professionals to complete lasting, high-quality additions to the campus built environment. These Standards, along with applicable codes, ensure that new construction and renovation projects at UC Berkeley integrate industry best practices and experience with existing campus buildings, infrastructure, grounds, and maintenance issues.

Administration: The Campus Design Standards are administered by Inspection Services and were developed in concert with the Real Estate Division’s Construction & Design, Facilities Services, Environment, Health & Safety, and other campus units. They apply to all UC-sponsored construction projects. These standards use the Construction Standards Institute’s 2014 MasterFormat. Where a division is not listed in this document, there are no current campus standards and current applicable code shall prevail.

Changes and Revisions: The Campus Design Standards are formally revised triennially in sync with the adoption cycle of the California Building Code. Due to the ever-evolving construction environment, revisions between code cycles may be necessary. As such, this document is meant to be malleable and not set in stone. As part of the plan review process, Inspections Services will consider project specific needs when evaluating requests for alternates to or exemptions from the standards. In addition, we welcome input on these standards at any time, from anyone. Questions and comments regarding, as well as proposed changes and revisions to the Campus Design Standards may be directed to: campusdesignstandards@lists.berkeley.edu or:

Inspection Services
2000 Carleton St. Rm 230,
Berkeley, CA 94720-1386

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Adopted August 2015

4
Part 1 - General

1. Name, Location and Access To Project
   a. Project Location: (Project Name, Address), University of California, Berkeley.
   b. Work Location: (Description of location, i.e., "Skylights on the roof of University Art Museum").
   c. Access: Permission for access to the site may be revoked for any and all persons who violate the University traffic regulations including, but not limited to, speed limits and parking restrictions. All Contractor's personnel, operations affiliates and delivery personnel shall be made aware of and shall comply at all times with campus traffic regulations.

2. Description Of Work
   a. General Requirements: The Contractor shall provide: qualified supervision; leads; workers and all labor; materials; equipment; services; transportation; insurance; licenses; building permits and all other items and work required to properly execute the intentions of the Contract.
   b. Scope of work includes, but is not limited to: (List general description of items included in the scope of work.)
   c. Intent of Document:
      i. It is the intent of the Contract Documents to include everything necessary for the proper completion of the project. Work necessary for completion or inferred by the Documents, even though not specifically shown or specified, shall be supplied.
      ii. Where removal of existing construction is required for performance of any work under this Contract, removal and replacement shall be accomplished whether shown or not.

3. Interpretations Of Terms
   a. The term "Owner's Representative," used in these specifications, is synonymous with the (Choose one (1): "Architect", "Engineer" or "University Representative.") "As directed," "as required," "as permitted," "approved," "acceptable," "satisfactory," means by or to the Owner's Representative.

4. Definitions Of Terms Used
   a. Owner
      The Regents of the University of California
   b. Owner's Representative
      (Company or Individual's Name)
      Street Address
      City, State, Zip Code
      Attention: ( )
      Phone Number: ( )
      E-Mail: ( )
(If UC will be signing Certification:)

c. Campus Architect  
Emily Marthinsen, AIA  
Assistant Vice Chancellor and Campus Architect  
University of California, Berkeley  
1936 University Ave., 2nd Floor  
Berkeley, CA 94720-1380  
E-Mail: emarthinsen@berkeley.edu

(If UC Project Manager is also Owner's Representative:)

d. UC Project Manager  
University of California, Berkeley  
Real Estate Division, Construction & Design  
Owner's Representative  
1936 University Ave., 2nd Floor  
Berkeley, CA 94720-1380  
Attention: (Project Manager's Name)  
(510) _______________  
E-Mail: ( )

e. Project Inspector:  
Assigned by Owner’s Inspection Services after Advertisement of Bid

f. Contractor:  
The successful bidder, to whom the Contract is awarded.

5. Definitions

a. The following terms, when used on the Drawings and/or in the Specifications, shall have the following meanings:

<table>
<thead>
<tr>
<th>TERM</th>
<th>MEANING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adequate; Careful; Proper; Sufficient; Suitable; Satisfactory</td>
<td>These terms refer to interpretation by Owner's Representative, and are subject to approval upon request.</td>
</tr>
<tr>
<td>Applicable Codes</td>
<td>&quot;Codes listed in Section 01 41 00.&quot; referencing the Regulatory Requirements.</td>
</tr>
<tr>
<td>Approved</td>
<td>&quot;As approved by Owner's Representative.&quot;</td>
</tr>
<tr>
<td>As Directed</td>
<td>&quot;As directed by Owner's Representative.&quot;</td>
</tr>
<tr>
<td>As Required</td>
<td>&quot;As required by Applicable Code Requirements; by industry best practices; by the conditions prevailing; by the Contract Documents; by Owner, or by Owner's Representative.&quot;</td>
</tr>
<tr>
<td>As Selected</td>
<td>&quot;As selected by Owner's Representative.&quot;</td>
</tr>
<tr>
<td>By Others</td>
<td>Work on this Project that is outside the scope of Work to be performed by Contractor under this Contract, but that will be performed by Owner, other Contractors, or other means.</td>
</tr>
<tr>
<td>Equal</td>
<td>Of same quality, appearance, and utility to that specified, as determined by Owner's Representative. Contractor bears the burden of proof of equality.</td>
</tr>
<tr>
<td>Furnish</td>
<td>&quot;Supply only, not install (unless required to be</td>
</tr>
</tbody>
</table>
6. Inconsistencies In Contract Documents  
   a. In addition to the requirements of the General Conditions, if there is an inconsistency in the Contract Documents, the stricter, more stringent standards and requirements shall be followed at no additional cost to Owner.

7. Building Permits  
   a. The Contractor is required to take out building permits for work done on University property. Permits for work on University Property may be obtained at no charge from Inspection Services (http://realestate.berkeley.edu/what-we-do/construction/inspection-services). Permits are also required by the City of Berkeley for work encroaching on City property. Prior to obtaining such permit(s), the Contractor shall submit it to Owner for review, before executing.

8. Publicity Releases  
   a. Do not release any information, story, photograph, plan or drawing relaying information about the project to anyone, including press or other public communications medium without prior written permission from the University.

9. Notification  
   a. Notify Owner's Representative not less than two (2) (change number of days as applicable) working days in advance of any inspection, meeting or consultation requiring the Owner’s Representative's presence.

01 12 00     Multiple Contract Summary

1. Multiple prime Contractors with separate construction contracts will be on the Project site and will perform work simultaneously. Scheduling of work and utilization of the Project site by the various prime Contractors will be coordinated by Owner’s Representative. A summary of these prime contracts and their estimated Notice to Proceed (NTP) dates will be provided by the Project Manager. These dates are subject to revision.
01 14 00 Work Restrictions

1. Work Hours
   a. The Work of this Project shall be accomplished in accordance with the City of Berkeley’s Construction Noise Standards: http://www.ci.berkeley.ca.us/uploadedFiles/Online_Service_Center/Planning/Construction%20Noise%20Standards.pdf.
   b. No work shall be performed on Saturdays, Sundays or University holidays, unless otherwise approved by the Owner's Representative.
   c. All roto-hammering, chipping, doweling, pneumatic fastening, or any other activity that may cause excessive noise and/or vibration in central campus environs shall be performed between 10:00 p.m. and 7:00 a.m. and must be scheduled with the Owner's Representative ten (10) working days before the activity commences. Such work occurring near residences shall be scheduled to cause the least possible disturbance to residents.
   d. All crane work shall be schedule to cause the least possible disruption to the campus and surrounding environs.
   e. Alterations to the above contract requirements may be made in advance, with the written permission of the Campus Building Official or Campus Architect.

01 20 00 Price and Payment Procedures

01 21 00 Allowances

1. General
   a. Included in the Contract Sum are all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or firms as Owner's Representative may direct.
   b. The following shall apply, unless otherwise provided in the Contract Documents:
      i. Allowances shall cover the cost to Contractor of labor, materials and equipment delivered to the Project site and all required taxes, less applicable trade discounts.
      ii. Contractor's costs required for storage on and off the Project site, security, loading and unloading, handling at the Project site, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum and not in the allowances.
      iii. Whenever costs are more than or less than allowances, the Contract Sum shall be adjusted by change order based on: (1) the difference between actual costs and the allowances; and (2) changes in Contractor's costs.

01 21 43 Time Allowances

1. Weather Caused Delays
   a. Time lost in the progress of the Work caused by stormy or inclement weather conditions shall not be considered an Excusable Delay as defined in the General Conditions, unless the aggregate of such lost time in any calendar month exceeds the average number of rain days for said month.
   b. The average number of rain days when precipitation amounts greater than one half inch (.50") occur shall be based on the data published for Berkeley, California (Note: Change city if work is being performed in a remote location), by:

   National Climatic Data Center
   Federal Building
   151 Patton Avenue

Adopted August 2015
c. The mean average of rain days shall be based on data covering the last ten (10) years from this source.

01 22 00  Unit Prices

1. Work Included
   a. Provide the Owner with Unit Prices specified herein.
   b. Specifications for Work Requiring Unit Prices: See applicable Sections.

2. Description of Unit Prices
   a. Provide the following Unit Price(s) in the appropriate spaces on the Bid Form:
      i. (Insert description of Unit price. State unit, i.e., "per cubic yard", "per linear foot", "per door", "per toilet fixture", etc. Reference applicable Specification Section.)
      ii. (Continue listing consecutively numbered Unit Prices as needed.)
   b. Amount of unit prices includes:
      i. The cost of materials and installation billed to the Contractor, including taxes.
      ii. Delivery to the site (or removal from site and legal disposal of materials).
      iii. Handling of materials at the site, including unloading and storage.
      iv. Other expenses required to complete the installation.
      v. Contractor's and Subcontractor’s overhead and profit.

3. Contractor Responsibility For Installation
   a. On notification of selection, enter into agreement with designated Subcontractor.
   b. Arrange for and process product data and samples as required.
   c. Install and finish products in compliance with requirements of referenced Specifications Sections.

4. Adjustment Of Cost
   a. Base bid price shall be inclusive of all work shown and specified on the drawings and specifications. Unit Prices shall be the basis for determining payment to the Contractor for work, incorporated into the contract with a Change Order, over and above (or less than) that work shown on the drawings and specifications.
      i. Quantities installed shall be determined by field measurements. After performing Unit Price work as directed by Owner's Representative, Contractor shall take necessary measurements in the presence of the Owner's Inspector and shall submit calculation of quantities to the Owner for approval. Contractor shall notify the Owner one (1) day in advance of taking measurements.
   b. At Contract closeout, reflect all approved changes in Contract Sum in the final statement of accounting.

01 23 00  Alternates

1. Work Included
   a. This section identifies each Alternate and describes basic changes to the Work only when that Alternate is made a part of the Work by specific provision in the Agreement.
   b. The Lump Sum Base Bid and Alternates shall include the costs of all supporting elements required, so that the combination of the Lump Sum Base Bid and any Alternates shall be complete. The scope of Work for all Alternates shall be in accordance with applicable Drawings and Specifications.
c. Except as otherwise specifically provided by Owner, the Work described in Alternates shall be completed with no increase in Contract Time.
d. This section includes only the non-technical descriptions of the Alternates. Refer to the specific sections of Divisions 02-50 of the Specifications for technical descriptions of the Alternates.
e. Coordinate related Work and modify surrounding Work as required to properly and completely integrate the Alternates into the Work.
f. The Lump Sum Base Bid shall include all work shown except work described as Alternates.
g. The Alternates described below are intended to:
   i. Allow the Owner to identify the cost of a portion of the work for funding purposes, and
   ii. Provide the Owner flexibility to adjust the project scope to suit funds available.
h. The Owner reserves the right to award none, any one or more selected in any order, or all of the Alternates in combination with the work covered by the Lump Sum Base Bid. Alternates shall not be awarded without awarding the Lump Sum Base Bid.
i. The Owner reserves the right to determine the low bid as the Lump Sum Base Bid alone or the sum of the Lump Sum Base Bid and any combination of Alternates it chooses to award. The bid documents shall identify the evaluation method to be used for choosing the alternates for purposes of identifying the low bid.
j. Each Alternate is intended to cover all of the work required for a complete finished job.
k. All Alternates are either "additive" or "deductive" or "No Change" (as appropriate) to the Lump Sum Base Bid. The amounts shall be quoted in the appropriate spaces provided on the form for the Bid for Lump Sum Contracts.
l. Failure to either quote an amount; select the “No Change” option or the insertion of the words "no bid," "none" or words of similar import, shall be considered as not completing the Bid for Lump Sum Contract and may constitute disqualification of the entire bid at Owner's discretion.
m. The Base Bid and the Alternates are exclusive in their scope of work. There is no overlap between or among the Base Bid and Alternates. The cost of any item of work shall be included only once, in the Base Bid or in the Alternates.

01 25 00  Substitution Procedures

01 25 13  Product Substitution Procedures

1. Substitution of Materials and Equipment
   a. Catalog numbers and specific brands of trade names followed by the designation "or equal" are used in conjunction with the material and equipment required by the Specification to establish the standards of quality, utility and appearance required. Substitutions which are equal in quality, utility and appearance to those specified may be accepted subject to the following provisions:
      i. All substitutions must be approved by the Owner's Representative in writing.
      ii. Contractor shall submit to the Owner's Representative, within (Project Manager to insert appropriate number of calendar days) after the date of commencement specified in the Notice to Proceed, a typewritten list containing a description of each proposed substitute item or material, along with the documents required by Paragraph 1.1C.
      iii. The Owner's Representative will accept, in writing, such proposed substitutions as are, in the Owner's Representative's opinion, equal in quality, utility and appearance to the items or materials specified.
      iv. Such approval shall not relieve the Contractor from complying with the requirements of the drawings and specifications.
      v. Contractor shall be responsible at the Contractor's own expense for any changes resulting from the Contractor's proposed substitution which affect other parts of the Contractor's own work or the work of others.
      vi. The decision of the Owner's Representative shall be final.
b. If a request for substitution occurs after the period specified in paragraph a, ii, (above), the substitution may be reviewed at the discretion of the Owner's Representative; and the costs of such review, as approved by Owner, shall be borne by Contractor and will be deducted from or added to the Contract Sum.

c. Requests for substitutions will only be considered if Contractor submits the following supporting data:
   i. Complete technical data including drawings, performance specifications, samples and test reports of the article proposed for substitution; and any additional information required by the Owner's Representative.
   ii. Data described in Subparagraph C-1 for the specified item for which substitution is proposed.
   iii. List similar projects using product, dates of installation, and names of Owner and Owner's Representative.
   iv. Statement by Contractor that the proposed substitution is in full compliance with the requirements of the Contract Documents and Applicable Code Requirements.
   v. Itemized comparison of proposed substitution with specified product, listing variations, and reference to Specifications section name and number, article and paragraph numbers.
   vi. List availability of maintenance services and replacement materials.
   vii. List of Subcontractors, if any, that may be affected by the substitution.
   viii. If the proposed substitution requires that portions of the work be redesigned or removed in order to accommodate the substituted item, submit design and engineering calculations prepared by a properly licensed design professional.

d. The Owner's Representative may reject any substitutions not proposed in the manner and within the time prescribed above.

e. For products specified by naming only one product and manufacturer, without the qualifying phrase “or equal” there is no option, and no substitution will be allowed. Such is the case with products, materials, equipment or systems which are specified for the purpose of matching a specific function or economy of maintenance of other products, materials, equipment or systems already in use in existing portions of the University’s installations. Where matching with an existing item is required, the final decision whether a product proposed matches the item satisfactorily is University Representative's judgment.

f. The seventy (70) calendar day submittal period does not excuse the Contractor from completing the Project within the performance time stipulated in the Agreement or excuse the Contractor from the payment of liquidated damages if final completion is delayed.

g. Wherever more than one manufacturer's product is specified, any of the specified products are acceptable and a substitution request is not required; however, the first-named product is the basis for the design used in the work and the use of alternative-named manufacturer's products or substitutes may require dimensional modification in the project design and construction and resulting adjustments in location of related work. If such alternatives are proposed by Contractor in accordance with submittal requirements and are favorably reviewed by the Owner's Representative, Contractor shall assume all costs required to make necessary dimensional revisions and modifications. Such approval will not be unreasonably withheld.

h. If the Owner's Representative, in review of the list of materials and equipment, requires revisions or corrections to be made or shop drawings and/or supplemental data to be submitted, Contractor shall promptly do so. If any proposed substitute is judged by the Owner's Representative to be
acceptable, the specified item shall be provided; further submissions will not be allowed, unless directed by the Owner's Representative.

i. Samples may be required. Tests required by the Owner's Representative for the determination of the quality and utility shall be made by Contractor's Testing Laboratory, and at the expense of Contractor, with acceptance of the test procedure first given by the Owner's Representative.

j. In review of the data submitted in support of substitutes, the Owner's Representative will use for purposes of comparison all the characteristics of the specified item as they appear in the manufacturer's published data even though all the characteristics of the specified item may not have been particularly mentioned in the specification. If more than two (2) submissions of data are required, the cost of reviewing these additional submissions shall be charged directly against the Contractor; and the Owner will withhold the funds necessary to cover these costs.

2. Anchors and Fasteners
   a. Submit manufacturer's literature and calculations for anchoring and fastening devices to Owner's Representative for approval.
      i. For concrete, use two-piece cinch anchors, epoxied anchors and/or wedge anchors, as appropriate for conditions and function.
      ii. The use of pneumatic-driven anchors or fasteners and power-driven or powder-driven anchors or fasteners is prohibited.

   - - - OR - - -

   i. Submit manufacturer's literature and calculations for anchoring and fastening devices to Owner's Representative for approval.
   ii. For concrete, except as listed below, use two-piece cinch anchors, epoxied anchors and/or wedge anchors, as appropriate for conditions and function. Concrete nails are not permitted.
   iii. The use of low velocity powder-activated tools is permitted only for the conditions described below. The use of medium and high velocity powder-activated fasteners as defined by ANSI A10.3 is prohibited.
      a. Permitted Uses of Low Velocity Powder-Actuated Fasteners:
         i. Anchoring metal track for interior non-load bearing walls. Note: Door frames shall be fastened with two-piece expansion anchors.
         ii. Fastening of furring strips to concrete walls.
         iii. Temporary fastening and concrete forming.
         iv. Installation of incidental straps and wires used to suspend the following:
            a. Metal duct work of 25 pounds per linear foot or less;
            b. Piping of 1" diameter or less;
            c. Electrical conduit of 2" diameter or less.
         v. Fastening of plaster accessories, flashing and similar items with negligible loading.
      b. Requirements for Low Velocity Powder Actuated Fasteners.
         i. Minimum shank: .143 inch diameter; minimum penetration: 1.25 inches for 3000 psi concrete; minimum rated tensile strength: 310 lbs; minimum rated shear strength: 420 lbs. Contractor shall submit calculations to substantiate selection.
         ii. Weight suspended from each connection shall not exceed 200 lbs.
         iii. Where designated by Owner's Representative, anchors, fasteners and ties installed utilizing low velocity powder-actuated tools will be tested by an independent testing laboratory to resist two times the design load. Any such anchor, fastener or tie which fails such a test shall be replaced by Contractor at no cost to Owner.
      c. Procedures for use of low velocity powder actuated tools:
         i. The use of low velocity powder actuated tools shall comply with Federal OSHA safety requirements and California Code of Regulations Title 24, including the
requirement that the operator of the tool be trained and certified. Submit certification to Owner's Representative.

ii. Submittal of manufacturer's literature and calculations for anchoring and fastening devices shall include load calculations and minimum spacing for fasteners for each specific use. Design for a factor of safety of two times allowable load. Calculations shall be signed by Contractor's structural engineer. Structural engineer shall be registered in California.

iii. Conform to SMACNA low velocity shotpin installation requirements.

01 26 00 Contract Modification Procedures

01 26 39 Field Orders

1. Field Clarifications and Field Orders
   a. From time to time it may become necessary to issue Field Clarifications to the Contractor for minor changes not affecting Contract Sum or Contract Time.
   b. Where the change affects the Contract Sum or the Contract Time, and to minimize delays, a Field Order may be issued.
   c. A Field Order will be superseded by a Supplement and, subsequently, an executed Change Order.

01 26 63 Change Orders

1. Supplements
   a. When construction changes are proposed, they will be originated with a Supplement issued by the Owner's Representative to the Contractor.
   b. Supplements will be numerically sequential and may include multiple items.
   c. Supplements may be issued due to changes requested in the Project by the Owner, the Owner's Representative or the Contractor.
   d. Supplements are not Change Orders; however, some Supplements may become Change Orders.
   e. The Contractor shall prepare a Cost Proposal (backup) in response to the Supplements as rapidly and accurately as possible.

2. Contractor's Cost Proposal (Backup)
   a. Following receipt of a Supplement, the Contractor shall prepare an estimate of cost and/or time for execution of the proposed change which, if accepted, will become the backup for a Change Order (i.e., Cost Proposal).
   b. The Cost Proposal shall identify each item of work affected by the proposed change, value of the change, and a summary of overhead, profit, total cost and any time extension request.
   c. Cost Proposals shall show, as applicable, General Contractor's, Subcontractor's, and Sub-Subcontractor's work. Cost Proposals shall also show detailed breakdown of material, labor, etc., plus applicable percentages for overhead and profit as provided in the General Conditions.
   d. Contractor shall provide quotations for Supplements on Exhibit 7: Cost Proposal as provided in the Contract Documents. No other form of quotation will be accepted by the Owner's Representative. The Contractor may, however, attach additional documentation to Exhibit 7.

3. Change Orders
   a. Change Orders will be numerically sequential and may include multiple change items.
   b. Change Orders will reference (at a minimum):
c. All Change Orders will be appended with Contractor's Backup (Supplements, Cost Proposals, or any other written documents referenced in the Change Order).
d. Change Orders will adjust Contract Sum and/or Contract Time as applicable.
e. Following receipt and acceptance of Contractor's Backup, Change Orders will be prepared and issued by the Owner's Representative. The Owner's Representative will transmit the Change Order (with backup) to the Contractor for signature. The Contractor will then return the Change Order (with backup) to the Owner (labeled "Attention: Project Manager") for final execution.
f. The Owner's Representative, the Contractor, and the Owner shall sign each original part of the Change Order in ink.
g. Upon execution by the Owner's Representative, Contractor and Owner, the Change Order will become part of the Contract Documents.
h. The Contractor shall not bill for a Change Order on the Application for Payment prior to its execution by the Owner. The Owner's Representative will not approve the portion of any Application for Payment which bills for a Change Order not yet executed by the Owner.

4. Project Schedule
   a. Contractor shall adjust its construction schedule to reflect fully-executed Change Orders (if any), in accordance with the General Conditions.

01 30 00 Administrative Requirements

01 31 00 Project Management and Coordination

1. Coordinate the Work and do not delegate responsibility for coordination to any Subcontractor.
2. Anticipate the interrelationship of all subcontractors and their relationship with the Work.
3. Resolve differences or disputes between subcontractors concerning coordination, interference or extent of the work between sections.
4. Coordinate the work of subcontractors so that portions of the work are performed in a manner that minimizes interference with the progress of the work.
5. Do not obstruct spaces and installations that are required to be clear by Applicable Code Requirements.
6. Do not cover any piping, wiring, ducts or other installations until they have been inspected and approved and required certificates of inspection issued.
7. Remove and replace all work which does not comply with the Contract Documents. Repair or replace any other work or property damaged by these operations with no adjustment of Contract Sum.
8. Coordinate all portions of the Work requiring careful coordination in order to fit in space available. Before commencing such portions of the work, prepare supplementary drawings for review by the Owner's Representative.

01 31 19 Project Meetings

1. Procedure Meetings
   a. After execution of the construction contract, and typically prior to commencement of the Work, a Procedure Meeting (kick-off meeting) will be conducted by Owner to discuss and review procedures which are to be followed during performance of the Work. The Contractor and Owner's Representative shall be prepared to review job schedules, discuss various aspects of the work, and administrative procedures for smooth job progress.
   b. Location: As designated by Owner.
   c. Attending shall be:
2. Billing Meeting
   a. A Billing Meeting shall be conducted by Owner's Representative each month prior to submittal of the Application for Payment.

   b. Location: As designated by Owner's Representative.

   c. Attending shall be:
      i. Owner's Representative.
      ii. Owner.
      iii. Owner's Project Inspector.
      iv. Owner's Consultants and Owner's Representative's Consultants, as appropriate.
      v. Contractor.
      vi. Contractor's Superintendent.
      vii. Subcontractors, as appropriate.
      viii. Others, as appropriate.

3. Progress Meetings
   a. During the course of construction, Progress Meetings will be held to review progress of the work and resolve construction problems. The written record of these meetings shall be prepared by the Owner's Representative and issued as expeditiously as possible to:
      i. Owner's Representative.
      ii. Owner.
      iii. Owner's Project Inspector.
      iv. Owner's Consultants and Owner's Representative's Consultants, as appropriate.
      v. Contractor.
      vi. Contractor's Superintendent.
      vii. Subcontractors, as appropriate.
      viii. Others, as appropriate.

   b. Location: As designated by Owner's Representative.

   c. Attending shall be:
      i. Owner's Representative.
      ii. Owner.
      iii. Owner's Project Inspector.
      iv. Owner's Consultants and Owner's Representative's Consultants, as appropriate.
      v. Contractor.
      vi. Contractor's Superintendent.
      vii. Subcontractors, as appropriate.
      viii. Others, as appropriate.

4. Warranties/Guarantees, Bonds, and Service and Maintenance Contracts Review Meeting

Adopted August 2015
a. Eleven (11) months following the date of Beneficial Occupancy, Substantial Completion, if applicable, or Final Completion, a meeting shall be conducted by Owner for the purpose of reviewing the warrantees/guarantees, bonds, and service and maintenance contracts for materials and equipment.

b. Attending shall be:
   i. Owner.
   ii. Owner's Consultants, as appropriate.
   iii. Contractor.
   iv. Subcontractors, as appropriate.
   v. Others, as appropriate.

01 32 00 Construction Progress Documentation

01 32 13 Scheduling of Work

1. Submission:
   a. Within ten (10) calendar days after receipt of Notice of Apparent Lowest Responsible Bidder, submit detailed Preliminary Cost Breakdown with other required documents to Owner, and to Owner's Representative for approval.
   b. Submit the Contract Schedule, in a form acceptable to Owner's Representative, within ten (10) calendar days of the date of commencement as specified in the Notice To Proceed.
   c. The Owner's Representative will determine acceptability of the Contract Schedule within seven (7) calendar days after its receipt.
   d. No Application for Payment will be processed nor shall any progress payment become due until the Contract Schedule is approved by the Owner's Representative.
   e. Submit Material and Safety Data Sheets (MSDS) within ten (10) calendar days of the date of commencement as specified in the Notice To Proceed. MSDS must be kept on the job site throughout the course of work.

2. Form:
   a. The Contract Schedule shall be a bar chart showing continuous flow from left to right, specific calendar dates shall be clearly and legibly shown for the start and finish of each work activity.
   b. The Contract Schedule shall be suitable for monitoring progress of the Work, in sufficient detail to demonstrate adequate planning for the Work, and represent a practical plan to complete the work within the Contract time and within the dates shown on the Notice To Proceed.
   c. Identify the following milestone event on the Contract Schedule:
      i. Order all equipment and start shop fabrication after signing the Construction Contract.
   d. Determine in advance and allow for special events, final examinations or other activities where Owner will not permit noisy, dusty and disruptive construction work.
   e. Identify all University holidays and other non-working days on the Contract Schedule.

3. Activities:
   a. Submit list of major Contractor-furnished equipment, materials and building elements, and scheduled activities requiring Owner's Representative's prior approval. Dates shall be shown for the procurement, fabrication, delivery and installation of major equipment, materials and building elements, and for scheduled activities designated by Owner's Representative. A minimum of fourteen (14) calendar days (modify as appropriate) shall be allotted for the Owner's Representative to review each submittal.
   b. Submit system test dates.
c. Submit Contractor's requests for designated working spaces, storage areas, access and other facilities to be provided by Owner.
d. Submit Contractor's request for orders and decisions that would be required from Owner's Representative on other designated items.
e. Provide dates for penetrating existing structures.
f. The presentation of each Work activity on the Contract Schedule shall include a brief description of the work activity, the duration of the work activity in days, and a responsibility code identifying the organization or trades performing the work activity.

01 32 16  Construction Progress Schedule

Projects Under $5 million.

1. Preliminary Contract Schedule
   a. Submission:
      i. Submit the Preliminary Contract Schedule to Owner's Representative within ten (10) calendar days after receipt of the Notice of Selection as Apparent Lowest Responsible Bidder.
      ii. Within seven (7) calendar days after receipt of the Preliminary Contract Schedule, Owner's Representative will notify Contractor of its acceptance of, or its review comments about, the schedule so that appropriate adjustments can be made by Contractor in the development of the Contract Schedule.
   b. Form (to be determined by Owner’s Representative):
      i. Prepare the Preliminary Contract Schedule as a C&DM, time-scaled network diagram showing continuous flow from left to right.
      OR
      i. Prepare the Preliminary Contract Schedule as a bar chart showing continuous flow from left to right. Specific calendar dates shall be clearly and legibly shown for the start and finish of each Work Activity.
      ii. Prepare the Preliminary Contract Schedule in sufficient detail to demonstrate preliminary planning for the Work and to represent a practical plan to complete the Work within the Contract Time and within the dates shown on the Notice To Proceed.
      iii. Identify the following milestone events on the Preliminary Contract Schedule (this may be modified as needed by the Owner’s Representative):
         1. Off-Site Improvements
         2. Earthwork
         3. Excavation
         4. Foundation
         5. Structural (Framing)
         6. Rough-Outs (Mechanical; Electrical; Plumbing; HVAC)
         7. Exterior Finishes (Roof)
         8. Trim:
            a. Plumbing
            b. Electrical
            c. HVAC
         9. Interior Drywall/Plaster
         10. Finishes:
            a. Painting
         11. Final Inspection and correction of any deficiencies.
         12. Beneficial Occupancy or Substantial Completion.
13. On-Site:
   a. Curbs
   b. Gutters
   c. Asphalt

14. Landscaping and Irrigation
15. Punchlist Items
   iv. Identify all University holidays and other non-working days on the Preliminary Contract Schedule.
   c. Activities: Identify all work activities which constitute the critical path.

2. Contract Schedule
   a. Submission:
      i. Submit the Contract Schedule, in the form and having general content acceptable to Owner's Representative within ten (10) calendar days following date of Commencement as shown on the Notice to Proceed and prior to submitting the first Application For Payment.
      ii. Owner's Representative will determine acceptability of the Contract Schedule within seven (7) calendar days after its receipt.
      iii. No Application For Payment will be processed nor shall any progress payment become due until the Contract Schedule is accepted by Owner's Representative.

   b. Form:
      i. The Contract Schedule shall be a C&DM, time-scaled network diagram showing continuous flow from left to right.
      OR
      i. The Contract Schedule shall be a bar chart showing continuous flow from left to right. Specific calendar dates shall be clearly and legibly shown for the start and finish of each Work Activity.
      ii. The Contract Schedule shall be suitable for monitoring progress of the Work, in sufficient detail to demonstrate adequate planning for the Work, and represent a practical plan to complete the Work within the Contract Time.
      iii. Identify the following milestone events on the Contract Schedule (this may be modified as needed by Owner’s Representative):
         1. Off-Site Improvements
         2. Earthwork
         3. Excavation
         4. Foundation
         5. Structural (Framing)
         6. Rough-Outs (Mechanical; Electrical; Plumbing; HVAC)
         7. Exterior Finishes (Roof)
         8. Trim:
            a. Plumbing
            b. Electrical
            c. HVAC
         9. Interior Drywall/Plaster
         10. Finishes:
            a. Painting
         11. Final Inspection and correction of any deficiencies.
         12. Beneficial Occupancy or Substantial Completion.
         13. On-Site:
            a. Curbs
b. Gutters

c. Asphalt

14. Landscaping and Irrigation

15. Punchlist

iv. Identify all University holidays and other non-working days on the Contract Schedule.

v. If the Contract Schedule is shown on more than one (1) sheet, provide a summary sheet.

c. Activities:

i. Identify all Work activities in correct sequence for the completion of the Work. Work activities shall include the following:

1. Major Contractor-furnished equipment, materials, and building elements, and scheduled activities requiring submittals or Owner's prior approval.

2. Show dates for the submission, review, and approval of each submittal. Dates shall be shown for the procurement, fabrication, delivery, and installation of major equipment, materials, and building elements, and for scheduled activities designated by Owner.

3. A minimum of seven (7) calendar days shall be allotted for Owner's Representative to review each submittal.

4. System test dates.

5. Scheduled overtime Work if required by Contract Documents.

6. Dates Contractor requests designated working spaces, storage areas, access, and other facilities to be provided by Owner.

7. Dates Contractor requests orders and decisions from Owner on designated items.

8. Dates Contractor requests Owner-furnished equipment.


10. Connection and relocation of existing utilities.

11. Connecting to or penetrating existing structures.

12. Scheduled inspections as required by Codes, or as otherwise specified.

ii. Identify all Work activities that constitute the critical path.

iii. Critical Work activities are defined as Work activities which, if delayed or extended, will delay the scheduled completion of one or more of the milestones specified in this Section or the scheduled completion of the Work, or both. All other Work activities are defined as non-critical Work activities and are considered to have float.

iv. Float is defined as the time that a non-critical Work activity can be delayed or extended without delaying the scheduled completion of milestones specified in this Section or the scheduled completion of the Work, or both. Neither Contractor nor Owner shall have an exclusive right to the use of float. The party using float shall document the effect on the updated Contract Schedule.

v. Delays of any non-critical Work shall not be the basis for an extension of Contract Time until the delays consume the float associated with that non-critical Work activity and cause the Work activity to become critical.

vi. The presentation of each Work activity on the Contract Schedule shall include a brief description of the Work activity, the duration of the Work activity in days, and a responsibility code identifying the organization or trades performing the Work activity.

vii. Contractor shall furnish cost estimates for each Work activity which cumulatively equal the total contract cost. Mobilization costs may be shown separately; however, other costs (i.e., profit and bond) shall be pro-rated throughout all activities.

d. Updating:

i. Review the Contract Schedule with Owner's Representative once each week to incorporate in the Contract Schedule all changes in the progress, sequences, and scope of Work activities.
ii. Prepare and submit to Owner's Representative an updated Contract Schedule once each month.
   1. The updated Contract Schedule shall accurately represent the as-built condition of all completed and in-progress Work activities as of the date of the updated Contract Schedule.
   2. The updated Contract Schedule shall incorporate all changes mutually agreed upon by Contractor and Owner during preceding periodic reviews and all changes resulting from Change Orders and Field Orders.
   3. Contractor shall perform the Work in accordance with the updated Contract Schedule. Contractor may change the Contract Schedule to modify the order or method of accomplishing the Work only with prior agreement by Owner and Owner's Representative.

iii. Contractor shall submit the updated Contract Schedule, in the form acceptable to Owner's Representative, at least seven (7) calendar days prior to submitting the Application For Payment.

iv. Owner's Representative will determine acceptability of the updated Contract Schedule within seven (7) calendar days after its receipt.

v. No Applications For Payment will be processed nor shall any progress payments become due until updated Contract Schedules are accepted by Owner's Representative.

vi. The accepted, updated Contract Schedule shall be the Contract Schedule of record for the period it is current and shall be the basis for payment during that period.

Projects Over $5 million.

1. General
   a. Description
      i. Contractor shall develop a network plan and schedule for the Project demonstrating complete fulfillment of all contract requirements, shall keep the network plans up to date in accordance with the requirements of this section and shall utilize the Critical Path Method (CPM) in planning, coordinating, performing and reporting the work under this contract, including all activities of Subcontractors, equipment vendors, and suppliers, and in assisting Owner's Representative and Owner in monitoring the progress of the Work.
      ii. Insert one of the following methods: time scaled activity-on-arrow diagramming method (ADM) OR precedence diagramming method (PDM); shall be utilized in preparing the C&DM Schedule network diagrams.
      iii. The principles and definition of C&DM in terms used herein shall be as follows:
          1. C&DM network is a graphic description of the construction plan, showing the sequential steps needed to reach the completion of the Work. It shall depict events and jobs, and their interrelationships, and shall recognize the progress that must be made in one task before subsequent tasks can begin. C&DM network shall be comprehensive and shall include all interdependencies and interactions required to perform the Work of the Project.

   b. Submittals
      i. Submit Preliminary Contract Schedule with signed Agreement.
      ii. Refer to Section 01 33 00: Submittal Procedures for Shop Drawings, Product Data, Samples and Procedures.
      iii. Within ten (10) calendar days following receipt of Notice of Selection as Apparent Low Responsible Bidder and with signed Agreement, and prior to engaging a consultant or commencing performance of the work specified in this Section with its own forces, Contractor shall submit to Owner's Representative:
1. The name and the address of the proposed consultant.
2. Information sufficient to show that the proposed consultant or Contractor's own organization has staff and computer facilities meeting the requirements herein.
3. A list of prior projects for which the proposed consultant or Contractor's own organization or staff thereof has performed services similar to those required for this Contract.

iv. Detailed Contract Schedule.

v. Final As-Built Schedule.

vi. All other required reports referenced herein.

vii. Submit one (1) electronic and six (6) prints of each required schedule and report. Contractor shall also submit a copy of the computer data disks used to produce hard copy submittals.

viii. Monthly updated Contract Schedules (hereinafter Baseline Schedules) and reports referenced herein shall be submitted concurrently in a single package.

c. Approvals

i. Owner's Representative shall have the right to accept or reject both the proposed scheduling consultant or performance by Contractor's own organization.

ii. Acceptance of the Detailed Contract Schedule will be a condition precedent to the making of any progress payment for work performed beyond sixty (60) calendar days from receipt of the Notice to Proceed.

iii. The required schedules and reports shall be prepared and submitted for review and approval in accordance with the General Conditions and this Section.

1. For submittals due within the first sixty (60) calendar days following Notice to Proceed, and prior to acceptance of the Detailed Contract Schedule, Owner's Representative review will not exceed ten (10) working days from receipt of required submittals.

iv. The monthly updating of the Baseline Schedule and reports shall be an integral part and basic element of the estimate upon which progress payments will be made. Submittal, review and approval by the Owner's Representative of these items shall be a condition precedent to the making of progress payments. If, in the judgment of the Owner's Representative, the Contractor fails or refuses to provide a complete updated Baseline Schedule or reports, as specified, the Contractor will be deemed to have not provided the required estimate upon which progress payments may be made, and shall not be entitled to such progress payments unless or until it has furnished the aforesaid schedules.

d. Construction Analysis

i. Contractor shall use a computerized critical path scheduling system capable of producing computer generated reports with the following minimum information:

1. Activity identification code keyed to Summary and Detailed Contract Schedule activities;
2. Activity description;
3. Status date and remaining duration;
4. Activity percentage complete;
5. Activity duration;
6. Early start/finish and late start/finish;
7. Total float;
8. Free float;
9. The predecessor and successor activities for each individual activity;
10. A comparison between the current update and the baseline schedule;
11. Designation of the planned work day/work week for each activity;
12. A critical item list of activities with ten (10) working days or less total float;
13. Scheduled and actual manpower loading for each activity; and
14. Scheduled and actual progress payment for each activity.

e. Quality Assurance
   i. To assist in the preparation and for the production of the required submittal of the Schedules and Reports outlined in this Section, the Contractor shall engage, at its own expense, a C&DM consultant having the following qualifications, except that the Contractor may perform these services with its own organization if the Contractor has such qualifications:
      1. Have a staff of two (2) or more employees regularly engaged and skilled in the application of C&DM to projects similar in size, or larger in size, than this Project.
      2. Possess or have access to a library of computer programs for preparation and production of schedules and reports; and
      3. Have computer facilities or access on short notice to computer facilities with the capability of delivering readouts within 48-hours.
      4. Use a software program compatible with Primavera without the need for the Owner to perform conversion. Primavera, Microsoft Project (with conversion capabilities to Primavera performed by Contractor), or equal (no known equals).

f. Contract Deliverables
   i. Preliminary Contract Schedule:
      1. Submission:
         a. Submit the Preliminary Contract Schedule to Owner's Representative within ten (10) calendar days after receipt of Notice of Selection as Apparent Lowest Responsible Bidder.
         b. Any revisions deemed necessary by Owner's Representative as a result of its review shall be re-submitted to Owner's Representative for review within seven (7) calendar days after Contractor's receipt of the Preliminary Contract Schedule from Owner's Representative.
         c. Three (3) week Look-Ahead Schedule.
      2. Form:
         a. Prepare the Preliminary Contract Schedule as a time-scaled bar chart showing continuous flow from left to right. Durations and specific calendar dates shall be clearly and legibly shown for the start and finish of each work activity.
         b. Prepare the Preliminary Contract Schedule in sufficient detail to demonstrate preliminary planning for the Work and to represent a practical plan to complete the Work within the Contract Time.
      3. The Preliminary Contract Schedule shall include but shall not be limited to:
         a. A legend of scheduled activities.
         b. Scheduled work activities which clearly indicate the scope of work to be completed.
         c. Major milestones which are critical to the completion of the work, including but not limited to the following:
            i. Off-Site Improvements
            ii. Earthwork
            iii. Excavation
            iv. Foundation
            v. Structural:
               1. Framing
               2. Elevator superstructure/supports
            vi. Rough-Ins:
               1. Plumbing
2. Mechanical
3. Electrical
4. HVAC

vii. Exterior Finishes:
   1. Walls/finish
   2. Roof

viii. Trim:
   1. Plumbing
   2. Electrical
   3. HVAC
   4. Elevator motors

ix. Elevator cabs

x. Interior Drywall/Plaster

xi. Interior Finishes:
   1. Painting
   2. Flooring
   3. Finish carpentry
   4. Hardware

xii. On-Site:
   1. Curbs
   2. Gutters
   3. Asphalt

xiii. Landscaping and Irrigation

xiv. Final Inspection and correction of any deficiencies.

xv. Beneficial Occupancy and/or Substantial Completion

xvi. Punchlist items

   d. A plot of the Preliminary Contract Schedule with a clearly highlighted critical path.
   e. Identification of all University holidays and other non-working days.

ii. Detailed Contract Schedule:
   1. Contractor shall submit to Owner's Representative for review and approval a Detailed Contract Schedule no later than thirty-five (35) calendar days after Notice to Proceed, but in such time to allow for review and approval in the first sixty (60) calendar days from the Notice to Proceed. The Detailed Contract Schedule shall be a computerized detailed task level C&DM diagram in a time scaled activity-on-arrow diagramming method (ADM) OR precedence diagramming method (PDM) format (determined by Owner’s Representative). A clear delineation of construction activities shall be shown on the Detailed Contract Schedule. This schedule shall be manpower, resource and cost loaded.
      a. Contractor shall participate in a review of the proposed Detailed Contract Schedule by the Owner's Representative when requested to do so. Any revisions deemed necessary by the Owner's Representative as a result of this joint review shall be re-submitted within seven (7) calendar days after said meeting.
   2. All activities in the Detailed Contract Schedule shall be grouped to enable "rollup" of the activities in the form of a Summary Schedule. Submit the Detailed Contract Schedule monthly with an Updated Detailed Contract Schedule. A clear delineation of construction activities shall be shown on the Summary Schedule. This schedule shall be manpower, resource and cost loaded.
   3. The work activities comprising the Detailed Contract Schedule shall be of sufficient detail to ensure adequate planning and execution of the Work and such that the
schedules provide an appropriate basis for monitoring and evaluating the progress of the Work. A work activity is defined as an activity which requires time and resources (manpower, equipment, and/or material) to complete in a continuous operation. No activity shall be less than one (1) nor more than fourteen (14) calendar days in duration for any on-site operation. All University holidays and other non-working days shall also be identified.

4. Failure by the Contractor to include any element of the work required for the performance of this Contract and completion of the Project shall not excuse the Contractor from completing all work required within the time for completion, notwithstanding Owner's Representative's acceptance of the Detailed Contract Schedule.

5. No more than twenty percent (20%) of the total number of activities shown on the schedule shall be critical or near critical. Near critical is defined as having a float of less than ten (10) calendar days. This period may be modified by the Owner’s Representative.

6. These schedules shall indicate the sequence and interdependency of work activities. They shall include, but not be limited to, the following items:
   a. Mobilization;
   b. Submittal preparation by Contractor and review and approval by the Owner's Representative, including Shop Drawings, technical manuals, and all other submittals and re-submittals as required;
   c. Order, manufacture, fabrication, delivery, installation, and check out of long lead and major construction material, and major equipment;
   d. Installation of dewatering system(s);
   e. Excavation, backfill, grading, paving;
   f. Concrete placement sequence;
   g. Concrete block placement;
   h. Waterproofing;
   i. Building framing;
   j. Structural framing, miscellaneous metal, masonry, equipment installation;
   k. Roofing;
   l. Glass;
   m. Elevators;
   n. Plumbing;
   o. H.V.A.C.;
   p. Electrical;
   q. Interior finishes (shall be detailed);
   r. Delivery and installation of casework, etc;
   s. Fire sprinklers;
   t. Fire alarm;
   u. Telecommunication Systems;
   v. Security system;
   w. All other major construction activities;
   x. Subcontractor's Work activities;
   y. All utility interfaces required within the scope of work;
   z. Landscape/Irrigation;
   aa. Performance and acceptance tests and supervisory service activities;
   bb. All interfaces with work performed by other Contractors;
   cc. Punch-out and acceptance of all facilities;
   dd. Delivery, installation, and check out of Owner-furnished equipment and material (if any);
ee. All Contract-stipulated milestone dates, Beneficial Occupancy and/or Substantial Completion date, and Final Completion date; and
ff. Final cleanup.
gg. Allowance for Owner move-in;
hh. Each approved Change Order and Field Order shall be listed and plotted as a separate and independent activity.

The above schedule components shall be organized into logical groupings by location, responsibility, Specification Article, etc.

7. A combined three (3) week Look-Ahead Schedule with a two (2) week As-Built Schedule for previous two (2) weeks (derived from the Baseline Schedule) shall be submitted by Contractor to Owner's Representative for review and approval at each weekly progress meeting.
8. Critical Work activities are defined as Work activities which, if delayed or extended, will delay the scheduled completion of the Work, or both. All other Work activities are defined as non-critical Work activities and are considered to have float.
9. Float is defined as the time that a non-critical Work activity can be delayed or extended without delaying the scheduled completion of milestones specified in this Section or the scheduled completion of the Work, or both. Float or slack time is not for the exclusive use or benefit of either Contractor or owner. Neither Contractor nor Owner shall have an exclusive right to the use of float. Document the effect on the updated Contract Schedule whenever float has been used.
10. Delays of any non-critical Work shall not be the basis for an extension of Contract Time until the delays consume the float associated with that non-critical Work activity and cause the Work activity to become critical.
11. Contractor shall not sequester float through strategies including extending activity duration estimates to consume available float, using preferential logic, using extensive or insufficient crew/resource loading, use of float suppression techniques, special lead/lag logic restraints or imposed dates. Use of float time disclosed or implied by the use of alternate float suppression techniques shall be shared to the benefit of both Owner and Contractor.
12. It is acknowledged that Owner-caused time savings (i.e., critical path submittal reviews returned in less time than allowed by the Contract Documents, approval of substitution requests which result in a savings of time for Contractor, etc.) create shared float. Conversely, Owner-caused delays may be offset by Owner-caused time savings.
13. A Schedule showing the Work completed in less than the Contract Time, which is found to be practical by the Owner's Representative, shall be acceptable only if the Contractor and the Owner execute a binding Contract modification revising the Contract completion date to that shown on the proposed schedule. A Schedule extending beyond the Contract time will not be acceptable.
14. Once approved by the Owner's Representative, the Contractor's Detailed Contract Schedule shall be known as the Baseline Schedule and shall be used by the Contractor for executing the Work of the Contract, including planning, organizing and directing the Work, and reporting its progress until subsequently revised.

iii. Baseline Schedule Updating and Progress Payments:

1. The Baseline Schedule, shall be updated on a monthly basis (or at lesser intervals if deemed necessary by the Owner's Representative without additional cost to the Owner for reasons such as work activities being fourteen (14) calendar days or more behind schedule) for the purpose of recording and monitoring the progress of the work. The Contractor shall meet with the Owner's Representative and the Owner each
month to review actual progress made to date, activities started and completed to
date, and the percentage of work completed to date on each activity started but not
completed. Upon completion of the joint review, the Contractor shall prepare the
updated Baseline Schedule and submit it to the Owner's Representative.

2. The updated Baseline Schedule shall incorporate all changes mutually agreed upon by
the Contractor and the Owner during preceding periodic reviews and all changes
resulting from approved Change Orders and Field Orders.

3. Acceptance of the Updated Baseline Schedule will be a condition precedent to the
making of any progress payments for work performed.

iv. Reports:

1. Variance: A Variance Report shall be submitted monthly comparing the approved
Baseline and the Updated Baseline Schedules.
   a. The report shall include a description of all activities completed during the
      preceding month, a description of progress made and planned for activities
      listed as started but not completed on the updated Contract Baseline Schedule,
      and shall report noncritical activities which have been delayed ten (10)
      calendar or more days and critical (eight [8] days or less total float) activities
      which have incurred any delay. The format of this report shall include:
      1. Activity code and description.
      2. Baseline scheduled early start/finish dates.
      3. Current anticipated early start/finish dates.
      4. Working days remaining to complete the activity.
      5. Percentage complete of the activity.
      6. Total float of the activity.

2. Progress Curves: The Contractor shall submit the first Progress Curves Report within
thirty-five (35) calendar days after the date of commencement specified in the Notice
to Proceed. The curves shall show the cumulative schedule percent complete, time-
scaled in calendar days from the date of commencement specified in the Notice to
Proceed to the Detailed Contract schedule completion date. The curves shall be
derived from the Cash Flow Curve.
   a. The Progress Curves shall be updated monthly showing actual progress. They
      shall be submitted to Owner's Representative with each monthly progress
      payment request. The updated curves shall include scheduled, actual and
      forecasted progress plotted as a time-scaled curve from zero (0) to one
      hundred (100) percent. The scheduled, actual, and forecasted progress shall be
derived from the Cash Flow Curve.

3. Equipment Schedule:
   a. Contractor shall submit within thirty-five (35) calendar days after the date of
      commencement specified in the Notice to Proceed, a schedule showing dates
      when key construction equipment shall be brought to the Project site in order
      to accomplish the Work in accordance with the Detailed Contract Schedule.
      This schedule shall list the quantity of equipment by type and capacity
      (excluding small tools) in a bar chart form.
   b. The Equipment Schedule shall be updated monthly showing actual equipment
      on-site at time of reporting period and forecasted equipment requirements
      necessary to achieve the Contract Baseline Schedule.

4. Material Status:
   a. Contractor shall submit within thirty-five (35) calendar days after the date of
      commencement specified in the Notice to Proceed, a Material Status report
      showing the planned delivery of long-lead and major construction materials,
by activity, that are required to maintain the Detailed Contract Schedule. Items in this report shall include:

i. Activity and description of the type of material;
ii. Total quantity required;
iii. Required delivery schedule; and
iv. Scheduled order date.

b. The Material Status Report shall be updated and resubmitted monthly showing:

i. Actual order date;
ii. Scheduled delivery date to Site;
iii. Actual delivery to Site, date, and quantity;
iv. Total quantity delivered to Site to date;
v. Remaining quantity to be delivered; and
vi. Estimated delivery date of remaining materials.

5. Cash Flow Curve:

a. The Contractor shall submit within thirty-five (35) calendar days after the date of commencement specified in the Notice to Proceed, a Cash Flow Curve of expected progress payments over the time of the Project. The curve shall be plotted against the Detailed Contract Schedule using contractual bid item amounts.

b. The Contractor shall update the curve with actuals from the approved progress payments and forecasted progress payments and submit it to Owner's Representative monthly. The total of approved progress payments and forecasted progress payments shall equal the contractual bid amounts plus approved Contract modifications. The updated curve shall be plotted against the Baseline Schedule.

6. Manpower Curve:

a. The Contractor shall submit, within thirty-five (35) calendar days after the date of commencement specified in the Notice to Proceed, a Manpower Curve of the labor requirements per calendar week over the time of the Project. The curve shall show the number of persons in each craft for each week.

b. The Contractor shall update the curve with the actual labor employed and forecasted labor requirements necessary to achieve the Baseline Schedule and submit it to Owner's Representative monthly. The updated curve shall be plotted against the Baseline Schedule.

7. Submittal Schedule:

a. The Contractor, within thirty-five (35) calendar days after the date of commencement specified in the Notice to Proceed, shall prepare and submit to the Owner's Representative a comprehensive Submittal Schedule which will maintain the Detailed Contract Schedule. The Contractor shall identify on the Submittal Schedule all of the submittal items required by the Contract Documents governing the Work, listing shop drawings, mock-ups, samples and product data or literature separately. The Contractor shall indicate for each submittal item on the Submittal Schedule:

i. The date by which that item will be submitted to the Owner's Representative.
ii. Whether the submittal is for review, substitution, or for record only.
iii. The date by which response by the Owner's Representative is required.
iv. The date by which the material or equipment must be on the Site in order not to delay the progress of the Work.

b. In preparing the Submittal Schedule, the Contractor shall consider the nature and complexity of each submittal item and shall allow ample time for review, revision or correction. Submittals will be returned to the Contractor within fifteen (15) work days.

c. The Submittal Schedule shall be updated monthly showing actual submittal status at the time of the reporting period and forecasted submittal requirements necessary to achieve the Contract Baseline Schedule.

d. Owner's Representative will review the Contractor's updated Submittal Schedule to determine its completeness and compatibility with the Baseline Schedule. A Submittal Schedule which is incompatible with the Detailed Contract or Baseline Schedule or which creates an unreasonable labor demand on the Owner for review of said submittals will be sufficient reason(s) to reject the Submittal Schedule.

8. Submittal of the monthly reports and schedule updates by the Contractor are required regardless of the approval status of the Contract Baseline Schedule.

g. Responsibility For Completion

i. Contractor agrees that at the sole judgment of Owner's Representative, whenever it becomes apparent from the current monthly updated Contract Baseline Schedule that the contract completion date will not be met, it will take some or all of the following actions, as approved by Owner's Representative, at no additional cost to Owner:

1. Increase construction manpower in such quantities and crafts as will substantially eliminate, in the judgment of Owner's Representative, the backlog of work.

2. Increase the number of working hours per shift, shifts per working day, working days per week, or the amount of construction equipment, or any combination of the foregoing, sufficiently to substantially eliminate, in the judgment of Owner's Representative, the backlog of work. This paragraph shall not be construed to permit Contractor to violate the work hour restrictions specified in the Contract Document.

3. Reschedule activities to achieve maximum practical concurrence of accomplishment of activities.

h. Adjustment Of Times For Completion

i. In addition to provisions of the General Conditions, the time for completion of the work will be adjusted in accordance with these procedures.

ii. Any request for an adjustment of the Contract Time for completion submitted by the Contractor for changes or alleged delays shall be accompanied by a complete Time Impact Analysis, which shall be submitted for review within twenty (20) calendar days after the request by the Contractor. Time extensions will not be granted unless substantiated by the CPM Schedule, and then not until the CPM project contingency becomes zero.

iii. Each Time Impact Analysis shall provide information justifying the request and stating the extent of the adjustment requested for each specific change or alleged delay. Each Time Impact Analysis shall be in form and content acceptable to the Owner's Representative, and shall include, but not be limited to, the following:

a. A fragmentary CPM type network (Fragnet) illustrating how the Contractor proposes to incorporate the change or alleged delay into the current updated Baseline Schedule;
b. Identification of activities in the current updated Baseline Schedule which are proposed to be amended due to the change or alleged delay, together with engineering estimates and other appropriate data justifying the proposal.

d. The Time Impact Analysis shall be determined on the basis of the date or dates when the change or changes were issued, or the date or dates when the alleged delay or delays began. The status of the construction project and Time Impact Analysis shall include event time computations for all affected activities.

e. Owner's Representative may require that Time Impact Analyses be provided in order to demonstrate the time impact upon the overall project and the time for completion, at no additional cost to Owner.

vi. If Owner's Representative finds, after review of the Time Impact Analysis, that the Contractor is entitled to any extension of time for completion, the time for completion will be adjusted accordingly by the Owner's Representative, and the Contractor shall then revise the Baseline Schedule accordingly.

i. Final As-Built Schedule

b. As a condition precedent to final acceptance of the Project, submit a final As-Built Construction Schedule and all final reports which accurately reflect the manner in which the Project was constructed and include actual start and completion dates for all work activities on the Baseline Schedule.

01 33 00 Submittal Procedures

1. Contractor's Submittals

a. Within ten (10) calendar days after receipt of Notice of Apparent Lowest Responsible Bidder, submit detailed Preliminary Contract Schedule/Cost Breakdown (choose one) with other required documents to the Owner, and to the Owner's Representative for approval.

b. Project Schedule: Submit detailed project schedule to the Owner's Representative for approval as required in Specification Section (Insert Specification Section Number) and in the General Conditions.

c. Schedule of Values (Cost Breakdown): Submit detailed project Schedule of Values to the Owner's Representative for approval as required in Specification Section (Insert Article Number) and in the General Conditions.

d. Submittal Schedule: Submit detailed Submittal Schedule (as provided in the Contract Documents, may for each project) to the Owner's Representative for approval.

e. Staffing Plan: Submit detailed Staffing Plan to the Owner's Representative for approval as required in Section 01 11 00.

f. Product Literature: Submit detailed technical literature fully describing every product or item proposed for use including manufacturer's literature and items specified.

g. Samples: Submit samples of materials specified to permit full evaluation of work or items proposed.

h. Shop Drawings: For detailed requirements refer to individual sections.

i. Light Fixture Receipts: (Delete for all projects except those for the Residential and Student Services Programs (RSSP) unit.) Where light fixtures are to be retrofitted, submit all fixture invoices to the Owner's Representative.

j. Operations and Maintenance Manuals (O&M) (Both Electronic AND Hard Copies Required):

1. Submit a minimum of three (3) Optical Discs (CDs, DVDs, or Blu-Ray Disc) copies of each O&M manual in Portable Document Format (PDF).

2. Submit a minimum of three (3) hard copies of each O&M manual. Format for hard copies shall be:

   a. Three-ring vinyl view binders with clear plastic pockets on front and back covers. Rings shall not exceed 3” in diameter.
b. Binder cover (front, back and spine) shall be entitled Operation and Maintenance Manual, and shall also include UCB Building and UCB Project Names, UCB Project No., UCB CAAN No., and description of binder contents.

c. Provide a Table of Contents listing each indexed and labeled tab (divider).

d. Provide individual indexed and labeled tabs for each Section in the binder, and organize by ascending Specification Section Number.

e. Provide a Project Directory and/or Contact List that includes the Contractor’s, and all First-Tier Subcontractors’, company names, addresses, telephone nos., E-Mail addresses. Include a description of their work provided (i.e., specification section title, etc.).

2. Existing Conditions
   a. Submittals
      i. When conditions encountered differ from that shown, submit in writing proposed remedial methods for approval.
      ii. Cross-reference to Contract Documents including shop drawings, samples and product data as appropriate

b. Materials
   i. Manufacturers and Fabrication: Comply with the requirements established by the Contract Documents.

c. Execution
   i. Inspect existing conditions and surfaces that will become substrates for, or contiguous surfaces with, the work under this contract. Should deviations from tolerances established by the Contract Documents interfere with lines, levels or the tolerances established for the work under this contract, correct prior to commencement of adjacent new work.
   ii. Submit a written list of conflicts and remedial requirements within ten (10) calendar days of the Notice to Proceed. Any conflicts not identified at that time shall be remedied at the Contractor's expense.
   iii. If photographic, video or other media is utilized to record condition prior to the start of construction, submit two (2) sets/copies of media to the Owner for its records.

d. Workmanship
   i. Work shall be done in accordance with tolerances established by the Contract Documents.

3. Correspondence
   a. Contractor's correspondence (any written document other than a full-size drawing) directed to Owner's Representative shall be distributed as follows:
      i. Original to Owner's Representative.
      ii. Copies to (provide standard correspondence distribution project specific).
      iii. Owner's Representative's correspondence (any written document other than a full-size drawing) directed to Contractor shall be distributed as follows:
         1. Original to Contractor.
         2. Copies to all persons or offices listed on the standard correspondence distribution list (project specific).

4. Cost Breakdown
   a. Within ten (10) calendar days after receipt of Notice of Apparent Lowest Responsible Bidder, submit detailed Preliminary Contract Schedule/Cost Breakdown (choose one—require both if appropriate) with other required documents to Owner, and to Owner’s Representative for approval.
b. The Contractor shall include a separate allowance (or line item) identified as "Project Closeout" with a corresponding value attributed to this item.

c. The Contractor shall also include a separate allowance (or line item) identified as "Building Commissioning" or "Systems Commissioning" with a corresponding value attributed to this item.

d. The Contractor shall not submit a Payment Application to the Owner or to the Owner's Representative prior to the Owner's Representative's approval of the Cost Breakdown submittal.

5. Payment By Owner

a. Summarize quantities and percentages of completion, agreed upon by Contractor, Inspector of Record, and Owner's Representative, on the Cost Breakdown contained in each Application for Payment.

i. Contractor shall submit billings on the Application for Payment contained in the Exhibits of the construction bidding documents.

ii. One (1) copy of the complete Payment Application shall be submitted by the Contractor to the Owner (via email only, to epaccounting@berkeley.edu).

iii. One (1) copy of the complete Payment Application shall be submitted by the Contractor to the Owner's Representative.

iv. One (1) copy of the complete Certificate for Payment to the Owner shall be submitted by the Contractor to the Owner (via email only, to epaccounting@berkeley.edu).

b. In accordance with the General Conditions of the Contract, the Owner will make payments within twenty (20) calendar days after the Owner's receipt of an original valid Application for Payment, an original valid Certificate for Payment, and all required supporting data.

6. Owner Back-Charges

a. The Contractor shall be cognizant of costs to the Owner caused by execution of the work of this contract. The following activities are costs to the Owner:

i. Laboratory Testing

ii. Utility Shutdowns

iii. Inspections

iv. Coordinated hazardous materials abatement (selected identification by Contractor, abatement by Owner.)

v. (Note: List other items as appropriate.)

b. Excessive or repeat scheduling and canceling of activities may result in back-charges to the Contractor. If excessive or repeat scheduling of Owner activities occurs, the Owner's Representative shall notify the Contractor in writing, and allow five (5) calendar days’ notice for the Contractor to "cure." Failure of the Contractor to "cure" excessive or repeat scheduling of activities beyond the five (5) calendar day notice period shall cause the Owner to back-charge the Contractor for costs of these activities. Back-charges shall be deducted from amounts owing to the Contractor.

01 33 23 Shop Drawings, Product Data and Samples

1. General

a. Requirements Included

i. Shop Drawings, Product Data and Samples, other than in connection with proposed substitutions, shall be submitted to the Owner's Representative only when specifically required; and the Owner's Representative will not review any other such submittals. Product Data and Samples for proposed substitutions shall be submitted to the Owner's Representative in accordance with Section (insert Section Number). The Contractor shall be responsible for obtaining such copies of Shop Drawings, Product Data and Samples as it may require for its own use.
b. Related Requirements
   i. Definitions:
      1. The terms "Shop Drawings" and "Product Data" as used herein also include, but are not limited to, fabrication, erection, layout and setting drawings, manufacturers' standard drawings, descriptive literature, catalogues, brochures, performance and test data, wiring and control diagrams, all other drawings and descriptive data pertaining to materials, equipment, piping, duct and conduit systems, and methods of construction as may be required to show that the materials, equipment, or systems and the positions thereof conform to the Contract Documents.
      2. As used herein, the term "manufactured" applies to standard units usually mass-produced. The term "fabricated" means items specifically assembled or made out of selected materials to meet individual design requirements. Shop Drawings shall establish the actual detail of all manufactured or fabricated items, indicate correct relation to adjoining Work, and amplify design details of mechanical and electrical equipment in accurate relation to physical spaces in the structure.
   ii. Manufacturers' Instructions: Where any item of Work is required by the Contract Documents to be furnished, installed, or performed in accordance with a specified product manufacturer's instructions, the Contractor shall procure and distribute the necessary copies of such instructions to the Owner's Representative and all other concerned parties; and the Contractor shall furnish, install, or perform the Work in strict accordance therewith.
   iii. Submittal Schedule:
      1. The Contractor shall provide a Submittal Schedule to the Owner's Representative for approval no later than ten (10) calendar days after the date of commencement specified in the Notice To Proceed.
      2. The schedule for submission of Shop Drawings, Product Data, and Samples by the Contractor (the "Submittal Schedule"), and their processing and return by the Owner's Representative, shall be agreed upon by both parties in order that the items covered by these submittals will be available when needed by the construction process and so that each party can plan its workload in an orderly manner.
      3. The Contractor shall prepare the Submittal Schedule in the format contained in the Exhibits and coordinate it with the Contract Schedule. No submittals shall be processed before the Submittal Schedule has been submitted to and approved by the Owner's Representative, except in such cases where the processing of submittals is required before the approval of the Submittal Schedule.
      4. In preparing the Submittal Schedule, the Contractor shall first determine from the Contract Schedule the date the particular item is needed for the Work. Working backwards, the Contractor shall add the required number of days for shipment, time for fabrication, and similar items to determine the date of the first submittal.
      5. The Submittal Schedule shall be adjusted to meet the needs of the construction process and the Contract Schedule. Submit two (2) copies (minimum) of the Submittal Schedule after it is completed and each time it is updated by the Contractor.

c. Shop Drawings
   i. Present information required on Shop Drawings in a clear and thorough manner. Identify details by reference to drawing and detail, schedule, or room numbers shown and specified.
d. Product Data
   i. Preparation:
      1. Clearly mark each copy to identify pertinent products or models.
      2. Show performance characteristics and capacities.
      3. Show dimensions and clearances required.
      4. Show wiring or piping diagrams and controls.
      5. Do not submit superfluous information unrelated to Project.
   ii. Manufacturers' standard schematic drawings and diagrams:
      1. Modify the Drawings and other diagrams to delete information which is not applicable to the Work.
      2. Supplement standard information to provide information specifically applicable to the Work.

e. Samples
   i. Office Samples shall be of sufficient size, quality, and quantities to clearly illustrate the following:
      1. Functional characteristics of the products, with integrally related parts and attachment devices.
      2. Full ranges of color, texture, and pattern.
   ii. Field Samples and Mock-Ups:
      1. Erect at the Project site, at a location as directed by Owner's Representative.
      2. Fabricate each Sample and Mock-Up completely and fully finished.
      3. Wherever possible, in-place mock-ups that may be utilized as part of the finished work are preferred.
      4. The Owner's Representative must specifically approve incorporation of mock-up into the work of the project. Contractor must remove mock-up if not approved for incorporation.

f. Contractor's Review of Submittals
   i. Review, mark up as appropriate, and stamp Shop Drawings, Product Data, and Samples prior to submission. Submittals shall clearly show that they have been reviewed by the Contractor for conformance with the requirements of the Contract Documents and for coordination of the Work.
   ii. Determine and Verify:
      1. Field measurements.
      2. Field construction criteria.
      3. Catalog numbers and similar data.
   iii. Coordinate each submittal with requirements of the Work and of the Contract Documents.
   iv. Notify the Owner's Representative in writing, at time of submission, of any changes in the submittals from requirements of the Contract Documents.
   v. Begin no fabrication or Work which requires submittals until the return of the Owner's Representative's final reviewed submittals.

g. Submission Requirements
   i. Make submittals promptly in accordance with the Submittal Schedule and in such sequence as to cause no delay in the Work or in the work of any separate Contractor.
   ii. Number of Submittals Required:
      1. Shop Drawings: Submit one (1) reproducible transparency and two (2) opaque reproductions. After checking, the Owner's Representative will make prints for
themselves, their consultants, and Owner and then return the reproducible copy to the Contractor. The Contractor shall make prints as required for its use and for any Subcontractor’s use.

2. Product Data and Non-Reproducible Submittals: Submit the number of copies which the Contractor will need, plus four (4) copies (minimum) which will be retained by the Owner's Representative.

3. Samples: Submit the number specified in the Specification Section which requires them.

iii. Submittals shall contain:
   1. Date of submission and dates of any previous submissions.
   2. UCB Project name and UCB Project number.
   4. The names of:
      a. Contractor.
      b. Subcontractor.
      c. Supplier.
      d. Manufacturer.
      e. Other (if applicable).
   5. Identification of the product, with the Specification Section number.
   6. Field dimensions, clearly identified as such.
   7. Relation to adjacent or critical features of the Work or materials.
   8. Reference standards, such as ASTM or Federal Specification numbers.
   10. Identification of revisions on resubmittals.
   11. An 8-inch x 3-inch (8” x 3”) blank space for review stamps.
   12. Contractor's stamp, initialed or signed, certifying to the review of submittal; verification of materials and field measurements and conditions; and compliance of the information within the submittal with requirements of the Work and of the Contract Documents.

iv. Resubmission Requirements:
   1. Shop Drawings and Product Data:
      a. Revise Shop Drawings or Product Data, and resubmit as specified for the initial submittal.
      b. Identify any changes which have been made other than those requested.
      c. Note any departures from the Contract Documents or changes in previously reviewed submittals which were not commented upon by Owner's Representative.
   2. Samples: Submit new samples as required for initial submittal.

v. Distribution:
   1. The Owner's Representative shall distribute approved Shop Drawings, Product Data and Samples, (all of which carry the Owner's Representative's review stamp) to the following:
      a. Owner - Two (2) copies minimum.
      b. Contractor - Two (2) copies minimum.
      c. Owner's Representative - Two (2) copies minimum.

vi. Owner Representative's Review:
1. Owner's Representative will review Contractor's submittals, such as Shop Drawings, Product Data, and Samples, for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents.

01 35 00  Special Procedures

01 35 04  Precautions

1. Due to the nature of the research, extreme care must be taken to ensure that no dust is brought into the University facilities. If dust or dirt is brought into the facility where work is being performed or any adjacent facility, all construction work will be stopped until the material is cleaned and procedures have been established to rectify the problem, all at no additional cost to the Owner.

2. In the event that artifacts, human remains, or other cultural resources are discovered during construction, the Contractor shall protect the discovered items, cease work for a distance of thirty-five feet (35'-0") radius in the area, and notify the Owner's Representative in writing. The Owner may retain an archaeological consultant to evaluate findings in accordance with standard practice and applicable regulations. Artifact recovery, if deemed appropriate, will be conducted during the period when construction activities are on hold. Following completion of artifact recovery, a Change Order may be issued to adjust the contract time if required.

01 35 05  Utility Shutdowns and Interruptions

1. Submit in writing to the Owner, an eleven (11) calendar days' advance notice of need to shut off existing utility service(s) or equipment interruptions. The Owner shall set exact date, time and duration for and execute the shutdown. All work required to re-establish service, such as connections, line taps, cable splicing, shall be performed by the Contractor.

2. Obtain Owner's approval at least eleven (11) calendar days in advance of deliveries of material or equipment or other activities which may conflict with Owner's use of facilities.

3. Excessive scheduling of utility shutdowns or repeated requests to schedule and subsequent cancellation or re-scheduling of shut-downs may be subject to back-charges to the Contractor in accordance with Section 01 26 63 (Change Orders).

01 35 13.43  Special Project procedures for Contaminated Sites

Asbestos Related Construction Activities

1. The Contractor shall not include any costs associated with asbestos removal in its bid. If during the course of construction, asbestos is discovered, the removal of such asbestos shall not be the responsibility of the Contractor.

2. If asbestos is suspected, the Contractor shall immediately stop its work and notify the Owner's Representative. The Owner's Representative shall notify the Real Estate Division’s Facilities Services Abatement Shop. EH&S shall make the required tests to determine if, in fact, asbestos is present.

3. If asbestos is suspected (or identified), the Contractor shall immediately transfer its work effort to other areas of the site that are not impacted by asbestos.

4. If it is determined by the Owner that asbestos is present, the Contractor shall not be permitted to work in the affected area of the Project until the asbestos hazard is removed, by a separate licensed asbestos abatement
Contractor, and the affected area is determined to be safe by the Environment Health and Safety Office (EH&S).

5. If asbestos removal by the Owner is necessary, a Change Order shall be issued by the Owner's Representative to account for the project delay and to establish a new Construction Completion Date, if required.

Lead Related Construction Activities

1. Summary
   a. Project activities that this specification applies to include preparation of the building interior and exterior walls for painting, wall and floor demolition, structural steel welding, shear wall preparation, or any other activity that may disturb lead containing materials.
   b. In accordance with Cal/OSHA regulations, the Contractor shall be ultimately responsible for ensuring and documenting the health and safety of its employees. Therefore, the Contractor shall conduct personal air monitoring or obtain objective data (Section 1, Subsection F of these specifications) and maintain documentation of those air samples. Results of any air monitoring conducted by the Contractor during this project shall be made available to the Office of Environment, Health & Safety (EH&S) within 24 hours of the Contractor’s receipt of the results.
   c. The tools, procedures, and engineering controls the Contractor is using and the lead content of the paint determine the applicability of these specifications. Thus, if the lead exposure to Contractor’s employees can be held below the Permissible Exposure Limit of 50 µg/m³, then the DHS Certification mentioned in Section 1, Subsection O, “Training, and Certification” shall not be required.
   d. The work practices and procedures discussed in this specification apply to any activities that may disturb lead containing materials.
   e. Cal/OSHA Lead Work Notification
      i. The Contractor and its subcontractors shall comply with the Lead Work Notification required by Cal/OSHA §1532.1 (p) where applicable. The notification shall include the eleven items of information listed in Cal/OSHA §1532.1 (p)(B)(2). A copy of the notification provided to Cal/OSHA shall also be provided to the Real Estate Division’s Project Manager and the EH&S Construction Health and Safety Specialist within 24 hours of the time the Contractor or Subcontractor has provided it to Cal/OSHA.
      ii. The notification can be provided to Cal/OSHA, and the Real Estate Division’s EH&S unit by electronic mail or facsimile transmission (fax).
   f. Provisional Independent Oversight
      i. UC Berkeley may retain the services of an independent third party oversight consultant (Consultant) to perform the following functions: review of training certificates, review of personal monitoring results, perimeter air monitoring, inspection of barriers and polyethylene sheeting, occasional site visits, review of waste handling procedures, and clearance inspections (if applicable). The Project Manager may delegate these responsibilities to EH&S at its discretion, subject to agreement by EH&S. The term "Consultant" shall, in these specifications, apply to an independent consultant, its designee, or any other party mutually acceptable to the Project Manager and EH&S to serve in this capacity.
   g. Provisional Perimeter Air Monitoring
      i. At UC Berkeley’s discretion, the Consultant (see Subsection F, above) may collect air samples approximately 20 feet (20’-0”) downwind of the working surfaces at the temporary perimeter or barrier tape. The Consultant shall perform continuous air monitoring during any activities that may disturb lead containing material. The Consultant may collect additional samples as appropriate to represent site perimeter lead air concentrations. See Section 3, subsection A: Containment System.
h. **Provisional Personal Air Monitoring**
   
i. UC Berkeley may, at its discretion, direct the Consultant to conduct an exposure assessment on an employee of a Contractor using the criteria mentioned in Cal/OSHA regulations (Title 8 CCR 1529 and Title 8 CCR 1532.1) as mentioned in the introduction to this Section. If this option is chosen by UC Berkeley, the Consultant shall forward all personal monitoring results to EH&S within 24 hours after the work is performed. The results should be hand delivered, emailed or faxed to the attention of the EH&S Construction Health & Safety Specialist, fax number (510) 643-7595.

i. **Previous Exposure Assessment for Disturbance of Lead Containing Materials**
   
i. If the Contractor’s employees may be exposed to lead at or above the Cal/OSHA PEL of 50 µg /m3, the Contractor shall perform personal air monitoring as an Initial Exposure Assessment, or collect objective data from general industry sources. The Contractor shall have documentation of that data available to EH&S upon request within 24 hours. That documentation, from either a previous exposure assessment or from objective data, shall include the following:
      1. A description of the activities on similar projects during which exposure monitoring was conducted.
      2. Exposure assessment data from similar projects that includes the following:
         a. The date the samples were collected;
         b. The results of the samples expressed in both the analytical results and the eight (8) hour time-weighted average (TWA);
         c. The personnel who performed the activities; and
         d. The person(s) who conducted the monitoring and their qualifications.
      3. A copy of the Written Compliance Program used for the specific project.
      4. A copy of the laboratory or X-ray fluorescent analyzer (XRF) analytical results that show the lead content of the materials that were disturbed.

j. **Contractor Notification Requirement**
   
i. The Contractor shall provide notice to all other Contractors and Subcontractors on site of any upcoming work that will impact lead, and may generate levels of airborne lead that could present a potential exposure to workers at or above the PEL. This notice shall provide information on the control measures being implemented and a warning to remain outside of the immediate area where such activities are occurring.

k. **Coordinate Removal of Items on the Building Exterior or Interior Prior to the Start of Work**
   
i. The Contractor shall remove or protect items (if any) located within twenty feet (20'-0") of the paint preparation areas to avoid contaminating these items with lead. These items shall be relocated or disposed of prior to the start of work. The Contractor shall coordinate this activity with the Owner’s Representative.

l. **Coordinate Access/Egress Issues**
   
i. Work that may disturb lead-containing materials and may present a potential for exposure to concentrations above the PEL shall be performed after other Contractors, subcontractors or occupants working on site have been temporarily evacuated from the immediate area. If this is not possible, the Owner’s Representative and Project Manager shall arrange for a safe means of access/egress. Only qualified personnel trained to work with lead, as appropriate, shall be permitted inside controlled areas during any activities that may generate levels of lead that may present a potential for worker exposure above the PEL.

m. **Coordinate/Ensure Clearance Inspections**
   
i. The Contractor shall conduct visual inspections as necessary to ensure that all loose or chipped paint has been removed from the surface and debris is not left behind as a result of the paint preparation, or other activities that disturb lead containing materials. Clearance air and wipe sampling shall not be required, but UC Berkeley, or its Consultant, may perform a visual inspection to ensure that the Contractor has adequately cleaned all surfaces.

Adopted August 2015
n. Follow All Applicable Regulations
   i. The Contractor shall perform all work that disturbs lead containing materials in accordance with all applicable health, safety, and environmental regulations, including the Cal-OSHA Lead Standard (Title 8 CCR 1532.1), and Bay Area Air Quality Management District (BAAQMD) regulations. The Contractor shall provide a copy of its written compliance program (as required by Cal/OSHA 1532.1) to the Owner’s Representative, the Project Manager and EH&S for review and approval prior to commencing work.

o. Training and Certification.
   i. If the Contractor’s employees may be exposed to lead above the Cal/OSHA Action Level of 30 \( \mu g /m^3 \), employees shall be trained according to Cal/OSHA § 1532.1 (l)(2).
   ii. If the Contractor’s personnel may be exposed to lead above the Cal/OSHA Permissible Exposure Limit (PEL) of 50 micrograms per cubic meter of air sampled (\( \mu g/m^3 \)) then the Contractor shall provide personnel who are certified by the California Department of Health Services (DHS) as Lead Workers or Supervisors for all activities that may disturb lead containing materials unless or until IEA monitoring shows that the work does not expose workers to concentrations of lead at or above the PEL.
   iii. Training certificates for all the Contractor’s employees subject to this requirement shall be supplied to the Owner’s Representative and Project Manager, and reviewed and approved by EH&S or the on-site Consultant prior to commencing work.

p. Suspension of Work
   i. The Contractor, the Consultant, the Owner’s Representative, the Project Manager, or EH&S may suspend lead related work if any controls (such as barriers) fail, if excessive amounts of debris known or suspected to contain lead are detected outside the controlled area, or if the work is on the exterior and wind speeds are more than twenty (20) miles per hour. The Consultant and EH&S shall assist the Contractor in evaluating the effectiveness of the control measures.
   ii. If work is suspended due to the Contractor's failure to use adequate engineering methods, maintain barriers, or implement good housekeeping, all costs associated with the suspension, including remedial actions and any additional sampling required according to this specification, shall be the Contractor's responsibility.

q. Project Documentation and Submittals
   i. The Contractor shall maintain on the job site copies of applicable documents (Sections 6 and 12) that show compliance with this specification, including but not limited to:
      1. Cal/OSHA Lead Notification
      2. Training records
      3. DHS Certifications
      4. Respiratory protection program
      5. Respirator fit testing records
      6. Medical clearances (Cal/OSHA)
      7. Written lead compliance program (Cal/OSHA)
      8. Description of barriers and engineering controls
      9. A description of personal protective equipment
      10. All air monitoring results
      11. All waste disposal documentation
   ii. Waste documentation and air monitoring results shall be submitted to the Owner’s Representative, the Project Manager and EH&S as they are received and not later than two (2) weeks after completion of activities that may disturb lead. All other documentation shall be submitted to the Owner’s Representative, the Project Manager and EH&S prior to performing any activities that may disturb lead containing materials.

2. Materials and Equipment

Adopted August 2015
a. Containment Plastic Sheeting
   i. Any form of ventilation containment sheeting or fabric used to control the flow of dust or
      fumes associated with the disturbance of lead containing materials shall be fire retardant (see
      Section 3, Subsections A1 and A2).

b. Vacuum Assisted Tools.
   i. Wherever possible, the Contractor shall use a HEPA vacuum for manual activities that
      disturb lead containing materials. All power tools and abrasive blasting used for activities
      that may disturb lead-containing materials shall be HEPA vacuum assisted. HEPA assisted
      power tools shall be approved by the Owner’s Representative and the Project Manager prior
      to use.

3. Execution
      i. The Contractor shall collect lead contaminated dust and debris that fall to the ground by
         using one (1) or more layers of fire retardant polyethylene of at least six-mil thickness (or a
         material of similar durability) to cover horizontal surfaces below the work area. This plastic
         shall be secured to the building and extend horizontally at least ten feet (10'-0”), where
         practicable.
      ii. The Contractor shall seal all windows and doors located within twenty feet (20'-0”) of the
          work surfaces using at least one (1) layer of fire retardant six-mil polyethylene or similar
          material. Windows scheduled to undergo external paint removal shall also be sealed on the
          interior of the building, using at least two (2) layers of six-mil polyethylene or similar
          material, with no gaps between the interior wall and the material. This shall remain in place
          until removal and subsequent clean-up of lead containing material from the building have
          been completed.
      iii. Perimeter air samples may be collected by the Consultant or EH&S in areas adjacent to the
          work areas where lead containing materials are being disturbed. If the results exceed 15
          µg/m³ over an 8-hour Time Weighted Average (TWA), the Contractor shall construct a
          means of containment that controls ventilation or production of dust and debris in order to
          maintain perimeter airborne lead concentrations below 15 µg/m³. If the controls do not
          maintain perimeter airborne lead concentrations below 15 µg/m³ TWA during any given
          shift, the lead-related work shall be stopped by UC Berkeley EH&S or its Consultant. Within
          one (1) day of the work stoppage, UC Berkeley’s Environmental Consultant shall convene a
          meeting to review engineering controls and work practices. The meeting shall be attended by
          all parties affected on the job site as determined by the General Contractor and UC Berkeley
          EH&S. The Contractor shall perform the control measures decided upon at that meeting at no
          additional cost to UC Berkeley or UC Berkeley’s Consultant.

b. Controlled Area/Work Perimeter.
   i. If the perimeter samples mentioned in Section 1, Subsection 9 are at or above 15 µg/m³, the
      Contractor shall maintain a temporary fence or barrier tape at a distance of at least twenty
      (20'-0”) feet from the work surfaces whenever possible. The Contractor shall post warning
      signs around the perimeter of the work area in accordance with Cal/OSHA requirements.

c. Restricted Access to Controlled Area.
   i. The Contractor shall restrict work area access to only trained, qualified and properly
      protected personnel during activities that disturb lead containing materials and may generate
      airborne levels of lead at or above the PEL.

d. Wet Methods.
   i. The Contractor shall use wet methods to manually remove lead containing materials. The
      debris generated must be maintained in a wetted state while it is being disturbed. All lead
      containing debris shall be collected and contained by the end of the shift and shall not be left
uncovered overnight. Other methods, such as chemical strippers or HEPA vacuum assisted power tools, do not need to be kept wet.

e. Cleaning.
   i. After surfaces have been scraped and prepared for coating and sealing, the Contractor shall use a HEPA vacuum to remove dust and debris. All loose debris must be collected and contained before the end of each working shift and shall not be left uncovered overnight.

f. Respirators.
   i. If the lead exposure to its employees is at or above the PEL, the Contractor shall use respirators and personal protective equipment as required by Cal/OSHA's task related triggers for lead, or as appropriate, based on personal air monitoring results. All respirators shall be NIOSH/MSHA approved. Respirator fit test records and the respiratory protection program shall be retained on site as part of the project documentation if respiratory protection is used on this Project. Disposable dust/mist respirators shall not be used as personal protective equipment for lead.

g. Air Quality.
   i. The Contractor shall maintain adequate engineering controls to ensure that work does not generate airborne lead concentrations in excess of 1.0 µg/m³ above background levels, as measured by the Consultant or EH&S at the perimeter of the job site.

h. Hazardous Waste Management and Disposal
   i. All lead containing materials shall be treated as hazardous waste unless the Contractor is notified otherwise by EH&S, Facilities Services Abatement Shop, or the Consultant. The handling, transport, and disposal of all hazardous waste shall be managed in accordance with all applicable Federal, State, and local hazardous waste laws and regulations.

   ii. Non-Hazardous materials must have Bills of Lading or other shipping documents for transportation to acceptance site signed by UC representatives.

   iii. Hazardous materials disposal manifests can only be signed by EH&S Campus Staff with DOT training.

   iv. All soil shipping documents (BOLs and manifests) must be sent to EH&S for final record retention.

   v. The Contractor shall provide personnel trained in hazardous waste handling in accordance to Title 22 CCR, Section 66262.34 to package or otherwise handle hazardous waste.

      1. Containers
         a. Small containers used for storage of waste shall be United States Department of Transportation (DOT) approved. Contractor shall supply appropriate waste containers for scope of work and shall select containers that are chemically compatible with the material(s) to be stored in them.
         b. The Contractor shall supply bulk containers (bins, tanks, or tank trucks) when necessary.
         c. The Contractor shall keep containers closed at all times except when material is being added.

      2. Labels
         a. Containers of hazardous waste shall display hazardous waste labels. Before waste is accumulated, the Contractor and UC Berkeley Environment, Health and Safety (EH&S) shall identify and define waste streams. The Contractor shall not mix different waste streams in the same container. The Contractor shall mark the initial accumulation date on the hazardous waste label when waste is first placed in the container.

      3. Waste Storage Area
         a. The Contractor shall store closed and sealed waste containers on the construction site in a locked, secured area out of the elements. The storage
area, room or structure shall be selected and identified by UC Berkeley and the Contractor on an as needed basis.

4. Inspections
   a. The Contractor shall inspect the waste storage area weekly to ensure the containers are not leaking, are segregated into compatible groups, and labeled properly with appropriate dates, quantity limits are complied with, and waste descriptions. The Contractor shall log this information on a weekly inspection log. The Contractor shall allow UC Berkeley representatives to review the log when requested.

5. Disposal
   a. Small Containers
      i. Contractor shall ensure containers are properly removed with shipping documents signed by appropriate UC parties.
   b. Bulk Containers
      i. For bulk hazardous waste containers, the Contractor shall manifest, transport and dispose of at UC Berkeley approved disposal facilities.

6. Spill Response
   a. The Contractor shall maintain sufficient quantities of spill response supplies to contain at least 110% of any accumulated waste. Immediately notify UC Berkeley when there is a spill. Respond to the spill at the soonest, safest possible moment. The Contractor shall clean up the spill and contain it according to the requirements of this specification. UC Berkeley EH&S will provide assistance in regulatory agency notification, and reporting (if necessary).

01 35 53 Security Procedures

Guidelines for Operations During a Protest

1. Project Security
   a. Project security is the responsibility of the Contractor. However, there may be occasions when campus events elicit a protest response from campus and community constituencies. If protests occur at the Project site, the Owner shall insure a safe work environment for construction activities. If the safety of the site cannot be assured by the Owner (both for the construction personnel and for the equipment and materials), the Contractor shall be directed to vacate the Project site and asked to not return until the site is secured.

2. Procedures During A Protest
   a. Known Protests (Most Common):
      i. In most cases, protests will be anticipated. Information is provided in advance to the University of California Police Department (UCPD), or the assemblage can be seen from the Project site. Under these conditions, UCPD shall dispatch officers to the site. UCPD shall notify the Project Manager who shall contact the Project Inspector (and the On Site Project Coordinator, if any). Once on site, the supervising UCPD officer shall introduce themselves to the Contractor's Superintendent, the Project Inspector (and the On Site Project Coordinator, if any) and a review of the situation shall be made. The supervising UCPD officer shall determine if the Contractor should cease work in certain areas, relocate its work forces, or vacate the premises. The Project Inspector (and On Site Project Coordinator, if any) shall document the action in their daily report(s), and consideration may be given to the Contractor for an extension of contract time and/or cost. Any extension of contract time and/or cost shall be by an executed Change Order.
b. Unknown Event:
   i. In the event that protest activities occur without prior notification and consultation with
      UCPD, the Contractor shall cease all work activities that may directly or indirectly cause
      harm to a worker or protestor. The Contractor shall leave the affected area, and if possible,
      remove tools, equipment and construction materials. The Contractor’s Superintendent shall
      notify the Project Inspector (and the On Site Project Coordinator, if any) of the event. The
      Project Inspector (and the On Site Project Coordinator, if any) shall record this activity in
      their daily report(s) and consideration may be given to the Contractor for an extension of
      contract time and/or cost.

c. If the Contractor is prevented from vacating the affected area by protestors, it shall be the
   responsibility of UCPD to provide safe egress for the Contractor.

d. Under no circumstances is the Contractor to confront protestors, incite activity, or physically impede
   their intended activity.

e. The Contractor shall be aware of the work area and cognizant of any unusual visitors to the Project
   site.

f. Jurisdiction is as follows:
   On-Site Events:
   University of California Police Department (Non-Emergency)
   (510) 642-6760

   Off-Site Events:
   City of Berkeley Police Department (Non-Emergency)
   (510) 644-6743

Security for Tower Crane (If Used):

1. Provide and install wood structure around base of tower crane. Wood base shall be constructed of 5/8
   inch thick minimum, fire retardant, treated exterior plywood. Flare top of wood base at a 45 degree
   angle. Provide a working platform at top of base structure with opening to accommodate the ladder
   leading to operator's cab. Extend structure from ground level to top of tower. Provide one strand of
   barbed wire at top of structure and another strand ten (10’-0”) feet above ground.
2. Access Door: Provide solid wood door with full mortise butt hinges (NRP) and two (2) padlocks with
   hasps and staples, one (1) padlock on exterior and one (1) on interior side of door.
3. Alarm: Install audible alarm.
4. Operator's Cab: Provide two (2) locks on the access door to cab, one (1) on exterior of cab and one (1)
   on interior of cab.

01 40 00 Quality Requirements

01 41 00 Regulatory Requirements

1. General
   a. Perform all Work in compliance with requirements of:
      i. State of California Code of Regulations (CCR):
         1. Title 8, Industrial Relations,
         2. Title 19, Public Safety,
         3. Title 21, Public Works, Chapter One, Subchapter One, Group 2, Office of Owner's
            Representative and Construction dealing with portions applicable to provisions for the
            Handicapped,
         4. Title 22, Public Health,
         5. Title 24, Building Standards.
ii. Occupational Safety and Health Act (OSHA).
v. Bay Area Air Quality Management District Regulations including but not limited to permit requirements for portable internal combustion equipment (engines and gas turbines greater than 50 horsepower).
v. All other applicable health and safety requirements, codes and regulations.

b. Unless otherwise specified, specific references to codes, regulations, standards, manufacturers' instructions, or requirements of regulatory agencies, when used to specify requirements for materials or design elements, shall mean the latest edition of each in effect at the date of submission of bids, or the date of the Change Order or Field Order, as applicable.

2. Conflicts
   a. If a conflict exists between referenced regulatory requirements or between referenced regulatory requirements and the Contract Documents, the Contractor shall notify the Owner's Representative and request that the conflict be resolved. The fact that the Contract Documents may establish higher or more costly requirements than the minimum Code or other regulatory requirements referenced above shall not constitute a "conflict"

01 45 00  Quality Control

01 45 23  Testing and Inspecting Services

1. General
   a. Access To The Work
      i. In addition to the requirements of the General Conditions, the Owner, the Owner's Representative and their representatives shall at all times have access to the Work wherever it is in preparation or progress and Contractor shall provide safe and proper facilities for such access and for inspection. The inspection and written acceptance of material and workmanship, unless otherwise stated in these Specifications, shall be final except as provided in the General Conditions.
   
   b. Testing and Approval
      i. In addition to the requirements of the General Conditions, if any law, ordinance or public authority or the Specifications or Owner's Representative's instructions requires any work to be specially tested or approved (including use of ionizing radiation for radiography), the Contractor shall give the Owner's Project Inspector timely written notice of its readiness for inspection, and if the inspection is by another authority than the Owner's Project Inspector, of the date fixed for such inspection.
      ii. Re-examination of questioned work may be ordered by the Owner's Representative or the Owner's Project Inspector.

   c. Owner's Inspectors
      i. The Owner shall supply personnel who shall observe construction in progress. Project Inspectors shall have the following responsibilities and limitations on authority:
         1. Observe installations and work in progress as a basis for determining conformance of the work, materials and equipment with the Construction Documents. Project Inspector shall report any discrepancies observed to Owner's Representative and Contractor. Only the Owner's Representative has the authority to make approvals or rejections.
2. Only the Owner's Representative shall interpret the requirements of the Construction Documents. If any item is ambiguous, Owner's Representative shall make a written interpretation. If the Contractor requests changes or modifications to the Construction Documents, the Owner's Representative shall make a written determination on the requested changes or modifications.

3. Prepare an inspection report for each inspection performed.

4. Review the monthly progress payment request before Contractor submits it to Owner's Representative.

5. Assist the Owner's Representative in reviewing the test and inspection results of testing laboratories.

6. The Project Inspector is not authorized to permit deviations from the requirements of the Contract Documents unless such deviation has been approved by the Owner's Representative in writing.

7. The Project Inspector is not authorized to advise on or issue directions to the Contractor about any aspect of construction means, methods, techniques, sequences or procedures, or relating to safety programs in connection with the Project.

ii. The failure of the Owner, the Owner's Representative and/or consultants, or the Owner's Project Inspector to observe or inspect the Work, or to detect deficiencies in the Work, or to inform the Contractor of any deficiencies which may be discovered, shall not relieve the Contractor, its subcontractors, regardless of tier, or suppliers from their responsibility for construction means, methods, techniques, sequences and procedures, construction safety, nor from their responsibilities to carry out the work in accordance with the Contract Documents and to detect and correct defective work. The term "defective work" means work that is unsatisfactory, faulty, omitted, incomplete, deficient, or does not conform to the requirements of the Contract Documents, directives of Owner's Representative, or the requirements of any inspection, prevailing code, reference standard, test, or approval specified in the Contract Documents, or has been damaged prior to final completion, unless responsibility for the protection of such work has been assumed by the Owner through Beneficial Occupancy (or Substantial Completion, where applicable) in accordance with the General Conditions.

d. Inspection Requests

i. The Contractor shall request, in writing, inspection of completed portions of the Work through the Owner's Project Inspector, at least twenty-four (24) hours in advance of the inspection to be performed.

ii. The Owner's Project Inspector or the Owner's Project Manager shall be on site for all work that takes place during normal work hours or that takes place on weekends or on University or other holidays.

iii. Repeat inspection or inspections requested and subsequently canceled, may be subject to back-charges in accordance with Section 01 33 00.

01 45 29 Testing Laboratory Services

1. Part 1 – General
   a. Definitions:

   i. The term "Owner's Testing Laboratory" means a testing laboratory retained and paid for by the Owner for the purpose of reviewing material and product reports and performing other services as determined by the Owner.

   ii. The term "Contractor's Testing Laboratory" means a testing laboratory retained and paid for by the Contractor to perform the testing services required by the Contract Documents. The Contractor's Testing Laboratory shall be an organization other than the Owner's Testing
Laboratory and shall be acceptable to the Owner's Representative. It may be a commercial testing organization, the testing laboratory of a trade association, the certified laboratory of a supplier, the Contractor's own forces, or other organization. The Contractor's Testing Laboratory shall have performed testing of the type specified for at least five (5) years.

b. Tests, inspections, and approvals of portions of the Work required by the Contract Documents or by Applicable Code Requirements shall be made at the times needed in order not to hinder the progress of the Work. Except as otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with the Contractor's Testing Laboratory. The Contractor shall give the Owner's Representative timely notice of when and where tests and inspections are to be made.

c. If such procedures for testing, inspection, or approval reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, the Contractor shall bear all costs made necessary by such failure including those of repeated procedures and compensation for the Owner's Representative's services and expenses.

d. If the Owner's Representative is to observe tests, inspections, or make approvals required by the Contract Documents, the Owner's Representative will do so, where practicable, at the normal place of testing.

e. Do not incorporate into the Work materials represented by samples under test without the written approval of the Owner's Representative.

2. Contractor's Responsibilities Regarding Owner's Testing Laboratory

a. Secure and make available to the Project, specified quantities of representative samples of materials proposed for use as specified.

b. Submit to Owner the preliminary design mixes proposed to be used for concrete and other materials which require review by the Owner's Testing Laboratory, the Inspector of Record, and the Owner's Representative.

c. Submit copies of product test reports as specified.

d. Furnish incidental labor and facilities:
   i. To provide the Owner's Testing Laboratory access to Work to be tested.
   ii. To obtain and handle samples at the Project site or at the source of the product to be tested.
   iii. To facilitate inspections and tests.

e. Provide written notice to the Owner's Representative, the Owner's Testing Laboratory, and the Inspector of Record, forty-eight (48) hours in advance of operations to allow for assignment of personnel and scheduling of tests.

f. If Work is not performed when scheduled, Contractor shall reimburse the Owner for the Owner's Testing Laboratory personnel and travel expenses incurred.

3. Tests and Inspections

a. Certain portions of the Work shall be tested or inspected at various stages. Nothing in any prior acceptance or satisfactory test result shall govern, if at any subsequent time the work, or portion thereof, is found not to conform to the requirements of the Contract Documents.

b. The Owner's Representative shall make periodic on-site observations of construction as it progresses and upon completion, and shall make off-site reviews of fabricated materials and equipment when such off-site reviews are specified in the Contract Documents.

c. The Inspector(s) shall be selected and employed by the Owner. The Inspector(s) shall observe testing and inspection done by the Contractor as required in the Contract Documents and coordinate and observe special testing and inspection when requested by the Owner's Representative or the Owner.

D. The Contractor shall personally supervise all work and inspect all materials as they arrive for compliance with the Contract Documents, and shall reject defective work and material without waiting for such rejection from others in authority. Opportunity for observation and inspection by the Owner's Representative and Inspector(s) shall be afforded throughout the construction.
4. Additional Testing and Inspection
   a. If initial tests or inspections made by the Owner's Testing Laboratory or the Owner's Geotechnical Engineer reveal that any portion of the Work does not comply with Contract Documents, or if the Owner's Representative determines that any portion of the Work requires additional testing or inspection, additional tests and inspections shall be made as directed.
   b. If such additional tests or inspections establish that such portion of the Work complies with the Contract Documents, all costs of such additional tests or inspections shall be paid by the Owner.
   c. If such additional tests or inspections establish that such portion of the Work fails to comply with the Contract Documents, all costs of such additional tests and inspections, and all other costs resulting from such failure, including compensation for the Owner's Representative, the Inspector of Record, and the Owner's consultants, shall be deducted from the Contract Sum.

5. Test Report
   a. Owner's Testing Laboratory and Contractor's Testing Laboratory shall distribute copies of all reports as follows:
      i. Owner's Representative: One (1) copy.
      ii. Inspector of Record: One (1) copy.
      iii. Owner's Consultants: One (1) copy each.
      iv. The number of copies for the Contractor and Subcontractor being tested shall be determined upon commencement of Contract.
   b. Uncovering Of Work
      i. If a portion of the Work is covered contrary to the Owner's Representative's request or direction, or contrary to the requirements of the Contract Documents, it shall, if required in writing by the Owner's Representative, be uncovered for the Owner's Representative's observation and be replaced at the Contractor's expense without adjustment of the Contract Time or the Contract Sum.
      ii. If a portion of the Work has been covered, which is not required by the Contract Documents to be observed or inspected prior to it being covered and which the Owner's Representative has not specifically requested to observe prior to it being covered, the Owner's Representative may request to see such Work and it shall be uncovered and replaced by the Contractor. If such work is in accordance with the Contract Documents, the costs of uncovering and replacing the Work shall be added to the Contract Sum by Change Order; and if the uncovering and replacing of the Work extends the Contract Time, an appropriate adjustment of the Contract Time shall be made by Change Order. If such Work is not in accordance with the Contract Documents, the Contractor shall pay such costs and shall not be entitled to an adjustment of the Contract Time or the Contract Sum.

(Note: Delete the following paragraph if not applicable.)

6. Geotechnical Engineer
   a. The Owner shall retain and pay the expenses of a Geotechnical Engineer to perform inspection, testing, and observation functions specified by the Owner. The Geotechnical Engineer shall communicate only with the Owner and the Owner's Representative. The Owner's Representative will then give notice to the Contractor, with a copy to the Owner, of any action required of the Contractor.

01 45 16.13 Contractor Quality Control

1. Superintendent
   a. In addition to requirements of the General Conditions:
      i. Submit qualifications showing five (5) years minimum experience as Superintendent.
ii. Failure to maintain a Superintendent on the Project site at all times work is in progress shall be considered a material breach of this Contract, entitling the Owner to terminate the Contract or, alternatively, issue a Stop Work Order until the Superintendent is on Project site. If, by virtue of issuance of said stop order, the Contractor fails to complete the Contract on time, it will be assessed liquidated damages in accordance with the Agreement.

iii. The Superintendent approved for this Project shall be able to read, write, and verbally communicate fluently in English.

iv. The Superintendent may not perform the work of any trade, pick up materials, or perform any work not directly related to the supervision and coordination of the work at the Project site when work is in progress.

-- OR --

a. In addition to requirements of the General Conditions:

i. The Contractor shall employ a competent Superintendent and a minimum of two (2) assistants who shall be in attendance at the Project site during the progress of the work. The Superintendent shall represent the Contractor and all communications given to the Superintendent shall be as binding as if given to the Contractor. If requested by the Owner, the Contractor shall provide a management organizational chart and a list of personnel comprising the superintendence staff. All references to the Superintendent elsewhere in the Contract Documents shall mean the superintendence staff.

ii. The Superintendent shall be in attendance at the Project site not less than eight (8) hours per day, five (5) days per week, unless the Work is stopped due to a general strike or conditions beyond the control of the Contractor or until termination of the Contract in accordance with the Contract Documents. The Superintendent shall be acceptable to the Owner and shall continue in that capacity for the duration of the Project, unless Superintendent ceases to be on Contractor's payroll or the Owner otherwise agrees. The Superintendent shall not be employed on any other project by the Contractor or any other entity during the course of the Work.

iii. In the event any of the following conditions exist, the Contractor shall require that the Superintendent be at the Project site not less than ten (10) hours per day, six (6) days per week until the condition no longer exists or the phase is completed:

a. Should any phase not be accomplished in accordance with the Contract Schedule.

b. Should the Contract Schedule indicate in the opinion of the Owner's Representative that the Contractor is fourteen (14) or more calendar days behind schedule at any time during construction up until thirty (30) calendar days prior to scheduled completion of phase.

c. Should the Contract Schedule indicate, in the opinion of the Owner's Representative, that the Contractor is seven (7) or more calendar days behind schedule at any time during the last thirty (30) calendar days prior to scheduled completion of a phase.

iv. Submit Superintendent's qualifications showing a minimum of five (5) years’ experience in coordinating cast-in-place concrete framing, structural steel framing, masonry, window wall, electrical, plumbing and heating, ventilating and air conditioning installation or appropriate trade or trades.

v. Failure to maintain a Superintendent on the Project site at all times work is in progress shall be considered a material breach of this Contract, entitling Owner to terminate the Contract or, alternatively, issue a Stop Work Order until the Superintendent is on Project site. If, by virtue of issuance of said stop order, the Contractor fails to complete the Contract on time, it shall be assessed liquidated damages in accordance with the Agreement.

vi. The Superintendent and assistants approved for this Project shall be able to read, write, and verbally communicate fluently in English.
vii. The Superintendent may not perform the work of any trade, pick up materials, or perform any work not directly related to the supervision and coordination of the work at the Project site when work is in progress.

2. Contractor’s Staffing
   a. Where applicable and simultaneously with submittal of a signed Agreement, the Contractor shall submit a proposed Staffing Plan for review and acceptance by the Owner's Representative.
   b. The Contractor's proposed Staffing Plan shall identify individual persons proposed to fill the following positions, or their respective equivalents, for the Project:
      i. Project Manager (full time, one [1] position minimum),
      ii. Project Superintendent (full time, one [1] position minimum),
      iii. Field Engineer (full time, one [1] position minimum),
      iv. Job-site Administrative support (full time, one [1] position minimum),
      v. Administrative support personnel at Contractor's home office as appropriate.
   c. The Staffing Plan shall be consistent with staff commitments included in the Contractor's Prequalification submittal document, where applicable. (Note: Delete this paragraph if no Prequalification process was performed for the Project.)
   d. The Contractor shall provide information as appropriate to document the qualifications of individual persons named in proposed Staffing Plan, for their respective positions.
   e. The Contractor shall revise and re-submit the proposed Staffing Plan as required for acceptance by the Owner's Representative.
   f. Acceptance of the Contractor's Staffing Plan by the Owner's Representative shall be a condition precedent to the making of any progress payment for work performed beyond sixty (60) calendar days (change time period as appropriate) from the date of commencement as specified in the Notice To Proceed.
   g. After acceptance of the Staffing Plan, the Contractor shall notify the Owner's Representative in writing of any revisions to the Staffing Plan. Changes in the level of staffing or substitutions of staff for those named in the accepted Staffing Plan shall require the acceptance of the Owner's Representative.

01 50 00  Temporary Facilities and Controls

01 51 00  Temporary Utilities

1. General
   a. Provide and maintain temporary utilities for construction operations and related necessary temporary structures. Remove them when they are no longer needed.
   b. Pay for connections for water and electricity to Project site sources.
   c. The Owner does not guarantee amounts of water and electricity available from existing Owner's sources, nor shall the Owner be responsible for interruptions in service.

01 51 13  Temporary Electricity

1. Service Required:
   a. Furnish, install and maintain all necessary temporary electrical equipment, connections, etc., as necessary for the Work. Before Final Acceptance, all temporary equipment and connections installed by the Contractor shall be removed in a manner approved by the Owner's Representative. Electric power shall be provided by the Owner at no cost to the Contractor.
2. Electric Service:
   a. The Contractor shall verify characteristics of power available in building. Where power of higher voltage or different phase of current is required, the Contractor shall be fully responsible for providing such service and shall pay all costs required therefore. Service connections shall be made by the Contractor to the existing electrical distribution system at a point which will be made available. This point of connection shall be made from the following:
      i. Power for small tools and lighting may be taken from the existing 120 Volt 60 Hz 1-phase convenience receptacles in the building.
      ii. Power for larger equipment may be taken directly from the existing 208Y/120V 3-phase 4-wire lighting panelboard on the same floor of this Project.
      iii. The load connected to any circuit shall not exceed 25% of the circuit or feeder capacity as labeled in the panelboard.
      iv. There shall be no disturbance to building occupants and functions. Cables and conductors shall not prevent closing of fire labeled doors.
   b. Provide conduit and wires, drops, circuit breaker and disconnect switches. Temporary electric service shall be removed when no longer required. Characteristics of current furnished by the Owner is limited to that existing and available; if current of other characteristics or quantity is required by the Contractor, it shall supply the power as necessary at no extra cost to the Owner.
      i. At its own expense, the Contractor shall repair and make good all damage to existing electrical facilities caused by the Contractor's use, as requested and approved.

3. Requirements of Regulatory Agencies: Comply with applicable State and Federal codes, regulations and requirements. All work shall be done in accordance with applicable California Administrative Codes

4. Use of Permanent System: Any part of the permanent electrical system which is used for construction purposes shall be operated in a manner so as to ensure the safety of all personnel and to prevent interference with the orderly progress of the Work. The Owner shall provide and pay for necessary power required during the course of construction. The Contractor shall be responsible for providing temporary facilities required to deliver such utility services from their existing location in the building to the point of intended use.

01 51 16 Temporary Fire Protection

1. Where the existing fire protection system of the building is inadequate or impaired by construction operations, provide temporary fire protection for the building during the course of construction.
   a. Provide and maintain fire protection equipment including extinguishers, fire hoses, and other equipment as necessary for complete fire protection during the course of the Work.
   b. Install a reduced pressure type backflow device, approved by the Owner's Representative, at point of connection to the Owner's water system.
2. Use fire protection equipment only for fighting fires.

01 51 26 Temporary Lighting

1. The Contractor shall furnish, wire, install and maintain temporary electric lights wherever it is necessary to provide illumination for the proper performance and observation of the Work.

01 51 33 Temporary Telecommunications
1. Telephone service shall not be provided by the Owner, except in case of emergency involving life and safety. The Contractor shall make arrangements for temporary telephone service. The telephone services must comply with e911 and route to UCPD for fire, police and medical response.

01 51 36 Temporary Water

1. Water service shall be provided at locations where shown and as approved. The Contractor shall furnish, install and maintain necessary temporary supply connections, piping, fittings, etc., as necessary for the Work. Before Final Acceptance, all temporary connections and piping installed by the Contractor shall be removed in a manner approved by the Owner's Representative. Water shall be provided by the Owner at no cost to the Contractor.

2. Use backflow preventers on water lines at point of connection to the Owner's water supply. Backflow preventers shall comply with requirements of the Uniform Plumbing Code.

01 52 00 Construction Facilities

01 52 13 Field Offices and Sheds

1. Temporary Job Office
   a. Erect and maintain, for duration of operations and in locations as approved, suitable temporary office facilities as required for the Contractor's, the Owner's and the Owner's Representative's administration of the Work. Provide necessary sheds and facilities for the storage of tools, materials, and equipment employed in the performance of the Work. Temporary buildings shall be weathertight with raised solid floors, solid sheathed and composition roofs, and adequately glazed and screened windows for light and ventilation. Provide for the Owner and the Owner's Representative a clean 12' x 40' (minimum) trailer in good condition inside and outside, including electricity, heating and lighting, complete with air conditioning and a 120-208 volt/100 amp electric service and hook up for Owner's Representative and Owner with a cylinder locked door and at least four (4) keys. The trailer shall have two (2) 12' long partitions with doors located as approved by the Owner's Representative. Configuration shall be as approved by the Owner's Representative. Temporary buildings shall be painted using colors as approved. The Contractor shall furnish daily janitorial service in the trailer. Provide stairs and handicapped ramp per code. Equipment shall include: plan desk, plan rack, telephones, photocopy/fax machine, files, stools or chairs, and lights in a room or area to be designated at the Procedure Meeting. Restrooms shall be provided in locations where none are easily accessible otherwise. One set of keys will be given to UCPD for responding to emergencies. Coordinate with UCPD Crime Prevention Unit: (510) 642-3722 (Note: Delete paragraph if not applicable, modify as needed for shared Job Site Offices.)
   b. In the Contractor's temporary job office, maintain a complete set of Contract Documents, all reviewed shop drawings, submittals, samples, and all executed Change Orders.

2. Site Decorum
   a. The Contractor shall control the conduct of its employees so as to prevent unwanted interaction initiated by the Contractor's employees with University students, University faculty, University staff, or other individuals (except those associated with the Project), adjacent to the Project site. Without limitation, unwanted interaction by the Contractor’s employees shall include whistling at or initiating conversation with passersby. In the event that any of the Contractor’s employees initiates such unwanted interaction, the Contractor shall, either upon request of the Owner's Representative or on their own initiative, replace said employee with another of equivalent technical skill, at no additional cost to the Owner.
3. Project Security
   a. The Contractor is responsible for project security of materials, tools, equipment, supplies and partially completed construction.

4. No Smoking In Campus Buildings and Outdoor Spaces
   a. The University has adopted a no-smoking provision in all campus buildings and all outdoor spaces. The Contractor, its forces and its employees shall observe this requirement while performing work in all University buildings and outdoor spaces.
   b. Effective January, 2014, smoking, the use of tobacco products, and the use of unregulated nicotine cigarette products (e.g. “e-cigarettes”) is strictly prohibited in all campus indoor and outdoor spaces, including sidewalks, greenways, parking lots, roads and private residential spaces.
   c. Failure to comply with the above shall result in citation and fine by UCPD.

5. Radios
   a. The playing of radios on University project sites is prohibited at all times. The Contractor, its forces, and its employees shall observe this requirement while performing work on the University Project site.

01 52 16 Sanitary Facilities

(Insert one [1] of the following:)

Toilet facilities for use by workers on the job or other personnel of the Contractor shall be provided by the Owner in existing toilet facilities; these shall be used for toilet purposes only and not for disposal of materials or cleaning of tools. Contractor shall be responsible for cleanliness.

OR

Install temporary toilets and maintain toilets in a clean and sanitary condition.
   1. All portable toilets shall be located within the fenced Project site.
   2. Provide one (1) toilet per each fifteen (15) persons on the Project site at any one time, minimum.

01 54 00 Construction Aids

01 54 13 Temporary Elevators

1. Existing Elevators
   a. The Contractor shall obtain special permission from the Owner in order to use existing building elevators for construction operations.
   b. The Owner shall specify which elevator(s) shall be used for construction purposes. The Contractor is responsible for any damages to the existing elevator(s) due to the Construction process and shall take adequate precautions to protect the elevator(s).
   c. At least one (1) elevator in the University/Owner’s Building shall be operable at all times during construction to provide access for disabled persons.

01 55 00 Vehicular Access and Parking

1. Parking and Access To Site
   a. Vehicular access to the site is not shown on plans and shall only be by routes on University property and Project site as designated by both the Project Manager and the Parking & Transportation Office.
b. The Contractor is responsible for complying with University regulations regarding on-campus parking and vehicle access throughout the campus. The Contractor is responsible for purchasing and obtaining campus parking permits as required and allowed by the Parking & Transportation Office.

c. Due to limited number and high demand of campus parking spaces, Contractor parking shall be negotiated on Project-specific basis. Parking for construction vehicles shall be accommodated, if possible, in approved locations. Parking is not assured. Construction vehicles are defined as vehicles specifically required to be in immediate proximity to the construction site in order to perform the work. In these cases, the Contractor may be allowed to purchase a maximum of two (2) parking permits. All permitted vehicles must be properly parked in marked and/or designated spaces. Parking permits will be issued based on availability, for a duration to be determined by the Project Manager and the Parking & Transportation Office.

d. Campus Parking Permit Procurement Procedures: Parking Permit Requests shall be submitted to the Project Manager for processing to the Parking & Transportation Office. The Contractor shall pay for permits. Permits will be issued by Parking & Transportation, 2150 Kittredge, Berkeley 94720-5740.

  i. All vehicles parked on University's property shall properly and visibly display a valid University parking permit unless specifically exempted. Violators are subject to citation and/or towing. Parking & Transportation is the enforcement agency.

  ii. All vehicles shall observe posted hours of control, permit requirements and parking instructions.

  iii. Overnight parking is not permitted on University property.

  iv. Access to the site may be revoked for violations of University traffic regulations, including speed limits and parking restrictions.

e. Construction Staging Areas: Parking in construction staging areas is limited to construction vehicles only. If a dedicated staging area is anticipated, the Contractor, the Project Manager and the Parking & Transportation Office shall review the extent and cost of allowing non-construction vehicle parking on-site. Such use shall require review and approval of proposed Site Utilization Plan by the Project Manager and the Parking & Transportation Office.

f. Construction Worker Commuter Vehicles: Commuter vehicles for construction workers shall not be allowed in campus parking spaces. Parking for construction workers' commuter vehicles is not provided by the University. Contractor is encouraged to promote and consider alternative modes of travel to the campus including carpooling and public transit systems. The Contractor is responsible for arranging off-campus parking for its own forces and those of its subcontractors.

01 55 26 Traffic Control

1. Provide traffic control barriers and flag persons throughout the construction period.

   a. Provide flag persons at pedestrian crossings of construction equipment right-of-ways one hundred percent of the time such equipment is operating. When equipment is not operating, such equipment right-of-ways shall be closed to equipment by means of a chain link gate.

   b. Provide temporary traffic control barriers to ensure safety of all persons and property.

   c. Provide numbers of flag persons necessary for vehicular and pedestrian traffic control. Flag persons shall be on duty at all times when the Work is in progress.

01 56 00 Temporary Barriers and Enclosures

01 56 16 Temporary Dust Barriers

1. The Contractor shall employ measures to prevent the creation of dust, air pollution and odors.

   a. Unpaved areas where vehicles are operated shall be periodically wetted down or given an equivalent form of treatment to eliminate dust formation.

   b. All volatile liquids including fuels or solvents, shall be stored in closed containers.
c. No open burning of debris, lumber or other scrap shall be permitted.
d. Equipment shall be maintained in a manner to reduce gaseous emissions.
e. Low sulfur fuel shall be used for construction equipment.
f. Stockpiles of excavated materials shall be covered with material approved by the Owner's Representative.
g. The Contractor shall provide street sweeping whenever silt from the construction site is carried over to adjacent public thoroughfares.

01 56 19 Temporary Noise Barriers

1. The following noise control procedures shall be employed (these requirements may be modified for projects as required by Environmental Impact Report Mitigation Measures where needed):
   a. Maximum Noise: The Contractor shall use equipment and methods during the course of this Work that are least disruptive to adjacent buildings, offices, or residences. Note: Modify the following, if necessary, for E.I.R. Mitigation Measures (if any). Noise levels for trenchers, graders, trucks and pile drivers shall not exceed ninety decibels (90 dBA) at fifty feet (50'-0") as measured under the noisiest operating conditions. For all other equipment, noise levels shall not exceed eighty-five decibels (85 dBA) at fifty feet (50'-0")
   b. Equipment. Jack hammers shall be equipped with exhaust mufflers and steel muffling sleeves. All diesel equipment shall have exhaust muffled. Air compressors shall be of a quiet type such as a "whisperized" compressor.
   c. Operations: Machines shall not be left idling. Electric power shall be used in lieu of internal combustion engine power wherever possible. Equipment shall be maintained to reduce noise from vibration, faulty mufflers, or other sources.
   d. Scheduling: Noisy operations shall be scheduled so as to minimize their disturbance to occupied adjacent areas and duration at any given location.

01 56 23 Temporary Barricades

1. Provide temporary barricades as necessary. Maintain barricades in a clean and neat condition until no longer required and removal is approved or requested.

01 56 26 Temporary Fencing

1. Where applicable, chain link fencing shall be installed straight and plumb, using galvanized steel pipe and 9 gauge galvanized 2-inch (2") diamond mesh wire fabric fastened to the posts and rails.
2. Posts shall be 2.375 inch O.D.; securely set in the ground and spaced a maximum of ten feet (10'-0") O.C. and eight feet (8'-0") height with a continuous top pipe rail. Posts shall not be set in or on existing concrete paving or walls to remain, but shall be located in soil, planter or brick paved areas.
3. Maintain fencing in a straight, clean and neat condition throughout construction as approved by the Owner's Representative.

01 56 39 Temporary Tree and Plant Protection

1. General
   a. Summary
      i. Protect existing trees not specifically designated for removal, including pruning, protection and irrigation during site work and construction.
   b. Quality Assurance
      i. Pruning and transplanting work shall be done as directed by Owner.
   c. Scheduling
      i. Install barricades before starting construction.
d. Guarantee
   i. If a tree to remain is destroyed, or damaged so that in the judgment of the Owner's Representative or the Owner it should be replaced, it shall be removed at Contractor's expense. Damages will be assessed at the rate of $350.00 per inch of circumference at twelve inches (12”) above grade for trees with a diameter of eight inches (8”) or less and at Diameter at Breast Height (DBH) for diameters greater than eight inches (8”).

2. Products
   a. Tree Protection Materials:
      i. Barricade:
         1. Chain-link fencing at least six feet (6’) high with sufficient coverage to protect trees from any and all construction related activities.
         2. Posts: Metal, sufficient to hold fencing plumb and taut. Posts to be approved by University Representative.
      ii. Anti-desiccant: Manufactured for use on plants. Provide evidence that material can be used on specified trees. Do not use anti-desiccant without approval of the University Representative.

3. Execution
   a. Construction Requirements:
      i. Protect existing trees from damage or injury.
      ii. Permit no traffic, storage, disposal, fires or stockpiling within dripline.
      iii. Prevent puddling or continuous running water within dripline.
      iv. Earth surface within dripline shall not be changed. Existing mulch layer under trees shall remain.
      v. Exercise extreme care in removing concrete or asphalt within dripline. Paving pieces shall be lifted rather than dragged. Protect surface roots immediately with four inch (4”) layer of chipped mulch.
      vi. At start of construction, irrigate trees as directed by subsurface pressure injection. Soil within the dripline shall be moist to eighteen inch (18”) depth.
      vii. Work within dripline shall be as directed by the University representative. Trenching, grading or excavation within the dripline shall be done by hand. Pipes shall be jacked or bored. Protect exposed roots with wet burlap.
      viii. Clearly mark trees to remain with removable flags of a different color than trees flagged for removal.
   b. Barricades:
      i. Install barricades around trees.
      ii. Locate fence at dripline as directed by the University Representative.
      iii. Locate roots before setting post. Prevent damage to roots.
      iv. Space posts appropriately so barricade is plumb, taut and sturdy.
      v. Repair sagging, leaning or damaged barricades immediately. Remove barricades upon completion of work.
   c. Pruning:
      i. Only as directed by Owner.

4. Monetary Damages
   a. If a tree which is to remain is destroyed through any action by the Contractor, or damaged so that in the judgment of the Owner's Representative or Owner it should be replaced, it shall be removed at the Contractor's expense. Monetary damages will be assessed at rates established in the most recent edition of the International Society of Arboriculture Guide for Plant Appraisal.
Temporary Controls

Temporary Erosion and Sediment Control

1. Applicable codes include (but are not limited to) the following:
   a. Federal Clean Water Act Section 208
   b. Resource Conservation Act (Public Resources Code Section 9001 et seq.)
   c. Water Code (Section 13240 et seq.)
   d. San Francisco Bay Basin (Region 2) Water Quality Control Plan policies

2. If the Project disturbs more than one (1) acre of soil, a General Construction Permit shall be obtained from the Regional Water Quality Control Board through the Division of Real Estate’s EH&S department.

3. Site’s disturbing below an acre of soil, will comply with SWRQCB Phase II Small Non-Traditional MS4 General Permit 2013-0001-DWQ.

4. If possible, construction activities involving grading, excavation, or other severe soil disturbance shall be timed so as to coincide with dry weather. This will minimize erosion and expedite the construction process. Appropriate erosion control measures shall be taken if work is to be performed during the rainy season.

5. Standard erosion control practices shall be implemented to control site runoff and prevent soil erosion during the rainy season. The erosion control methods chosen will depend on the specific site. The following standard erosion control policies shall be adhered to:
   a. The amount of land exposed at any time during construction shall be minimized.
   b. The period of exposure for land under construction shall be kept to the shortest period that is practical.
   c. Temporary vegetation or mulch shall be used to stabilize critical areas where staging of construction cannot avoid a time lag prior to permanent cover for exposed lands.
   d. Reasonable measures shall be taken to prevent the transport of sediment by runoff from sites under construction.
   e. Permanent final vegetation and structures shall be installed as soon as practical in the construction process.
   f. Wherever feasible, natural vegetation shall be retained and protected.

6. Unnecessary soil disturbance is prohibited. This includes undue exposure or stripping of bare soils, soil compaction, or unnecessary alteration of existing grades or slopes. Where grading is necessary, practices shall minimize erosion potential and facilitate vegetative establishment, if appropriate. Site grading shall be performed in stages if possible in order to more effectively control erosion. Slope gradients and lengths shall be kept to a minimum and terraces shall be installed on long slopes. A terrace shall be graded back towards the slope and drain with a gentle gradient to a stable outlet. The surfaces of cut and fill slopes shall be left rough or be serrated so that they hold seeds well and allow for good vegetative establishment, if appropriate.

7. Development shall fit the existing topography and soils as much as possible to minimize land disturbance and erosion potential. Grading that shall result in radical loss of vegetation and/or topsoil shall be avoided or re-evaluated. Grading that shall interrupt natural drainage patterns or result in aesthetic degradation shall be avoided. Grading on steep slopes (greater than 25%) shall be avoided.

8. Construction near Creeks and Wetlands
   a. Applicable codes include (but are not limited to) the following:
      i. Federal Clean Water Act (Section 404)
      ii. Federal Rivers and Harbors Act (Sections 9-10)
      iii. San Francisco Bay Conservation and Development Commission Policies
      iv. Fish and Game Code (Sections 1601-1606)
      v. California Environmental Quality Act (Public Resources Code Sections 21000 et seq.)
      vi. Coastal Act of 1976 (Public Resources Code Sections 30000-30900)
      vii. San Francisco Bay Basin (Region 2) Water Quality Control Plan policies
      viii. Water Code (Section 13142)
b. All required permits shall be obtained from the appropriate regulatory agencies working with the campus EH&S department. Discharges due to construction or testing shall be monitored by EH&S, with the appropriate Discharge Form filed by the project: [http://ehs.berkeley.edu/sites/default/files/lines-of-services/environmental-protection/2013ucbwatertdischargeform.pdf](http://ehs.berkeley.edu/sites/default/files/lines-of-services/environmental-protection/2013ucbwatertdischargeform.pdf)

c. Physical alteration of creek channels shall be avoided unless there is no practical alternative. Alteration includes culverting, channelization, channel confinement, extensive bridging or lining of the streambed or banks with concrete or other artificial materials. Diversion, realignment or other alteration of the natural path of creek channels is prohibited. Excavation or filling of any creek channel, marsh, or any wetland area is prohibited.

d. Encroachment upon creek-side areas or wetlands shall be avoided. An undisturbed buffer zone shall be maintained between buildings or structures and creek or wetland areas per the UC Berkeley Landscape Master Plan which designates Zone 1, the riparian zone, as a section at least one hundred feet (100’-0”) in width, centered on the stream course. Zone 2, a broader zone that includes other rustic woodland areas adjacent to the riparian zone shall also be protected. Vegetation disturbance or alteration shall be avoided in these natural areas.

e. Designs shall not detract from the visual amenity and variety provided by creeks or wetlands or other natural areas. Designs shall not affect the open space or recreational and educational functions of any critical or sensitive ecological habitats.

f. An undisturbed buffer zone of at least one hundred feet (100’-0”) in width, centered on the stream course shall be maintained between construction site activities and creek or wetland areas. Storage or staging areas for equipment, building materials, chemicals, etc., shall be located as far away as is practical from creek or wetland areas and be stored in covered secondary containment.

g. Excavation or filling or other disturbance of streambeds, stream banks, or wetlands during construction is prohibited. Siltation or sedimentation of creek channels or wetlands as a result of site runoff or grading is prohibited.

9. Construction in other Sensitive Areas

a. Applicable codes include (but are not limited to) the following:
   i. San Francisco Bay Conservation and Development Commission Policies
   ii. Coastal Act of 1976 (Public Resources Code Sections 30000-30900)
   iii. California Department of Fish and Game policies
   iv. California Environmental Quality Act (Public Resources Code Sections 21000 et seq.)
   v. Federal Endangered Species Act
   vi. National Historic Preservation Act of 1966 (Section 106)

b. Development upon identified aquifer recharge areas shall be designed so as to minimize impervious surface area on the Site.

c. Development shall accommodate sites or areas of historical or archeological significance. Approval shall be obtained before altering any archeological, historical, or cultural resource eligible for, or listed in the National Register of Historic Places.

d. Unnecessary vegetation disturbance is prohibited. This includes unnecessary stripping, removal, trampling, or other damage. Compaction, excavation, paving, or addition of soil (filling) of root zone areas within the drip line (generally the area surrounding the stem roughly equal to the diameter of the canopy) of permanent vegetation is prohibited. Vegetation that must be removed shall be left on the site as long as possible.

e. Development shall not be detrimental to known endangered plant or animal species or their critical habitats or migration routes. In general, wildlife habitat shall be preserved and enhanced to the extent possible.

f. Activities within one hundred feet (100’-0") of the high tide mark of San Francisco Bay, including dredging or filling, grading, or substantial change in land use, require the approval of the San Francisco Bay Conservation and Development Commission.

10. Construction Site Hazards
a. Applicable codes include (but are not limited to) the following:
   i. Alquist-Priolo Special Studies Zone Act (Public Resources Code Sections 2621 et seq.)
   ii. Cobey-Alquist Flood Plain Management Act (Water Code Sections 8400-8415)
b. All development within any primary 100-year floodway channel is prohibited. All structures built on the 100-year floodplain (Zone A as designed on FEMA Flood Insurance Rate Maps) shall be flood-proofed according to standard practices. Development on the 100-year floodplain that poses an obstruction to floodwaters or reduces the storm water carrying capacity of the channel or floodplain shall be avoided. Development shall also be avoided in areas subject to tidal inundation or coastal flooding hazards. Development shall be avoided on sites having groundwater levels close to the land surface if this interferes with the function of planned facilities or land uses.
c. Construction within fifty feet (50’-0”) of a known active fault trace is prohibited. Development upon suspected fault zones or other earthquake hazard areas shall be avoided if possible. If this is not possible, special consideration shall be given to placing and constructing buildings so as to reduce the hazard to a minimum.
d. Development that will disturb colluvium or landslide bodies shall be avoided.

01 57 16 Temporary Pest Controls

1. Jobsites shall designate an area in which Contractor’s and subcontractors’ employees shall eat their meals.
   a. Food shall only be consumed in the designated area, with refuse being deposited in closed-lid containers until collection.
2. See Division 10 81 00: Pest Control Devices.

01 57 19 Temporary Environmental Controls

1. Codes.
   a. Applicable codes include (but are not limited to) the following:
      i. California Code of Regulations
      ii. California Fish and Game Code
      iii. California Government Code
      iv. California Health and Safety Code
      v. California Penal Code
      vi. California Public Resources Code
      vii. California Water Code
      viii. Federal Clean Air Act
      ix. Federal Clean Water Act
      x. Federal Endangered Species Act
      xi. Federal Rivers and Harbors Act
      xii. National Flood Disaster Prevention Act
      xiii. National Flood Insurance Act
      xiv. National Historic Preservation Act

2. General
   a. Environment, Health & Safety (EH&S) is the liaison with regulatory agencies when obtaining permits for environmental work.
   b. Refer to Section 01 57 23 for Storm Water Pollution Control specifications.
3. Air Quality
   a. Applicable codes include (but are not limited to) the following:
      i. Federal Clean Air Act
ii. California Health and Safety Code, Division 26, Air Resources
iii. Bay Area Air Quality Management District, Regulations

b. Demolition and construction activities shall be conducted in a manner that eliminates, as much as feasible, emissions of fugitive dust, aerosols, mist, smoke, odors and gaseous pollutants from the construction site. Elimination and suppression of air pollutants shall be accomplished using methods such as wetting, covering, filtration, adsorption, material substitution or any other method deemed effective by a consensus of University and supervising construction site representatives. Methods shall not pose additional hazards to site personnel nor soil or water through the transfer of captured pollutants to these receptors. Captured air pollutants shall be handled in accordance with all applicable waste laws.

c. Activities where asbestos or asbestos containing materials are disturbed, removed, or modified shall comply with Bay Area Air Quality Management District notification and containment requirements.

d. Abrasive blasting operations shall be entirely contained or employ a verified method that captures ninety-eight percent (98%) by weight of blast media and removed surface debris.

e. All construction-related engines, both mobile and stationary, shall be operated and maintained in a manner that reduces emissions to the maximum extent feasible and shall be in compliance with current State and local requirements for the class of equipment or vehicle in use on site.

f. Engine idling shall be monitored and curtailed to the maximum extent feasible.

g. All coatings, adhesives, and surface treatments in use containing Reactive Organic Compounds shall not exceed local and State regulatory limits on percent volatiles by weight or volume nor be used in a manner inconsistent with their intended use and shall be applied and stored in a method that minimizes to the maximum extent feasible fugitive emissions from these sources.

h. On site fueling, lubrication, and cleaning of vehicles shall occur in a method that eliminates spills and releases of fuel or volatile products. Fueling operations must include Vapor Recovery Equipment for both the fuel container and receiving vehicle or equipment where required.

i. Smoking and the use of any tobacco products shall not be permitted on or within twenty-five feet (25‘-0”) of any University of California, Berkeley property. See 01 52 13 4.A-C.

4. Water Quality

a. Applicable codes include (but are not limited to) the following:

   i. Federal Clean Water Act (Section 401-402)
   ii. Fish and Game Code (Section 5650)
   iv. Hazardous Waste Control Law (Health and Safety Code Sections 25100 et seq.)
   v. San Francisco Bay Basin (Region 2) Water Quality Control Plan Policies

b. Buildings shall be designed so that no waste-waters (such as steam condensate, cooling tower or boiler effluent) shall be discharged either directly to surface waters or indirectly to surface waters via the storm drain system. It is preferable to route building floor drains and basement sumps to the sanitary sewer system to prevent water pollution from these sources.

c. Improper disposal of excess or remnant materials or chemicals is prohibited. No materials such as paint, stucco, plaster, cement slurry, oil, solvents, or other residual materials shall be disposed of directly to surface waters or wetlands or indirectly to surface waters via catch basins or any other outside storm drain. No material other than uncontaminated surface water runoff should be allowed to enter the storm drain system. Residual materials or runoff from on-site cleaning of equipment, tools, brushes, etc. shall not be allowed to enter surface waters either directly or via the storm drain system.

01 57 23 Temporary Storm Water Pollution Controls
1. Refer to Division 22 14 00: Facility Storm Drainage for requirements of permanent Storm Water remediation

2. Impervious surface area on a site shall be minimized in order to mitigate the adverse effects of storm water runoff on receiving waters. The campus shall maintain the ‘no net increase’ of runoff per the draft 2020 Long Range Development Plan (LRDP). This can be achieved through storm water detention practices and designs that minimize impervious surfaces and employ such methods as open paving or porous pavement surfaces. Where appropriate, storm water systems shall be designed to permit aquifer recharge.

3. General
   a. Background
      i. Storm drains discharge directly to creeks and the Bay without treatment. Discharge of pollutants (any substance, material, or waste other than uncontaminated storm water) from this Project into the storm drain system is strictly prohibited by the California Regional Water Quality Control Board’s (RWQCB) Water Quality Control Plan (Basin Plan), except as provided in Paragraph 3.08 of this specification.

4. General Contractor Scope
   a. Provide all material, labor, equipment, for installation, implementation, and maintenance of all surface-water pollution prevention measures. The Contractor shall not be required to maintain post-construction pollution prevention structures. This work includes the following:
      i. All sites that will create and/or replace greater than 2,500 square feet of impervious surface area must comply with all design and operational requirements outlined for Non-Traditional Permittees in the State Water Board’s Phase II Small MS4 General Permit, Waste Discharge Requirements Order No: 2013-0001-DWQ. Post-Construction Site Design Measures will be documented with the State’s ‘Post-Construction Water Balance Calculator’ and additional hydro-modification facilities will be registered with UCB EH&S. Projects must also submit a Storm Water Pollution Prevention Plan to UCB EH&S.
      ii. Construction sites that will disturb (e.g., digging, trenching, grading, clearing, filling) greater than 1 acre of site soil will be required to register for the State Water Board’s Construction General Permit Order No: 2009-0009 in that agency’s Storm Water Multiple Application and Report Tracking (SMART) System.
      iii. Furnishing, placing, and installing effective measures for preventing erosion and runoff of soil, silts, gravel, hazardous chemicals or other materials prohibited by the San Francisco Bay Region Water Quality Control Board from entering the stormwater drainage system.
      iv. Management of on-site construction materials in such a manner as to prevent said materials from contacting stormwater or wash water and running off into the storm drain system.
      v. Complying with applicable standards and regulations per Paragraph 1.03.
      vi. Include post-construction stormwater pollution prevention structures in the stormwater pollution prevention plan. Contractor shall use construction drawings as the reference for post-construction BMPs.
   b. This section does not replace any other relevant section of the project specifications. Where sections are in disagreement, the more stringent requirement shall apply.
   c. In this section, the term "storm drain system" shall include storm water conduits, storm drain inlets and other storm drain structures, street gutters, channels, watercourses, creeks, lakes, and the San Francisco Bay.
   d. Sanitary sewer discharge regulations are intended to provide protection of the sanitary sewer system and East Bay Municipal Utility District’s (EBMUD) water pollution control plant. In this section, “sanitary sewer” shall include any sanitary sewer manhole, clean-out, side sewer or other connection to the EBMUD wastewater treatment plant.
e. The Contractor shall have storm drain pollution prevention measures in place and follow this specification during the rainy season (October 1 through May 1), and anytime rain is predicted in the San Francisco Bay Area. It is the responsibility of the Contractor to be prepared for a rain event in the non-rainy season, and to be aware of weather predictions. The University is not responsible for informing the Contractor of rain predictions.

f. Sanitary sewer blockage will likely result in a back-up and overflow to the storm drain system. The Contractor shall immediately notify the Project Manager or the Inspector of Record if there is a clogged sanitary sewer.

g. The Contractor shall not allow any non-storm water to enter the storm drain system. Non-storm water includes domestic supply water used to wash streets, painting and drywall equipment, tools, equipment, or vehicles.

5. Regulations and Standards
   a. Contractor shall comply with the following applicable regulations:
      iii. Regional Water Quality Control Board – Construction General Permit — Stormwater Pollution Prevention Order No: 2009-0009-DWQ.
      iv. Small Municipal Separate Storm Sewer System (MS4) General Permit (Section F. Non-Traditional Small MS4 Permittee Provisions), Waste Discharge Requirements Order No: 2013-0001-DWQ.

   b. Contractor shall comply with the following standards and guidelines on storm drain pollution prevention:
      i. Stormwater Best Management Practice Handbook – New Development and Redevelopment; California Stormwater Quality Association
         Order From: California Stormwater Quality Association, P.O. Box 2105, Menlo Park, CA 94026-2105
         Phone: (650) 366-1042
         Order From: San Francisco Estuary Project
         1515 Clay Street, Suite 1400
         Oakland, CA 94612
         (510) 622-2465
      iii. Construction Site Monitoring Program Guidance Manual; CalTrans
         Order From: Storm Water Liaison,
         Caltrans Division of Environmental Analysis, MS 27, P.O. Box 942874
         Sacramento, CA 94274

6. Submittals/Deliverables
   a. Submit a Storm Water Pollution Prevention Plan (SWPPP) to the Construction & Design Project Manager for plan approval. Contractor shall not disturb soil onsite until the University approves the plan.

*** If the project disturbs greater than one (1) acre of soil, the University shall send a “Notice of Intent” (NOI) to the RWQCB, with the applicable fee (Contractor shall supply Owner with the check
for this fee). Upon completion of the Project, the University shall send a “Notice of Termination” (NOT), as required by the RWQCB. All permit-related documents shall be submitted to the RWQCB by UC Berkeley EH&S.

The plan shall include the following:

1. Title Page. The title page shall primarily identify that the document is a SWPPP. Elements that shall be included on the title page are the following:
   a. UCB Project Name and UCB Project Number,
   b. Owner and Contractor of the Project,
   c. Contact person(s)/address/daytime and emergency phone numbers with area codes.
   d. Waste Discharge Identification Number (WDID No.) for the Project. This number is assigned by the RWQCB upon submission of the NOI. The number shall be included in the plan after it is assigned.

2. Certification Page
   The Contractor shall include a certification page immediately following the SWPPP title page. This page shall be signed by the University and state the following:

   “I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted, is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.”

   ___________________________ ______________________
   Name, Title    Date of Preparation

3. Amendments
   The Contractor shall amend the SWPPP whenever there is a change in construction or operations which may affect the discharge of significant quantities of pollutants to surface waters, ground waters, or a municipal separate storm sewer system. The SWPPP shall also be amended if it is in violation of any condition of the State of California General Permit or has not achieved the general objective of reducing pollutants in storm water discharges. In addition, the University shall require the Contractor to amend the SWPPP if the discharge is in violation of the RWQCB San Francisco Bay Basin (Region 2) Water Quality Control Plan.

   The following items shall be discussed in the Amendment section as appropriate:
   a. Location of proposed change shall be shown on the site map, and referenced in the Amendment section of the SWPPP.
   b. Describe the existing condition and why it is being amended.
   c. List the person or agency who requested the amendment.
   d. Describe the new control measure.
   e. Attach a certification page to the beginning of the amendment.

4. Table of Contents
   a. Include a Table of Contents in the SWPPP, including page numbers.
5. Introduction
   a. The Introduction shall provide the following information:
      i. Type and size of the construction project, including land area in acres.
      ii. Project location, including county, and address.
      iii. The beginning date of the Project groundbreaking.
      iv. The beginning and end dates for all phases.

6. Source Identification and Best Management Practices
   a. Identify storm water and non-storm water pollutant sources at the construction site. Choose an appropriate storm water pollution prevention best management practice (BMP) to control the pollution source.
   b. Provide in the SWPPP a geographical description of potential storm water pollution sources. Topographic and site maps shall be used for this purpose.
      i. Topography Map
         1. The map shall extend approximately one quarter mile beyond the construction site boundary and show the following: the construction site, surface water bodies (including springs and wetlands), known wells, an outline of off-site drainage discharging into the construction site, general topography, and the storm water discharge locations for construction site storm water.
         2. The Contractor shall use a U.S. Geological Survey quad map and shall modify it to show the required information. Include dimensions, scale, legends, flow direction of water bodies, run-on and run-off water and drainage, drainage locations, and delineation of permanent erosion and sediment control measures.
      ii. Site Map
         1. The Contractor shall identify pollution sources, construct and implement storm water and non-storm water pollution prevention BMPs at the construction site. The Contractor shall implement the SWPPP. The Contractor shall include SWPPP for the post-construction pollution sources and erosion and sediment control BMPs. A separate map may be used for showing the locations of the post-construction BMPs.
         2. The site map shall be one (1) or more detailed map(s) showing the location of pollution sources, (e.g. construction site drainage patterns, grading activities that change drainage patterns, drain inlets, hazardous materials storage, contaminated soil). The site map shall show the location of BMPs designed to prevent pollution sources from causing storm water or non-storm water pollution. The Contractor shall choose the best available performance-based technology and methods to prevent storm water pollution for construction site activity. Many of those methods are detailed in the reference materials listed in Regulations and Standards, above.
         3. The following is a list of BMPs, geographic features or pollution sources to be shown (if applicable) on the site map. Further detail on these topics is in “Execution” of this Section below (Paragraph number in parentheses).
            a. Storm water flow drainage patterns and grading activities that change drainage patterns (10);
            b. Perennial, intermittent or seasonal surface water bodies, oceans, lakes, rivers, creeks or streams, ponds, springs, and wetlands. (11)
c. Areas of existing vegetation (12)
d. Areas of disturbed soil (13)
e. Existing and planned paved areas and buildings (14)
f. Dust suppression water management (15)
g. Fire hydrant protection (16)
h. De-watering and sediment settling (17);
i. Erosion and sediment control measures (18);
j. On-site soils movement and storage (19);
k. Site ingress and egress mud tracking prevention (20);
l. Storm drain inlet protection (21);
m. Construction materials storage (22);
n. Concrete, mortar, saw cutting (23);
o. Sanitary Sewer Discharge Point Identification (24);
p. Fueling, washing and equipment cleaning (25);
q. Building wash or hydro-blasting water management (26);
r. Inspection, monitoring and maintenance of BMP control structures (27);
s. Spill Prevention and Control (28);
t. Water Main Break Contingency Plan (29);
u. Housekeeping Practices (30);
v. Post-construction storm water run-off control measures (31);
w. Personnel training (32);
x. List of Contractors and phone numbers (33);
y. Or other appropriate site-specific storm drain pollution prevention methods necessary to achieve the objectives stated in Section 4: General Contractor Scope, above.

7. Impervious Surface Calculations
   a. All projects regardless of size, will document installations or changes to: landscaping, roofing, walkways, permeable or impermeable surfaces as outlined in both Water Board Order Numbers: 2009-0009-DWQ and 2013-0001-DWQ by using the State Water Board’s Post Water Balance Calculator.

8. Environmental Enforcement
   a. The Regional Water Quality Control Board (RWQCB), East Bay Municipal Utilities District (EBMUD), and the City of Berkeley (COB) have authority to enforce, through codified regulations, any portions of this Section that if not implemented may violate applicable regulations. Agency enforcement may include but is not limited to: citations, orders to abate, bills for cleanup costs and administration, civil suits, and/or criminal charges. Contract compliance action by UC Berkeley shall not be construed to void or suspend any enforcement actions by these or other regulatory agencies.

9. Materials
   a. General
      i. Provide materials as required for execution of the Work.

10. Execution
    a. For each applicable sub-part(s) below, the Contractor shall delineate on the site map BMP locations and provide a detailed description in the plan for pollution prevention structures or methods that shall be constructed, implemented and maintained on site.

11. Storm Water Drainage Patterns and Graded Slopes

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a. Drainage patterns shall be shown on the site map. Drainage patterns that are modified during the
construction of the project shall be clearly shown on the site map. All slopes shall indicate grading
ratio and flow direction.
b. The size of the construction site (in acres).
c. The run-off coefficient of the site before and after construction.
d. The percentage of the area of construction that is impervious before and after construction.

12. Surface Water Locations
   a. All surface water locations shall be clearly delineated on the site map. Surface water bodies include:
oceans, lakes, rivers, creeks or streams, ponds, springs and wet lands. Include intermittent or
seasonal surface water bodies. Estimate the storm water flow onto the site, assuming a ten (10) year
six-hour (6h) rain event. Estimate the volume of water the site could contain in trenches,
evacuations, pier holes, or pits for the different phases of work.

13. Areas Of Existing Vegetation
   a. The Contractor shall protect existing vegetation that is to be preserved on the site from mechanical
or other injury during the Project. Areas of existing vegetation shall be clearly delineated on the site
map.

14. Areas Of Disturbed Soil
   a. The Contractor shall clearly identify on the site map all areas of soil disturbance. These areas shall
include soil removal or augmentation, such as holes, pits, excavations, trenches, berms, slopes, fill,
and imported top soil.

15. Existing and Planned Paved Areas and Buildings
   a. Areas that are covered by concrete, asphalt, or other permanent coverage of the soil shall be clearly
delineated on the site map. Imprints of buildings shall also be indicated whether they are permanent
or temporary.

16. Dust-Suppression Water Management
   a. The Contractor shall use best available dust suppression equipment and methods to control dust so
that the dust does not cause discomfort or nuisance to occupants of the project site neighboring
property. Contractor shall control dust suppression water so that it is effective in controlling dust, but
does not enter the storm drain system. Contractor shall describe its dust suppression water
management methods in this plan.

17. Fire Hydrant Protection
   a. The Contractor shall protect fire hydrants on and near the project site from mechanical damage. If
the Contractor’s or subcontractors’ personnel causes damage that results in a release of fire
suppression water, the Contractor shall implement the clean-up procedures described in these
Specifications.

18. De-Watering and Sediment Management
   a. If storm water or groundwater in site excavations or drilled holes, (e.g., trenches, pits, pier holes,
footings), needs to be removed, it shall be made clean by filtering, settling, or other method capable
of removing solids and suspended particles from this water prior to discharge to the storm drain
system. The Contractor shall ensure that this discharge complies with all applicable provisions of the
Basin Plan (see Paragraph 1.01 of this Section). Contractor will be required to document discharge

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b. If excavation water is domestic supply water, or the water is contaminated with a hazardous substance, then the Contractor shall dispose of according to guidance from the Project Manager. For disposal authorization, the Contractor shall contact the Project Manager (PM) to determine the discharge requirement. The PM will work with UC Berkeley Office of Environment, Health & Safety (EH&S), who will establish the discharge requirements.

   i. If the Contractor suspects the presence of contaminated groundwater, or domestic supply water, the Contractor shall immediately notify Owner’s Representative or EH&S at (510) 642-3073. The Contractor shall not attempt to pump out or treat any material suspected of containing a hazardous material or petroleum product.

19. Description Of Erosion and Sediment Control Measures
   a. Provide a description of erosion and sediment control measures that will be used on the site, and correlate the description with the site map (may be listed on the map in a comments section). Areas requiring erosion control measures are exposed soil, such as soil piles, bare soil, sloped soil, and any area of disturbed soil. Erosion control measures include paving, tarp placement, soil blankets, mulching, seeding, hydro-mulching, the use of straw wattles, and spreading straw. Sediment control measures include drain inlet protection, filter fabric, geo-textile silt fencing, gravel placement, gravel or sandbag placement, sediment settling tanks, and straw wattle placement. This list is not all inclusive and the Contractor shall refer to the resources listed in Paragraph 1.03 of this Section. Both erosion and sediment control practices are designed to be implemented as an integrated system of pollution control. Without erosion controls, sediment controls are easily overwhelmed and will not prevent pollution.

20. On-Site Soils Movement and Storage
   a. The Contractor shall describe and implement proven methods to prevent erosion from soils stored on site.

21. Site Ingress and Egress Management Mud Tracking Prevention
   a. The Contractor shall ensure that mud is not tracked from the site onto public or campus roads. The Contractor shall select the most appropriate Best Management Practice (BMP) to accomplish this.

22. Storm Drain Inlet Protection
   a. The Contractor shall protect storm drain inlets from receiving sediment, hazardous chemicals, gasoline, diesel, oil or grease, trash, debris or other pollutants from the construction site.

23. Construction Materials Storage
   a. Storage and exposure of raw materials, byproducts, finished products, and hazardous materials containers shall be controlled as described below:

      i. All construction materials shall be stored at least ten feet (10’-0”) away from storm drain system inlets, catch basins, and curb returns.

      ii. The Contractor shall not allow any material to enter the storm drain system.

      iii. At the end of each working day, the Contractor shall collect and prepare for disposal all scrap, debris, and waste material generated by Project activities.

      iv. During wet weather or when rain is in the forecast, the Contractor shall store materials, (that can flow or be transported by storm water), inside a building or under a secured waterproof covering to prevent accidental release to the storm drain system. Examples: use sealed debris bins in rainy weather; store fuel containers out of the weather; cover soil, sand, or debris piles with tarps.
v. The Contractor is responsible for ensuring that storage and disposal of all hazardous materials brought on site for this project (e.g., coatings, thinners, solvents, and fuels), and all hazardous waste generated during project activities (e.g., waste oil) is in compliance with all applicable federal, state, and local standards and requirements.

vi. Liquid materials shall be stored in secondary containment. The containment shall be designed to hold at least 110% of the volume of the largest stored container.

24. Concrete, Mortar, Saw Cutting
   a. For concrete or mortar application to be performed on-site, the Contractor shall comply with the following provisions:
      i. Washing sweepings of exposed aggregate concrete into the street or storm drain system as defined in this Specification is prohibited. Collect and return sweepings to aggregate base stockpile, or dispose of as construction debris.
      ii. Do not wash out concrete trucks and equipment into the storm drain system. Whenever possible, perform washout of concrete trucks (if any) and equipment off-site where discharge is controlled.
      iii. If on-site washout of trucks and equipment is necessary, then the Contractor shall comply with the following procedures:
         1. Locate washout area at least fifty feet (50’-0”) from storm drains, open ditches or water bodies, preferably in a dirt area.
         2. Do not allow storm water run-off from the washout area.
         3. Construct a temporary pit or berm-enclosed area large enough to contain the wash-water and surplus concrete waste.
         4. Wash out concrete waste into the temporary pit where the concrete can set, be broken up, and then disposed of as construction debris. If the volume of water is greater than what will allow concrete to set, allow the wash water to concentrate and/or evaporate, if possible. Otherwise, allow water to settle before filtering it, and then pump to the sanitary sewer (as long as the pH is less than hazardous waste limit of 12.5).
      iv. Wash-water from tools used for mixing mortar, in sheet rock work, plaster, drywall, mortar work or similar work shall be settled before disposal to the sanitary sewer. Solids shall be disposed to the debris bin. This wash-water is prohibited from storm water discharge.
   v. Concrete sawing or drill cutting lubricating/cooling water or shall be collected using a wet-vacuum. The lubricating/cooling water shall be settled before disposal to the sanitary sewer. Solids shall be disposed to the debris bin. This lubricant/cooling water is prohibited from storm water discharge.

25. Sanitary Sewer Discharge Point Identification
   a. If the Contractor will be disposing of water from a settling operation, or any other water approved by EH&S for sanitary sewer disposal, the Contractor shall verify with Facilities Services Utilities Operations unit that the manhole used for disposal is a sanitary sewer and not a storm drain. (Note: Do not assume that a manhole is a sanitary sewer, even if the words “sanitary sewer” are embossed on it. Sometimes utility maps and manhole cover designations are incorrect.) The Contractor shall be given Facilities Services’ contact information by the Project Manager.

26. Fueling, Washing and Equipment Cleaning
   a. The Contractor shall not perform vehicle cleaning on site, unless a properly designed wash area prevents run-off from entering the storm drain system. Domestic water supply is prohibited from entering the storm drain because it contains chloramines. It can go to the sanitary sewer if the sediment is allowed to settle before discharge and it meets the standards of the EBMUD Wastewater Discharge Permit pollutant strength limits.
b. If fueling must occur on-site, use designated areas away from drainage. Locate on-site fuel storage tanks within a berm-enclosed area designed to hold the tank volume. The area shall be covered so that rain water will not get into the berm-enclosed area. The berm-enclosed area shall be lined so that leaks, spills or drips will not contaminate the soil. Use secondary containment while fueling or changing fluids to catch drips or small spills.

c. The Contractor shall dispose of wash water from the cleaning of non-hazardous water-based coating equipment (such as latex paints or drywall compounds) and tools to the sanitary sewer. Unused latex paint, oil based paint, used or new paint thinner and solvents are prohibited from disposal to the sanitary sewer and the storm drain system. The Contractor shall dispose of these wastes in accordance with federal, state, and local hazardous waste and solid waste regulations.

27. Building Wash Or Hydro-Blasting Water Management
   a. Contractors shall follow UC Berkeley Water Protection Policy (http://campuspol.chance.berkeley.edu/policies/waterprotection.pdf) if washing buildings, surrounding environs or hydro-blasting to complete any portion of the Work.

28. Inspection, Monitoring and Maintenance Of Pollution Control Systems
   a. Inspect the site before and after storm events, or during any storm event lasting more than twenty-four 24) hours. Inspections shall be done during the storm water observation period (October 1 through May 1) to ensure that storm drain pollution prevention controls are in place. Provide documentation of these inspections, and improvements or modifications of the control systems. The Contractor shall designate an inspector and list the name and contact information of the inspector in the list of Project contacts as required by the contract submittals. The Contractor shall maintain structural controls and updates/amendments to the SWPPP. Representatives from UC Berkeley shall conduct periodic inspections of the site to verify adequacy of storm drain pollution prevention controls and compliance with applicable regulations and standards as stated in subpart 1.03(A).
   b. UC Berkeley shall disclose historic site activities that may have included the use of hazardous materials (e.g., gas station, dry cleaner, underground storage tank, manufacturing facility) and that have or are suspected to have caused pollution at the Site. The University shall write and implement a plan to monitor, sample and analyze storm water discharges for pollutants related to the construction activity. If applicable to Site conditions, the Contractor shall include this hazardous materials monitoring plan in the SWPPP.

29. Spill Prevention and Control
   a. The Contractor shall take precautions to prevent accidental spills of pollutants, including hazardous materials brought onsite by the Contractor. However, in the event of a spill, the Contractor shall be held responsible for the following:
      i. Immediately contain and prevent leaks and spills of prohibited pollutants from entering the storm drain system. Clean up the spill and label the container. Store the container in a safe place and contact the Project Manager to arrange disposal of the waste. The Contractor shall keep a spill kit on site at all times for this purpose.
      ii. The Contractor shall comply with all federal, state, and local hazardous waste requirements and ensure that no spilled materials are washed into the storm water or non-storm water systems.
      iii. Report any hazardous or unknown material spills immediately to EH&S at 510-642-3073. If a spill occurs after hours or on a weekend, call 9-911 from campus phones (911 from off-campus phones, or 642-3333 from cellular phones) to contact the UC Berkeley Police Department.
   b. The Contractor is responsible for ensuring that its employees and subcontractors (if any) working on site are aware of the location of the campus phone nearest the Project site.
30. Water Main and Sanitary Sewer Line Break Contingency Plan
   a. If working on or near a water main line or sanitary sewer line, the Contractor shall have a written emergency response plan that states procedures for responding to a break and release of supply water to the storm drain system. The Contractor shall meet the following requirements:
      i. Water Main Work
         1. Determine the direction of water flow if the main were to break.
         2. Build a containment berm between the work area and the storm drain inlet(s) that the water would flow into. Make the containment structure large enough to hold the water so that it can be pumped to a sanitary sewer.
         3. Build this containment structure before digging.
         4. If there is a water main break, pump the water that collects in the containment structure to a sanitary sewer.
         5. If the containment fails, prevent chlorinated water from entering the storm drain system by placing dechlorination sodium sulfite tablets in the sewage according to Attachment 2 of this Section.
         6. Put in place, before digging, sediment control structures upstream of drain inlets and at drain inlets.
         7. If a break occurs, contact the Project Manager (PM) or Inspector of Record immediately. Include in the plan the phone numbers of the PM and EH&S contacts.
      ii. Sanitary Sewer Line Work
         1. This sub-part applies only to Contractors who are hired to work on sanitary sewer lines and are trained to work near sewage.
            a. Determine where the sewage will flow if the Work could cause a blockage.
            b. Build a containment structure between the work area and the storm drain inlet(s) that the sewage water would flow into. Make the containment structure large enough to hold the sewage flow so that it can be pumped to a sanitary sewer.
            c. Build the containment before working on the sewer line. Put in place, before digging, solids (toilet paper, etc.) control structures upstream of drain inlets and at drain inlets.
            d. If a sewage blockage occurs, pump it to a sanitary sewer, and do not allow it to flow into the storm drain system.
            e. If the containment fails, prevent chlorinated water from entering the storm drain system by placing dechlorination sodium sulfite tablets in the sewage according to Attachment 2 of this Section.
            f. If a sewage blockage or spill occurs contact the Project Manager or Inspector of Record immediately. The PM will immediately notify EH&S. Include in the plan the phone numbers of the PM and EH&S contacts.
      iii. Excavation Work
         1. This Paragraph applies to Contractors who excavate in the vicinity of sanitary sewer lines and cause or discover a sewage spill, leak or blockage.
            a. Immediately notify the Project Manager (PM). The PM shall immediately notify EH&S. Include in the plan the phone numbers of the PM and EH&S contacts.

31. Housekeeping Practices
   a. The Contractor shall implement the following applicable good housekeeping practices:
      i. Store materials that have the potential to be transported to the storm drain system by storm runoff or spillage away from areas of heavy traffic and under cover in a contained area or in sealed waterproof containers.
ii. Use tarps on the ground to collect fallen debris or splatters that could contribute to storm water pollution.

iii. Secure opened bags of powdered materials (if any) that could contribute to storm water pollution and visible dust emissions.

iv. Pick up litter, construction debris, and other waste generated by Project activities daily from adjacent areas, including the sidewalk area, gutter, street pavement, and storm drains impacted by the Project. All wastes shall be stored in covered containers, disposed of, or recycled immediately.

v. Clean sidewalks, driveways, or other paved areas within the construction site to eliminate or prevent mud-tracking conditions. Vacuuming, power sweeping, or manual sweeping is acceptable. Dispose of sweepings in a place that shall not pollute the storm drain system. Domestic water may be used but it shall be contained and directed to landscapes or the sanitary sewer. The discharge of wash-water to the storm drain system is prohibited.

vi. Inspect vehicles and equipment arriving on site for leaking fluids, and promptly repair leaking vehicles and equipment. Use drip pans to catch leaks until repairs are made.

vii. Avoid spills by handling materials carefully. Keep a stockpile of appropriate spill clean-up materials, such as rags or absorbent materials, readily accessible on site. Clean up all spills of materials brought on site for project activities according to the requirements of these specifications.

viii. Train employees regularly on good housekeeping practices and procedures. Assign responsibility to specific employees for inspecting good housekeeping, and responding to spills.

32. Post-Construction Storm Water Run-Off Control Measures

a. All permanent structural and nonstructural control measures that are planned for the project to control pollutants in storm water discharges after construction is completed shall be delineated on a site map. These controls shall be part of the design of the project and included in the architectural drawings. Post-construction Best Management Practices (BMPs) include, but are not limited to:
   i. Minimization of land disturbance
   ii. Minimization of impervious surfaces
   iii. Treatment of storm water run-off using infiltration
   iv. Water detention/retention
   v. Bio-filter BMPs
   vi. Efficient irrigation systems
   vii. Ensuring that interior building drains and trash enclosures are tied to the sanitary sewer system, and not the storm drain system
   viii. Appropriately designed and constructed energy dissipation devices

b. Post-construction BMPs shall be consistent with all local post-construction storm water management requirements, policies and guidelines as mandated by:
   i. State Water Resources Board Order No. 2013-0001 DWQ – Phase II Small MS4 Permit for sites below an acre and;
   ii. State Water Resources Board Order No. 2009-0009 as Modified by 2010-0014 DWQ for sites above an acre, registered in SMARTS.

c. The Contractor shall provide operation and maintenance manuals for post-construction storm water management controls installed as part of this Project. Funding for the operation and maintenance of the BMPs shall be identified by the Project Manager, and included in the manuals by the Contractor.

d. The Contractor shall refer to construction drawings for post-construction BMPs and include them in the SWPPP.

e. Develop a maintenance plan for the permanent BMPs installed at the site.

33. Personnel Training

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a. The Contractor shall train its employees working on the site on the requirements contained in this Section. The Contractor shall document this training in writing. University Representatives for the site will request to see the training materials and records at the onset of work.
b. The Contractor shall inform all subcontractors (if any) of the water pollution prevention requirements contained in this specification and include appropriate subcontract provisions to ensure that these requirements are met.

34. List Of Contractors Designated SWPPP Contacts and Phone Numbers
   a. Provide a list of employees who shall be responsible for writing, implementing and updating the SWPPP.

01 58 00 Project Identification

01 58 13 Temporary Project Signage

1. Advertising Signage: The use of Contractor or subcontractor advertising signage is prohibited except as approved by the Owner’s Representative in a written contract between the advertising entity and the owner. Do not display such advertising or job signs except as may be required for identification and deliveries as approved by the Owner’s Representative.
2. Owner-Furnished Warning Signs: Whenever required by the Owner's Representative, post Owner-furnished warning signs in locations as directed.

01 60 00 Product Requirements

01 61 00 Common Product Requirements

1. Manufacturers of products shall have produced said product (or like product) for at least five (5) years.
2. Cut sheets, installation manuals, and operations and maintenance manuals for each product shall be published, in English, on the manufacturer’s website and easily accessible. Contractor to furnish this documentation via submittals outlined in 01 78 00 Closeout Submittals.
3. Manufacturers shall have been doing business in the State of California for a minimum of five (5) years.

01 64 00 Owner-Furnished Products

1. General
   a. Certain materials, equipment and other items are identified in the Contract Documents as being furnished by the Owner and installed by the Contractor.
   b. In all cases so identified, the Contractor shall give timely notice to the Owner's Representative of its readiness to perform the Work.
   c. The Contractor shall receive all material furnished by the Owner or others at the Project site, as designated by the Owner's Representative. Upon delivery, the Contractor shall inspect the material and notify the Owner's Representative of any damage or insufficiency that would preclude the Contractor performing the Work.
   d. Where material furnished by others requires connections or attachments made by Separate Contractors for other Bid Packages, the Contractor shall coordinate with such other Separate Contractors to assure a complete installation.
   e. The Contractor shall store and protect material furnished by the Owner and assume all responsibility for security and protection of such equipment from the time it is received through Final Completion.
f. Once received by the Contractor, all material or equipment furnished by the Owner and installed by Contractor shall be subject to all terms of the Contract, including General Conditions.

01 70 00 Execution and Closeout Requirements

01 71 00 Examination and Preparation

01 71 23.16 Construction Surveying

1. Surrounding Site Condition Survey
   a. Prior to commencing the Work, the Contractor and the Owner shall tour the Project site together to examine and record the damage to existing adjacent buildings and improvements. This record shall serve as a basis for determination of subsequent damage due to the Contractor's operations, and shall be signed by all parties making the tour. Any cracks, sags, or damage to the adjacent buildings and improvements not noted in the original survey, but subsequently discovered, shall be reported to the Owner's Representative.

2. Laying Out Of The Work
   a. Actual field conditions deviating from the Drawings shall be reported to the Owner's Representative before proceeding, and the Contractor shall bear the expense of corrective work necessitated by its failure to so report. The Contractor shall employ a California registered Civil Engineer or Land Surveyor to lay out the Work and set grades, lines, levels, and positions throughout the Project site. (Note: Delete if not applicable.) Before beginning the Work, locate general reference points, establish monuments, and take action as is necessary to prevent their destruction; then lay out all lines, elevations, and measurements for buildings, grading, paving, utilities, and other parts of the Work. Verify figures and dimensions shown on the Drawings and accept responsibility for any error resulting from failure to so verify, including the cost of any additional re-surveying. Establish permanent monuments on curbs, manholes, or pavements, or with concrete embedded steel pipe with lead plug and brass nail, as approved.

3. Examination Of Existing Conditions
   a. Verify measurements in field, as required, for work fabricated to fit job conditions. Before starting work, examine adjoining work on which installment is in any way dependent for perfect workmanship and fit. Submit written description of any existing deficiencies detrimental to proper and timely installation of work to the Owner’s Representative.

01 71 33 Protection of Adjacent Construction

1. Protection Of Existing Structures and Utilities
   a. The Drawings show, if applicable, existing above and below grade structures, drainage lines, storm drains, sewers, water, gas, electrical, hot water, and other utilities which are known to the Owner.
   b. The Contractor shall locate all known existing utility installations before proceeding with construction operations which may cause damage to such installations. The existing installations shall be kept in service where shown and damage shall be repaired at no increase in Contract Sum or Contract Time.
   c. If any other structures or utilities are encountered, request the Owner's Representative to provide direction on how to proceed with the Work.
   d. If any structure or utility is damaged, take immediate action to ensure the safety of persons and property.
   e. Shoring:
      i. General Protection. Pursuant to Labor Code Sections 6705 and 6707, the Contractor shall include in its base bid all costs incident to the provision of adequate sheeting, shoring, bracing or equivalent method for the protection of life and limb which shall conform to the applicable Federal and State Safety Orders.
ii. Before beginning excavation five feet (5’-0”) or more in depth, the Contractor shall submit to the Owner's Representative a detailed plan showing the design of shoring, bracing, sloping, or other provisions to be made for worker protection from the hazards of caving ground during the excavation. The proposed plan shall comply with the State of California Construction Safety Orders and Title 24 of the California Code of Regulations (CCR). If the detailed plan varies from such shoring system standards, it shall be prepared by a registered civil or structural engineer whose name and registration number shall be indicated on the Drawing(s). If a dispute arises as to whether the plan must be prepared by a registered civil or structural engineer, the Owner's Representative's determination of the matter shall be final and conclusive. The cost of required engineering services shall be borne by the Contractor and shall be deemed to have been included in the amount bid for the Work as stated in the Agreement.

iii. Neither the review nor approval of any plan showing the design of shoring, bracing, sloping, or other provisions for worker protection, shall relieve the Contractor from its obligation to comply with Construction Safety Orders Standards and Title 24 CCR for the design and construction of such protective Work, and the Contractor shall indemnify the Owner and the Owner's Representative from any and all claims, liability, costs, action and causes of action arising out of or related to the failure of such protective systems. The Contractor shall defend the Owner, its officers, employees, and agents and the Owner's Representative in any litigation of proceeding brought with respect to the failure of such protective systems.

iv. Comply with State of California Construction Safety Orders, Article 6 - Excavations, Trenches, Earthwork whether or not the excavation, trench, or earthwork is five feet (5’-0”) or more in depth.

2. Care Of Existing Facilities
   a. The Contractor shall be responsible for repair or replacement of existing facilities including any landscaping, paving, roads and sidewalks damaged as a result of the performance of this Work. Any facilities or finishes damaged shall be repaired or replaced with materials and workmanship equivalent to that employed in executing the original work and to the satisfaction of the Owner's Representative.
   b. The Contractor shall take care not to overload the existing structure by storing material, erecting shoring, placing equipment or other materials upon or against the building.
   c. Do not park any vehicles, store materials or cross over landscaped areas. Any plant materials damaged as a result of the performance of this Work shall either be replaced with new plant materials equal in size to those damaged or by payment of an amount representing the value of the damaged material as determined by the Owner’s Representative. See 01 56 39: Temporary Tree and Plant Protection.

3. Noise and Dust Control
   a. The Contractor shall note that the building and adjacent facilities shall remain in operation during the entire construction period, and shall take all reasonable precautions to eliminate dust and minimize noise.
   b. The Contractor shall erect temporary partitions to confine noise and dust as required.

4. Access and Exit-Ways
   a. Do not interfere with use of or access to occupied portions of building or adjacent property.
   b. Maintain all corridors, stairs, halls and other exit-ways of occupied buildings clear and free of debris or obstructions at all times.
a. General:
   i. All material and equipment incorporated in the Work shall be:
      1. New.
      2. In condition acceptable to Owner's Representative.
      3. Suitable for intended use.
   ii. Keep materials clean, dry, and undamaged.

b. UL Label: Materials and equipment for which UL standards have been established and their label 
   service is available, shall bear the appropriate UL Label.

c. Manufacturer's Trade Marks and Names: Owner's Representative reserves the right to review and 
   request the removal or redesign of manufacturers' trade marks and names on items of materials and 
   equipment which will be exposed to view in the completed Work. Such removal or redesign shall be 
   at no increase in Contract Sum.

d. Delivery of Materials: Deliver all materials in the original packages, containers or bundles bearing 
   the name, brand, type and grade of material of the manufacturer or the supplier for whom the 
   product is manufactured.

2. Apparatus and Equipment Locations
   a. Locations of apparatus and equipment indicated on the Drawings (if any) are approximate only, and 
      are subject to change to suit operational service as approved by the Owner's Representative.
   b. Furnish and install apparatus and equipment in a manner and in locations which keep openings and 
      passageways clear. Make changes in locations of equipment and materials which may be necessary 
      to accomplish these purposes as approved by the Owner's Representative.

3. Welding and Burning
   a. Welding and burning of steel shall be eliminated as much as possible. When unavoidable, welding 
      and burning shall be done with all possible precaution to avoid fire hazard. Contractor shall provide 
      a fire watch for one-half (1/2) hour after all burning stops. The Contractor shall provide protection 
      for all adjacent surfaces.

4. Excavation, Shoring and Trenching
   a. Refer to 01 71 33 (1e: Shoring) for additional requirements.

01 73 29 Cutting and Patching

Whenever any cutting, removal, or alterations of existing work is required to form connections with new work 
or otherwise meet the requirements of the Contract Documents, perform such work so as not to damage the 
work that shall remain in place. Perform patching and repairs occasioned thereby using materials, construction 
details, and finishes matching those of the existing work as closely as possible and to the approval of Owner's 
Representative.

1. General
   a. The Contractor shall be responsible for all cutting, fitting and patching required to complete the 
      work and to:
      i. Make its several parts fit together properly.
      ii. Uncover portions of the Work to provide for installation of ill-timed work.
      iii. Remove and replace work not conforming to requirements of the Contract Documents.
      iv. Provide routine penetrations of nonstructural surfaces for installation of electrical 
          conduit, plumbing and ductwork.

2. Submittals
   a. Submit a written request to Owner's Representative well in advance of executing any cutting or 
      alteration which affects:
      i. The Work of the Owner or any separate Contractor.
      ii. The structural value or integrity of any element of the existing building.

Adopted August 2015
iii. The integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
iv. The efficiency, operational life, maintenance or safety of operational elements.
v. The visual qualities of sight-exposed elements.

b. The request shall include:
   i. Identification of the Project.
   ii. Description of the affected work.
   iii. The necessity for cutting alteration.
   iv. The effect of the Work on the Owner or any separate Contractor and on the structural or weatherproof integrity of the existing building.
   v. Description of the proposed work:
      1. The scope of cutting, patching or alteration,
      2. The trades who will execute the work,
      3. Products proposed to be used,
      4. The extent of refinishing to be done.
   vi. Alternatives to cutting and patching.
   vii. Cost proposal, when applicable.
   viii. Written permission from any separate Contractor whose work will be affected.

c. Should conditions of the Work or the schedule indicate a change of products, submit a written request for substitution.

d. Submit a written notice to the Owner's Representative designating the date and the time the work will be uncovered.

3. Materials
   a. Comply with the Contract Documents for each specific product involved.

4. Execution
   a. Inspection
      i. Inspect existing conditions of the Project, including elements subject to damage or to movement during cutting and patching.
      ii. After uncovering work, inspect the conditions affecting the installation of products or performance of the Work.
      iii. Report unsatisfactory or questionable conditions to the Owner's Representative in writing; do not proceed with the Work until the Owner's Representative has provided further instructions.
   b. Preparation
      i. Provide adequate temporary support as necessary to assure the structural value or integrity of the affected portion of the work.
      ii. Provide devices and methods to protect other portions of the Project from damage.
      iii. Provide protection from the elements for that portion of the Project which may be exposed by cutting and patching work.
   c. Performance
      i. Execute cutting and demolition by methods which will prevent damage to other work and will provide proper surfaces to receive installation of reports.
      ii. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.
      iii. Restore work which has been cut or removed; install new products to provide completed work in accordance with requirements of Contract Documents.
      iv. Fit work airtight to pipes, sleeves, ducts, conduit and other penetrations through surfaces.
      v. Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes.
         1. For continuous surfaces, refinish to nearest intersection.
2. For an assembly, refinish the entire unit.

01 74 00 Cleaning and Waste Management

01 74 13 Progress Cleaning

1. Under no circumstances shall rubbish, debris, waste, dust, dirt, or surplus materials be allowed to accumulate in the building, or on the Project site, and all such material shall be removed continually as the Work progresses and by the end of each day's Work.
   a. Materials: In occupied building areas, only sufficient materials and flammable or toxic substances necessary for the Work being performed that day or shift shall be brought into the building and work areas. In no case shall flammable or toxic substances be stored in the building, and these substances shall be immediately removed from the building when not needed and not later than the end of the day's Work.
   b. Splattering or spilling of material shall be promptly cleaned up at time of occurrence.

2. Contractor shall provide street sweeping whenever silt from construction site is carried over to adjacent public thoroughfares.

3. Failure to maintain a clean and orderly project site shall necessitate action by the Owner. In the event that the Contractor fails to clean up and maintain the Project in a clean and orderly manner, the Owner may clean the job-site and back-charge the Contractor for costs in accordance with Section 01 33 00: Submittal Procedures.

01 74 16 Construction Waste Management and Disposal

1. Goals:
   a. UC Berkeley has a goal of achieving a seventy-five percent (75%) diversion rate by June 2012, and zero waste by 2020. See: http://sustainability.berkeley.edu/waste

2. Definitions
   a. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk or similar products.
   b. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash debris and rubble resulting from construction, remodeling repair and demolition operations. Hazardous materials are not included.
   c. Diversion from Landfill: To remove, or have removed, from the site for recycling, reuse or salvage material that might otherwise be sent to a landfill. Diversion from Landfill shall not include using the material as alternative daily cover at a landfill site, nor shall it include burning, incinerating, transformation processing or thermally destroying waste.
   d. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product.
   e. Recycle (recycling): To sort, separate, process, treat or reconstitute solid waste and other discarded materials for the purpose of redirecting such materials into the manufacture of useful products. Recycling does not include burning, incinerating, transforming or thermally destroying waste.
   f. Return: To give back reusable items or unused products to vendors.
   g. Reuse: To reuse excess of discarded construction material in some manner on the Project site.
   h. Salvage: To remove waste material from the Project site for resale or reuse.
   i. 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.
   j. Waste Management Plan: A Project-related plan for the collection, transportation and disposal of waste generated at the construction site. The purpose of the plan is to ultimately reduce the amount of material going to landfill.

3. Waste Management Requirements

Adopted August 2015
a. All projects shall generate the least amount of waste possible and the process shall ensure the generation of as little waste as possible due to error, inaccurate planning, breakage, mishandling, contamination, or other factors.

b. Of the inevitable waste that is generated, as many of the waste materials as feasible, and as stated here, shall be reused, salvaged, or recycled. Waste disposal in landfills shall be minimized.

c. A minimum of fifty percent (50%) of total project demolition and construction waste (by weight) shall be diverted from the landfill and projects shall attempt to divert seventy-five percent (75%). Volume reporting is only permitted by exception. The following waste categories are likely candidates to be included in the diversion plan.
   i. Inerts (and clearing debris, rock and dirt)
   ii. Concrete
   iii. Bricks
   iv. Concrete Masonry Units (CMU)
   v. Asphalt
   vi. Metals (e.g. banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized, stainless steel, aluminum, copper, zinc, brass, bronze)
   vii. Cardboard, packaging
   viii. Clean dimensional wood
   ix. Asphalt shingles or roofing
   x. Drywall
   xi. Carpet and pad
   xii. Ceiling tiles
   xiii. Glass
   xiv. Shrink- or stretch-wrap from furniture/palletized deliveries
   xv. Greenwaste and organic landscaping materials (brush, chips, trees, stumps)
   xvi. Reuse items indicated on the Drawings and/or elsewhere in the Specification

b. All fluorescent lamps, HID lamps and mercury-containing thermostats removed from the site shall be recycled and disposed of through existing campus procedures. See http://www.ehs.berkeley.edu/sites/default/files/lines-of-services/workplace-safety/55electronicwaste.pdf

4. Submittals
   a. The General Contractor shall be responsible for the development and implementation of a Waste Management Plan for the Project. The Plan shall be approved by the Owner’s Representative (OR)
   b. Waste Management Plan. Before any work begins, the General Contractor shall submit to the OR its Waste Management Plan containing the following:
      i. Estimate of the total proposed jobsite waste to be generated, including types and quantities (by weight).
      ii. Proposed alternatives to Landfilling: A list of each material proposed to be salvaged, reused, or recycled during the course of the Project, the proposed destination for each material and the projected amount (by weight).
      iii. Material handling procedures. A description of the means by which any waste materials identified in item (b) above shall be protected from contamination, and a description of the means to be employed in recycling the above materials consistent with the requirements for acceptance by recycling processors to be utilized.
      iv. List of documentation to be provided in Progress Reports.
      v. Tiered pricing for waste removal to reflect potential hauling costs as Class 1, Class 2 and Class 3 materials for disposal at landfills.

5. Progress Reports

Adopted August 2015
a. The Contractor shall submit Waste Management Progress Report(s) at a regular time interval specified by the OR. The Progress Report shall contain the following information:
   i. Project title, name of company completing report, and dates of period covered by the report.
   ii. Report on the disposal of all jobsite waste, including:
       1. Recycled materials. For each material, provide the following:
          a. Amount (in tons)
          b. Dates removed from the jobsite
          c. Receiving Party
       2. Reused or salvaged materials. For each material, provide the following:
          a. Amount (in tons)
          b. Description of intended or actual use
       3. Landfilled materials. Provide the following:
          a. Amount (in tons)
          b. Dates removed from the jobsite
          c. Identity of the transfer station or landfill
   iii. Include legible copies of on-site logs, weight tickets and receipts. Receipts shall be from recycling and/or disposal site operators who can legally accept the materials for the purpose of reuse, recycling or disposal. If mixed construction and demolition waste is sorted off-site, provide a letter from the processor stating the average percentage of mixed C&D waste they recycle. The Contractor shall save original documents and provide certified weight tags for the duration of the contract.
   iv. This plan and all reports shall be submitted to the solid waste/recycling manager on campus, for inclusion in campus waste generation and diversion reports.

6. Project Meetings
   a. Waste management plans and implementation shall be discussed at the following meetings:
      i. Pre-demolition meeting
      ii. Pre-construction meeting
      iii. Regular job-site meetings

7. Summary
   a. This section applies to all UC Berkeley projects. The information and activities required in this section shall meet UC Berkeley Green Building Requirements and USGBC Leadership in Energy and Environmental Design (LEED) for the Construction Waste Management (LEED NC v2.2 MR Credit 2.1 and MR 2.2 and LEED- CI v2.0 credit MR 2.1 and MR 2.2). See http://recycle.berkeley.edu for campus recycling resource information.

01 74 23 Final Cleaning

1. The Owner's Representative's Inspection: Give the Owner's Representative a minimum twenty-four (24) hours advance notice of readiness for inspection. Any deficient cleaning operations, as determined by the Owner's Representative, shall be immediately corrected as approved at the Contractor's expense.
   a. Interior surfaces and areas where Work is performed shall be left in vacuum clean condition with all dust, dirt, stains, hand marks, paint spots, plaster droppings, and other blemishes and defects completely removed. To the extent of the Contractor's operations, use or materials, the following requirements apply to all areas where Work is performed:
      i. Walls: Bare and painted surfaces shall be cleaned and free of dust, lint, streaks, or stains.
      ii. Hardware and metal surfaces shall be cleaned and polished using non-corrosive and non-abrasive materials.
      iii. Glass: New glass and soiled existing glass shall be washed and polished both sides and left free of dirt and spots. Labels shall be removed.
iv. Ceilings shall be clean and free of stains, hand marks, and defacing.

v. Fixtures and Equipment: New mechanical and electrical fixtures and like items shall be cleaned and polished. Lighting fixtures shall be free of dust, dirt, stains, or waste material. Equipment and machinery shall be cleaned, serviced, and ready for use. Existing items shall be cleaned as required including ventilating supply and return equipment in walls and ceilings.

vi. Surfaces not mentioned shall be cleaned according to the intent of this Section and as required for Owner's Representative's approval.

2. Disposal
   a. Under no circumstances shall debris, rubbish, or waste material be disposed of on the Owner's property by burying or otherwise, and all shall be removed from the Owner's property to a legal disposal area. The Contractor shall bear all dumping charges.

3. Corrective Work
   a. Where existing Work has been dirtied, stained, defaced, or otherwise made defective and cleaning operations are not satisfactory, as determined by the Owner's Representative, the Contractor shall remove the Defective Work and install new Work as requested and approved, at no extra cost or extra time to the Owner.

4. Clean Up Specified In Other Sections
   a. Any clean up specified in other Sections of these Specifications shall be in addition to, and not in lieu of, these requirements.

01 77 00 Closeout Procedures

01 77 19 Closeout Requirements

Preparation for Acceptance (Prior to Final Inspection):
1. Temporary facilities and utilities shall be properly disconnected, removed and disposed of off-site.
2. All systems, equipment and devices shall be in full and proper adjustment and operation and properly labeled and identified.
3. All materials and finishes shall be neat, clean and unmarred.
4. All broken work, including glass, curbs, slabs, paving, landscape sprinklers, etc., shall be replaced or properly repaired.
5. Clean-up of the site shall be complete (see 01 74 23).
6. All warranties/guarantees, operation and maintenance manuals, as-built drawings and as-built specifications, building equipment and/or systems training, extra stock, record documents and other submittals as specified in the body of theSpecifications and Contract Documents, shall be assembled in an orderly manner and delivered to the Owner's Representative. Final payment will be withheld in instances where the Contractor fails to meet closeout requirements and/or submit required documents.

Final Inspection
1. Upon receipt of written notice from the Contractor that the Work is ready for final inspection and acceptance, the Owner's Representative and the Contractor shall promptly make a joint inspection of the Work and note deficiencies, if any. When noted deficiencies have been removed and the Owner's Representative finds the Work to be complete in every respect of the Contract Documents, the Owner's Representative shall advise the Owner to file a Notice of Completion.
2. The Notice of Completion shall be prepared and recorded in the County Recorder's Office. The date of Final Acceptance in the Notice of Completion shall start the Warranty/Guarantee period.
3. The Contractor shall not submit a Payment Application representing the Work of the Project to be one hundred percent (100%) complete prior to the recordation of the Notice of Completion.

01 78 00 Closeout Submittals

01 78 36 Warranties/Guarantees

1. The General Conditions require all items to be guaranteed for a period of at least one (1) year.
   a. Guarantees for more than one (1) year required by individual Specification Sections require a separate written Guarantee form by Contractor.

2. Form Of Guarantee
   a. Use only the Guarantee form in Appendix B: Forms.

3. Submittal Requirements
   a. Submit all Guarantee forms, along with a Project Directory or List of Contacts, prior to the date of final completion and prior to final application for payment.
   b. Provide three (3) original wet signed copies of each different Guarantee form.
   c. The Guarantee form may be reproduced on the letterhead of the Contractor, the Subcontractor(s), or the supplier doing the work or supplying the item guaranteed.
   d. The Contractor shall not modify any wording or punctuation on the Guarantee form. Contractor shall only complete the blank portions of the Guarantee form.
   e. The Contractor signs all Guarantee forms.

01 78 39 Project Record Documents

1. Maintenance Of Documents and Samples
   a. Store Project As-Built documents and Samples in the Contractor's field office separate from documents used for construction.
   b. Maintain As-Built documents in order and in a clean, dry, legible condition.
   c. Do not use As-Built documents for construction.

2. As-Built Documents
   a. The Owner's Representative shall, at no cost, provide the Contractor with a set of Drawings and Specifications of the original Contract Documents, which shall be used for recording the "As Built" condition of all the Work.
   b. As-Built Drawings: Record the following kinds of information on the As-Built Drawings:
      i. Locations of Work buried under or outside the building, such as (but not limited to) plumbing and electrical lines and conduits. Provide horizontal and vertical dimensions from fixed points.
      ii. All electrical work shall be shown diagrammatically. In addition, the actual numbering of each electrical circuit shall be identified clearly
      iii. Locations of all HVAC, plumbing and electrical Work concealed inside the building; and other work that is changed by Contractor from that shown on the Drawings.
      iv. Locations of all items, not necessarily concealed, which vary from the locations shown on the Drawings.
      v. Contractor shall provide, on DVD, color CCTV footage of sanitary sewer lines rehabilitated/installed.
c. The following requirements for As-Built Drawings are in addition to those specified elsewhere:
   i. They shall be done carefully and neatly by a competent drafter, familiar with the Work involved, using methods acceptable to the Owner's Representative.
      1. They shall be kept up to date during the entire progress of the Work and made available to the Owner's Representative at any time.
      2. Additional Drawings shall be provided as required to accurately describe changes.
      3. Record all changes in size, location, and other features of installation shown on the Drawings.
      4. The Contractor shall cross-reference all changes approved by the Owner to develop the as-built drawings and as-built specifications from the last conformed set of Contract Documents, noting the type and number of the document authorizing the change (Request for Information, Change and Field Orders, Bulletins, etc.)
      5. Record all locations of underground Work, points of connection, valves, manholes, catch basins, capped stubouts, invert elevations, etc.
      6. Record sufficient information such that the Work concealed in the building can be located with ease and accuracy. This may be accomplished by dimensioning or by stating the relationship to the spaces in the building near which the Work was installed. The Owner's Representative's decision on what constitutes sufficient information shall be final.
      7. Provide compact, digital video or Blu-Ray disc (as appropriate for file size) of “As-Built” drawings using AutoCAD 2009 or later, in addition to one (1) full size set of reproducible black-line drawings (collated, but not bound).

d. Shop Drawings: Provide final Shop Drawings which have been updated to show actual conditions, for Work specified in the individual specifications.

e. As-Built Specifications and Addenda:
   i. Record the following:
      1. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
      2. Changes made by Addenda, Change Order, or Field Order, and clarifications and interpretations made by Letter of Instruction.
      3. Provide compact, digital video or Blu-Ray disc (as appropriate for file size) in Microsoft Word or Portable Document formats – Version 2010 or later, and one (1) hard copy in 3-ring view binder(s).
1. The UC System and UC Berkeley have a goal of being carbon neutral - no harmful greenhouse gas related emissions - from building energy use, refrigerant related releases, emergency generator fuel use, and campus fleet use by the year 2025. This over-arching goal shall be considered in the design and building of new and renovated facilities.

2. Additionally, the UC System and UC Berkeley have sustainability policies and goals related to energy efficiency, renewable energy supply, water, waste, procurement, food, transportation, land-use, and student service learning. These goals can be found at http://sustainability.berkeley.edu/.

3. In addition, the campus requires full compliance with Title 24 2013, Part 6 in regard to the design, construction, commissioning and acceptance testing, and full compliance with Title 20 in regard to appliances that might be installed or furnished as part of Project scope.

4. To enable incorporation of these into the design and building of new and renovated facilities, a consultation with the Office of Sustainability and Energy (or a sustainable design charrette, depending on the size of the Project) will be required early in the design phase of projects to ensure incorporation of sustainable features.

1. Building Commissioning Or System(S) Commissioning (Prior To Final Acceptance)
   a. (Note: Owner's Representative to select appropriate paragraph title and edit the following paragraph as applicable.) Prior to final inspection, the Contractor shall schedule, through the Owner's Representative, training sessions, agendas, programs, manuals and documentation as required to educate and familiarize maintenance and operations staff with equipment and system's operations. At minimum, one (1) training session per system and major piece of equipment is required. Final inspection shall not be scheduled until training sessions for all building systems and major pieces of equipment have been satisfactorily conducted. Submit in writing to the Owner a minimum fourteen (14) days' advance notice of each training. Notice shall include the following: proposed training date, training start time, approximate duration, location, company name of Subcontractor and/or Manufacturer, and a detailed agenda that outlines the operation and maintenance information to be reviewed and demonstrated during the training session. UC Berkeley’s preferred training days are Tuesday, Wednesday and Thursday, with starting times no earlier than 8:30AM and ending no later than 3:00PM, with a thirty (30) minute lunch break beginning at approximately 11:30AM.
02 00 00  Existing Conditions

02 40 00  Demolition and Structure Moving

Clearly identify on drawings the extent and scope of demolition work.

02 42 00  Removal and Salvage of Construction Materials

1. See Section 01 74 00: Cleaning and Waste Management for more information
2. Clearly identify on drawings the items to be turned over to the Owner. Specify a procedure for delivery to Owner. Identify those items which:
   a. go to Excess & Salvage
   b. go to Facilities Services
   c. go to Building or Department Representative (i.e. Building Coordinator or Department’s Management Services Officer)
   d. other
3. Clearly identify on drawings items to be:
   a. relocated and where items are to be relocated
   b. saved and protected
   c. removed and disposed (where possible, try to comply with UC Berkeley’s goal of Zero Waste by 2020)
   d. salvaged, maintained and relocated (e.g. specimen trees)
4. Utility disconnection and re-establishment of services: Coordinate with Facilities Services, EBMUD and PG&E via the University of California Project Manager.
5. Protect building exterior and landscape areas and repair any damage caused by the Project to new condition (see Division 32: Exterior Improvements).
6. Path of travel for ingress to and egress from campus shall include requirements for site protection, clean up and repairs.
7. The Contractor shall be responsible for disposal of all construction debris.

02 41 19  Selective Demolition

Selective Demolition: All requirements in 02 42 00 (Removal and Salvage of Construction Materials) apply to this Section. In addition the following shall be considered in selective demolition:
1. Utility Disconnection: Coordinate with Facilities Services via the University of California Project Manager.
2. Path of travel for debris removal - include requirements in specifications for:
   a. Dust protection.
   b. Cleanliness.
   c. Clean-up.
   d. Protection of ventilation systems.
   e. Vibration and Noise control.
3. Temporary Partitions and Barriers: Ensure assemblies are rated if in an exit corridor.
4. Protect from dust intrusion all smoke alarm and sprinkler heads. Where sprinkler heads are protected from dust and paint overspray, remove protection daily at the close of the construction day, re-enabling the system to function. Coordinate with the Project Manager for disarming fire alarm devices where there is a risk of dust. Bagging of smoke detectors is prohibited without prior approval of the Designated Campus Fire Marshal (DCFM).
5. Protect special architectural features, plaques and ornamentation.
6. Protect elevators.
7. The Contractor shall confirm structural capacity for debris removal and equipment along the path of travel.
8. Coordinate with the University Police Crime Prevention Unit for disarming or protecting intrusion alarm systems/components and video systems/components.
9. Coordinate with the University Police Crime Prevention Unit for disabling or modifications to campus emergency phones.

02 70 00 Water Remediation

1. Storm Water Discharge:
   a. See Division 01 57 00: Temporary Controls for construction-related specification.
   b. See Division 22 14 00: Facility Storm Drainage for permanent installation requirements.
   c. The Project Manager will coordinate with Physical and Environmental Planning (PEP) and Environment, Health & Safety (EH&S) for project-appropriate specification language.
03 00 00 Concrete

03 05 00 Common Work Results for Concrete

1. All Work to minimally conform to ACI 318 (latest edition), “Building Code Requirements for Structural Concrete and Commentary” and all other American Concrete Institute Standards.
2. Exterior exposed concrete surfaces not to receive other finishes shall be treated with a fluid-applied penetrating water repellent. See Division 07 00 00: Thermal and Moisture Protection.

03 30 00 Cast-In-Place Concrete

1. Under-slab Vapor Retarder Barrier: Provide beneath all slabs on grade.
   b. Provide Class A retarder conforming to ASTM E1745-11, “Specification for Plastic Water Vapor Retarders used in Contact with Soil or Granular fill Under Concrete Slabs,” where slabs are to receive resilient, wood, and carpet flooring and where recommended by the Project’s Geotechnical Engineer for existing and anticipated below grade hydrostatic water conditions at the Project site.
   c. Install over prepared aggregate base material.
   d. Joints in the barrier shall be lapped and taped.
2. Curing materials, surface texture, flatness and levelness for concrete flatwork shall be selected for compatibility with finish floor materials. Where surface is to remain unfinished, an appropriate curing agent shall be applied.
3. Floor and slab construction shall conform to the following:
   a. Flatwork tolerances shall be determined using flatness and levelness F-numbers measured in accordance with ASTM E1155-14, “Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers”.
   b. Use “Alpha” Class designations where the scope of work is limited or less than 3,000 square feet.
4. Completed exposed concrete flatwork shall maintain a surface coefficient of friction of more than 0.05 percent for slip resistance. Field tests indicating compliance are required and shall be in accordance with ASTM D2047, "Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine." Where sealers are to be used, field tests shall be taken after application of the sealer.

03 33 00 Architectural Concrete

For architecturally-exposed concrete where appearance is important, the University’s Representative shall:

1. Require submission of formwork design for review of form types, location of joints and ties, details of reveals, chamfers, textured surfaces, and other visual aspects of concrete.
2. Require a full-size mock-up of a typical section of work at the Project site (in-place mock-up preferable).
3. Stress proper storage and repair of forms with restrictions on reuse of worn forms.
4. Review slump, aggregate size, and steel placement to ensure proper placing and aggregation of concrete for desired appearance.
5. Consider use of superplasticizers and integral color.
6. Require small samples prior to fabrication of full-size mock-up (in-place mock-up preferable). Set clear tolerances for finish surfaces.
7. Clearly limit deviation from line and plumb.
8. Set amount of rock pockets, sand streaks and similar surface defects that are allowable. Set maximum amount and types of patching that are acceptable.
9. Require conformance to appropriate formwork class.

03 45 00      Precast Architectural Concrete

1. For pre-cast architectural concrete, the same requirements as Section 03 33 00 (above) shall apply.
1. General
   a. Reinforcing steel shall be inspected to verify proper placement, tying and clearances prior to grouting.
   b. If not painted, the exposed exterior face of concrete masonry units (CMU) and brickwork shall be treated with a fluid-applied penetrating water repellent. Division 07: Thermal and Moisture Protection.

2. Products
   a. Hollow and solid CMU shall conform to ASTM C90, “Specification for Loadbearing Concrete Masonry Units,” Grade N.
   b. Solid clay brick shall conform to ASTM C216, “Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale),” Grade MW.
   c. Hollow facing and building clay brick shall conform to ASTM C652, “Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale),” Grade MW.
   d. An integral water-repellent admixture shall be used in the manufacturer of block and in mortar mix at the jobsite for concrete masonry construction at exterior walls not to be covered by other exterior finish materials.

3. Execution
   a. Material and workmanship for installation of CMU shall conform to requirements of the National Concrete Masonry Association (NCMA), the Concrete Masonry Association of California and Nevada (CMACN) and the California Building Code (CBC).
   b. Cold and hot-weather construction procedures shall be used, demonstrating compliance with requirements included in ACI 530.1, “Specification for Masonry Structures.”
   c. Control joints shall be caulked on both interior and exterior faces before interior wall finish materials are applied.
   d. Mortar profile at exposed exterior horizontal joints shall be selected to discourage collection of water in joints.
   e. "Cap" concrete masonry unit walls by filling the top row of the blocks with cement to eliminate rodent access to the interior of the wall.
05 00 00  Metals

05 05 00  Common Work Results for Metals

1. Shop drawings are required for fabrication of structural steel and custom fabricated assembles.
   a. The Contractor shall be required to verify field conditions and dimensions.
   b. Drawings shall be reviewed for constructibility.
2. Steel base plates shall be provided for items bearing on concrete. Anchor bolts shall be used for leveling.
   Space below plates shall be filled solid with appropriate non-shrink grout.
3. Exposed welds shall be ground smooth. Templates shall be used for setting anchor bolts.
4. The Contractor shall supervise installation of anchor bolts and related items to assure proper setting in concrete.
5. Metal exposed to atmosphere, moisture or embedded directly in concrete shall be hot dipped galvanized minimum four inches (4") above surface of concrete.
6. Metal exposed to atmosphere or moisture shall be lead-free coated, hot-dip galvanized.
7. The Contractor shall be required to submit completed “Procedure Qualification Record” (PQR), “Welding Procedures Specification” (WPS) and Welder Performance Qualification Records. Certified manufacturers’ test reports are required for all steel brought on site. Any pre-welded steel shall be accompanied by appropriate material and workmanship qualifications.
8. Mock-ups: Full-size, partial mock-ups may be considered for ornamental metal items to verify conformance to design intent, review quality of workmanship, and evaluate applied coatings and colors (in-place mock-ups preferred).

05 05 13  Shop-Applied Coatings for Metal

1. General:
   b. Shop-primed ornamental metal shall be spray finished in the shop to the greatest extent possible
2. Products:
   a. Galvanizing-Repair Paint: Minimum 82 percent zinc-dust-content paint for re-galvanizing welds in galvanized steel, complying with FS DOD-P-21035a. Where repaired galvanizing is to be left exposed, use repair paint that will closely match appearance of hot-dip galvanizing.
   b. Primer for Galvanized Steel: Inorganic, zinc-rich: "Tneme-Zinc 90-97," Glidden, or equal, 2.0 to 3.5 mil dry-film thickness (DFT).
   c. Finish Coatings:
      i. Select coatings for durability, fade resistance, and abrasion resistance where subjected to any contact
      ii. Field applied coatings shall be VOC compliant and selected for long-term durability and ease of maintenance and repair.
3. Galvanizing:
4. Surface Preparation of AESS and Ornamental Metal: Comply with SSPC: The Society for Protective Coatings (SSPC) surface preparation specification No. 6 or No. 10. If steel is to be galvanized, prepare surface to this standard prior to galvanizing.
   a. Galvanized Steel Prior to Priming: SSPC SP No. 1 exercising care not to damage galvanizing.

6. Zinc-coated surfaces to be painted shall be chemically treated prior to painting in accordance with SSPC standard SP-1, “Solvent Cleaning,” exercising care not to damage galvanizing.

7. After erection, abraded areas of shop primer, field bolts, and welds shall be spot painted and touched-up with the same coating used for shop priming.

8. Clearly indicate whether protective coatings are to be shop and/or field applied including intermediate and finish coats.

05 10 00 Structural Metal Framing
05 12 00 Structural Steel Framing
05 12 13 Architecturally-Exposed Structural Steel Framing

1. Members intended to be left exposed in completed construction shall be designated as "Architecturally Exposed Structural Steel" (AESS) or "Architecturally Exposed Steel" (AES) shall meet, as a minimum, the special requirements of AISC 303-10: Code of Standard Practice for Steel Buildings and Bridges, Section 10. An upgrade to these minimum requirements shall be considered for structural steel based on project conditions.

2. In addition to AISC 303-10, Section 10, ornamental metal work shall conform to recommended practices of the National Association of Architectural Metal Manufacturers (NAAMM).

05 70 00 Decorative Metal

1. Walkway canopies, railings, and guardrails shall be designed to reflect their exposure to student use.

2. Shop drawings are required for fabrication of canopies, railings, guardrails, and similar work.
07 00 00  Thermal and Moisture Protection

07 05 00  Common Work Results for Thermal and Moisture Protection

1. General:
   a. Ease and efficiency of future re-roofing operations shall be considered when selecting a roofing system.
      i. Minimize the number of roof penetrations and equipment pads. Use one larger pad and not several smaller pads to greatest extent possible.
      ii. Protect existing adjacent building roofs from construction activity. Clearly specify and document access requirements, staging areas, protection of building and surrounding areas, and scaffolding.

2. References:
   a. The latest editions of the following documents and publications shall apply to roofing work:
      ii. FM Global (FM): Loss prevention data books and materials approval publications.

07 10 00  Dampproofing and Waterproofing

1. Introduction:
   a. Below grade foundation walls, retaining walls, above-grade concrete and masonry planters, and other structures subject to hydrostatic pressure shall receive appropriate dampproofing or waterproofing.
   b. The Contractor shall give the manufacturer and the University’s Representative seventy-two (72) hours’ notice prior to beginning work.

2. Warranty:
   a. The Manufacturer shall supply a minimum twenty (20) year written warranty against water penetration through the treated areas.

3. Installation of Systems:
   a. A written clarification from the Manufacturer’s Representative shall be required when a particular condition warrants special design or substitution of materials.

07 14 00  Fluid-Applied Waterproofing

1. Introduction:
   a. Exterior exposed masonry and concrete surfaces that will not receive other finishes shall be treated with a fluid-applied penetrating water repellent.
   b. The Manufacturer’s Representative shall be present and approve surface preparation, application methods, and completed work.

2. Warranty:
a. The Manufacturer shall supply a five (5) year written warranty that surfaces treated with water repellent shall be free of defects in materials and workmanship, and that surfaces shall remain water repellent.
b. Where terms of the manufacturer's guarantee require, provide a full-time jobsite inspector to supervise application.

3. Products:
   a. Water repellent material formulation and concentration shall be selected based on porosity and composition of material to receive treatment, and level of water-repellency required.
   b. Products shall be VOC compliant.

4. Preparation:
   a. Power-wash surfaces prior to application.
   b. Wash water shall not be discharged to or allowed to enter the storm drain system. Wash water shall be contained and properly disposed in accordance with UC Berkeley’s Water Protection Policy.
   c. Repoint joints and/or route cracks as required. Repointing and/or filler materials shall be compatible with the water repellent.
   d. Cleaning and repointing/filling shall be completed and areas allowed to dry prior to application of water repellent.
   e. Prior to application, manufacturer shall certify in writing if moisture content is acceptable.

5. Adjacent surfaces and landscaping shall be protected from overspray. Application: Apply material as recommended by the manufacturer.

07 20 00 Thermal Protection
07 21 00 Thermal Insulation

1. General
   a. Asbestos containing materials shall not be used and project specifications shall specifically prohibit their use.

2. Criteria
   a. Insulating values shall be based on conformance with requirements of the latest version of California Code of Regulations Title 24 but shall be not less than the following:
      i. Walls: R-19 for assemblies above grade, R-13 for interior below grade and R-5 for exterior below grade.
      ii. Roofs/Ceilings: R-30 for total assembly.
      iii. Raised Floor (non-concrete): R-19 for total assembly.

07 30 00 Steep Slope Roofing
07 31 00 Shingles and Shakes
07 31 13 Asphalt Shingles

1. Materials
   a. Utilize only “Premium” quality, heavy-duty, dimensional shingles unless otherwise approved by the Project Manager complying with ASTM D3018, Type I, ASTM D3462, and with the following characteristics:
      b. Weight: Not less than 240 pounds per square, nominal.
      c. Fire Rating: UL Class A.

2. Execution:
   a. Use an eighteen-inch (18”) wide self-adhesive strip at rakes, eaves and roof to wall intersections. The self-adhesive strip shall turn up vertical surfaces a minimum of three inches (3”) and shall be
installed prior to underlayment. The Manufacturer of underlayment and pre-strips shall be approved by the University.

b. Use corrosion resistant fasteners. Staples are not permitted.

c. Use six (6) nails and two (2) dabs of mastic per shingle when slope exceeds sixty degrees (60°).

d. Provide for step flashing at inside and outside corners and intersections with vertical surfaces.

e. Provide reglet-type detachable 2-piece metal counterflashing.

f. Provide metal flashing at rake-to-rake intersections.

g. Utilize two layers of ridge shingles with mastic sealant between butt ends at ridges. Provide ridge venting where required.

h. Use metal eave nosing and strap gutters to fascia or rafter ends. Do not use wing-type gutters. Fascia shall be installed after underlayment; double seal.

i. Double-seal valley pans to underlayment.

j. Use shingle vent whenever possible. Do not use staples as fasteners.

3. Guarantees/Warranties
   

b. Contractor: As required for asphalt shingles.

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07 31 29 Wood Shingles and Shakes

1. General: Comply with applicable standards of the Cedar Shake & Shingle Bureau, Sumas, WA.

2. Materials:
   
a. Shingles: "Number 1 Red Cedar Shingle" with "Certi-Guard" blue label fire retardant treatment and UL Class C label for exterior fire exposure.
   
b. Fasteners: Corrosion-resistant "box" nails of size as recommended by manufacturer.

3. Guarantees/Warranties:
   
a. Manufacturer’s Warranty: Not less than thirty (30) years.
   
b. Contractor: Five (5) year workmanship and installation guarantee against leakage and other workmanship and installation failures. Terms of warranty shall include:
      
i. Defects include water leakage from the roof and flashing, curling or cupping of shingles, shingles which have blown off, loosening or dislodgement of metal flashing, and excessive loss of surface granules.
      
ii. Making emergency, temporary repairs within twenty-four (24) hours of notification
      
iii. Completion of permanent repairs within thirty (30) days.

07 32 00 Roof Tiles

07 32 13/16 Clay/Concrete Roof Tiles

1. Existing Tile Roofs:
   
a. Verify historic significance and ascertain requirements for replacement or patching with the University Project Manager.
   
b. Issues to be reviewed include extent of impact on roofing by the Project, condition of existing tiles, weatherproofness of existing system, condition of existing flashing, and availability of matching replacement tiles.
   
c. When feasible, reuse tiles.

2. Materials:
   
a. Sheet underlayment shall be 1 or 2-plys of self-adhering (SA) membrane or a 2-ply built-up, inorganic underlayment (only on wood substrate).
   
b. Fasteners: Minimum penetration, tile tie systems are preferred. Use utility double flashings at pipe penetrations.
3. Provide reglet-type detachable 2-piece metal counterflashing. Do not use surface-mounted reglets.

07 50 00  Membrane Roofing

1. General
   a. Use of catalytic converter fume eliminator shall be required on all hot applications.
2. Single-ply membrane systems shall not be used except where specific project requirements necessitate their use or a single ply system is the most appropriate solution.
3. Guarantees/Warranties:
   a. Built-up Bitumen Membrane and Rubber Systems:
      i. Contractor: Five (5) year workmanship and installation guaranty against leakage and other workmanship and installation failures.
      ii. Manufacturer: Minimum twenty (20) year "Membrane System Warranty."

07 60 00  Flashing and Sheet Metal

1. General:
   a. Low slope metal roofing, less than 4:12, is not allowed.
   b. Sheet underlayment shall be inorganic.
   c. Use utility double flashings at pipe penetrations.
2. Guarantees
   a. Metal Flashing Systems:
      i. Contractor: Five (5) year workmanship and installation guaranty against leakage and other workmanship and installation failures.

3. Quality Assurance
   a. Work shall be in accordance with applicable provisions of the following:
      ii. FM Global (FM): Loss prevention data books and materials approval publications.
      iii. NRCA "Roofing and Waterproofing Manual."
4. Installation
   a. Sheet metal joints shall be pop riveted and soldered.
   b. Exposed edges shall be hemmed 1/2 inch.
   c. Dissimilar metals shall be separated.
   d. At all perimeter edges, provide a continuous cleat to meet FM Global Property Loss guidelines.
   e. Protect all roof surfaces from damage due to sheet metal work.

07 70 00  Roof and Wall Specialties and Accessories

07 72 00  Roof Accessories

1. Fall Protection System:
   a. Installation of permanent fall protection systems shall be required for new roofs and ledge projections to protect personnel from the risk of falls when working at elevated heights.
   b. The System shall be designed in consultation with Facilities Services, appropriate trades areas, Environment, Health and Safety, and other affected University personnel.

07 90 00  Joint Protection

07 92 00  Joint Sealants

1. Warranties
a. General: Joint sealants shall be repaired or replaced that fail to achieve airtight and watertight seal or otherwise fail to perform as intended because of leaking, crumbling, hardening, shrinkage, bleeding, sagging, staining, loss of adhesion or cohesion, or do not cure within the specified warranty periods.
   i. Contractor: Five (5) years.
   ii. Manufacturer: Twenty (20) years.

2. Quality Assurance
   a. Work shall comply with ASTM C1193.
   b. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to Project joint substrates as follows:
      i. Locate a mock-up test joint.
      ii. Conduct field tests for each type of elastomeric sealant and joint substrate indicated.
      iii. Notify Architect seven (7) days in advance of dates and times when test joints will be erected.
      iv. Arrange for tests to take place with the Owner’s Representative and joint-sealant manufacturer's technical representative, if available, present.
      v. Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 unless other method included in Appendix of ASTM C1193 is more appropriate.
         1. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
         2. For sealants that fail adhesively, retesting shall be done until satisfactory adhesion is obtained.
      vi. Contractor shall submit written report whether sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Data on pull distance used to test each type of product and joint substrate shall be included in the report.
      vii. Evaluation: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, shall be considered satisfactory.
      viii. Sealants that fail to adhere to joint substrates during testing shall not be used.
      ix. Joint profile shall shed water.
      x. Use primer prior to application of sealant.
Openings

Doors and Frames

Metal Doors and Frames

1. Frames
   a. Type: Fully welded conforming to ANSI /SDI-100 Standard. Knock-down frames shall be acceptable for inner office locations and on renovation projects.
   b. Grouted or poured in place frames shall have mortar boxes for hardware.
   c. Header Reinforcing: Building entrance and restroom frames to receive full closer 14-gauge steel channel reinforcement, all other frames to receive 14-gauge sleeve.
   d. Frames at exterior openings and interior openings four feet (4’-0”) wide and wider shall be 14-gauge.
   e. Exterior frames shall be galvanized.
   f. Except as otherwise required for fire rating and by size of opening, frames at interior openings shall be 16-gauge.
   g. Provide three (3) silencers for each single door and two (2) at head of pairs of doors except at frames with weather-stripping, smoke, or sound seals.
   h. Fire-rated frames shall be labeled with required rating indicated.

2. Doors
   a. Type: Flush, conforming to ANSI /SDI-100 Standard, Grade II, Model 2 (Seamless). No hollow-core doors shall be allowed.
   b. Face Sheets: 16-gauge for all exterior doors, and interior doors four feet (4’-0”) wide and wider. Exterior doors, restroom doors and animal lab doors shall be galvanized.
   c. Reinforce doors for finish hardware in accordance with referenced ANSI/SDI Standard modified as follows:
      i. Hinges: 1-1/2 inch steel plate six inches (6”) longer than hinge and secured with not less than six (6) spot welds.
   d. Surface-Applied Closers: All metal doors shall be reinforced for closers. Required Clearances: In accordance with ANSI/SDI Standard except as follows.
   e. Non Fire-Rated Doors:
      i. Jambs and Head: 3/32 inch.
      ii. Meeting Edges at Pairs of Doors: 1/8 inch.
      iii. Bottom: 3/8 inch there is no threshold or carpet, 1/8 inch at thresholds or carpet.
   f. Glazing Beads:
      i. Type: Screw on, 1/2 inch by 1/2 inch by 14-gauge steel channels, factory installed and secured with countersunk, flat head, machine screws at six inches (6”) on center.
      ii. Corners shall be mitered.
      iii. Fixed frame stops shall be securely welded to the door on the secure side.
   g. Louvers:
      i. Locate factory-prepped louvers a minimum twelve inches (12”) above finish floor.
   h. Finishes, General:
      i. Comply with NAAM’s “Metal Finishes Manual for Architectural and Metal Products” for recommendations for cleaning, treating, priming, and when specified, finishing,
      i. Steel Sheet Finishes:
         i. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, “Solvent Cleaning”; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, form uncoated steel, complying with SSPC-SP3, “Power Tool Cleaning,” or SSPC-SP6/NACE No. 3, “Commercial Blast Cleaning.”
ii. Factory Priming for Field-Painted Finish: Apply shop primer specified in Division 9 Sections “Painting” and “High-Performance Coating” for exterior doors and frames, immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mils.

3. Installation Of Steel Doors and Frames
   a. Frames shall be installed in accordance with SDI Standard 105.
   b. Field cutting for hardware and other modifications is not permitted.
   c. Coat inside of frames and anchors with asphaltic paint where frames are set in masonry walls and are to be grout filled.

08 14 00 Wood Doors

1. Flush Doors
   a. Warranty: Interior solid-core doors; lifetime of the original installation.
   b. Fabrication:
      i. Door Grade: WIC Custom.
      ii. Hardwood Face Panel Grade at Transparent Finish Doors: HPVA “A.”
      iii. Hardboard faces are not acceptable.
      iv. Doors shall be fabricated to conform to the Architectural Woodwork Institute (AWI) “Architectural Woodwork Quality Standards.”
      vi. Use mineral core where required for fire rating.
      vii. Vertical Exposed Edges of Stiles: Solid stock, fire-retardant treated where required, with no finger joints, knots, pitch pockets, or other defects. Provide matching hardwood, solid stock or minimum 1/4-inch thick veneer, same species as door faces with concealed cross banding at transparent-finished doors.
      viii. Provide lock blocks to suit hardware for mineral-core doors; two (2) four inch (4”) minimum (including stiles) width and twenty inch (20”) length.
      ix. Provide 5-inch top and bottom rail for mineral-core doors.
      x. Pre-fit and pre-machine doors for hardware at place of manufacturer.
      xi. Manufacture rated doors for libraries, labs, computer labs, and student lounges with a raceway to accommodate electric locks.
      xii. Factory-cut openings for vision panels and louvers:
         1. Discuss security with Client regarding vision panel use.

2. Stile and Rail Doors
   a. Doors shall be fabricated to conform to the Architectural Woodwork Institute (AWI) “Architectural Woodwork Quality Standards.”
   c. Grade: Premium.
   d. Custom veneers at transparent finish shall be minimum 1/16-inch thick over engineered core.
   e. Source Limitations: Obtain stile and rail wood doors through one (1) source from a single manufacturer.

3. Finishing
   a. Transparent Finish: Provide factory finish only.
   b. Opaque Finish: Factory primed and either shop or field-finish painted.

4. Delivery, Storage and Handling
   a. If shop drawings exist, mark each door on top and bottom rail with opening number used on drawings.

5. Installation
   a. Doors shall be installed in accordance with requirements to WIC standards.
1. Access Doors
   a. Provide in locations required to give access to plumbing, mechanical, electrical, or similar devices concealed in walls or ceilings.
   b. Doors shall be sized to provide sufficient access for maintenance. Document to show actual location and size of access. Placement of door shall be for reasonable access to equipment.
   c. Where located in a fire-rated assembly, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in UL "Classified Building Materials Index." Provide UL label on each access door.
   d. Doors shall be fabricated of continuous welded-steel construction.
   e. Designs:
      i. Framed Partitions: Flanged type for flush mounting with concealed frames.
      ii. Tile, Masonry and Concrete: Trim style with 3/4-inch wide, flush flange.
   f. Locks:
      i. Nonpublic Areas: Allen type screwdriver-operated latch.
      ii. Public Areas: Key-operated cylinder lock with Medeco KeyMark x4 SFIC cylinder to match the building key system. No substitution.
   g. Finishes:
      i. Typical Locations: Factory-applied rust-resistant prime coat. Doors shall be finish painted at exposed locations.
      ii. At Tiled Walls and Ceilings: Stainless steel with No. 4 satin finish.

2. Overhead Coiling Fire Doors
   a. Provide in locations required to give access to plumbing, mechanical, electrical, or similar devices concealed in walls or ceilings.
   b. Doors shall be motor-operated, automatic closing.
   c. One (1) set of all tools and devices necessary to safely reset and service the door shall be provided to the University for each type of door.
   d. Source Limitations: Obtain overhead coiling doors through one (1) source from a single manufacturer.
      i. Obtain operators and controls from the overhead coiling door manufacturer.
   e. Discontinued models of doors shall not be installed.
   f. Power and Operator:
      i. Motor shall lower and raise door.
      ii. Each door shall be on its own dedicated, 120V AC circuit with circuit(s) clearly noted on respective electrical panel.
      iii. Fire-release electrical circuits shall be dedicated circuits.
      iv. Motor shall be connected to the building fire alarm system.
   g. Automatic Closing:
      i. Doors shall be equipped with both audible and visible warning device when automatic release is activated.
      ii. Backup battery shall allow for system operation for a minimum of seventy-two (72) hours during a power outage. If power outage is longer than seventy-two (72) hours, the door shall close automatically.
      iii. An automatic reverse safety switch located within a resilient housing shall extend the full width of the bottom rail.
   h. Keys and Keying:
      i. If overhead coiling door is required to be lockable, locksets shall be furnished with Medeco KeyMark x4 SFIC cylinder to match building key system; no substitution.
   i. Installation:
i. Installation shall allow for sufficient and safe access to mechanisms for resetting, servicing and repair.
ii. Engage an experienced installer who is an authorized representative of the overhead coiling door manufacturer for both installation and maintenance of units.

08 40 00  Entrances, Storefronts and Curtain Walls

08 41 00  Entrances and Storefronts

08 41 13  Aluminum-Framed Entrances and Storefronts

1. Performance:
   a. Doors shall meet resistance to corner racking when tested by the Dual Moment Load test.
   b. Doors shall be weatherstripped to meet the following air infiltration requirements when tested in accordance with ASTM E283:
      i. Pairs of Doors: Maximum of 2.3 cfm per linear foot of perimeter crack at a pressure differential of 1.56 psf.
      ii. Single Doors: Maximum of 2.0 cfm per linear foot of perimeter crack at a pressure differential of 6.24 psf.
   c. No exposed fasteners in frame or door.

2. Aluminum alloy tubular extrusions, 0.125-inch minimum wall thickness – 1 piece

3. Stile width:
   a. Top: eight inches (8”)
   b. Center: six inches (6”)
   c. Bottom: eighteen inches (18”)

4. Welding of doors or frames is not acceptable.

5. Warranty: Warrant doors and frames including excessive deflection, faulty operation and deterioration of finish or construction in excess of normal weathering.

6. Warranty Period: Ten (10) years.

7. Hardware:
   b. See 08 70 00 for additional hardware requirements.

08 42 00  Entrances

08 42 29  Automatic Entrances

1. Automatic entrance doors shall be installed at the main entries of new major buildings and at new main entries for renovation projects.

2. The design, style, functional characteristic, hardware, and other door features shall be selected and specified on a case-by-case basis.

3. Operation:
   a. Operation is swinging.
   b. Operator is electric.

4. Exit devices shall be concealed vertical rod.

5. Activators:
   a. Radio Frequency actuators are preferred.
   b. Interior and exterior push pads mounted at two (2) levels for both upper body and foot control. Preferred height for lower pad is eighteen inches (18”).
   c. Pads shall be located at the correct distance from the door for safe clearances and proper travel time.
   d. Only one (1) leaf is required to be activated by push pads at double doors.
6. Products:
   a. Exterior doors: Horton Automatics Heavy Duty HD-Swing 4000 LE series or equal
   b. Interior doors: Horton Automatics EasyAccess Series 7100 Low Energy or equal
7. Installer Qualifications:
   a. Engage an experienced installer to assume engineering responsibility and perform work who has
      specialized in installing entrance systems and who is acceptable to the manufacturer.
8. Warranty Period:
   a. Ten (10) years on all components of storefront door systems and replacement doors.

08 70 00 Hardware

1. General Requirements
   a. One (1) each of any non-standard installation and maintenance tool.
   b. On pairs of exterior doors provide exit only hardware on inactive leaf.

2. Warranties
   a. Finish hardware shall have the following extended warranties against all defects in materials and
      workmanship, including without limitation against failure to perform as required as follows from
      date of acceptance:
      i. Door Closers: Ten (10) years.
      ii. Locksets: Five (5) years.
      iii. Exit Devices: Three (3) years.
      iv. All Other Hardware: Two (2) years.

3. Locks and Cores (UCPD Mandatory Locks and Cores Requirements – No Substitutions)
   a. Small 7-pin Format Interchangeable Cores (SFIC).
      i. Medeco KeyMark x4 system on all interior doors.
      ii. Medeco KeyMark x4 system on all exterior doors. Buildings with a card-key shall have the
          exterior doors keyed to a Medeco KeyMark x4 EMS system.
      iii. Medeco KeyMark x4 system on interior card-keyed doors.
   b. At existing projects where Medeco is not already the existing keyway, if the scope of work affects
      less than twenty-five percent (25%) of door locks, retain existing keyway and match to existing
      product type and keyway.
   c. All permanent cores and keying shall be provided and installed by Facilities Services.
   d. For temporary/jobsite security, Contractor shall provide and install metal construction cores only.
      Composite construction cores are not acceptable.

4. Hinges
   a. Manufacturer: Stanley, McKinney, Hager and Ives Hinge Division.
      i. Interior openings: Butt Hinges
      ii. Exterior openings: Continuous Hinges
      iii. Butt Hinge Type: Five-knuckle, button tips, except as otherwise required. Hinges for doors
          with closers shall be ball bearing.
      iv. Continuous Hinge Type: Pin and barrel stainless steel.
      v. Exterior cut swinging doors shall have non-removable pins and shall be non-ferrous.
      vi. Labeled Doors: Steel or Stainless Steel.
      vii. Bearings and raceways shall be stainless steel.
      viii. Hinges shall be secured with stainless steel or silicone bronze screws. Riveted or welded
            hinges are not acceptable.
        ix. The size and weight of butt hinges shall be determined by the following:
            1. Doors 1-3/4 Inches Thick and up to 41 Inches Wide: 4-1/2 Inches tall.
2. Doors 1-3/4 Inches Thick and 41 Inches to 48 Inches Wide: 5 Inches tall.
3. Widths: Sufficient to clear trim projection when door swings 180 degrees.
4. Exterior and high traffic openings: Heavy Weight
5. Interior low traffic openings: Standard Weight

x. Quantity: Two (2) hinges for doors up to five feet (5’) high, and one (1) additional hinge for each 2-1/2 feet of height or fraction thereof over five feet (5’).

5. Locksets and Latchsets
   a. Provide all locks, latches, and cylinders of the same Manufacturer to ensure compatibility and warranty.
   b. General:
      i. Type: Mortised.
      ii. Lever design
         1. At renovations, match existing.
         2. At new construction projects Schlage 06A or Sargent L Series.
      iv. Mortise: Schlage L9000 Series or Sargent 8200 Series; no known equal.
      v. Provide mortise housing to accept either, based on the Project’s key system 7-pin SFIC.
      vi. At existing sites currently using cylindrical locksets:
          1. Cylindrical: Schlage D Series or Sargent 10 Line; no known equal.
          2. Provide levers to accept SFIC 7 pin cylinders.
      vii. Strikes: Standard curved lip, or with extended curved lips where required to protect trim and jamb from being marred by latch bolt. Provide with dust pockets.
      viii. Dead bolts shall have a one inch (1”) projection.

6. Exit Devices
   a. Models: Von Duprin 99 Series or Sargent 80 Series based on compliance of performance specifications as specified below.
   b. Selected devices shall have the following characteristics:
      i. Materials: Aluminum, Brass, Bronze or Stainless Steel base metal, plated or finished to match required hardware finish. Moving parts of die-cast “pot” or “white” metals are not acceptable.
      ii. Provide certification by independent testing laboratory that specified devices have completed over 1,000,000 cycles and still perform in accordance to ANSI/BMHMA A156.3 – 1994.
      iii. All devices shall have the ability of conversion to electrified usage.
      iv. Furnish glass bead kits for vision lites where required.
      v. The unlatching force shall not exceed fifteen pounds (15#) applied in the direction of travel.
      vi. Electrified devices shall use an electric power transfer unit to wire transfer between the frame and the door,
   c. Interior Doors:
      i. Single Doors: Von Duprin L99 or Sargent 80 Series, no known equal.
      ii. Double Doors with Vertical Rod Combinations: Von Duprin 9927L or Sargent 8600 Series, no known equal.
   d. Exterior Doors:
      i. Single Doors: Von Duprin L99 or Sargent 80 Series, no substitution.
      ii. Double Doors:: Von Duprin L99 or Sargent 80 Series with keyed removable mullions, no substitution.
   e. Operation:
      i. Lock automatically when closed-key retracts latchbolt.
ii. When push pad is locked down by hex key dogging, latchbolt is retracted and doors operate push-pull.

7. Closers
   a. Manufacturers: LCN or Norton 7500XSN – Based on compliance with performance specification listed below.
      i. Internal Closers: LCN 4040XP or Norton 7500XSN; no known equal.
      ii. External Closers: LCN 4040XP or Norton 7500XSN; no known equal.
   b. All closers shall be by the same Manufacturer to facilitate maintenance and servicing. An authorized factory representative shall inspect closers after installation to ensure proper adjustment and operation.
   c. Closers shall be non-handed and shall be capable of mounting hinge side, top jamb, stop side or on a bracket.
   d. All closers shall utilize a temperature stable fluid capable of withstanding temperature ranges of 120 degrees F to -30 degrees F without requiring seasonal adjustment of closer speed to properly close the door.
   e. Use parallel-arm closers at reverse-bevel doors and where doors swing full 180 degrees.
   f. Closers shall have separate and independent screw valve adjustments for latch speed, general speed, and hydraulic back-check. Back-check shall be located to effectively slow the swing of door at minimum of 10 degrees in advance of the dead stop location.
   g. Parallel arm closers shall incorporate one-piece solid forged steel stud shoulder bolts and shall be incorporated in regular arms and hold-open arms. All other closers shall have forged steel main arms. Built-in stop arms or “cush” stop arms are not acceptable.
   h. Exterior or vestibule doors where conditions would be better suited for floor closers, use Rixson #27 or equal including an intermediate pivot.

8. Electronic Hardware
   a. Card key control systems shall conform to U.C. Police control equipment and policy (see Division 26: Electrical). Architectural hardware shall conform to Division 8.
   b. Automatic swing entrance hardware shall be electronic; Horton 4100 or Horton 7100; no known equal.
   c. Electronic hardware shall be fail secure with provision for emergency exiting where required.
   d. Electric strikes shall be by Von Duprin or HES.
   e. Electronic systems shall be of the same manufacturer (locking device, power supply, etc.).

9. Fasteners and Anchors
   a. Hardware shall be furnished with required fasteners in accordance with the following guidelines:
      i. Finish on exposed fasteners shall match finish on item being fastened.
      ii. Fasteners shall be appropriate to substrate which hardware is being fastened.
      iii. Closer at wood fire doors shall be attached using hex bolts.
      iv. Exposed screws shall have Phillips style head.
      v. Hardware fastened to concrete or masonry shall be installed with manufacturer-supplied fasteners.

10. Miscellaneous Items
    a. Doorstops: Provide where required to prevent door or hardware from striking an adjacent wall or obstruction.
    b. Push and Pull Plates:
       i. Manufacturers: Ives, Rockwood, DonJo.
       ii. Size: Four inches (4”) by sixteen inches (16”).
iii. Plates shall be without screw holes when used with pulls. Pulls shall be through-bolted at grip only.
iv. Doors with push plates and pulls with the cylinder on the push side shall have recessed pulls used in conjunction with the push plates; Rockwood No. 95, or equal.
v. For double doors, remove the exterior handle or pull associated with the inoperative leaf.

c. Vestibule Doors (including Aluminum Doors):
i. Door Pulls: Rockwood #146 or similar.
ii. Push Plates: 18 Gauge Stainless Steel.
d. Kick Plates: Provide at doors with closers.
e. Surface and Flush Bolts:
i. Automatic Flush Bolts shall be of the low operating force design. Utilize the top bolt only model for interior door where applicable and as permitted by testing.
ii. Manual Flush Bolts only permitted on storage or mechanical openings as scheduled.
iii. Provide dust proof strikes at openings using bottom bolts.
iv. Flush Bolts:
   1. Metal Doors: Glynn-Johnson Constant Latching FB50 Series.
   2. Wood Doors: Glynn-Johnson Constant Latching FB60 Series.
   3. Flush bolts shall have a lever arm that is connected to the bolt mechanism and is not friction-operated.
   4. Face plates shall be shaped to match the door edge.
   5. Operating mechanism for bottom flush bolts shall be not more than twelve inches (12”) above the finish floor, and top flush bolt shall be not more than seventy-two inches (72”) above the finish floor.
   6. Bottom flush bolts shall have dustproof strikes.
v. Surface Bolts shall have a dustproof strike or easy-to-clean floor strike.
vi. Lifting handles on surface bolts shall be mechanically fastened, not press fitted.
f. Stops, Holders, and Bumpers:
i. Stops:
   1. Preferred: Wall type; Ives WS407, or equal.
   2. Where wall type is not suitable, use floor type; Ives FS436, FS437, or equal.
ii. Overhead Stops and Holders: Glynn-Johnson 90M.
iii. Holders and Bumpers: Glynn-Johnson F9, F10 or W2, or equal.
iv. Stops shall be solid or forged bronze; wrought is not acceptable.
v. Wall-mounted stops shall be secured with concealed fasteners.
vi. Rubber bumpers shall be fastened by a pin or screw that goes through the rubber and seats into the metal on the opposite side. A rubber bumper that is screwed into the metal holder is acceptable.
vii. Stops and holders shall be secured with anchors in concrete. Use screws to stud or backing at framed walls in high-traffic areas.
viii. Automatic holders at exterior doors are not allowed.
g. Thresholds:
i. Manufacturers: NGP, Pemko.
ii. Design shall have a center reinforcing leg as designed by the manufacturer.
iii. The threshold shall extend the full width of the opening as a single piece with ends cut to jamb profile except where floor closers are installed. In this situation, the threshold shall be cut in half to facilitate changing closers without the need to pull a pair of doors to change a single closer.
h. Silencers:
i. Provide at exterior and interior doorframes except at frames to receive sound seals or weatherstripping.
ii. Quantity:
1. Single Doors: Three (3) each lock jamb frame.
2. Double Doors: Two (2) for each leaf at head frame, plus three (3) each on astragal.

iii. Manufacturer and Product:
   1. Metal Frames: Glynn-Johnson 64 or equal.
   2. Wood Frames: Glynn-Johnson 65 or equal.

i. Smoke Seals and Weatherstripping:
   i. 20-Minute Rated Wood Doors: NGP 5050 Self-Adhesive Gasketing – Silicone.
   ii. 60-90 Minute Rated Wood Doors: NGP 9440 Self-Adhesive Gasketing – Intumescent Batwig.

j. Padlocks shall be provided with Small format IC core as required, keyed to building master keying system.
k. Coordinators: Provide at double doors with closers to assure proper closing.
l. Campus lock boxes for UCPD and/or Facility Services access shall be installed on all buildings or adjacent locations by Facility Services.

11. Keys and Keying
   a. New Buildings: Medeco keymark x4, 7-pin SFIC.
      i. All housing, locking (rim, mortise or cylindrical) devices to accept the 7-pin SFIC.
      ii. For construction purposes, use SFIC 7-pin temporary metal construction core.
      iii. Facilities Services’ Lock Shop shall provide and install final cores.
   b. Major Additions, Renovations to Existing Buildings: Cores to match existing building key system or 7-pin Small Format Interchangeable Core (as directed by Facilities Services’ Lock Shop); no substitute:
      i. All housing, locking (rim, mortise or cylindrical) devices to accept the 7-pin SFIC cylinder.
      ii. For construction purposes, use SFIC temporary construction core.
      iii. Facilities Services’ Lock Shop shall provide and install final cores.
   c. Mechanical, Electrical, Utility, Data Rooms: 7-Pin Small Format Interchangeable Core; no substitute:
      i. All housing, locking (rim, mortise or cylindrical) devices to accept the 7-pin SFIC cylinder.
      ii. For construction purposes, use 7-pin SFIC temporary construction core.
      iii. Facilities Services’ Lock Shop shall provide and install final cores.
   d. Keyed Elevator Switches: 7-Pin Small Format Interchangeable Core; no substitute.
   e. Key-Operated Mailboxes: 7-Pin Small Format Interchangeable Core; no substitute.
   g. Removable Mullions: 7-Pin Small Format Interchangeable Core, no substitute.

12. Finishes
   a. Campus standard is satin chromium plated, 626, 612, or oil-rubbed bronze, 613.
   b. Existing Facilities: Finishes shall be as listed or to match existing.

13. Installation
   a. Locksets and latchsets shall be installed after doors have received final finish coat. If installed prior to application of final coat, lockset or latchset shall be removed to permit painting.
   b. Locksets and latchsets in wood doors shall be installed in mortise or holes prepared by using a mortising or boring jig.

14. Recommended Hardware By Room Type
   a. General:
      i. Lockset: Mortise. Cylindrical only at sites to match existing.
      ii. Function: Listed functions for each space are general guidelines. Final function shall be determined based on usage of space.
iii. Additional hardware shall be provided as required in accordance with these guidelines, code, and specific Project conditions.

<table>
<thead>
<tr>
<th>Room Type</th>
<th>Schlage</th>
<th>Sargent</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office</td>
<td>L9050</td>
<td>8205</td>
<td>Latchbolt retracted by lever from either side unless outside is made inoperative by key outside or by lever inside. Outside lever remains locked until thumbturn is returned to vertical or by counter clockwise rotation of key. Auxiliary latch deadlocks latchbolt when door is closed.</td>
</tr>
<tr>
<td>Labs, Entrances</td>
<td>L9060</td>
<td>35H7G3H</td>
<td>Latchbolt retracted by lever from either side unless outside is locked by key from inside. When locked, latchbolt retracted by key outside or lever inside. Auxiliary latch deadlocks when door is closed.</td>
</tr>
<tr>
<td>Storage and Mechanical</td>
<td>L9080</td>
<td>35H7EW3H</td>
<td>Latchbolt retracted by key outside or by lever inside. Outside lever always inoperative.</td>
</tr>
<tr>
<td>Rooms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passage, non-locking</td>
<td>L9010</td>
<td>35H7N3H</td>
<td>Latchbolt retracted by lever from either side at all times.</td>
</tr>
<tr>
<td>Classroom, Public Toilets</td>
<td>L9070</td>
<td>35H7J3H</td>
<td>Latchbolt retracted by lever from either side unless outside is locked by key. Unlocked from outside by key. Inside lever always free for immediate exit.</td>
</tr>
<tr>
<td>Uncontrolled Library Exit</td>
<td></td>
<td></td>
<td>All Exterior doors shall be equipped, in coordination with the exterior door hardware, with an emergency exit similar to Detex EA500 or Alarm lock PG21 or PG21e. The emergency exit alarm locks may be key operated from inside, outside or both as directed by the Project Manager and Library Architect.</td>
</tr>
</tbody>
</table>

Cylindrical Locksets: Schlage or Best; no known equal

<table>
<thead>
<tr>
<th>Room Type</th>
<th>Schlage</th>
<th>Best</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office</td>
<td>D53JD or BD</td>
<td>93K7AB15D</td>
<td>Pushing button locks outside lever until unlocked by key or by turning inside lever.</td>
</tr>
<tr>
<td>Labs, Entrances</td>
<td>D60JD or BD</td>
<td>93K7C15D</td>
<td>Unlocked by key from outside when outside lever is locked by key in inside lever. Inside lever is always unlocked.</td>
</tr>
<tr>
<td>Storage and Mechanical</td>
<td>D80JD or BD</td>
<td>93K7D15D</td>
<td>Outside lever fixed. Entrance by key only. Inside lever always unlocked.</td>
</tr>
<tr>
<td>Rooms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passage, non-locking</td>
<td>D10S</td>
<td>93K7N15D</td>
<td>Latchbolt retracted by lever from either side at all times.</td>
</tr>
<tr>
<td>Classroom, Public Toilets</td>
<td>D70JD or BD</td>
<td>93K7R15D</td>
<td>Latchbolt retracted by lever from either side unless outside is locked by key. Unlocked from outside by key. Inside lever always free for immediate exit.</td>
</tr>
</tbody>
</table>
1. Industry Standard

2. Glass Materials
   a. Annealed Float Glass: ASTM C1036, Type I, Class 1, Quality q3 or better.
      i. Obtain annealed float glass units from one (1) manufacturer using the same type of glass and other components for each type of unit indicated.
   b. Heat-Strengthened and Tempered Float Glass: ASTM C1036, Type I float glass as specified above and conforming to requirements of ASTM C1048 and as specified.
      i. Tempered glass shall meet ANSI Z97.1 test requirements.
      ii. Glass shall be tempered using the roller hearth method.
      iii. Heat-strengthened glass shall have surface compression levels between 3500 and 7000 psi.
      iv. Obtain heat-strengthened and tempered float glass units from one (1) manufacturer using the same type of glass and other components for each type of unit indicated.
   c. Insulating Glass: Certified under IGMA-approved program and meeting CBA Grade requirement when tested in accordance with ASTM E773 and ASTM E774.
      i. Units shall be fabricated from specified float glass.
      ii. Provide tempered glass for both lights of glass where required by code.
      iii. Obtain insulating glass units from one manufacturer using the same type of glass and other components for each type of unit indicated.
   d. Flat Wire Glass: ASTM C1036, Type II, Class 1, Form 1, Quality q8, 6.0 mm thick.
      i. Mesh Design: Baroque or Georgian (square).
      ii. Obtain flat wire glass units from one manufacturer using the same type of glass and other components for each type of unit indicated.
   e. Mirror Glass: ASTM C1036, Type I, Class 1, quality q2, 1/4 inch thick.
      i. Provide silver coating, copper-protective coating, and 1-mil-thick mirror backing paint.
      ii. Comply with CS 27.
   f. Spectrally Selective and Tinted Glass: These are acceptable glass Types and should be considered where required to control excessive heat gain and use is acceptable to Project Manager.
      i. Obtain spectrally selective and tinted glass units from one (1) manufacturer using the same type of glass and other components for each type of unit indicated.
   g. Spandrel Glass: Subject to approval by the Owner’s Representative.
   h. Reflective Glass shall not be allowed for exterior windows.
      i. Other glass Types such as obscure, laminated, decorative, and others as may be required based on usage, shall be considered on an individual basis.

3. Glazing Materials
   a. Sealants for Glazing:
      i. Interior Locations, If Not Dry Glazed:
         1. Typical: One-part, gun grade; Tremco "Mono," Pecora "60 Plus," or equal.
   b. Glazing Blocks and Spacers: Closed-cell neoprene complying with ASTM C509, in black color.
   c. Glazing Gaskets: Types and sizes as required, preformed, premolded corners; F.H. Maloney, D.S. Brown, or equal.
      i. Full-Density EPDM: Conforming to NAAMM Standard SG-1.
      ii. Closed-Cell Neoprene: Capable of 24 percent to 40 percent compression.
iii. PVC: Complying with ASTM D2287.
iv. Standard products provided by aluminum framing, window, or entrance manufacturer, if at variance with the above, are acceptable.

d. Glazing Tape:
   i. Typical: Butyl rubber type, black color; Pecora "Extru-Seal Tape G-66," Tremco "440 Tape," or equal.
   ii. Fire-Rated Glass: Closed-cell PVC or as otherwise approved by glass manufacturer for required fire rating.

e. Source Limitations for Glazing Accessories:
   i. Obtain glazing accessories from one source for each product and installation method.
f. Glass doors shall not possess panic hardware with manual dogging devices.
09 00 00  Finishes

09 20 00  Plaster and Gypsum Board

09 21 00  Plaster and Gypsum Board Assemblies

09 21 16  Gypsum Board Assemblies

1. Non-Load Bearing Metal Framing
   a. Wall Systems: Select steel studs in accordance with the manufacturer's standard load tables and the following design pressures and deflections:
      i. At Stairs, Elevator Hoistways, and Other Vertical Shafts: L/120 at 10 psf.
      ii. At Ground Floor Lobbies: L/120 at 15 psf.
      iii. At Partitions to Receive Stone Cladding: L/360 at 15 psf or 0.5 G (half the weight of stone cladding) applied laterally, as required by CBC Section 1632.
      iv. At Partitions to Receive Lath and Plaster: L/360 at 15 psf.
      v. At All Other Partitions: L/240 at 5 psf.
      vi. At non-composite conditions where wallboard is partial height, require calculations be submitted by a structural engineer licensed in the State of California verifying compliance with required deflection.

b. Joisted ceiling deflection shall be designed to limit deflection to L/360.

c. Steel framing shall be isolated from the building structure so as to prevent transfer of loading imposed by structural movement.

d. The contractor shall be required to submit and conform to the ICC Report of framing system for stud gauge and spacing for all wall conditions.

e. Require submittals that utilized manufacturer's standard details for bracing, top and bottom plate, and framing all openings. Specify fasteners, top and bottom, both sides.

f. Materials:
   i. General: Metal studs, track, and sheet metal furring channels shall comply with ASTM C645.
   ii. Partitions:
      2. Use 16-gauge studs at least 3-5/8 inches wide at wall-mounted fixtures, casework, equipment, shelving, handrails, and grab bars.
   iii. Wire for tying and bracing shall be galvanized, soft annealed steel.
   iv. Specify that installation of metal framing complies with requirements of ASTM C754.

g. Show and detail metal backing plates on Drawings, 16-gauge minimum.

h. If a fire rated assembly is required, indicate UL, CBC or other CSFM approved listing on Drawings. Assembly detail shall match the referenced assembly.

i. Powder driven fasteners, if used, shall conform to the requirements specified in Division 1 and restrictions imposed by the Project’s Structural Engineer at post-tensioned slabs.

j. In gypsum board ceilings, locate and show required access panels as specified for HVAC, fire protection or other systems. Size access panels large enough to provide maintenance access.

k. Where multi pipe/cable runs occur in corridors such as in Laboratory buildings, the use of suspended finished ceilings is discouraged.

l. Use Manufacturer’s span table to determine appropriate framing size. For example, see http://www.ssma.com/filebin/pdf/SSMA_Product_Technical_Info_Catalog_2011_FINAL.pdf or http://www.clarkdietrich.com/support-tools/support-docs/load-tables
2. Gypsum Board
   a. Industry Standards: Work shall comply with the applicable requirements of GA publication GA-216 and GA-214.
   b. Materials:
      i. Fire-Rated Board: ASTM C1396, Type X, unless more stringent type required by code.
         1. Thickness: 5/8 inch, unless otherwise noted.
         2. Edges: Tapered and rounded.
         3. Size: Four feet (4’-0”) wide by lengths that will result in minimum footage of joints.
      ii. Fire-Rated Water-Resistant Board: ASTM C1396, Type X.
         1. Thickness: 5/8 inch.
         2. Edges: Tapered.
         3. Size: Four feet (4’-0”) wide by lengths that will result in minimum footage of joints.
      iii. Shaft-Liner Board: ASTM C442, 1 inch thick, square edge, unless otherwise required for selected UL assembly.
      iv. Laminating Adhesive: VOC compliant and as recommended by gypsum board manufacturer for laminating gypsum board together in fire-rated construction.
      v. Screws: Phillips head with bugle shape, Type S, conforming to ASTM C1002. Use Type W for attachment to wood.
      vii. Taping and Finishing Products: Comply with ASTM C475 and with manufacturer's recommendations for specific project conditions.
   c. Installation:
      i. General: Comply with ASTM C840 and GA-216 in addition to requirements of the CBC. Conform to UL designs for fire-rated partitions except where exceeded by other requirements.
      ii. Provide concealed metal reinforcement at external corners and where gypsum board meets dissimilar material.
      iii. Use water-resistant gypsum board at partitions to receive ceramic tile, in damp areas, and where exposed to excessive moisture. Do not use on ceilings unless support framing is minimum twelve inches (12”) on center. Use cementitious backer board or equivalent for partitions in wet areas.
      iv. Seal perimeter and penetrations at sound-rated construction to meet specific project acoustical requirements.
      v. Construction Tolerances:
         1. Gypsum board surfaces to be painted shall have no measurable variation in any two foot (2’-0”) direction and a maximum variation of 1/8 inch in ten feet (10”-0”) when a straightedge is laid on the surface in any direction.
         2. Coordinate with tolerances required for surfaces to receive tile.
         3. Do not exceed 1/16-inch offset between planes of abutting sheets at edges or ends.
      vi. Level of Finishes: In accordance with GA-214.
         1. At Locations Indicated to Receive "Fire-Taping" and at Unexposed Gypsum Board Applications: Level 1.
         3. Locations to Receive Paint with Gloss Level Greater than Eggshell (Except Restrooms and Utilitarian Areas such as Janitor Closets and Mechanical Rooms): Level 5.
         4. All Other Locations: Level 4.
1. Part 1: General
   a. General Requirements
      i. Completed work shall have a coefficient of friction that meets current ADA Requirements.
      ii. Ceramic and Tile flooring shall not be used in laboratory spaces.
      iii. Special patterns and layouts shall be shown on the Drawings.
      iv. Coordinate requirements for extra material quantities and delivery after completion with the Project Manager.
   b. Submittals
      i. Master grade certificates for each shipment, type, and composition of tile, signed by the manufacturer and installer.
   c. Green Building

2. Part 2: Products
   a. Materials
      i. General: Tile shall conform to ANSI A137.1 "Standard Grade" requirements.
      ii. Environmental Criteria:
         1. Preference shall be given to re-used or reclaimed ceramic or stone tiles that are in fair and usable condition.
         2. Ceramic, glass, ceramic/glass composite, and terrazzo-type tiles shall contain a minimum of 50% (combined) post-industrial/post-consumer recycled content.
         3. The specified percentage is based upon the weight of the component materials.
         4. Glazings used for the glazed tiles shall be lead-free.
      iii. Adhesives and Sealants:
         1. The VOC content of adhesives, sealants and sealant primers shall be less than the current VOC content limits of South Coast Air Quality Management District (SCAQMD) Rule 1168 and all sealants used as fillers shall meet or exceed the requirements of the Bay Area Air Quality Management District Regulation 8, Rule 51. (http://www.aqmd.gov/rules/reg/reg11/r1168.pdf; http://www.baaqmd.gov/dst/regulations/rg0851.pdf)
         2. Aerosol adhesives shall meet the VOC limits of the “Green Seal Environmental Standard for Certification of Commercial Adhesives” (GS-36) of Green Seal, Inc. (http://www.greenseal.org/certification/standards/commercialadhesives.cfm)
         3. All adhesives, sealants and sealant primers shall be free of the prohibited chemicals as defined in GS-36.
      iv. Mortars/Grouts:
         1. The VOC content of mortars or grouts for ceramic tile installations shall not be in excess of 150 grams/liter, less water and less exempted compounds.
      v. Metal Edging or Stone Threshold: Provide where tile flooring terminates at dissimilar floor material.
      vi. A waterproofing membrane shall be provided under tile at wet areas and Restrooms above grade.
      vii. Use of epoxy grout on floors of Restrooms is recommended but shall be reviewed and accepted by the Project Manager prior to being specified.
viii. Cementitious backer board at wet locations shall conform to ANSI A118.9. Use fire-rated backer board at rated partitions to maintain rating of partition.

ix. Sealers shall be used on unglazed floor tile only after review with the Project Manager and impact on the Project budget.

x. Protective Paper: Non-staining laminated and reinforced Kraft paper with bituminous or latex binder.

3. Part 3: Execution
   a. Installation
      i. Allowable Tolerances of Surfaces to Receive Tile:
         1. Maximum Variation in Vertical Surfaces: 1/8 inch in eight feet (8'-0").
         2. Maximum Variation in Horizontal Surfaces: 1/8 inch in ten feet (10'-0").
      ii. Surface preparation, setting of tile, grouting, and cleaning shall be in accordance with applicable requirements of ANSI standards for selected setting methods.
      iii. Recommended Installation Methods:
         1. TCA Methods are referenced. Coordinate final system selection on wall or partition construction, location in building, and anticipated abuse.
            a. Wall Tile at Dry Areas: TCA Method W243.
            b. Wall Tile at Showers: TCA Method B415 and W244.
            c. Floor Tile at Shower: TCA Method B420.
            d. Floor Tile at Restrooms: TCA Method F122.
      iv. Protective paper shall be applied over floor tile for minimum of three (3) days after grouting is completed to prevent escape of moisture, cure grout, and provide protection until acceptance.
   b. Site Environmental Procedures
      i. Waste Management: As specified in Section 01 74 19 – Construction Waste Management and Disposal and coordinate with the manufacturer(s) for take-back programs for collection of construction scrap, unused material, demolition scrap, and packaging material.

09 50 00  Ceilings

0951 00  Acoustical Ceilings

1. General Requirements
   a. Selection of acoustical ceiling systems shall be based on careful analysis of function, aesthetic, cost, sound absorption and noise reduction, and durability.
   b. For special assembly areas, retaining of an acoustical consultant shall be considered to provide assistance and advice in the design and acoustical treatment.
   c. Review need for extra stock with the Project Manager.

2. Quality Assurance
   a. Seismic Requirements: Ceilings shall comply with CCR T-24 and CBC code requirements for seismic bracing of ceiling suspension system.
   b. Surface Burning Characteristics: Provide products complying with ASTM E 1264 for Class A products and meeting the following when tested in accordance with ASTM E84.
      i. Flame Spread: 25 or less
      ii. Smoke Developed: 50 or less
   c. Fire-rated ceilings shall be rated in accordance with ASTM E119 and bear an Underwriters Laboratories Inc. (UL) Time Design number applicable to the proposed installation.
   d. Tolerances:
i. Deflection, ASTM C635: Maximum 1/360 of span. Applies to suspension system components, hangers, and fastening devices supporting light fixtures, ceiling grilles, and acoustical panels.

ii. Allowable Tolerance of Finished Acoustical Ceiling System: Level within 1/8 inch in twelve feet (12'-0”).

3. Warranty
   a. Acoustical ceiling products shall be provided with the following extended product warranties by manufacturer:
      i. Acoustical Panels: Ten (10) years.
      ii. Suspension Grid: Ten (10) years.

4. Materials
      i. Comply with ASTM C635.
      ii. Structural Classification: Not less than Intermediate-duty.
      iii. Main, Cross Members, Edge Moldings: Zinc coated; electrogalvanized or hot-dip galvanized cold-rolled steel. Use hot-dip galvanized system at damp locations.
      iv. Rough Suspension: Galvanized, soft-annealed, mild steel wire.
      v. Power-driven fasteners shall conform to Division 1 requirements.
   b. Acoustical Panels and Tiles:
      i. Acoustical panels shall conform to FS SS-S-118B, Type III (mineral fiber), Class 25, unless otherwise accepted by Project Manager for Project aesthetic or acoustical requirements.
      ii. Provide USDA/FSIS approved panels at food preparation areas. Minimum Performance Requirements:
      iii. Color/Light Reflectance (LR): 0.75. Noise Reduction Coefficient (NRC): 0.55. Ceiling Attenuation Class (CAC): 35.
   c. Products shall be selected with consideration of IAQ requirements.
   d. Consideration shall be given to products with recycled material content and that can be recycled.
   e. In renovation products, match existing adjacent acoustical units where possible. Do not mix new and existing units in any given space.
   f. Coordinate selection of acoustical units with existing building standard.


6. Leveling Splines for Tiles: Fiber, metal, or plastic, manufactured specifically for leveling adhesive- applied tile, as recommended by tile manufacturer.

7. Installation
   a. Suspension system, including necessary hangers, grillage, and other supporting hardware, shall conform to requirements of UBC Standard 25-2, "Metal Suspension Systems for Acoustical Tile and for Lay-in Panel Ceilings" and ASTM C636.
   b. Acoustical panels shall be installed in grid system in accordance with CISCA publication "Acoustical Ceiling Use and Practice."
   c. CBC Standard shall govern if in conflict or more restrictive than industry standards and publications.
   d. Where tegular edge panels are used, panel edges shall be trimmed or routed to provide regular edge at perimeter moldings.
   e. Suspension system shall not be secured to ductwork.
   f. Exit signs, sprinkler cases, signage and other items shall not be attached to lay-in panels.
1. Part 1: General
   a. General Requirements
      i. Slip Resistance: Flooring, after application of specified finishes, shall be laboratory or field tested in accordance with ASTM C1028 to verify that it has required minimum wet and dry coefficient of friction for both level and ramped surfaces. Completed work shall have a coefficient of friction that meets ADA requirements.
      ii. Existing Conditions:
          1. Coordinate requirements for mock-ups and submittals with the Project Manager.
          2. Removal or encapsulation of existing tile containing asbestos shall be coordinate with the Project Manager and conform to hazardous material procedures in Division 1.
      iii. Special patterns and layouts shall be shown on the Drawings.
      iv. Unless specifically requested, do not specify extra material.
   b. Green Building
      i. All new construction and major renovations must meet the LEED equivalent certification standard and strive toward the Silver-equivalent rating.

2. Part 2: Products
   a. Materials
      i. Environmental Criteria:
         1. Preference shall be given to rapidly renewable materials or products (materials or products made from plants that are typically harvested within a ten (10) year or shorter cycle).
         2. At the discretion of the Owner’s Representative, linoleum tile or sheet flooring may consist primarily of renewable materials including linseed oil, cork flour, wood flour, pine rosin, and jute. Additional components may include inert fillers, pigments, or other secondary materials; however, the products shall not contain synthetic latex, vinyl, or other thermoplastics or thermosetting plastics as backing or prefinished coatings.
         3. To the extent feasible, linoleum products shall comply with the Hard Surface Flooring emission criteria defined in the GREENGUARD directory of low emitting interior products and building materials, by Air Quality Sciences, Inc. (http://www.aqs.com/DesktopDefault.aspx; http://www.greenguard.org/)
      ii. Vinyl Composition Tile (VCT): Conform to ASTM F1066.
         2. Color: Integral throughout with distinct pattern. Use of solid and light colored tile shall be avoided.
      iii. Sheet Flooring:
         1. Vinyl shall conform to ASTM F1913 and as described in the environmental criteria above.
         2. Flooring at Laboratories, glass wash and other areas where liquids are used or stored shall be watertight and chemical resistant. Flooring shall be compatible with the chemicals to be used or stored.
         3. Flooring shall be suitable for installation as a seamless floor with welded seams at all locations.
         4. Self-coved base shall have cove filler strip backing.
      iv. Resilient Base: Conform to ASTM F1861, Type TS, vulcanized rubber or Type TP, rubber.
         1. Avoid use of pre-molded pieces except at exposed ends.
2. Lengths: Roll type to allow for minimum number of joints.

v. Adhesives and Sealants:
1. The VOC content of adhesives, sealants and sealant primers shall be less than the current VOC content limits of South Coast Air Quality Management District (SCAQMD) Rule 1168 and all sealants used as fillers shall meet or exceed the requirements of the Bay Area Air Quality Management District Regulation 8, Rule 51. (http://www.aqmd.gov/rules/reg/reg11/r1168.pdf; http://www.baaqmd.gov/dst/regulations/r0851.pdf)
2. Aerosol adhesives shall meet the VOC limits of the “Green Seal Environmental Standard for Certification of Commercial Adhesives” (GS-36) of Green Seal, Inc. (http://www.greenseal.org/certification/standards/commercialadhesives.cfm)
3. All adhesives, sealants and sealant primers shall be free of the prohibited chemicals as defined in GS-36.

vi. Water-resistant, as recommended by manufacturer of resilient flooring material for conditions of installation. Adhesive shall meet VOC requirements.
1. Waxes and Applied Finishes:
   a. New Buildings: The Contractor shall use Facilities Services’ current specified wax and no known equal. Special restrictions on maintenance coatings for installed products shall be provided to the Owner.
   b. Renovations: Except for specialty coatings such as static control coatings, final waxing or finish will be provided and applied by the Owner. Special restrictions on maintenance coatings for installed products shall be provided to the Owner.
2. Edge Strips: Provide where resilient flooring terminates, exposing edge of covering, unless included as part of abutting floor material installation.
3. Other resilient flooring materials, including rubber and solid vinyl, shall be reviewed with the Project Manager prior to selection for appropriateness and conformance with the Project budget.

3. Part 3: Execution
   a. Installation
      i. Comply, at minimum, with the linoleum manufacturer recommendations for space ventilation during and after installation.
      ii. For larger areas, it is strongly encouraged that a supply of 100% outside air is provided during construction and for as long as possible following construction.
      iii. When installed over concrete slabs, verify compatibility of the linoleum and adhesives with curing compounds, leveling agents, or sealing agents used for slab preparation.
      iv. Comply with ASTM F710 and manufacturer's recommendations for surface preparation.
      v. Concrete surfaces shall be subject to moisture content testing to determine the subsurface moisture content of the concrete slab to receive resilient flooring.
         1. Flooring shall not be installed over substrates that exceed maximum moisture content allowed by the manufacturer to effect required warranty.
         2. Review alternative solutions and construction assemblies for concrete slab on grade to mitigate potential or tested moisture vapor problems including topical coatings, concrete additives, and below slab barriers.
         vi. Flooring shall fit tile neatly and tightly into breaks and recesses to fit within 1/64 inch of abutting surfaces.
         vii. Flooring shall extend under fixed base cabinets and floor-mounted cases.
   b. Site Environmental Procedures
i. Waste Management: As specified in Section 01 74 19: Construction Waste Management and Disposal. Coordinate with manufacturer(s) for take-back programs for collection of construction scrap, unused material, demolition scrap, and packaging material.

09 68 00 Carpets

1. Part 1: General
   a. General Requirements
      i. The selection of carpet shall consider use, user, durability, serviceability, replacement accessibility, sustainability, and appearance.
      ii. Use of carpet in high traffic areas requires approval of the Owner’s Representative.
         1. Carpet shall not be used on walls or in elevators.
         2. Carpet shall not be used in laboratory spaces.
         3. Carpet tiles shall not be used except at raised access floors; they pull-up with extraction cleaning.
      iii. Specify that carpet edges be buttered and sealed to minimize unraveling.
      iv. Specify edge conditions; require thresholds.
      v. Carpet which is to be removed for disposal shall be placed in a recycling program.
      vi. All new carpet specified must be from a supplier that will take back the carpet at the end of its life and recycle the used product. [http://www.ucop.edu/purchserv/psa_db/search.php](http://www.ucop.edu/purchserv/psa_db/search.php)
      vii. Unless specifically requested, do not specify extra material.
   b. Submittals
      i. Seaming diagrams for review by the Project Manager shall be required.
   c. Warranty
      i. The Contractor shall provide a five (5) year extended written warranty, co-executed by the installing Subcontractor, agreeing to repair, replace, reset, or restretch carpeting that fails in installation materials or workmanship within the specified warranty period.
      ii. In addition to others available for selected carpet, the following manufacturer product warranties are required:
         1. Against surface pile abrasive wear (fiber loss) in excess of ten percent (10%) for a period of ten (10) years from the date of installation.
         2. Ten (10) years’ antistatic warranty.
   d. Green Building

2. Part 2: Products
   a. Materials
      i. Adhesives: Provide manufacturer's recommended water-based, mildew-resistant adhesive, produced expressly for use with type of carpet and substrates indicated.
         1. The VOC content of adhesives, sealants and sealant primers shall be less than the current VOC content limits of South Coast Air Quality Management District (SCAQMD) Rule 1168 [http://www.aqmd.gov](http://www.aqmd.gov)
         2. All sealants used as fillers must meet or exceed the requirements of the Bay Area Air Quality Management District Regulation 8, Rule 51. [http://www.baaqmd.gov](http://www.baaqmd.gov)
         4. All adhesives, sealants and sealant primers shall be free of the prohibited chemicals as defined in GS-36. On glue-down installations, latex adhesives shall not be used.
5. Specify acrylic, rather than latex adhesives.

ii. Carpet:
   1. General:
      a. Specify carpets manufactured with fusion-bonded backing, rather than latex-backed carpets.
   2. Environmental Criteria:
      a. All carpet and rugs purchased or used shall comply with the California Gold Sustainable Carpet Standard. [Link]
   3. The use of the higher environmental standard, California Platinum Sustainable Carpet Standard, shall be the discretion of the owner. Flammability: Conform to the following, unless otherwise acceptable to, or required by, the State of California.
      a. DOC FF-1-70 or DOC FF-1-70 (Methanamine Tablet Test): Pass and meet the "Standards for the Surface Flammability of Carpets."
      b. NFPA 258 or ASTM E662 (Smoke Density): Specific Optical Density (DM) of 450 or less (flaming).
      c. ASTM E648 (Floor Radiant Panel Test): 0.22 or higher.
   4. Product Specifications – Typical Locations:
      a. Construction: Tufted, low nap or level loop. Pattern: Non geometric, non-directional.
      b. Colors and Shades: Medium intensity; not so light as to easily show soiling, or so dark as to show dust and lint. Do not use solid colors.
      c. Face Fiber: 100 percent solution dyed 6,6 nylon.
      d. Face Weight:
         i. Tufted: 28 ounces per square yard, minimum.
         ii. Woven: 25 ounces per square yard, minimum.
      e. Effective Gauge: 1/8-inch minimum.
      f. Protective Anti-soiling Treatment: Standard of carpet manufacturer.
      g. Static Control: AATCC 134 (Electrostatic Propensity of Carpet). Less than three kilovolts (3.0 kV) of static at seventy degrees Fahrenheit (70°F) and twenty percent (20%) humidity. Use carpet that develops less than two kilovolts (2.0 kV) of static at computer areas.
      h. Lifetime antimicrobial warrantee.
   5. Rapidly Renewable
      a. Certain carpet systems made from rapidly renewable materials (e.g. wool carpet) shall be investigated as an environmentally friendly alternative.

3. Part 3: Execution
   a. Installation
      i. Carpet and adhesive shall be applied in accordance with manufacturer's instructions and requirements of CRI 104.
      ii. Prior to carpet installation, the contractor shall verify that dirt and dust have been removed and that the surface to receive carpet is level to standard tolerances.
   b. Site Environmental Procedures
      i. Waste Management: As specified in Section 01 74 19: Construction Waste Management and Disposal. Coordinate with manufacturer(s) for take-back programs for collection of construction scrap, unused material, demolition scrap, and packaging material.
1. Part 1: General
   a. General Requirements
      i. Do not specify alkyd paints for interior applications without special authorization from the Owner’s Representative and Real Estate Division’s Environment, Health & Safety Office.
      ii. To the maximum extent practicable, materials shall be by a single manufacturer with additional manufacturers providing systems not offered by the principal manufacturer.
      iii. Selection of paints and coatings shall be based on careful analysis of function, aesthetic, cost, sustainability and durability.
      iv. Preparing painted surfaces for repainting may cause disturbance of lead containing coatings in a manner that could result in elevated blood lead levels for workers performing those activities. See Division 01 35 13.43: Special Project procedures for Contaminated Sites.
   b. Green Building
      i. This Section may allow for LEED-CI v2.0 credit in the following categories: MR 2.1, MR 2.2, MR 3.1, MR 3.2, MR 4.1, MR 4.2, MR 5.1, MR 5.2, EQ 3.1, EQ 3.2, EQ 4.2 and ID 1.
   c. Submittals
      i. The Contractor shall provide the Owner with a complete list of materials including those resulting from field changes. List to include manufacturer’s code, name, lot number, and paint label analysis or formula. List shall be cross referenced to systems and numbers used in the Contract Documents.
      ii. Unless specifically requested, do not specify extra paint stock.
      iii. Verification of experience of applicators, including clear sealer at Wet Lab floors, shall be submitted by the Contractor.

2. Part 2: Products
   a. Materials
      i. General:
         1. Use the manufacturer's best quality paint in the manufacturer’s professional product line. Products shall be free of mercury and lead.
         2. Materials selected for coating systems for each type surface shall be the product of a single manufacturer or shall be acceptable to the manufacturer of finish coating for system.
         3. Paints and stains shall be delivered ready-mixed to jobsite.
      ii. Environmental Criteria:
         1. All interior and exterior paints and coatings used shall be certified according to the latest “Green Seal Environmental Standard for Paints” (GS-11), Green Seal, Inc. http://www.greenseal.org/index.cfm
         2. All anti-corrosive paints shall satisfy the latest “Green Seal Environmental Standard for Anti- Corrosive Paints”, (GS-03), Green Seal, Inc. http://www.greenseal.org/index.cfm
         4. The Owner shall have the discretion to require more stringent Zero VOC paints and coatings or natural paints.
      iii. Indoor Air Quality:
         1. VOC limits for interior and exterior paints and coatings are defined by the latest GS-11 as follows:
a. Interior Paints and Primers: Non-flat: 150, Flat: 50
b. Exterior Paints and Primers: Non-flat: 200, Flat: 100

2. VOC limits for anti-corrosive paint are defined by the latest GS-03 as follows:

3. Restricted chemical compounds as defined by the latest GS-11 and GS-03 shall not be used as ingredients in the manufacture of the product.

   iv. Gloss:
      1. Levels: 60-degree meter gloss reading range:
         a. Eggshell: 5 to 20.
         b. Satin: 20 to 25.
         c. Semi-gloss: 35 to 65.
      2. Locations of Use:
         a. Satin or eggshell finish shall be used in offices and departmental work space.
         b. Washable, semi-gloss finish shall be used in public areas, including entries, corridors, stairwells, classrooms, restrooms, and laboratories.

   v. Wet Lab Floors: Non-yellowing, water-borne, penetrating polymer resin applied to unpainted, smooth concrete by experienced applicator. Completed exposed concrete flatwork shall maintain a surface coefficient of friction that meets ADA requirements for wet surfaces.

b. Colors
   i. Use standardized paint colors from the University's color palettes as follows for high-traffic and public areas.

<table>
<thead>
<tr>
<th>Kelly Moore Color Code</th>
<th>Kelly Moore Color Name</th>
<th>Equivalent Acceptability*</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>Swiss Coffee</td>
<td>Yes</td>
</tr>
<tr>
<td>49</td>
<td>Antique White</td>
<td>Yes</td>
</tr>
<tr>
<td>14</td>
<td>Frost</td>
<td>Yes</td>
</tr>
<tr>
<td>41</td>
<td>Snip of Tannin</td>
<td>Yes</td>
</tr>
<tr>
<td>42</td>
<td>Wise Owl</td>
<td>Yes</td>
</tr>
<tr>
<td>36</td>
<td>Navajo White</td>
<td>Yes</td>
</tr>
<tr>
<td>27</td>
<td>Bone</td>
<td>Yes</td>
</tr>
<tr>
<td>46</td>
<td>Acoustic White</td>
<td>Yes</td>
</tr>
</tbody>
</table>

   * Benjamin Moore, Fuller O’Brien, or pre-approved equal.

   ii. Use Light Colors To:
      1. Reduce inventory to fewer colors.
      2. Reduce waste of non-used deep-tone colors.
      3. Save time matching colors.
      4. Enable faster turn-over rate on materials, reducing possibility of paint spoilage. Enable faster service, i.e., response, touch-ups.

   iii. Avoid use of deep-tone colors because they:
      1. Cost more.
      2. Do not reflect light as well as light colors.
      3. Are difficult, it not impossible, to match.
      4. Fade faster.

   iv. Where appropriate, specify paint mil thickness to ensure suitable coverage and durable finish.

3. Part 3: Execution
   a. Installation
i. Surface preparation as required by the paint manufacturer, including cleaning, patching, sealing at doors and windows, and leveling.

ii. Initial coatings shall not be applied until moisture content of surface is within limitations recommended by the paint manufacturer.

iii. Coordinate with the Project Manager for removing existing items on walls, storage and reinstallation.

iv. Do not paint over name plates and fire labels. Cross-reference and coordinate with Divisions 21: Fire Suppression and 26: Electrical. Note that the Contractor is responsible to coordinate with the Project Manager for the protection of smoke detectors and sprinkler heads during painting activities.

v. Minimum Required Number of Coats:
   1. Existing Coating or Shop-Applied Primer: Two (2).
   2. New and Not Shop Primed: Primer and two (2) finish coats.
   3. Additional coats shall be applied at no additional cost as required to hide base material completely, produce uniform color, and provide required and satisfactory finish.

b. Site Environmental Procedures
i. Waste Management: As specified in Section 01 74 19: Construction Waste Management and Disposal and as follows:
   1. Coordinate with manufacturer(s) for take-back program for collection of construction scrap, unused material, demolition scrap, and packaging material.
   2. Where feasible, separate demolition waste, construction waste, and recycling to further utilize waste reduction programs.

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09 91 13 Exterior Painting

1. Utilities and Poles
   a. All above ground utilities, such as backflow devices, light poles, signposts, water valves, etc., shall be painted the standard campus color “Elephant’s Breath” (or approved equal), direct to metal, with a water based paint with a satin enamel finish.
10 00 00 Specialties

10 05 00 Common Work Results for Specialties

1. Custodial Maintenance
   i. Custodial Maintenance areas must conform to the University of California Office of the President (UCOP) Custodial Ergonomic Design Guidelines for New Construction and Existing Buildings.
   ii. Additionally:
      1. Room to be for exclusive use of custodial staff. Do not place utilities or other functions in custodial maintenance areas. Key to preserve use by custodial staff.
      2. Door shall swing out, into hall or room.
      3. Adequate ventilation shall be provided.
      4. At least one (1) floor-mounted sanitary sewer sink per facility shall be provided for janitorial waste water to prevent illicit discharges into the storm drain system (WDR 2013-0001).
   b. All products, floor surfaces, tiles, wall finishes, etc., shall have specifications requiring cleaning and maintenance procedures and schedules and/or product manuals.

10 10 00 Information Specialties

10 11 00 Visual Display Units

1. Review schedule and lead time with the Project Manager; equipment may be Owner-furnished and Contractor installed.
2. Thoroughly coordinate details for mechanical operations, electrical operations, access, size and location.
3. Coordinate framing for backing and reinforcement.
4. Coordinate via the Project Manager with the Office of Media Services (OMS) for product selection and specification.

10 14 00 Signage

1. For building evacuation signage, display the street address, building name, and UCPD cellular phone number of 510-642-3333 (aside 911).
2. Consult Campus Sign Program Guidelines for all building signage:
   http://scr.berkeley.edu/sites/default/files/signage_guidelines.pdf

10 20 00 Interior Specialties

10 28 00 Toilet, Bath and Laundry Specialties

10 28 13.13 Commercial Toilet Accessories

1. Materials
   a. Walls and floors are required to have commercial grade ceramic tile not smaller than four inches by four inches (4" x 4") with dark colored grout.
   b. All plumbing fixtures shall be commercial grade.
   c. Use wall-hung toilets for ease of floor cleaning.
2. Accessories
   a. Paper and soap dispensers shall be surface mounted. Recessed units are not permitted. All soap and paper dispensers to be provided by Facilities Services.
   b. Freestanding trash receptacles to be specified. Recessed trash receptacles are not permitted.
c. The use of pull down shelving in toilet stalls is recommended; otherwise, well-anchored stainless steel shelves shall be utilized.
d. Always check with the Project Manager, who will coordinate with Facilities Services, before specifying toilet room accessories.

3. Stall Partitions
   a. Stall partitions shall be ceiling-hung, wherever possible.
   b. Stainless steel and enameled steel partitions are not permitted.
   c. Plastic laminate, solid phenolic plastic and solid polymer partitions are acceptable. Solid polymer partitions are preferred for maintenance and graffiti resistance. Review partition selection with the Project Manager to assure selection is appropriate for specific conditions.

4. Mirrors
   a. Mirrors, if at all possible, shall be on separate wall from sink basins. Mirrors hung above sink shall be set at a maximum height of seven feet (7'-0") above floor. Soap dispensers shall not be mounted on mirrors. Provide ceramic tile or painted wallboard as mounting surface for soap dispensers.

5. Electrical Outlet and Hose Bib
   a. Provide 110v electrical outlet and standard hose bib in every toilet room.

6. General Considerations
   a. In new construction and substantial remodels provide:
      i. Custodial Break Room for custodial staff. Consider storage for personal items, facilities such as phone and data and furnishings suitable for a staff break room. Discuss specific requirements with the Project Manager.
      ii. Lactation Room for building occupants and compliance with campus policy (Accommodation for Nursing Mothers). Rooms must:
         1. Provide private space
         2. Minimum of one (1) electrical outlet
         3. Provide a sink or close proximity to a sink
         4. Be keyed using Trilogy T-3 lock, in accordance with UCPD protocol for Lactation Rooms (programmed with 200 codes). Contact the Breastfeeding Support Program Manager to discuss other needs (breastfeeding@lists.berkeley.edu).
   b. Restrooms are high maintenance areas on campus. Therefore, it is important to use commercial grade products, designed for high usage. These products are cost effective in the long term.

10 40 00 Safety Specialties

10 44 00 Fire Protection Specialties

10 44 13.53 Security Fire Extinguisher Cabinets

1. Indicate location on drawing.
2. Recessed cabinets installed in corridors and fire rated walls require approval by the Designated Campus Fire Marshal (DCFM).
3. Install standard 5lbs, 2A10BC fire extinguishers for low-level hazards. Wherever possible, match existing brand and type for consistency within the building. Fire extinguishers shall comply with California Code of Regulations, Title 19.

10 80 00 Other Specialties

10 81 00 Pest Control Devices

1. Special consideration shall be paid to pest control when designing, building and repairing campus environs. In addition to the items outlined below, pest control design guidelines and best practices may be found here: http://www.sfenvironment.org/download/pest-prevention-by-design-guidelines.
2. Exterior Light Fixtures: Exterior light fixtures shall be designed so that birds cannot roost or nest on or in them. Surfaces that would be available for roosting should have a 45 degree angle, or bird-proofing materials should be installed. This is especially important for light fixtures next to entrances to the building.

3. Exterior Doors: Gaps under and between exterior doors shall not exceed 3/16” to exclude rodents. This includes roll-down loading dock doors. Door sweeps to a door is not a long-lasting solution; the actual door shall have no more than 3/16” clearance. In areas of high rodent pressure, affix to all external doors a 26-gauge sheet metal kick plate at least twelve inches (12”) tall.

4. Windows and Doors in Museum and Collection Storage: Windows opening to museums and collection storage areas such as libraries must be screened to exclude museum pests (beetles and moths). There shall be NO gap under and between exterior doors. Interior doors shall be tight-fitting, including sweeps, to prevent pests (beetles, moths, mice) from passing through.

5. Pipe Insulation and Furniture in Laboratories, Kitchens, and Animal Rooms: All pipe insulation must have smooth surfaces with no gaps. Do not install pegboard in kitchens, animal rooms or laboratories. All permanently installed furniture in kitchens, animal rooms and laboratories must be sealed at points of attachment, under countertops, and inside to prevent pests from harboring in the gaps. All built-in cabinets, closets, and similar casement/millwork must be sealed leaving no gaps in which pests may hide.

6. Exterior design: Decorative lattices shall not be placed over entrances, or shall be designed in such a way that birds will not roost on them. Avoid creating sheltered areas or cave-like openings under eaves, roof lines, etc. Use bird barrier netting or other devices to exclude pigeons from these areas. To prevent pigeons from roosting, ledges over 3 inches wide in protected areas shall have a 45 degree angle or pigeon-proofing materials shall be attached to them.

7. Exterior Pest Barriers and Seals: Seal all construction from foundation to roof to prevent access by pests such as bats, birds and rodents.

8. See Division 01 57 00: Temporary Controls for jobsite-related pest control requirements and Division 32 90 00: Planting for pest control-related planting requirements.
11 00 00 Equipment

11 50 00 Educational and Scientific Equipment

11 53 00 Laboratory Equipment

11 53 13 Laboratory Fume Hoods


1. Each hood must have a quantitative airflow monitor so that operators can determine at all times if hood is functioning properly (e.g., digital airflow meter, or magnahelic gauge). The monitor should be connected to an alarm.

2. Fume hoods shall be located in areas of minimum air turbulence and away from doors and windows, and in a manner that will not impede egress.

3. 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. Each valve shall be individually labeled with the name of the utility that valve services.

4. Initial testing results for fume hood face velocities must be forwarded to Environment, Health and Safety (EH&S). The position of the sashes while measurements were taken shall be indicated both on the hood and in the testing results. This shall be done prior to use of the fume hood. For vertically rising sashes, the typical maximum height is eighteen inches (18”), and there shall be stops on the sash to indicate the maximum opening.

5. If a Cal/OSHA regulated carcinogen, as listed in Title 8 CCR, 5209, is to be used or stored in a hood, the satisfactory average airflow face velocity design for that hood shall be 150 FPM, at indicated sash positioning, with no measurement below 125 FPM. The typical satisfactory range for campus fume hoods is 100 -150 FPM.

6. To reduce energy use of hood systems, use variable air volume (VAV) hood controls with bypass baffles set only below the last six inches (6”) of face in buildings that have a variable volume air distribution HVAC systems. Perform a life cycle cost analysis of variable volume and constant volume systems and select optimal system. Contact the Office of Sustainability and Energy for economic and financial assumptions. Any VAV control system shall have emergency switch that allows maximum flow. VAV systems are not to be used where carcinogens are regularly used.

7. See Division 23 00 00: Heating, Ventilating and Air Conditioning (HVAC) for fume hood ductwork requirements

8. Rooftop exhaust stacks for chemical fume hoods must extend at least seven feet (7’-0”) above the rooftop (ten feet [10’-0"] is preferred) and, discharge vertically upward. Where this is not feasible, alternate designs must be approved by EH&S. Each hood shall be labeled to indicate which hood fan it is connected to. Hood fans are typically located on roofs or outside the building envelope. Booster fans are not recommended for hazardous exhaust inside occupied buildings because they can positively pressurize the exhaust duct.

9. The fume hood exhaust system shall be designed with redundant hood fans so that exhaust is maintained in the event that one fan is not functioning.

10. Room air currents at the fume hood shall be minimized (not to exceed thirty percent [30%] of the face velocity).

11. Chemical storage areas under fume hoods shall be connected to the exhaust system. Flammable vapors shall be exhausted above the hood with metal piping. Corrosive vapors can be exhausted into the back plenum of the fume hood, only where the connecting exhaust piping rises at least ten inches (10”) above the work surface.

12. A minimum stack discharge of 3,000 FPM is recommended. (ANSI Z9.5)
13. Exhaust hood fans shall be connected to emergency power that will provide at least half of normal airflow during a power failure. (Note: Not required in buildings without emergency power generation).

14. New fume hoods shall be from a manufacturer acceptable to the university and specifically approved by EH&S. All fume hood designs shall demonstrate containment of tracer gas less than 4.0AM0.01 and 4.0AI0.05 when tested according to ASHRAE Test Standard 110-1995.

15. Ductless fume hoods are not permitted without prior written approval of EH&S.

11 53 33 Emergency Safety Appliances

1. Flammable liquid storage cabinets shall be approved and labeled by Underwriter’s Laboratory (UL) Factory Manual (FM) or the State Fire Marshal (SFM).

2. Provide capability to exhaust solvent storage cabinets. Vents shall be exhausted through the lower bung opening. Piping shall be resistant to high temperatures generated by fire. Stainless steel, hard-soldered copper and carbon steel are acceptable vent materials.

3. Doors to solvent storage cabinets shall be self-closing with a latch, but are not required to be self-latching in accordance with codes.

11 53 53 Biological Safety Cabinets

1. There are several classes of Biological Safety Cabinets (BSC), with the most common type on campus being the Class II. Consultation shall be required between the end user and EH&S when determining what type of cabinet is needed. For NIH guidelines, see: http://orf.od.nih.gov/PoliciesAndGuidelines/BiomedicalandAnimalResearchFacilitiesDesignPoliciesandGuidelines/Pages/News_to_Use_June_2010.aspx

a. Placement

i. Biological safety cabinets shall be located out of the traffic pattern and away from doors, preferably at the dead-end of the laboratory. The cabinet should be placed so that there is a minimum clearance of three inches (3”) on each side of the cabinet and at least one and one-half inches (1-1/2”) in back. Sufficient clearance shall be maintained above the cabinet to allow testing, a minimum of twelve feet (12’) above to any structure. The discharge from nearby supply air registers should be directed away from the cabinets. The electrical outlet for the cabinet shall be accessible for service and electrical safety testing without moving the cabinet.

b. Certification

i. Biological safety cabinets installed as part of a building or renovation project shall be tested and certified in place as meeting National Sanitation Foundation Standard 49 prior to completion of the Project. Records of certification shall be forwarded to Environment, Health and Safety (EH&S) by the Contractor or the testing and certification agency.

c. Utility Services

i. Utility services needed within a BSC shall be planned for carefully. Protection of vacuum systems shall be addressed. Electrical outlets inside the cabinet shall be protected with ground-fault circuit interrupters and shall be supplied by an independent circuit. When propane or natural gas is present, a clearly marked emergency gas shut-off valve outside the cabinet shall be installed for fire safety. All non-electrical utility services shall have exposed, accessible shut-off valves. The use of compressed air within a BSC shall be carefully considered and controlled to prevent aerosol production and reduce the potential for vessel pressurization.

d. Types of Biological Safety Cabinets. (refer to 8CCR5154.2 and National Sanitation Foundation Standard 49)
i. Class II, Type A cabinets are designed to return air to the laboratory, and do not generally require external venting. If a cabinet is vented into a common exhaust system, a canopy connection is recommended (see Recommendations for Installation from NSF Manual.)

ii. Class II, Type B cabinets require an external exhaust blower and should be connected directly to an exhaust system that discharges to the outdoors. The venting system shall include a leak-tight duct, a damper in the duct near the cabinet to permit flow adjustment and decontamination, and an external exhaust blower as the final system component (see Recommendations for Installation from NSF Manual).

1. The exhaust blower shall be sized to deliver the required exhaust airflow (as specified by the cabinet manufacturer), considering pressure losses in the duct, and allowing at least two inches of water gauge (2 iwg) for a dirty HEPA filter. If a charcoal filter is used downstream of the HEPA filter, an additional one inch water gauge (1 iwg) or the manufacturer's recommended resistance shall be provided.

2. An audible and visible alarm must be provided at the cabinet to indicate loss of exhaust flow in accordance with 8CCR5154.2. This can be a differential pressure switch across the exhaust filter, air-proving sail switch at the blower discharge, or flow measuring station in the exhaust duct.

3. It is recommended that each Type B cabinet have its own exhaust system and not be ganged with other Biological Safety Cabinets or chemical fume hoods. If a Type B cabinet contains an internal blower which provides or contributes to exhaust flow and feeds into a system with an external blower, the cabinet and external blowers must be interlocked.

11 80 00 Facility Maintenance and Operation Equipment.

11 82 00 Facility Solid Waste Handling Equipment

1. Refer to Division 32 33 00: Site Furnishings for waste receptacle and enclosure requirements.
2. Compactor use shall be approved by the Owner prior to design phase.
12 00 00  Furnishings
12 20 00  Window Treatments
12 21 00  Window Blinds
12 21 13  Horizontal Louver Blinds

1. Type: Manually-operated horizontal blind conforming to ANSI/WCMA Standard A 100.1 for safety of corded window coverings.
   a. Slat Width: one inch (1”). Use of two inch (2”) width blinds shall be reviewed with the Project Manager.

2. Materials:
   a. Slats: Minimum 0.008 inch thick spring-tempered aluminum with crowned profile and rounded corners.
   b. Slat Support: Woven polypropylene, ladder configuration.
   c. Head Rail Housing: Formed-steel "U" channel, internally fitted with hardware, pulleys, and bearings for blind operation cross braced for rigidity.
   d. Bottom Rail: Formed-steel box to match slat and reinforced to prevent twisting or sagging. End caps shall be metal.
   e. Lift Cord: Braided polyester/rayon, continuous loop.
   f. Tilter: Manufacturer's standard enclosed lubricated worm-and-gear drive actuated by wand with 180-degree tilt range, designed to hold slats at set angle.
   g. Control Wand: Extruded transparent plastic.
   h. Equalizers: Self-aligning, nylon, designed to maintain blind slats in horizontal position.
   i. Accessory Hardware:
      i. Pocket-type hinged mounting brackets.
      ii. Valances are not permitted unless they are integral part of head rail housing.
   j. Finish and Exposed Metal Components: Factory-applied, light-colored.

3. Fabrication and Installation:
   a. Control wand and lift cord shall be in length sufficient for easy operation from a convenient position and meet required ADA accessibility requirements. Locations shall be specified or indicated on the Drawings.
   b. Blind height shall not exceed twelve feet (12’-0”). At areas requiring greater height, provide two (2) blinds stacked one above the other.
   c. Widths shall not exceed seventy-two inches (72”).
   d. Blinds shall be “between jamb” mounted unless face of wall mounting is required by Project conditions.
   e. Divisions between blinds shall occur only at mullions of continuous windows or openings where more than one (1) blind for one (1) opening occurs.

12 21 16  Vertical Blinds

1. Type: Manually-operated, rotating and traversing vertical louver blinds.
   a. Louvers shall traverse and rotate 180 degrees.
   b. Slat Width: Nominal 3-1/2 inches.

2. Materials:
   a. Slats: Minimum 0.010 inch thick curved and spring-tempered aluminum
   b. Headrail: Heavy-duty gear-reduced aluminum channel track with matching end caps.
c. Rotation: Nickel-plated brass beaded chain.
   i. Sprocket and gear rack assembly shall provide not less than 10-to-1 mechanical advantage.
   ii. Louvers shall remain parallel to each other and rotate in unison.

d. Traversing:
   i. Control shall be a lock-knit polyester cord, stretch resistant, non-fraying and lint free.
   ii. End caps and traversing mechanism shall lead cord through carrier bodies away from gears.

3. Fabrication and Installation:
   a. Traversing shall conform to Project conditions with direction at each opening shown on Drawings.
   b. Chain operator shall be in length sufficient for easy operation from a convenient position and meeting required ADA accessibility requirements.
   c. Blinds shall be inside ceiling mounted unless face of wall mounting is required by Project conditions.
   d. Divisions between blinds shall occur only at fixed mullions.
   e. Finish and Exposed Metal Components: Factory-applied, light-colored.

12 24 00 Shades

1. General:
   a. Type of shade fabric and method of operation shall be selected to meet specific project requirements.
   b. Dual shade systems, with both shades located in the same pocket, shall be used where both blackout and light filtering fabrics are required at the same location.
   c. Use of motor-operated systems shall be reviewed with the Project Manager and shall be considered where bead chain length is excessive or not accessible, or blackout shades are required to interface with A/V equipment.
   d. Removal of shade shall not require disassembly of shade unit.

2. Materials and Fabrication:
   a. Shade Cloth:
      i. Shade cloth shall have no seams and hang flat without buckling or distortion.
      ii. Edge, when trimmed, shall hang straight without raveling.
      iii. An unguided roller shade cloth shall hang true and straight, without shifting sideways more than 1/8 inch in either direction due to warp distortion or weave design.
      iv. Shade fabrics shall be certified by an independent testing laboratory to pass NFPA 701 and applicable code requirements.
      v. Each shade shall fully cover the opening where it occurs.
   b. Drive Assembly:
      i. Shall be factory set for size and travel of shades.
      ii. Shall be adjustable from exterior of shade unit without disassembly of hardware.
      iii. Shall have a built-in shock absorber system to prevent chain breakage under normal usage conditions.
      i. Chain operator shall be in length sufficient for easy operation from a convenient position and meet required ADA accessibility requirements.
   d. Shade support hardware shall be capable of supporting 150 percent of the full weight of each shade.
   e. Power Operators:
      i. Control systems and components shall be approved as a system by either Underwriter Laboratories (UL) or Electrical Testing Laboratories (ETL).
      ii. Motor: Fractional horsepower asynchronous motor with reversible capacitor designed for intermittent operation.
         1. Thermally protected, temperature Class A, totally enclosed.
2. Solenoid activated disk brake mechanism shall stop and hold shade in any position and shall have externally adjustable internal limit switches. The brake shall automatically disengage when motor is operating.


4. The motor shall be concealed within the shade tube and shall be maintenance free.
   iii. Controls: three (3) position rocker-type wall switch. Locations shall be shown on the Drawings and match other switches provided under Division 26: Electrical.
   iv. Motor Control System: To be coordinated with the Project Manager for specific Project requirements and for interface with low voltage audio-visual systems.

3. Warranty:
   a. Tracks, gear-and-sprocket mechanism, and accessories for shades shall be warranted for five (5) years against defects in materials and workmanship which inhibit proper and intended functioning of products.
   b. Shadecloth shall not deteriorate, sag or warp and will remain fit for use for the full warranty period of not less than ten (10) years.
   c. Motors shall be warranted to be free of defects in manufacture for not less than two (2) years.

12 30 00 Casework

1. Review with the Project Manager all casework standard requirements.
2. Review with the Project Manager requirements for mock-ups.
3. Contact the Ergonomics@Work Program (ergotf@uhs.berkeley.edu) for an ergonomics review when designing the following environments: computer workstations, laboratory animal facilities, customer service reception counters/windows, dining facilities, housing facilities, research laboratories, computer labs and loading docks/receiving areas.

12 40 00 Furnishings and Accessories

12 40 00 Furnishing Accessories

12 46 33 Waste Receptacles

1. For all indoor public centralized locations such as lobbies, eateries, break rooms, common space, entrances and exits use:
   b. With prior approval from Facilities Services, Forms and Surfaces centralized collection unit may be used as alternate. https://www.forms-surfaces.com/triad-litter-recycling-receptacle
      i. Use the following FOUR Triad Receptacles as ONE SET with the following receptacles (note: new graphics on the rim plus new graphics on the top are required):
         1. Landfill:
            a. SB: Triad Receptacle
            b. Capacity: 16 Gallon;
            c. Lid Opening: Triangular;
            d. Lid Color: Black;
            e. Lid Graphic Copy/Color: "Landfill" & Symbol/White;
            f. Lid Graphic Background Color: Black;
            g. Body Material: Stainless Steel;
            h. Body Finish: Sandstone;
            i. Mounting: Freestanding
      2. Bottles And Cans:
         a. SB: Triad Receptacle
b. Capacity: 24 Gallon;
c. Lid Opening: Bottles/Cans;
d. Lid Color: Blue;
e. Lid Graphic: Bottles & Cans;
f. Lid Graphic Background: Blue

g. Lid Graphic Color: White;
h. Body Material: Stainless Steel;
i. Body Finish: Sandstone;
j. Mounting: Freestanding

3. Mixed Paper:
   a. SB: Triad Receptacle
   b. Capacity: 24 Gallon;
c. Lid Opening: Paper;
d. Lid Color: Blue;
e. Lid Graphic Copy/Color: "Paper" & Symbol/White;
f. Lid Graphic Background Color: Black;
g. Body Material: Stainless Steel;
h. Body Finish: Sandstone;
i. Mounting: Freestanding

4. Compost:
   a. SB: Triad Receptacle
   b. Capacity: 24 Gallon;
c. Lid Opening: Litter;
d. Lid Color: Green;
e. Lid Graphic: Compost;
f. Lid Graphic Background: Green

g. Lid Graphic Color: White;
h. Body Material: Stainless Steel;
i. Body Finish: Sandstone;
j. Mounting: Freestanding

12 50 00 Furniture
12 51 00 Office Furniture
12 51 16 Case Goods

1. Contact Ergonomics@Work Program (ergotf@uhs.berkeley.edu) for an ergonomics review when:
   a. Designing, building or installing computer workstations or computer labs;
   b. Trying to achieve the LEED credit (Innovation in Design) for following the campus ergonomics strategy;
   c. Selecting or purchasing office task chairs and stools that are not on the pre-approved products list
      (http://uhs.berkeley.edu/facstaff/Ergonomics/matchingfunds/productlist.shtml)

12 57 00 Industrial Furniture
12 57 19 Laser Containment Screens
1. Facilities in which Class 4 laser equipment will be used shall require special design considerations. Coordinate with the Project Manager and the EH&S Laser Safety Officer for special laser facility design requirements.
1. Facilities in which Class 4 laser equipment will be used shall require special design considerations. Coordinate with the Project Manager and the EH&S Laser Safety Officer for special laser facility design requirements. See also 12 57 19: Laser Containment Screens.

13 25 16 Toxic Gases

1. Facilities that handle toxic or pyrophoric gases (e.g. silane, carbon monoxide, ammonia, hydrogen, etc.) shall require special design considerations, and storage of cylinders with proper exhaust (e.g. gas cabinets). Coordinate with the Project Manager and EH&S for special construction and/or permit requirements (Bay Area Air Quality Management District, Cal-OSHA, et al). All projects shall comply with the UC Berkeley Toxic Gas Program: [http://www.ehs.berkeley.edu/sites/default/files/lines-of-services/workplace-safety/toxicgasprogram.pdf](http://www.ehs.berkeley.edu/sites/default/files/lines-of-services/workplace-safety/toxicgasprogram.pdf)

13 29 00 Food Facilities

1. Facilities in which food will be stored, prepared or otherwise handled will require design considerations and construction plans and will need to be approved by the EH&S Sanitarian. Coordinate with the Project Manager and EH&S for design requirements and approvals.
2. Commercial kitchen ventilation systems must comply with Title 24 2013 and shall not be considered as unregulated process loads.

13 40 00 Integrated Construction

13 49 00 Radiation Protection

13 49 13/16 Integrated/Modular X-Ray Shielding Assemblies

1. Coordinate with the UC Berkeley Environment, Health & Safety Office (EH&S) via the Project Manager.
2. Review with the Project Manager inspection requirements and testing. (See California Code of Regulations, [Title 17](#))
14 00 00 Conveying Equipment

14 20 00 Elevators

1. Conveying Systems Variance To Code
   a. No variance to code shall be sought from the State prior to written approval from the University. Copies of variances approved by the State shall be provided to the University’s Representative within fourteen (14) days after release.

2. Types Of Elevators
   a. Provide hydraulic elevators for a maximum rise of fifty feet (50’-0”). Use traction elevators for travel distance over fifty feet (50’-0”).
   b. Minimum of one (1) car shall be designated as a service/freight elevator.
   c. Stainless Steel or other easily-maintained finish shall be required.

3. Theoretical Traffic Analysis Study
   a. The Architect shall have the elevator consultant submit to the University’s Representative a completed theoretical traffic analysis of the anticipated traffic demands to evaluate the handling demands, based on speed, capacity and type of elevators to be incorporated into the building design.
   b. Analysis results shall be reviewed with the University’s Representative during the Schematic Design Phase and before proceeding to Design Development Phase.

4. Required Features and Products
   a. Each elevator shall be completely described in the Specifications.
   b. Provide elevators with the following:
      i. LED digital floor indicator light in car operating panel with arrows.
      ii. LED hall position indicator at main lobby floor only landings. Combine with hall lantern. Call buttons at all landings with 100,000-hour LED call button lamps.
      iii. LED hall lanterns at all floors with electronic chimes (one for up, two for down).
      iv. Should car-riding lanterns be required, provide LED type (two each car).
      v. Provide handicapped provisions. Specify dimensions and mounting heights in accordance with Title 24 2013 and current University of California at Berkeley Access Requirements.
      vi. Earthquake safety devices: Provide, at a minimum, dual ring and string and seismic switch on traction elevators. Provide, at a minimum, power unit tie-downs on hydraulic elevators.
      vii. An alarm bell at top and bottom of travel and every two (2) floors in between. Alarm to be different tone from classroom or fire alarms.
      viii. Provisions for a telephone with telephone conduit and box in Machine Room. Run conduit and telephone wire to telephone terminal. Provide and install speaker phone as manufactured by Ram Tech, Model No. R2A-S with DA1 and PD, consisting of a combination speaker/microphone, amplifier, automatic dialer, push button to activate system and off hook switch (off button). Provide telephone unit in standard telephone back box with four (4) tamper-proof screws. Phone system shall be operational with wiring from elevator car to the electrical equipment room. Automatic dialer shall be programmed as directed by the University. The system shall match existing University Ram Tech system without modification.
      x. Pad hooks and protection pad for all sides of car interior with sectional cut-outs for operating fixtures.
      xi. Heavy-duty door operator. Specify door operator as manufactured by GAL or MAC, no known equal. Manufacturer recommended diagnostic tools shall be provided.

Adopted August 2015
xii. Electronic scanning type door protection distributed the The Fixture Company, Model FCu 47 Detector Edge, no known equal.

xiii. Fire emergency service and products of combustion detectors where travel is twenty-five feet (25’-0”) or more.

xiv. Medeco KeyMark x4 system keys. Refer to Section 08 70 00: Hardware and coordinate keying with Project Manager and. Provide "Adams" Phase I, and Phase II firefighter’s service switches. To comply with DSA requirements, car floor buttons or hall call buttons shall not be subject to use of a key type switch to register the call.

xv. Machines shall be Hollister-Whitney. Rollers and guides shall be either Elsco or Elpro, no known equal.

xvi. Floor-passing gong. Gong shall operate as each floor is passed per code requirement.

xvii. Position indicators shall be manufactured by CE Electronics, ERM, and Adams Elevator Co., no known equal.

xviii. Certificate holders shall be provided by Nylube Products Co, or equal, and mounted above or adjacent to car opening panel.

c. Confirm with the Project Manager to ensure that the selected car entrance heights and internal cab heights are suitable for the intended movement of materials that require elevator transportation.

d. Coordinate miscellaneous metals work relating to elevators including machinery guards (designed and installed compliant to CalOSHA Title 8 3944 and 4186), pit ladders, machine room steps, guardrails in raised areas and at hazardous roof door entrances to machine rooms, sump pit gratings, and hoistway screens.

e. Provide door closers and locksets (that cannot be left unlocked) on access door or doors to Machine Room space.

f. Security:

i. When a building security system is incorporated into the elevator operation with the use of key switches and card readers, the security system shall be arranged to allow elevators to operate as intended by code and allow firefighter’s override.

ii. To assure compliance, the device shall be tested and witnessed by a Facilities Services representative within thirty (30) days of the elevator being turned over to the University.

5. Submittals

a. Submittals shall include:

i. Dimensioned shop drawings showing relationship to finishes and structure including hoistway plan, hoistway section, machine room plan, car and entrance details, mechanical and electrical connections.

ii. Product data and finish samples.

b. Before final payment, the following shall be submitted and provided:

i. Wiring diagrams: Five (5) hard copies and electronic version (both PDF and DWG format) of both full line and schematic diagrams. Include nomenclature definitions and symbols key.

ii. Five (5) hard copies and electronic version (PDF format) of operation and maintenance manuals, parts list, warranty/guarantee, diagnostic documentation, sequence of operation and manufacturer part numbers

iii. Five (5) additional hard copies and electronic version (PDF format) of final approved submittals to the University’s Representative.

iv. Wall Holder For Diagrams: The Contractor shall mount a complete set of wiring diagrams including a definition of all nomenclature and symbols on the Machine Room wall laminated in clear plastic. The mounting method is to be reviewed by the Project Management and Facilities Services Representatives.

v. Wire Pull Sheets: These shall be left at the Project site and shall become the Owner’s property for the purpose of future trouble-shooting.
c. Listing of Maintenance Materials to be Furnished by Contractor:
   i. Traction and Hydraulic Elevators:
      1. Expendable Parts: The elevator Contractor shall provide a metal cabinet in every
         machine room on Project premises containing the following expendable parts
         required for prompt replacement. The metal cabinet and the un-expendable parts shall
         become the property of the University and remain at the end of the twelve (12)
         months’ warranty/maintenance period.
         a. Two (2) relays of each type installed. Twenty (20) lamps of each type
            installed.
         b. Car and hall buttons with identical graphics installed; six (6) for
            manufacturer's standard buttons, one (1) of each type for special buttons.
         c. Twelve (12) fuses of each type installed.
         d. Other parts required for prompt replacement.
         e. One (1) digital LED position indicator and one driver board of each type. One
            (1) directional lantern and chime of each type.

6. Contract Document Coordination
   a. The Contract Documents shall be coordinated to comply with and provide the following items:
      i. Mechanical and Electrical:
         1. Light and GFCI electrical outlet in pit and machine room.
         3. Emergency power transfer switch prior signal for emergency and normal power
            operation.
         4. Elevator disconnects.
         5. Smoke detectors, shunt trips, and heat sensors where required. Telephone provisions
            in machine room.
         6. Utility piping or ducts in shaft is not allowed.
         7. Utility piping in machine room is not allowed.
         8. Adequate machine room ventilation to prevent heat build-up, in accordance with
            CBC- Chapter 30, Section 3005.1. Limit temperature range to sixty five to ninety
            degrees Fahrenheit (65° F to 90° F).
         9. Shaft and hoistway ventilation.
         10. Drain or provisions for pump in pit including isolation of accumulated waste.
         11. Emergency telephone in elevator cab (see Section 4: Required Features and Products,
             above). Provide heat sensors where required.
         12. Provide shunt trip device outside machine room and 120 V supply to operate the
             shunt trip plunger.
         13. Provide auxiliary contacts in hydraulic elevator disconnect, when using battery
             lowering.
         14. Provide two-way conversation between car and readily accessible point outside the
             hoistway, which is available to emergency personnel, with standby power back-up.
         15. Elevator Firefighters Service to override all car security systems.
         16. Electrical lights, switches and convenience outlets located below four feet (4’-0”)
             from floor to be NEMA-4 rated equipment.
      ii. Architectural:
         1. Shaft venting shall comply with all prevailing code.
         2. Ceiling height in machine room per code.
         3. Clearance between top of car and roof beam per code.
         4. Stairs (not vertical ladders) for access to, or in, machine room.
            Miscellaneous metals shown and specified: pit ladders, screens, sill angles, railings.
            Telephone provisions in car.
5. Vandal-resistant handrails and finishes.
6. Head, jamb, sill details.
7. Machine room walls/floor/ceiling and hoistway walls minimum STC rating of 50 at occupied spaces. Fire-ratings per code and guideline requirements.
8. When provided, locate security card readers recessed into car operating panels.

iii. Structural:
1. Provide structural supports for guide rails for the full height of each hoistway. Coordinate with the Designated Campus Fire Marshal (DCFM) and other jurisdictional agencies.

7. Warranty and Maintenance
a. The elevator company shall provide a one (1) year warranty including parts and labor and a one (1) year maintenance period conforming to the requirements of the Campus Elevator Maintenance Requirements.
b. The warranty and maintenance shall cover elevator equipment and controls.
c. The Contractor shall provide three (3) hours minimum of training for University personnel by a qualified elevator adjuster.
d. Starting time for warranty and maintenance periods shall be determined at time of elevator acceptance in coordination with the University Representative and Division 1.

8. Selection Of Equipment
a. For University dormitory and housing, consult with the University’s Representative for minimum-rated load requirements for passenger elevators due to student tendency to overcrowd cars.
b. Selection of traction or hydraulic elevators shall be based on an analysis of long-term cost, speed or quality of service, quietness and availability of machine room space. Selected equipment shall be approved by Facilities Services and the Project Manager.
c. The Architect shall prepare a vertical clearance diagram indicating travel of the car, top and bottom clearances, height of penthouse and depth of pit, all as related to the building structure. Submit this to the University’s Representative for approval before proceeding with the Contract Documents.
d. Controls shall be of the solid-state micro-processor type. Specify controls by Smartrise Engineering, Sacramento, CA or Motion Control Engineering, Rancho Cordova, CA; no known equal. If a field tool is required to service any part of the elevator, the tool and its supporting documentation shall be supplied and become the property of the University. Each system shall incorporate internal diagnostics with monitor and keyboard supplied in locked cabinet.
e. The disconnecting means for the elevator controller shall be a motor circuit switch rated in horsepower. It shall be fused with current limiting dual element fuses.
f. Signal fixtures shall be of the vandal-resistant type. Specify fixtures by Adams or ERM-CA-93, Survivor Plus type no known equal. Buttons shall be raised 1/8". Provide a Best on-off key switch for each floor in the car-operating panel subject to Division of the State Architect (DSA) and Committee for Campus Removal of Architectural Barriers (CCRAB) approval of the key switch control of car or lobby buttons.
g. Cab interiors for classrooms and student housing projects shall be vandal-resistant. Plastic, waffle grid type ceilings shall be avoided.
h. Cab lighting shall be long-life, UCB Standard size, LED lamps with easy access for lamp replacement.
i. The following controls shall be supplied:
   i. Gearless: SCR drive (static drive).
   ii. Geared: SCR drive or variable voltage, variable frequency.
9. Elevator Pit Drains
   a. Hydraulic elevator pits shall be constructed so as to capture and isolate contaminants such as oil or
      water from fire sprinkler systems. Equipment related to the water removal system shall not be
      located in the pit, elevator hoistway, or machine room. There shall be no connection to either
      sanitary sewer or storm drain systems (California Code of Regulations, Title 8, Ch. 4, Sub 6;
      EBMUD Ordinance; MS4 WDR 2013-001).
   b. Provide a GFCI outlet for a portable pump.
   c. Electrical lights, switches and convenience outlets located below four feet (4’-0”) from floor to be
      NEMA-4 rated equipment.
   d. Flood water discharge from elevator pits and sumps shall comply with the requirements and
      procedures included under Division 22.
   e. Elevator pits shall have waterproofing both interior and exterior. Coordinate with Division 7.

10. Equipment Room Ventilation
    a. When an elevator is provided with emergency power operation, the machine room mechanical
        ventilation shall be provided with emergency power.
    b. See additional requirements for ventilation included in Division 23.

11. Electrical Services
    a. The amperage requirements for elevator machine motors, isolating transformers and controllers,
       require higher full-load starting and running currents, and, due to distance from power source, are
       subject to higher voltage drop. These requirements and conditions shall be considered when
       selecting and sizing conductors.
    b. Obtain the full load current from the elevator manufacturer. Do not exceed voltage drop limitations.
       For motor voltage rating see Division 26.
    c. Provide lights, light switches and GFCI convenience outlets in pits and all machine room spaces.
       The car lighting and power circuit disconnect shall incorporate over-current protection.
    d. Provide a continuous grounding conductor from the building ground to the elevator
       controller/isolating transformer as applicable.

12. Controller Cabinets
    a. Controller cabinet doors shall have vertical piano hinges and be capable of key locking.

13. Hydraulic Elevators
    a. Installation of hydraulic elevators shall include:
       i. Manual pit shut off valve in the fluid line between the pump and jack. Provide second shut
          off valve in machine rooms not directly adjacent to hoistway.
       ii. Provide seismic shut off valve in fluid line adjacent to jack to shut off line in the event of a
           sudden loss of pressure or line rupture.
       iii. Oil viscosity control.
       iv. Roller guide shoes.
       v. Main line strainer.
       vi. Low oil control in the electric control circuit. Discuss the function with the Project
           Manager.
       vii. Provisions for noise reduction such as sound insulating panels, sound isolating couplings in
           oil lines, oil hydraulic silencer (muffler), and vibration pads.
       viii. Cathodic protection system for the jack cylinder: 100 psi, PVC liner with sealed bottom,
            special backfill, and isolated pipe couplings, as required for a complete installation.
       ix. Jack cylinder protective coating of two (2) layers of tape wrap or fiber glass, outer casing
           of 10 gauge steel with 0.20 percent copper content, inside diameter eight inches (8”) greater
           than outside diameter of buried cylinders, welded steel bottom or concrete plug.
x. Provide solid state closed transition Wye-Delta start for twenty-five (25) horsepower or larger pump motor; all starters heavy-duty horsepower NEMA rated regardless of horsepower. IEC method of rating starters is not acceptable.

xi. Electrically-operated scavenger pump to return oil from cylinder head to tank. Provide 3/8-inch copper tubing for return line. Pumps shall be secured to the pit floor to prevent them from overturning if water enters the elevator pit. Scavenger pumps shall be equipped with an external float device that will render the pump inoperable should the pump become submersed.

xii. Telescoping jacks are not allowed.

xiii. An auxiliary-power lowering device shall be provided that will, upon failure of the main power supply, allow a hydraulic elevator to descend to a lower landing and prevent entrapment of passengers.
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21 00 00 Fire Suppression

21 10 00 Water-Based Fire-Suppression Systems

21 11 00 Facility Fire-Suppression Water-Service Piping

1. Water supply for Fire-Suppression Systems
   a. Water main lines providing fire protection and/or domestic water are operated under the jurisdictions of UC Berkeley.
   b. A fire service main, as defined by these standards refers to the pipe and its appurtenances between the water main and the base of the system riser for water-based fire protection systems and/or the first fitting above finished grade for hydrants or monitor nozzles.
   c. See Division 33 00 00: Utilities.

21 13 00 Fire-Suppression Sprinkler Systems

1. Automatic fire sprinkler systems are required by the University for the following types of buildings:
   a. All new buildings.
   b. Existing campus buildings undergoing major remodeling.
   c. Newly purchased buildings that are to be renovated.
   d. Discuss small additions and minor remodeling projects with Designated Campus Fire Marshal (DCFM) and Construction & Design (C&D).

2. Submittals:
   a. All design work shall be done by a licensed fire protection engineer using separate 1/8" = 1' 0" minimum scale drawings for fire sprinklers and fire alarm system. All drawings submitted for review shall be stamped by the engineer. Before starting design work discuss the extent and type of fire protection system required with the Designated Campus Fire Marshal (DCFM). Design/Build specifications will be considered for small remodeling projects only; discuss with the Designated Campus Fire Marshal (DCFM) and Construction & Design (C&D).
   b. In high-content-value areas, or where water damage must be kept to a minimum, consider the use of a water mist or dry pipe system with early alarm and pre-activated system charging control, or on-off cycling system. See Division 26: Electrical, and discuss with Construction & Design (C&D) and the Designated Campus Fire Marshal (DCFM).
   c. Specify a separate maintenance air compressor for any dry pipe sprinkler system. To check for excessive air compressor operating time, install a digital operating time clock reading to minimum of 999 hours, together with a recorder capable of totaling the frequency of operation up to 999 cycles in motor electric service. Mount time clock adjacent to compressor in a visible location. Where available, provide a cross connection, with pressure reducing and check valve to the building’s compressed air system. Where cross connection is available a digital operating time clock shall not be required. Set for the minimum low pressure in the sprinkler system. Install discharge filter for oil and water removal ahead of pressure regulating valve.
   d. Discuss type of protection and alarm system for special areas such as computer rooms, tape storage areas, free access floor systems, paint or solvent storage rooms, transformer vaults, etc., with Construction & Design (C&D) and the Designated Campus Fire Marshal (DCFM).
   e. In new construction or major renovation, coordinate lighting/electrical and HVAC system (including diffuser/grille layout) with that of each sprinkler appurtenance and reflected ceiling plan.
   f. Coordinate the location, signage, keying, and access of fire sprinkler shutoff and zone valves with Construction & Design (C&D) and the Designated Campus Fire Marshal (DCFM). Access and signage shall be obvious. Visibility shall not be blocked by equipment.
g. Show a Gamewell, model PRS, or equivalent, water flow switch for each floor or sprinkler zone where a shunt type box is used. Switch shall have one (1) normally open and one (1) normally closed contact. For specifications relating to alarm wiring, see Division 26: Electrical and 28: Electronic Safety and Security

h. Show a test valve and drain piping for each flow switch. Terminate the drain pipe at an approved receptor. Show the receptor on the plumbing and sprinkler plans. Comply with applicable and current NFPA codes. The main drain piping for the fire sprinkler system shall be directly routed to the inside or the outside of the building. If the main drain is routed to a drain inside the building, the drain systems need to be sized to adequately handle the flow the main drain testing and the drain shall be connected to the sanitary sewer system with an air gap. The Plumbing/Mechanical contractor shall provide a four inch (4”) drain pipe with a four inch (4”) p-trap and a fixed air gap fitting for the fire sprinkler contractor to tie into with the main drain discharge. If an exterior drain is used it shall be piped to a sanitary sewer line.

i. Coordinate location of drains shown on plumbing drawings with requirements of fire sprinkler system. Show drain locations on fire sprinkler drawings. The Data sheets shall include, but not be limited to, the following components:
   i. Sprinkler heads and accessories
   ii. Pipes and fittings
   iii. Check valves
   iv. Gauges
   v. Alarm flow switches
   vi. Hangers and supports
   vii. Fire department connections
   viii. Control valves including post indicator valves, gate valves, butterfly valves, and globe valves
   ix. Valve supervisory switches
   x. Hose cabinets and sprinkler head cabinets
   xi. Identification signs
   xii. CSFM listing numbers (include any tamper alarm supervisory devices)

j. Shop drawings shall include, but not be limited to, the following information (clearly identify design parameter i.e., hydraulic or pipe schedule:
   i. Hydraulic calculations for hydraulically designed systems
   ii. Complete piping plan
   iii. Reflected ceiling plan with all areas clearly designated
   iv. Location and size of all hangers and earthquake bracing
   v. Project Location
   vi. Point of compass
   vii. Ceiling construction
   viii. Full length cross section
   ix. Location of fire walls
   x. Location of seismic joints
   xi. Locations of partitions
   xii. Occupancy hazard classification of each area or room
   xiii. Location and size of blank spaces and closets
   xiv. Any questionable small enclosure that no sprinkler is intended to be installed (shall be clearly identified)
   xv. Water supply information – calculate water available from point of connection with water main, upstream of any cross connection device
   xvi. Other sources of water supply
   xvii. Make, type, number, and nominal orifice size of sprinklers
   xviii. Temperature rating and location of high temperature sprinklers
xix. Total area protected by each system on each floor
xx. Number of sprinklers on each riser per floor
xxi. Location of alarm bells
xxii. Total number of sprinklers on each dry-pipe system, pre-action systems, combined dry-pipe/pre-action system or deluge system
xxiii. Nominal pipe size and cutting lengths or center-to-center dimensions of pipe
xxiv. Location and size of riser nipples
xxv. Type of fittings, joints, sleeves, and location of all welds and bends
xxvi. Location of all control valves, check valves, drain pipes, test pipes, and their terminals
xxvii. Size and location of hand hose, hose outlets, and related equipment
xxviii. Underground pipe size, length, location, weight, material, point of connection to city main, type of valves and meters, and the depth that the top of pipe is laid below grade
xxix. After provisions for flushing, all drains shall be sized to handle a maximum water volume and pressure from test valves and drain valves. Construction and Design (C&D) will coordinate with Mechanical/Plumbing Design Engineer regarding drain sizing.
xxx. Additions to an existing system shall include sufficient depiction of the existing system on the drawings as to make all conditions clear
xxxi. Complete name-plate data
xxxi. Name and address of Contractor
xxxii. California State Contractor’s license stamp and the identity of the designer
xxxiii. Mounting height of fire department connections
xxxiv. Penetrations of rated assemblies shall be fire-stopped. Fire stopping shall be an approved material as described in State Fire Marshal Standard 12-43.1
k. Require the following general notes on shop drawings submitted for approval to the Campus Building Official (CBO) and the Designated Campus Fire Marshal (DCFM).
   i. The automatic sprinkler system shall conform to the requirements of NFPA 13 adopted by the State of California
   ii. Penetrations of rated assemblies shall be fire-stopped. Fire stopping shall be an approved material as described in State Fire Marshal Standard 12-43.1
   iii. Installation of the sprinkler system shall not be started until completed plans and specifications (including water supply information and capacity of existing sprinkler system, if any) have been approved by the Campus Building Official (CBO) and the Designated Campus Fire Marshal (DCFM).
   iv. Approved plans and specifications shall be kept on the job site and made available upon request.
   v. At various stages and upon completion, the system must be tested in the presence of the Facilities Services Fire Prevention Services and the Designated Campus Fire Marshal (DCFM).
   v. Submittals having inaccurate hydraulic calculations, content, which is illegible, incomplete or unclear, will be returned without review or approval
m. Record and As-Built Drawing shall be submitted to Facilities Services Fire Prevention Unit, Inspection Services and Designated Campus Fire Marshal (DCFM). Both Record and As-built drawings shall be in PDF and DWG Format, submitted (one copy each) on CD, DVD or Blu-ray disc (as appropriate for file sizes). Where a Project uses East Bay Municipal Utility District (EBMUD) domestic water for a fire protection system, EBMUD shall also receive record and as-built drawings as described above.

3. Materials
   a. Underground Piping
      i. See Section 33 11 19: Fire Suppression Utility Water Distribution Piping and 33 11 00: Water Distribution, for requirements on underground piping.
b. Above Ground Piping
   i. Insulate water-filled supply piping in areas exposed to freezing, such as under eaves, cold rooms, passageways, etc.
   ii. All piping exposed to outside air or weather shall have corrosion protection.
   iii. Flanged fittings shall be used at the first connections above grade in exterior locations.
   iv. Riser and cross mains shall be steel pipe and joined by welding or by roll grooved pipe and fittings. The minimum nominal wall thickness for roll groove or welded steel pipe and pressures up to 300 psi (20.7 bars) shall be in accordance with Schedule 10 for sizes up to 5 in. (12 mm); 0.134 in (3.40 mm) for 6 in (152 mm); and 0.188 in (4.78 mm) and larger) or Schedule 40 (in sizes less than 8 in. (203 mm) pipe for pressures up to 300 psi (20.7 bars).
   v. Sprinkler piping shall conform to NFPA 13: Standard for the Installation of Sprinkler Systems
   vi. Riser shall be four-inch minimum pipe size from base of risers through the fittings to cross mains serving the first story.
   vii. Connections and fittings shall be threaded, flanged, grooved, or welded. Grooveless clamp or saddle fittings are not acceptable.
   viii. Grooved clamp tees and bolted branch outlets shall not exceed one-inch branch size and are subject to inspection prior to attachment of branch piping or sprinklers.
   ix. Reducing fittings shall be tapered cast metal products. Where grooved couplings are used, there shall be a separate coupling for each connection to the reducing fitting.
   x. Each sprinkler head shall be connected to supply piping via a threaded branch outlet and by a minimum one-inch to one-half inch threaded reducing fitting

c. Valves
   i. All valves shall be rated for the supply water pressure and UL or FM approved.
   ii. Gate Valves: Four inch pipe size and larger: OS&Y, iron body, and bronze mounted. A valve supervisory tamper switch shall be required. Three inch pipe size and smaller. OS&Y type, bronze gate with solid wedge; a valve supervisory tamper switch shall be required
   iii. Angle Valves: Bronze angle valve with screw-in bonnet, internal seat, and renewable disc.
   iv. Globe Valves: Bronze globe valve
   v. Check Valves: Iron body, bronze mounted, horizontal swing check valve with bolted bonnet. Check valves shall be designed for replacement of internal parts without removal of valve body from piping. Alarm check valves will not be used. All backflow protection devices shall be approved on the most recent “List of Approved Backflow Prevention Assemblies, “USC Foundation for Cross-connection Control and Hydraulic Research.
   vi. Post indicator valves: Cast iron, bronze mounted, double disc, non-rising stem gate valve with cast iron body indicator post handle shall be secured with Master 2018 padlock (University standard) and a valve supervisory tamper switch is required. Post indicator valves shall not be installed if the system has a listed indicating control valve located on the riser in the valve room or other accessible location as approved by the University’s designated representative.
   vii. Butterfly Valves: Bronze body, grooved connection, stainless steel disc and stem, two-inch and larger pipe size with integral tamper switch and geared slow-close mechanism.
   viii. Wafer Valves shall not be used.

d. Sprinkler Heads: Sprinkler heads shall be UL listed or FM approved and applicable for room occupancy. For exterior and corrosive atmospheres, provide poly-coated, nickel, lead or stainless steel sprinklers. For sleeping rooms, install Quick Response Standard type sprinklers.
i. Sprinkler Head Guards Install sprinkler head guards in storerooms and where subject to impact or less than 7 feet above finished floor.

e. Gauges: Gauges shall be installed on each side of the main check valve and at each test pipe.
   i. Pressure gauges shall be UL listed and labeled 3-½ inch dial, liquid filled type, 0-300 psi scale, markings not to exceed 5-psi increments.
   ii. Each pressure gauge shall be fitted with a three-way valve and ¼-inch test gauge connection.

f. Sleeves And Escutcheons
   i. Provide sleeves that shall be 1 inch for pipes through 3 and one-half inches, 2 inch for pipe sizes 4 inches and greater, and three inches for seismic joints.
   ii. For sleeves set in fire walls and floors, caulk the space between pipe and sleeve with flexible, approved fire-resistive packing compound to achieve rating at least equal to that of the wall or floor penetrated. Sleeves in floor on grade or exterior wall below grade shall be packed with oakum between pipe and sleeve, flush with top of sleeve for floors and with outer surface for walls. Sleeves at seismic or expansion joints shall not be packed unless located in a fire wall where piping is routed through fire walls which are seismic or expansion joints. Approved swing joints shall be used, and the sleeves appropriately packed as specified above.
   iii. In concrete slabs and walls, schedule 40 black steel pipe shall be used as sleeve material.
   iv. Sleeves set in walls and slabs with waterproof membrane may be either cast iron or steel and shall be provided with a flashing clamp device and corrosion resistant clamping bolts
   v. Furnish and install escutcheons of prime-coated steel set screw for exposed pipes passing through walls, floors, and partitions.

g. Flow Switches
   i. Provide CSFM-listed paddle type flow switches with automatic recycle retard and DPDT contacts.

h. Tamper Switches
   i. Provide CSFM listed weather-resistant tamper switches on all control valves. PIV switches shall monitor target position.
   ii. OS&Y switches shall monitor stem movement and shall be complete with J-bolts.

i. Control valves located on branch lines serving sprinkler protection in elevator spaces shall be provided with a tamper switch. Plug and loop type tamper switches shall not be used to supervise control valves.

j. Alarm Bells
   i. Provide weatherproof, ten inch (10”), 120 VAC electric bell with weatherproof back box.
   ii. UL or FM approved.
   iii. Locate on the face of the protected building adjacent to the fire department with a mounting height of eight to ten feet above finished grade.
   iv. Provide sign directly below the bell. Obtain sign information from the Facilities Services Fire Prevention Services.

k. Hangers
   i. Provide in accordance with referenced standards.
   ii. Do not mix piping material and hanger material of dissimilar metals.
   iii. All beam clamps shall be fitted with steel retainer straps.
   iv. Hanger rod of less than 3/8 inch diameter is not permitted.
   v. Sprinkler piping shall be hung with hangers and support independent of any other hanger, support systems or devices.
   vi. No non-sprinkler materials may be suspended from or attached to sprinkler piping or components.

4. Installation

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a. Piping
   i. Provide reducing fittings for all changes in pipe size, and provide fittings for all changes in pipe direction. Riser piping shall be installed plumb with offset fittings used where alignment adjustment is necessary.
   ii. Provide unions for pipe sizes below 2 inch and flanged or grooved fittings for sized 2 inch and above to permit disconnection of equipment and fixtures.
   iii. All welded piping shall bear a stamp or imprint of the certified welder and shall be inspected by the designated University representative prior to installation. The Contractor shall maintain certified records of welders or fabricators and have available for the University representative review on construction site.
   iv. All piping shall be installed to permit thorough drainage.

b. Valves
   i. Install Inspector’s test valves and drain valves in conveniently accessible locations and discharge shall be to the outside of the building or to a drain adequate in capacity to handle the full flow. All valves shall be rated for the supply water pressure, UL or FM approved.

c. Water flow and Tamper Switches
   i. Install water flow and tamper switches to monitor fire flow by floor and/or building.
   ii. Guards shall be installed on any heads subject to possible damage and all less than 7 feet.

d. Labels
   i. Each system shall be labeled, with valve numbers and locations posted at main riser.
   ii. Labels shall be engraved brass tags affixed with a split ring.

5. Inspection And Testing
   a. All tests described and referenced in these standards shall be performed by the Contractor in the presence of the Facilities Services Fire Prevention Unit and the Designated Campus Fire Marshal (DCFM). A minimum of 72 hours’ notice is required by the University prior to testing. Tests and inspections shall apply to all water-source fire protection systems, including fire hydrants, sprinklers, standpipes wet or dry or combination, and all underground piping which supplies these systems and devices.
   b. The contractor shall supply drawings to both Facilities Services and the Designated Campus Fire Marshal before testing commences.
   c. All piping shall be hydrostatic-pressure tested in accordance with these standards, and the following listed codes and standards:
   d. Systems shall be hydrostatic-pressure tested with installed drops and heads prior to installation of ceilings or enclosure of sprinkler piping. Inspection of hangers, sway bracing and arrangement of valves and sprinkler heads will be conducted at the start of hydrostatic test, when the pipe is filled with water. Adjustment of drops after installed ceilings will not require additional hydrostatic tests.
   e. For fire alarms and signal system components, see Division 28 30 00: Electronic Detection and Alarm.
   f. For alarm identification, see Division 28 30 00: Electronic Detection and Alarm.
   g. Guards shall be installed on any heads subject to possible damage.
   h. Provide wet and dry standpipes in all buildings where required by code.
   i. Install dry standpipe and fire sprinkler pumper connections together at locations approved by the Designated Campus Fire Marshal (DCFM).
   j. Specify National Standard hose threads, as adopted by NFPA, for all hose valves.
   k. Standpipe Testing:
i. Wet and dry standpipes shall be hydrostatically tested and proved tight under 200 psi of water or to actual pressure if higher than 200 psi. The test must be maintained a minimum of two (2) hours and shall be witnessed by the Designated Campus Fire Marshal (DCFM). Where any pipe connections are concealed, the tests shall be conducted before covering.

ii. Prior to testing, all systems shall be thoroughly flushed of foreign material. Start flushing at the highest point in the system to lowest drain point. All portions of the system shall be back-flushed.

iii. Provide piping and valves as necessary to facilitate full flow testing. Test discharge water shall be directed to prevent water damage and to comply with requirements in Division 02 70 00: Water Remediation.
1. Water Piping:
   a. Determine cold water service and building domestic hot and cold water demands for major buildings by the fixture unit method as outlined in the Uniform Plumbing Code. In addition to those given for sanitary fixtures, use 0.50 fixture unit for industrial cold water outlets over cup sinks in fume hoods and 1.0 fixture unit for each faucet at regular laboratory sinks with hot and cold water.
   b. Add known continuous demands to the total estimated demand. Discuss the use of a diversity factor with Construction & Design (C&D).
   c. Size water piping with velocities not exceeding 7.5' per second and minimum of 35 pounds per square inch residual pressure at the highest, or last, fixture or hose rack. For copper pipe, size with velocities of 5' to 8' per second.

2. Joints
   a. Joints shall be soldered or braised depending on the size and location of pipe. No PEX pipe joints will be allowed. Grooved (i.e. Victalic) joints are allowed.

3. Plumbing Isolating Valves
   a. Show all valves on drawings. Do not rely on listing in the specifications or a general requirement (where or as required, etc.) clause.
   b. Arrange and valve all utility services so that each floor and lab can be isolated without interrupting service to other parts of the building.
   c. Arrange and valve domestic hot and cold water piping so that restrooms can be isolated without interrupting service to other parts of the building.
   d. Show sectionalizing valves in top center and bottom of risers in hot water supply and return systems.
   e. Show accessible service isolating valves for laboratory piping at the point of branch connections from mains. Valves need not be provided at the laboratory furniture units except for individual outlet faucets or cocks, not furnished with units.
   f. Isolate the fire protection system (wet standpipe) by means of a main valve, or valves, at the bottom of the riser, locked open and marked with a suitable warning sign. Install a double check valve after the valve.
   g. Show isolating valves to permit separate chlorination of the water system in buildings or projects where occupancy may occur in increments, as construction is completed.
   h. Place valves on each side of a backflow or check valve to permit servicing.
   i. Show valves on all services left for future connections (tees, stubs, etc.) unless they are in a valved zone, or isolated by other valves, that permit only a minor loss of pipe contents when opened.
   j. Access panels for valves to be sized and located for service and maintenance.

4. Pipe Installation
   a. Specify a proper corrosion preventive wrapping for any black steel piping installed below grade (bituminous and paper wrapping or extruded plastic).
   b. Provide water hammer arrestors in water lines to equipment or fixtures having quick closing or flush valves and any equipment that might produce water hammer. Water hammer arrestors shall be certified by the Plumbing and Drainage Institute (PDI). Show location and size of all water hammer arrestors.
arrestors on plans and access for maintenance or replacement. Provide access panels if required. Do not rely on general note. Size and locate as recommended by the manufacturer.

c. Show clean-outs in sewer lines as required by code. In addition, vertical to horizontal changes in main risers that occur above furred ceilings shall have a clean-out extended from the base to a floor clean-out or a wall clean-out above the change in direction.

d. Specify “Y” pattern strainers for water lines three inches (3”) and smaller. Screens shall be Monel with 1/16” perforations. Furnish strainers with caps and gaskets for positive positioning of screens. Screens shall fit into a recess machined into cap and body. Provide a 1/2” plug-type blow off valve with hose end on each strainer. Above three inches (3”), specify basket-type strainers with the same screen and a screwed or clamped cover.

e. Insulate all plastic and glass piping where it penetrates a floor, wall or ceiling, to prevent flame spread between areas. Insulation and installation method shall be approved by the State Fire Marshal.

f. Do not embed piping in concrete. Where piping must penetrate concrete at foundations or ground floor slab, coordinate with the appropriate architectural sections and drawings to detail and dimension wrapping and/or sleeve with appropriate flexible seal to concrete.

g. Specify additional hangers or supports for all plastic piping.

5. Risers

a. Include a single-line, no-scale, riser diagram of each piping system on the plumbing drawings for all multistory buildings. Riser diagrams shall include soil, waste, vent, hot and cold water, compressed air, gases and distilled water systems.

b. Riser diagrams shall show pipe sizes, sectionalizing valves, expansion joints, water hammer arrestors and any equipment in the system. Show design quantities and pressure, where applicable, for both branch and riser at each connection point.

c. Indicate the basis used in sizing the pipes below the title of each diagram.

6. Hot Water Supply

a. When selecting steam-fired instantaneous water heaters, include the following:
   i. Add known industrial hot water demands, such as washers, process work, animal room cleaning, etc., to the total fixture demand.
   ii. Provide hot water temperature regulation to showers, with thermometers on hot and regulated water, for setting maximum temperature.
   iii. See this Division for water heater information.
   iv. Provide pumped circulation for all hot water systems.

7. Connections To Kitchen Equipment

a. Kitchen equipment is normally furnished under the specification section for kitchen equipment.

b. Include a schedule in the plumbing drawings for the rough-in and final connections to all kitchen equipment.

c. Coordinate the furnishing of all equipment trim, such as traps, faucets and valves, with the kitchen equipment drawings and specifications.

d. Provide a pressure regulating valve, pressure gauge, pressure relief valve, thermometer and shock absorber in the 180° rinse line to the dishwasher connection

8. Meters

a. See: 33 05 00: Common Work Results for Utilities, Subsection 10: Metering.

b. Provide two (2) meters in parallel for each building domestic cold water service. Locate meters inside the building in an accessible location to permit reading and maintenance.

c. Specify disc or turbine type meters for normal flow and compound type for cases where there is a large range of flow. Provide single or double registers reading in cubic feet.
d. Provide strainers and isolating valves at meters to permit operation with one (1) meter out of service.

e. Size each meter for one hundred percent (100%) of the estimated building cold water demand. Do not include fire sprinkler demand. Because of meter failure, one hundred percent (100%) demand on both meters shall be met. Research buildings shall have full demand met at all times.

f. Meter the cold water makeup to cooling towers if the refrigeration system capacity is greater than fifty (50) tons.

g. Meter the cold water fill line serving steam to space heating hot water shell and tube heat exchangers (to monitor leaks in the tube bundle).

9. Water Pressure Regulations

a. Provide two (2) water pressure regulators in parallel for each building, regardless of existing static pressure. System shall maintain a maximum of eighty pounds per square inch (80 psi) at the lowest point of use.

b. Locate regulators in the mechanical room for ease of maintenance. Provide proper drainage for pressure relief valve and leaks.

c. Size each regulator with a rated capacity at the reduced pressure for one hundred percent (100%) of the estimated cold water building demand. No device shall be sized with inlets or outlets smaller than the size of supply piping.

d. Provide low and high pressure gauges, strainers, pressure relief valves and isolating valves at regulators to permit operation with one (1) regulator out of service.

e. Adjust pressure differential settings so that one (1) regulator will operate on low demands and the second (or subsequent) will open on increased demands.

f. Where no regulation is required by present static pressure, set PRVs to no more than present static pressure.

g. Note that regulators must be provided to meet the building water demand. There may be low, medium and high volume demand at various pressure requirements. As many as three (3) regulators in parallel may be required.

10. Back Flow Prevention

a. The University of California, Berkeley adheres to State requirements (California Code of Regulations Title 17: Group 4) and adopts the standards and recommendations set forth by the Manual of Cross-Connection Control (10th edition, or subsequent revisions: USC, Foundation for Cross-Connection Control and Hydraulic Research). The proper design, selection, installation and maintenance of cross-connection control devices is imperative, particularly in a university/mixed-use environment, for the protection of potable drinking water and distribution systems. Appropriate backflow prevention assemblies shall be selected from the most current USC-FCCCHR List of Approved Backflow Prevention Assemblies and shall be inspected and tested before being placed into service and periodically tested as specified by the manufacturer by a certified tester in accordance with Title 17 Standards. When installing backflow preventers, contractors shall engage UC Berkeley Facilities Services Utilities Plumbing Shop for coordination and testing (510-642-1032; http://realestate.berkeley.edu/what-we-do/facilities-services).

b. Provide backflow protection at any building water system where there are connections, actual or potential, to a contaminating liquid. Examples include laboratory hose cocks and connection from domestic system to heating hot water (HHW) makeup and cooling towers.

c. Backflow may be prevented by installing a backflow prevention device at each individual point of possible contamination, where devices such as vacuum breakers or air gaps may be employed, or at a single point where an industrial water piping system is fed from the domestic water piping. Industrial water used in labs for experiments is assumed to be non-contaminated. The industrial system shall be protected from HHW, cooling towers, etc., by additional RP devices.

d. Select the type of backflow prevention system appropriate to each individual case. Generally, a separate industrial water system will be justified in buildings having numerous outlets that are

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susceptible to contamination. A chemistry or laboratory building is a good candidate for a separate industrial system.

e. Discuss the requirements for backflow prevention for any building off campus with Construction & Design (C&D) and the utility company.

11. Hose Bibs And Landscape Irrigation Service
   a. Provide hose bibs at important outside entrances to a building for washing down purposes. Locate these as inconspicuously as possible consistent with accessibility. Provide a ground level hose bib for wash-down at all large concrete areaways or shafts. Hose bibs shall be supplied from an industrial water system or have a separate RP device or vacuum breaker and backflow preventer on each hose bib.
   b. Landscape irrigation hose bibs and backflow preventer are normally under a separate landscaping contract. Provide a valved branch from the building service outside the building for future connection. Discuss size and location with Construction & Design (C&D). Note that all hose bibs require a backflow preventer.
   c. Provide four-inch (4") plastic pipe sleeves below all roads and walks to permit later installation of irrigation system to reach all areas from the service point without cutting new work. Install sleeves with eighteen-inch (18") minimum depth and mark locations.

12. Disinfection Of Water Systems
   a. In new construction, specify that the plumbing subcontractor shall be responsible for cleaning and disinfecting the domestic hot and cold water systems, including fire systems connected to the domestic water systems, in accordance with the standards in Division 33: Utilities. For remodeling work, modify the procedure as required to accommodate the occupants.

13. Laboratory Piping
   a. Size piping for gas, and industrial hot and cold water in accordance with the laboratory pipe sizing standards in the California Plumbing Code. Consult Construction & Design (C&D) for appropriate piping sizes for compressed air, vacuum and gas systems such as helium, oxygen and nitrogen.
   b. Size building distribution systems for all compressed gases and vacuum using a maximum of five percent (5%) loss of initial pressure to furthest point of use under maximum demand.
   c. Show a separate natural gas service to any room or area where gas burners are used with other gases, or air, under a greater pressure, such as a glass-blowing room. Provide Reliance Regulator Company, Type Y-183 diaphragm-operated check valve, or equal, to prevent a backflow of the higher pressure gas into the building’s natural gas distribution system. Vent check-valve discharge to a safe point.
   d. Affix clear labels to the exterior surface of all pipes installed in mechanical rooms and interstitial spaces that carry natural gas, propane or other flammable / hazardous materials to allow easy and rapid identification.

14. Laboratory Outlets
   a. Provide hoods, laboratory tables, etc., with required type outlets manufactured by Water Saver Faucet Company, T&S Brass Company or equal. Provide color index handles.
   b. Specify valves on laboratory benches, tables and other equipment with index handles showing type of service.
   c. Do not use plastic faucets for DI systems as they break frequently. Use appropriately lined metal faucets.

15. Connections For Laboratory Equipment And Casework
   a. Include the rough-in for all laboratory equipment and casework (benches) in the plumbing drawings and specifications. Terminate rough-ins with valved services and plugged drains.
b. Coordinate with laboratory casework and equipment specifications to make sure final plumbing connections are properly accounted for and specified in the appropriate specification section.

16. Special Laboratory Gas Systems (Cylinder Supplies)
   a. Coordinate all compressed gas system and storage designs with EH&S.

17. Distilled, De-Ionized (DI) and/or Demineralized Water Systems
   a. Consultation between end user, Construction & Design, and Facilities Services is required prior to the design or implementation of DI water systems.

18. Industrial Water Systems
   a. The term industrial water is defined in this use as water that is not potable due to contamination, either actual or potential.
   b. The industrial water system shall serve all points of water use that could cause contamination by their backflow into the domestic water system.
   c. Where an industrial water system is selected for a project, protect the domestic water system by installation of two (2) approved reduced pressure backflow prevention devices in parallel at the point of connection.
   d. Detail the installation of the devices in an accessible location with the lower a minimum of 1' above the floor and the upper a maximum of five feet (5'-0”). Provide adequate drainage below the devices for testing or malfunction, via floor drains.
   e. Each outlet or connection to the industrial water system shall be posted with a sign reading Industrial Water - Do Not Drink. These may be waterproof cloth tape with printing protected by clear vinyl and self-adhesive back; 1/4" high, black letters on yellow background.
   f. Where hot water outlets are required in an industrialized system, provide either a separate water heater in the industrial system or a separate backflow preventer in all branch connections which may be taken from the domestic hot water system. Selection shall depend on the number, extent and location of hot water outlets requiring industrialized water. If separate backflow devices are specified, give the operating temperature for proper selection. Heat Tape is not allowed.

19. Water-Conserving Equipment
   a. Water conservation shall be the prime consideration in the selection of equipment.
   b. Where possible, provide a flow control device on equipment which uses water for cooling.
   c. Where available, use cooling tower water for water-cooled equipment, or provide a cooling tower where the cooling water demand justifies the installation.

22 13 00 Facility Sanitary Sewerage

22 13 16 Sanitary Waste and Vent Piping

1. Kitchen or Food Service Waste System: Design a separate waste system for any lower-floor kitchen or food service where there are toilet rooms above. Keep this system separate and connect at a point in the building sanitary sewer system where a stoppage below the connection will not back sewage up to kitchen or food service floor drains or sinks.
2. Use corrosive-resistant pipe in any location where the waste may contain corrosives. Consult Construction & Design for acceptable piping materials. Keep such waste and vent system separate from the building plumbing soil, waste and vent systems to a point outside the building. In buildings with minor isolated points of corrosive use, discuss the method of handling with Construction & Design and Facilities Services.
3. Use gravity flow for all building drainage systems. Where this is impossible, projects shall obtain prior approval from UCB Facilities Services before installing pump systems.
22 13 19.13 Sanitary Drains

1. The architect shall carefully coordinate with the mechanical engineer in the selection of drains for appearance (as in toilet rooms, shower rooms and other visible locations).
2. Locate toilet room floor drains out of foot traffic below water closet partitions or between urinals.
3. Where floor drains are roughed in for future use, cover with a flush plate and gasket for protection against fume leakage.
4. Provide trap primers to retain trap seals on floor drains. Floor drains in toilet rooms shall have vacuum breaker trap primers.
5. All floor drains to have three-inch (3") or larger traps plus trap primers.
6. All horizontal drain runs shall have cleanouts on the end of the run on every floor. Toilet rooms shall have cleanouts above flood rim of fixture served.
7. Main drain stacks shall have cleanouts installed on each floor.

22 13 19.23 Fats, Oils, and Grease Disposal Systems

1. Grease traps shall be located for easy access and servicing, preferably outside, with proper venting. When considering installation of grease traps or interceptors contact EH&S.

23 13.23/26 Sanitary Waste Interceptors/Separators

1. Provide plaster, sediment or sand traps at sinks that may discharge these materials into the waste system. Examples include sculpture rooms, pottery rooms, earth science and geology laboratories, greenhouse sinks, etc. Consider the use of a single large separator for a series of sinks or an area. All traps or separators located below sinks shall be accessible, with easy-opening tops.

2. Greenhouse Waste System: Design a separate waste system for all greenhouse floor drains, potting sinks, etc., that could receive sand, soil or similar planting materials. Extend this system to an interceptor before discharging into the sanitary sewer system.
   a. Provide a sand and soil interceptor in all greenhouse waste lines serving floor drains and sinks only. Locate outside where possible and in an accessible location.

22 13 29.16 Submersible Sewerage Pumps

1. See Division 14: Conveyances for elevator pit drains.

22 14 00 Facility Storm Drainage

1. UC Berkeley is currently required to adhere to requirements set forth in the Clean Water Act and San Francisco Bay Region Water Quality Control Plan (also called the Basin Plan). Consultation between design teams, contractors and the Owner’s Representative during the planning, design and inspection stages of the project shall be required to ensure that all required Best Management Practices (BMPs) are implemented in accordance with UC Berkeley's Phase II Small MS4 General Permit 2013-0001-DWQ. All BMPs that will be implemented for projects will be reported to the State Water Quality Control Board on an annual basis by UC Berkeley. If you have any questions, contact EH&S at ehs@berkeley.edu or 510-642-3073.

22 14 13 Facility Storm Drainage Piping

1. Rainwater Leaders and Storm Drains: Compute rainwater quantity on the basis of 1.5" rainfall per hour minimum (.935 gallons per hour/square foot horizontal drainage area). Size all piping per UPC.
2. Roof, Floor And Areaway Drains
b. Include provisions in the specifications for coordination of drain and clean-out elevations and other work such as concrete and waterproofing.

c. The architect shall carefully coordinate with the mechanical engineer in the selection of drains for appearance (as in decks, terraces and other visible locations); type of clamping ring (built-up and single-ply roofing); size and type of waterproofing flange (for liquid applied systems); two-level drains; type of strainer, including removable internal strainers or buckets; gravel guards (ballasted or built-up roofs); method of anchorage to roof deck; movement due to seismic or deflection (steel framing systems) - ensure that movement is accommodated in leader below roof, not at roof membrane.

d. Specify galvanized beehive type roof and areaway drains.

e. Main drain stacks shall have cleanouts installed on each floor.

22 30 00 Plumbing Equipment

22 35 00 Domestic Water Heat Exchangers

1. Hot Water Circulating Pumps
   a. Pump construction shall be all bronze.
   b. Control pump by immersion aquastat. Provide a thermometer in the return line ahead of the pump for adjusting the aquastat. Set the aquastat for ninety degree Fahrenheit (90°F) minimum return temperature.
   c. Specify inline type pumps, self-lubricating, 3-speed canned rotor design similar to Grundfos Series 6000. Use for plumbing and hot water heating systems. Note that a starter with holding coil is required to interlock with the built-in thermal overload device.

22 37 00 Lab-Bench / Laboratory Building Vacuum Systems

1. Only design / install dry house vacuum systems that do not use water for cooling, pumps with water bearings, or drain disposal of aspirant unless specific planned processes in the building (e.g. surgical medical procedures) require such a system.

2. Design house vacuum systems to trap any particulates or liquids in separators / traps prior to attaching house piping to commercially-available skidded vacuum pumps / accumulator.

3. Size skidded house-vacuum systems such that one pump can be shut down and isolated from the others and the house vacuum system for maintenance, while other pumps operate to maintain full vacuum for the building.

4. Install a 4” high by 4” wide berm around the house vacuum system in the mechanical room, and have no floor drains located inside the berm.

5. Ensure house vacuum separator, filter, accumulation tank, muffler, etc. have site-glasses on them, or clear-bowls or housings for in-operation visual inspection.

6. Ensure house vacuum separator, filter, accumulation tank, muffler, etc. have drain-ports available that are at least 24” above the floor or any obstruction under the drain port with ball-valve access for quick open/closed operation with a 1⁄4 turn of the valve handle.

7. Install house vacuum system components in the following order-of-flow (see Appendix A: Drawings for piping schematic):
   a. Incoming piping from building
   b. Tee and pipe with vertical bypass leg at least 12” above the horizontal “flow- through” pipe
   c. Liquid separator with at least 4-gallon bowl
   d. Particle separator / filter with full-flow and maximum size 100 microns particulate (or manufacturer’s requirement, whichever is more stringent)
e. Post Separator / Filter T with vertical leg on the bypass at least 12” above the horizontal “flow-through” pipe Inlet to the skidded vacuum pumps and accumulator commercial package vacuum system the outlet of which Single manifold and outlet piping
f. Tee with vertical leg on the bypass at least 12” above the horizontal “flow-through” pipe
g. Muffler and vertical leg to building roof
h. Post Muffler T with vertical leg on the bypass at least 12” above the horizontal “flow-through” pipe
i. Rain-guard and associated safe-exhaust piping on the roof with final outlet at least 120” above the roof surface and well-away from any air intakes / make-up air plenums on the roof.

22 40 00 Plumbing Fixtures

22 42 00 Commercial Plumbing Fixtures

1. Fixtures, General
   a. Specify fixtures using a minimum of water consistent with fixture application. Install flow control devices to limit water use. Conservation of water shall be the prime consideration in the selection of fixtures.
   b. Vitreous ware shall be institutional quality.
   c. The manufacturer's name and numbers listed are used only to indicate type and quality. Fixtures of other manufacturers such as Crane, Eljer or Kohler equivalent may be specified.
   d. Specify fixtures complete with trim, where applicable. Exposed trim shall be coordinated with the finish of plumbing fittings.
   e. Coordinate handicapped fixtures, fittings, and mounting heights with the architectural drawings.
   f. Provide stops in hot and cold water lines serving all fixtures, including hose bibs.

2. Fixture Connections
   a. Specify the following items:
      i. Exposed water supply pipe, tubing and waste piping connections shall be chrome-plated brass.
      ii. Fit supply pipe, tubing, and other connections with chrome-plated brass escutcheons at walls.
      iii. Cover exposed bolt heads in floor flanges of any fixture, in the back of any fixture, or in the fixture itself, with porcelain bolt caps securely attached.
      iv. Fit fixtures tight to walls and seal joint. Coordinate sealant with architectural drawings.
      v. Specify red brass for all nipples from copper water lines to fixture stops. Galvanized nipples shall not be used.

22 42 13 Commercial Water Closets, Urinals, and Bidets

22 42 13.13 Commercial Water Closets

1. In general, water closets shall be the wall-mounted type with flush valves. Tank type may be used at single installations where water pressure is low. Confirm disabled access requirements.
2. Wall Mounted: Elongated American Standard, Kohler or equal with blowout flushing action, and Smith or equal appropriate foot support with short foot securely bolted to floor. Specify commercial wall hanger.
3. Floor Mounted: American Standard, Toto, Kohler or equal; all to be elongated.
4. Tank Type: American Standard or equal; Elongated.
5. For new construction or renovation, hands-free flush-valves shall be provided. They shall be powered by AC/DC transformer, not batteries.
7. Flush Valves: Non-hold-open diaphragm type with screwdriver stop and vacuum breaker.
22 42 13.16 Commercial Urinals

1. American Standard or equal, vitreous china urinal with top spud. Specify with two inch (2") waste to prevent clogging. Flush Valve: Non-hold-open diaphragm type with screwdriver stop and vacuum breaker. Specify commercial wall hanger.

22 42 16 Commercial Lavatories and Sinks

22 42 16.13 Commercial Lavatories

1. American Standard Lucerne 20" x 18" vitreous china with two-handle mixing faucets or equal. Where required for handicapped use, provide single-lever mixing faucets. Specify commercial wall hanger for wall mounted lavatories.

2. For new construction or renovation, hands free faucets shall be provided. They shall be powered by AC/DC transformer, not batteries.

22 42 16.16 Commercial Sinks

1. Trap Standard-Mounted: American Standard Lakewell or equal, with plain back.

2. Floor-Mounted: Fiat molded-stone type, size as required.

22 45 00 Emergency Plumbing Fixtures

1. Emergency Showers And Eyewash Station Locations
   a. The scope and application of the updated Cal/OSHA regulations are expanded from corrosive liquids to all hazardous substances, including materials that are otherwise harmful and likely to cause injury.
   b. Contact EHS (ehs@berkeley.edu or 510-642-3073) if unsure of emergency eyewash /shower requirements. In general, because research may change, all laboratories should have a combination emergency eyewash /shower or easy access to one close by.
   c. All emergency eyewash and showers shall comply with CCR Title 8, Section 5162, ANSI standard Z358.1-1981 and the following:
      i. An emergency eyewash/shower shall be provided in work areas where the eyes and/or body may come into contact with hazardous substances. The eyewash and shower shall be located such that they can be reached from any point in the laboratory within ten (10) seconds and be used simultaneously. Eyewash and shower shall be readily visible (using signs, bright paint, etc.) and area shall be well lighted. Eyewash and shower may be located between laboratories, ancillary spaces or corridors, provided ANSI standards are met.
      ii. The floor space below an emergency shower/eyewash must be kept free and clear of obstructions at all times for a distance of thirty-inch (30") diameter circle. In addition, the free floor space shall be delineated by two inch (2") wide yellow tape.
      iii. Personal eyewash/shower equipment (i.e., squeeze bottles, hand held drench hoses, etc.) may be installed to support shower and eyewash units but shall not be substituted for them.
      iv. All equipment shall be connected to a potable water supply with 1-1/2" minimum pipe size.
      v. All units require valve hold-open devices. Water flow must be intentionally shut off.

2. Emergency Shower And Eyewash Station Products
   a. Types:
      i. Wall-Mounted: Haws eyewash or equivalent, mounted with 42" rim height. Eye washes shall be provided with drains, trapped and connected to a waste system. Emergency shower shall be Haws or equivalent.
      ii. Pedestal-Mounted: Haws or equivalent. Use only in remodeling projects or where wall-mounted type is not practical.
b. Features and Installation:
   i. The eyewash basin must drain to a plumbed drain, not to the floor.
   ii. Provide chrome-plated tubing “P” traps only where the eyewash station trap is vented and the waste discharges into a sanitary sewer system.
   iii. No drum traps are allowed.
   iv. Provide trap primers at all eyewash stations and floor drains serving emergency showers. Trap primers must be easily serviceable for maintenance from an adjacent floor-mounted access plate or by other means without having to access associated plumbing from the floor below.
   v. Securely brace and anchor pedestal-mounted units to wall (coordinate with architectural drawings for blocking at stud walls).
   vi. Provide an accessible shutoff valve in the line serving both the eyewash station and the emergency shower.

22 47 00 Drinking Fountains and Water Coolers

1. Electric bottle fillers/drinking fountains shall be wall-mounted type, with minimum cooling capacity of six gallons (6 US gal.) per hour of fifty-degree Fahrenheit (50°F) drinking water at an inlet water temperature of seventy-degree Fahrenheit (70°F) and ambient temperature of eighty-degree Fahrenheit (80°F). Supply water temperature shall be adjustable. Drinking fountains shall be Haws, Elkay or a Facilities Services pre-approved equivalent.

2. Where possible, locate drinking fountains out of corridor traffic. The architect shall coordinate location, handicapped mounting requirements, finish and color with Construction & Design (C&D) and Facilities Services.

22 50 00 Pool and Fountain Plumbing Systems

22 52 00 Fountain Plumbing Systems

1. Ornamental Pools
   a. In designing the mechanical system, use the following design criteria:
      i. Place the pool circulating pump below the pool water level for a flooded suction.
   b. Provide dual suction strainers in parallel, valved so that either may be isolated for cleaning. Specify quick-removal covers.
   c. Where the pool does not have direct public access or is in a controlled area not subject to great amounts of paper, trash, bathers, dogs, etc., install a sand filter and water treatment feeders in the circulating system.
23 00 00 Heating, Ventilating, and Air Conditioning

23 05 00 Common Work Results for HVAC

1. Codes and Standards
   a. All mechanical systems shall be designed, constructed and commissioned to meet:
      i. California Code of Regulation Title 24 2013 (Fire and Life Safety, and Energy Efficiency Requirements) and Title 8 (Occupational Health and Safety requirements).
      iv. Title 24 Pt 6. compliance forms and other documentation required to verify compliance with code requirements shall be submitted with bid and/or contract documents.

2. Overview
   a. Occupant comfort, healthful indoor air quality and energy efficiency shall be the prime considerations in any proposed design. In addition, the designer must also satisfy requirements for future expansion, provide ease of maintenance, and minimize life-cycle cost. Because of the longevity of University buildings and the great expense of modifying or replacing existing mechanical systems, the designer shall strive to ensure that the proposed systems are capable of meeting the long term needs of the building in which they are installed.
   b. The heating and ventilating systems of a building are dependent upon its size, shape and occupancy and it is important that proposed type or types of systems be presented during the preliminary planning stage. Carefully select building orientation, materials, and systems for control of heat gain and loss in the building. During schematic design, evaluate the life-cycle cost of several design alternatives. Design the control system to provide optimal operation of the entire system.
   c. It is important that the architect retain a mechanical engineer early enough to permit their participation in the building study and design to avoid later changes that could affect the structure, or that would require modifications of the system to fit the structure.
   d. The architect shall coordinate with the mechanical and electrical consultants and Construction & Design (C&D) on the selection of the type of systems.
   e. All systems shall be commissioned and tested to meet or exceed Mechanical Acceptance Test Criterion as defined in Title 24 2013. In applications not covered by MATC, consultation with the Office of Sustainability and Energy on required functional performance test and/or optimized sequences shall be required.

3. Mechanical System Diagrams
   a. Include a single line, no scale, diagram of each mechanical system, including supply and exhaust air, fume hood exhaust, hot water heating, steam, chilled water and cooling water on the mechanical plans of all buildings. Show equipment names, sizes, flow rates, dampers, valves, and direction of flow arrows. Show normal position for each valve, either normally open (NO) or normally closed (NC).
   b. Include riser diagrams of supply and exhaust duct systems. Show equipment names, sizes, cubic feet per minute, velocities, fire dampers and volume control devices (dampers, splitters, etc.) Individual room outlets need not be shown.
   c. Include a riser diagram of the hot water heating system, showing pipe sizes, gallons per minute, balancing devices and direction of flow arrows.
d. Indicate size and design quantities on these diagrams for each branch connection to a riser and for the riser at that point.
e. Indicate the basis for sizing pipes or ducts below the title of each diagram.
f. Include control diagrams clearly indicating hard wired points and napped points for each piece of each assembly for systems or equipment added or modified within the scope of the project.

4. Redundancy
   a. Redundancy shall be provided for the following HVAC system components.
      i. Heating Hot Water Heat Exchangers - provide two (2) heat exchangers, each capable of handling fifty percent (50%) of the system capacity. Each heat exchanger shall have two (2) steam control valves to provide for a full range of steam flow controllability.
      ii. Heating Hot Water Pumps - provide two (2) pumps, each capable of handling one hundred percent (100%) of the system capacity.
      iii. Chilled Water Pumps - provide two (2) pumps, each capable of handling one hundred percent (100%) of the system capacity.
      iv. Tower Water Pumps - provide two (2) pumps, each capable of handling one hundred percent (100%) of the system capacity.

5. Criteria for Determining HVAC Loads
   a. The following outside air and indoor space temperatures shall be used to determine HVAC loads for spaces where occupant comfort is the sole consideration for the thermal environmental conditions:

<table>
<thead>
<tr>
<th>Season</th>
<th>Outside Air Temperature</th>
<th>Space Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>85°F db, 64°F wb</td>
<td>74°F</td>
</tr>
<tr>
<td>Winter</td>
<td>34°F</td>
<td>72°F</td>
</tr>
</tbody>
</table>

   b. Allowance for load safety factor shall not exceed ten percent (10%).
   c. The maximum allowance for pickup loads is as follows:

<table>
<thead>
<tr>
<th>Building Operating Schedule</th>
<th>Heating Pickup Load, Maximum</th>
<th>Cooling Pickup Load, Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than 24 hours/day</td>
<td>25%</td>
<td>0%</td>
</tr>
<tr>
<td>24 hours/day</td>
<td>15%</td>
<td>0%</td>
</tr>
</tbody>
</table>

   d. An allowance for future loads may be permitted. Consult with Construction & Design (C&D) when future additional loads are likely to occur.

6. Air Requirements
   a. Determine minimum outside air required according to Title 24, 2013 Energy Efficiency Standards or ASHRAE Standard 62 whichever applies. The minimum design quantity of outside air shall be that determined according to the standards plus an additional twenty percent (20%).
   b. In determining heating and ventilating supply air quantities, consider all of the following factors that may affect the quantity and use the largest resulting quantity:
      i. Air required by law or code, or campus health and safety requirements.
      ii. Air required to heat or cool the space or control humidity.
      iii. Make up air required for non-recirculated spaces, fume hoods, kitchen hoods, or other special exhausts.
      iv. Air required for combustion in fuel burning equipment.
   c. Criteria for supply air volume for heating shall be based on the reduction of objectionable air currents in the occupied zone per ASHRAE Standard 55. The supply air temperature required to meet the space-heating load should not exceed one hundred and five degrees Fahrenheit (105°F). Air
required to cool a space which is not mechanically cooled shall be based on a maximum allowable
temperature rise (DB) within the occupied zone of not more than ten degrees Fahrenheit (10°F)
above the coincident outside air temperature. Where operable windows are present the required air
volume may be provided from the combined volumes of mechanically supplied and natural
ventilation. For purposes of this calculation, all heat sources, gains and losses, must be properly
accounted for, with due regard to diversity and timing of intermittent loads. Where determined air
change rates are excessive or exceed twenty (20) per hour, consult with Construction & Design
(C&D). Provide mechanical ventilation for enclosed stairwells, trash rooms, elevator machinery
rooms, mechanical equipment rooms and electrical equipment rooms as follows:

i. Supply and exhaust electrical and elevator equipment rooms with air quantities sufficient to
prevent a temperature rise that would impair proper equipment operation. Filter supply air if
it is not from the filtered building system. Evaluate mechanical cooling for rooms with high
heat gains requiring large air volumes.

ii. Except for stairs designed as smoke-proof enclosures per UBC requirements, design stairwell
ventilation as follows: Supply air from the top of stairwell to prevent stagnation and odor
buildup and to overcome the stack effect in winter. Provide one (1) air change per hour
minimum, based on the total volume of the stairwell. Do not exhaust stairwell. However,
pressure required to open exit doors shall conform to code requirements. Provide required
fire dampers in ductwork.

iii. Exhaust only for trash rooms, giving a negative pressure in the room to confine odors.

iv. Provide sufficient supply and exhaust ventilation to mechanical equipment rooms to prevent
temperatures above ninety degrees Fahrenheit (90°F). Use a minimum of one cubic foot per
minute per square foot for cool rooms and two (2) cubic feet per minute per square foot for
hot.

7. Air Conditioning and Cooling

a. Air conditioning, for occupant comfort only, shall only be authorized for those spaces which qualify
under the University Air-Conditioning Policy. Where conditions indicate potentially high internal or
solar heat loads, discuss air conditioning, or provisions for its future addition, with Construction &
Design (C&D). Discuss temperature and humidity control, where required to meet laboratory or
process requirements, with Construction & Design (C&D) to establish clear understanding of
operating limits, loads and control features required.

b. Cooling is required for all ventilation supply air to spaces for animal occupancy. Obtain temperature
requirements from Construction & Design (C&D).

c. Select chiller based on lowest life cycle cost. Consider absorption, vapor compression and thermal
storage type systems and include the costs of auxiliary equipment. For electrical systems compute
energy costs using actual time of use rates including demand charges and include differential cost of
larger electrical system components (e.g. transformers).

d. For vapor compression type systems priority shall go to systems with the lowest CFC content.
Review preliminary selection of chiller equipment with Construction & Design (C&D), as
regulations change and previously used refrigerants may no longer be acceptable. Such systems shall
provide safe maintenance and access points for removal of hazardous materials. Consult EH&S
(ehs@berkeley.edu or 510-642-3073) for access and sampling port locations, location of site-glasses
(if needed), and drain requirements.

e. Variable Refrigerant Flow (VRF) systems shall be considered for areas approved for air
conditioning. These systems shall use brazed copper tubing. Manufacturer shall be Mitsubuishi or
approved equal. VRF systems shall be designed with shutoff valves as required to service individual
zones without the need to turn off the entire system and remove and recover the entire system
refrigerant charge.
f. Areas within buildings which require 24/7 cooling such as telecom or server spaces shall be considered to be cooled by individual split system air conditioning units of VRF systems depending on size and quantity of cooling required.

g. Chilled water piping shall be schedule 40 with welded or Victaulic style fittings for sizes larger than 2”. Sizes 2” and smaller shall be screwed.

h. Pumps for building condition shall be Bell and Gossett or equal.

8. Recirculation
   a. With the following exceptions, recirculation of HVAC system air is useful to reduce peak loads and energy requirements. During occupied periods system dampers/controls shall be configured to provide at least the required minimum outside air requirements by utilizing a separate minimum outside air damper section and actuator. Controls for systems with mechanical cooling shall include an economizer sequence.
   b. Exhaust ventilation for the rooms listed below or any other room with airborne hazardous materials shall not be recirculated:
      i. Laboratory spaces and storage rooms where hazardous materials are used or stored
      ii. Chemical laboratories
      iii. Noxious laboratories or rooms
      iv. Welding or soldering areas or shop areas where hazardous materials are used or stored
      v. Animal areas
      vi. Toilet rooms
      vii. Athletic locker rooms
      viii. Trash and garbage rooms
      ix. Janitors closets
      x. Duplicating rooms using volatile solvents
   c. For other occupancies, discuss air quality of recirculated supply air with Construction & Design (C&D).
   d. To reduce ductwork and the number of exhaust fans, consider grouping or stacking areas with common exhaust fans.
   e. Where recirculation is used, install smoke detection equipment as required by Title 24 2013 as applicable to the installation. When smoke is detected, dampers go to the 100% exhaust position.

9. Clean Room Recirculation
   a. Where clean rooms are included in the building program, type, filter efficiency, cooling and ventilation air requirements shall be obtained from Construction & Design (C&D).
   b. Prefabricated clean rooms, modules or benches are preferred where their use will meet requirements.
   c. Select equipment, air velocities, plenum and duct sizes for minimum noise generation within the work area.
   d. Provide a method for introducing test media into the room fan return plenum and for sampling the test media density above room filters. Discuss with Construction & Design (C&D).
   e. The testing of clean rooms, to check their compliance with specifications, shall be done by the University.
   f. Clean rooms require special consideration and design. Drawings and specifications shall cover, in detail, all points of construction, installation and sealing.

10. Cold Rooms
   a. A minimum quantity of outside air shall be supplied to cold rooms to provide a safe working environment. Review at earliest design stage with Construction & Design (C&D) and Environment, Health and Safety (EH&S).
   b. Cold rooms shall be designed with desiccant dehumidifiers when design requirements require precise humidity control.
c. Cold box control systems shall be capable of trending for two week minimum and shall be able to communicate with building automated control system to download trends and receive alarms.

11. Air Compressors
   a. Size laboratory building compressors using 0.15 cubic feet per minute free air per lab outlet. Minimum compressor size shall be twenty cubic feet per minute (20 cfm) capacity at forty pounds per square inch (40 psi) receiver pressure. Discuss diversity factor with Construction & Design (C&D).
   b. Where there are other known demands, such as air centrifuges, air-operated equipment that has a high demand with intermittent operation or high pressure, discuss the supply with Construction & Design (C&D).
   c. Select air compressors to operate with the minimum allowable receiver pressure, using a single stage if possible.
   d. Where calculated capacity is greater than thirty cubic feet per minute (30 cfpm), consider using two (2) compressors of fifty percent (50%) capacity each for reliability. A single large receiver may be used for two compressors.
   e. Receivers shall be an ASME standard pressure vessel.
   f. Where two (2) compressors are installed, arrange the piping and valves so that either or both may be used.
   g. Do not locate compressor air inlet in a hot area where the moisture in the air may cause objectionable condensation in the lines. Specify and show a Dollinger Model D or equivalent filter in the suction line.
   h. Provide Dollinger Model CPHS or equivalent filter with automatic drain in the supply line from the receiver.
   i. Specify compressors equipped with a refrigerated air dryer.
   j. Provide a pressure-reducing valve sized for the designated system use and operating pressure, with low-side pressure gauge and pressure relief valve set for minimum pounds per square inch over reduced pressure. Maximum pressure for laboratory and shop use is 30 pounds per square inch.

   a. Size laboratory building vacuum pumps, using 0.10 cubic feet per minute per lab outlet. Vacuum pump minimum capacity shall be ten cubic feet per minute (10 cfpm) at 27" Hg receiver vacuum. Discuss diversity factor with Construction & Design (C&D).
   b. Where the calculated capacity is greater than 20 cubic feet per minute, consider installation of two vacuum pumps of 50% capacity each for reliability. A single large receiver may be used for two vacuum pumps.
   c. Receiver and separator shall be ASME stamped for vacuum use.
   d. Where two (2) pumps are used, arrange piping and valves so that either or both pumps may be used.
   e. Provide a liquid separator with a valve in the suction line. Provide Dollinger Model CVH, or equivalent, vacuum filter in the suction line after separator.
   f. Vacuum pump exhaust shall have a muffler with discharge extended through the roof to prevent objectionable odors or contamination in the mechanical room and to prevent entrainment into the building fresh air ventilation system. Size discharge pipe large enough to minimize vacuum pump capacity reduction.

23 07 00 HVAC Insulation

27 07 19 HVAC Piping Insulation

Table 1: HVAC Piping Insulation
<table>
<thead>
<tr>
<th>Service</th>
<th>Material</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating Water, Hot Water, Cold Water</td>
<td>(a) Inside Buildings: See Note No. 2. Molded glass fiber with All-Purpose</td>
<td>Manville Flame-Safe - AP</td>
</tr>
<tr>
<td>and Chilled Water Piping</td>
<td>white jacket and PVC Zeston fittings covers. Seal all gaps.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b) Outside Buildings: Molded glass fiber with 0.016&quot; aluminum jacket</td>
<td>Manville Flame-Safe - ML</td>
</tr>
<tr>
<td></td>
<td>applied over pipe and fitting insulation. Aluminum jacket shall be</td>
<td>All laps to provide watershed.</td>
</tr>
<tr>
<td></td>
<td>sealed watertight with seams directed downwards and caulked.</td>
<td></td>
</tr>
<tr>
<td>Cooling Tower Water Piping</td>
<td></td>
<td>No insulation required. Piping shall be galvanized or painted to</td>
</tr>
<tr>
<td></td>
<td></td>
<td>prevent surface corrosion</td>
</tr>
<tr>
<td>Refrigeration Piping</td>
<td>(a) Closed-cell foam.</td>
<td>Armaflex or equivalent, paint or UNI-JAC jacket for exterior installations.</td>
</tr>
<tr>
<td>(Suction Lines)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b) Closed-cell foam plastic.</td>
<td>Manville Aerotube</td>
</tr>
<tr>
<td>Steam and Condensate Piping</td>
<td>(a) General inside building (to maximum 300°F): Molded glass fiber with</td>
<td>Manville Flame-Safe - AP</td>
</tr>
<tr>
<td></td>
<td>All-Purpose white jacket and PVC Zeston fittings covers. Seal all gaps.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b) General outside building (to maximum 300°F): Molded glass fiber with</td>
<td>Manville Flame-Safe - ML</td>
</tr>
<tr>
<td></td>
<td>0.016&quot; aluminum jacket applied over pipe and fitting insulation.</td>
<td>All laps to provide watershed.</td>
</tr>
<tr>
<td></td>
<td>(c) In mechanical rooms, underground ducts (above 300°F): Molded</td>
<td>Manville-Thermo-12 with Metal-On jacket</td>
</tr>
<tr>
<td></td>
<td>calcium silicate with 0.016&quot; aluminum applied over piping and fitting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>insulation.</td>
<td></td>
</tr>
<tr>
<td>Duct Insulation</td>
<td>(a) Exterior insulation: See Note No. 4. Fiberglass blanket with density</td>
<td>Manville Microlite with FSK facing</td>
</tr>
<tr>
<td></td>
<td>of 2 lbs. per cubic foot and flame resistant Foil-Scrim-Kraft vapor</td>
<td></td>
</tr>
<tr>
<td></td>
<td>barrier.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b) Interior insulation (lining): Fiberglass duct liner with air stream</td>
<td>Manville Linacoustic</td>
</tr>
<tr>
<td></td>
<td>surface covered with black plastic coated mat facing.</td>
<td></td>
</tr>
<tr>
<td>Equipment-Hot</td>
<td>Molded hydrous calcium silicate.</td>
<td>Finish with 6 oz. canvas. See note No. 3.</td>
</tr>
</tbody>
</table>
Equipment-Cold (below 50°F)

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foamed polystyrene</td>
<td>Finish with 6 oz. canvas. See note No. 3.</td>
</tr>
<tr>
<td>Cellular glass</td>
<td>Finish with 6 oz. canvas. See note No. 3.</td>
</tr>
<tr>
<td>Flexible foamed plastic sheet/tubing</td>
<td>Paint finish where exposed. See note No. 3.</td>
</tr>
</tbody>
</table>

Footnotes:

1. Manville and Pittsburg-Corning have been named as reference standards. Other manufacturers and methods may be specified where their use is suitable.
   a. Describe thickness and application methods for selected material in the specifications. Fiberglass lining in the interior of any air duct system is prohibited unless coated to preclude erosion of fibers into the air system.
   b. Discuss other materials or methods with Construction & Design.
   c. Where two (2) finish coats are specified on finish jacketing, they shall be of different colors for checking.
   d. Protect all glass fiber and non-rigid pipe insulation from crushing in hangers by means of an 18 gauge metal shield 12” minimum length x 120°F minimum arc outside of insulation.
2. Apply on cold water only in concealed or warm areas where condensation might occur.
3. Where 6 oz. canvas is indicated as FINISH, secure with Foster's or Arabol lagging adhesive. If the finish is not to be painted, apply a second coat without thinning.
4. Vapor barrier may be omitted if air is not cooled.
5. Steam valves, strainers, and pressure reducing valves shall be insulated with removable insulation blankets.

23 08 00 Commissioning of HVAC

1. Summary
   a. Air and water balancing shall be performed by an independent Test and Balance Agency retained either as a direct Subcontractor to the General Contractor or separately by the Owner. Coordinate an appropriate procurement method with the Construction & Design during the design phase. Require that the General and Mechanical Contractors provide all tests, inspections, and preparations necessary to facilitate activities of the Test and Balance Agency. Final test and balance report shall be submitted and approved prior to project Substantial Completion.
2. Quality Assurance
   a. Test and Balance Agency shall be a certified member of the Associated Air Balance Council with at least ten (10) years of experience in the testing and balancing of HVAC systems. The Test and Balance Agency shall be regularly engaged and specialize in the testing and balancing of HVAC systems. Testing and balancing shall be performed in complete accordance with the "National Standards for Total System Balance," as published by the Associated Air Balance Council (AABC).
   b. Personnel Qualifications: Require that the Test and Balance Agency assign personnel that have experience in projects of similar type and scope. Require submittal of names, qualifications, and project experience of all personnel proposed to perform testing and balancing.
      i. Field supervisor with day-to-day responsibility for the work shall be an AABC Certified Test and Balance Engineer with at least ten (10) years of testing and balancing experience in related projects. Qualifications shall include at least five (5) recent projects of similar
size, type, complexity, and regulatory requirements supervised and/or executed by the individual proposed for the Project. The approved AABC Certified Test and Balance Engineer shall directly supervise day-to-day activities and shall be on the job site every day that testing and balancing work is performed.

ii. Technicians performing work shall be AABC Certified Test and Balance Technicians with at least five (5) years of testing and balancing experience in related projects. Qualifications shall include at least five (5) recent projects of similar size, type, complexity, and regulatory requirements executed by technicians proposed for the Project.

iii. Apprentices used for this work shall have at least three (3) years of testing and balancing experience in related projects. Qualifications shall include at least three (3) recent projects of similar size, type, and complexity executed by apprentices proposed for the Project. Apprentices shall at all times work under the full-time direction and guidance of AABC Certified Test and Balance Technicians or Engineers.

iv. No testing, adjusting, balancing, or measurements shall be performed by personnel who are not approved by the Owner’s Representative. The Owner’s Representative retains the right to reject the qualifications of any personnel proposed for this project based on a reasonable review of submitted qualifications. Where specific personnel are rejected, require the submittal of alternate personnel with acceptable qualifications.

c. Instrumentation: Require that instruments have the maximum field measuring accuracy and are best suited to the function being measured. Scale ranges shall be appropriate for the value being measured. Utilize instruments with minimum scale and maximum subdivisions available for each measurement.

d. Performance Guarantee: Require the submittal of an “AABC National Performance Guarantee” for each project. The guaranty shall certify that all systems are balanced to optimum performance within the limits of the design and installation. The Test and Balance Agency shall furnish all labor and material to restore system performance, to the satisfaction of and at no cost to the Owner, any system that fails to maintain optimum performance during the warranty period.

3. Submittals
   a. Preliminary submittals shall include:
      i. Qualifications of the Test and Balance Agency and of personnel to be assigned to the Project. Detailed procedures for the Project.
      ii. Report forms filled out for the Project.
   b. Intermediate submittals shall include:
      i. Written reports describing any system deficiencies or components which do not function properly.
      ii. Intermediate test and balance reports as specified below.
   c. Final submittal shall include:
      i. Test and balance report typed in final form, including drawings identifying locations of every air outlet and inlet and pitot traverse. A draft report shall be submitted for review by the Owner’s Representative and the project Mechanical Engineer. The final report shall address all comments and be approved by the project Mechanical Engineer.
      ii. Fan and pump curves with design and actual operation points plotted. Certificates of calibration for all instruments used.
      iii. HVAC controls coordination report.
      iv. Performance Guarantee.
      v. The AABC Certified Test and Balance Engineer who supervised and is responsible for the work shall sign the final balance report, certifying the accuracy of the results and that work has been performed in accordance with specified standards and procedures.

4. Renovation Projects
a. Pre-demolition Measurements: Evaluate the impact of new work on the air and water balance in adjacent areas and, where appropriate, require the following measurements before demolition begins or as soon as ceiling access is made available.
   i. Measure airflow in every duct entering or leaving the Project area as close as possible to the Project boundary, unless this information is not pertinent
   ii. Measure airflows in other spaces outside the Project area that will be affected by demolition or new work.
   iii. Where connection to existing ducts will be made, measure available static pressure at the points of connection.
   iv. Where new ducts are connected to existing supply or exhaust fan systems, measure and report fan and motor data. Notify the Owner’s Representative in writing if existing fan system(s) are operating close to capacity and not able to adequately serve the Project area.

b. Intermediate Air Balancing: Whenever demolition, capping of existing ducts, or connection of new ductwork to existing systems causes airflows to change outside of the project area, provide immediate air balancing to adjust the fan speed, main duct dampers, and branch dampers so that existing airflows and pressure relationships are maintained outside of the project area. Intermediate test and balance reports are to be submitted within 24 hours after completion of duct modifications that affect airflows in other areas. Handwritten documentation on approved AABC forms will be acceptable only for intermediate test and balance reports.

5. Preparation
   a. Require the following pre-balance preparation by the Test and Balance Agency:
      i. Review the Drawings and Specifications and notify the Owner’s Representative in writing if the installation poses any potential balancing problems or if any additional balancing devices that are not shown or specified are necessary for a total system balance.
      ii. Review shop drawings to verify that all necessary balancing devices will be provided. Confirm final schedule and coordination issues. Identify the times and scope of any intermediate air balancing required during the construction.
      iii. Identify Testing Locations: After rough-in of ducts, piping, and equipment is complete, identify traverse locations, access requirements, and final placement of all balancing devices.
         1. Drill minimum 1/2-inch diameter holes in ductwork for temperature, pressure, and velocity readings. Drill test holes in the following locations:
            a. Each side of each filter, fan, coil, and multi-blade damper 0.6 inches on center for traverse readings in all main ducts. In each new branch duct connecting to an existing duct. As directed in the field.
         2. Install a “Ventlok 699” Instrument Test Hole with red painted cap in each hole. Trim and vapor seal duct insulation around all test holes.
         3. Test holes shall be fully visible and accessible from the ceiling access openings.
         4. Indicate above-ceiling testing locations in the final test and balance report.
   b. Require the following pre-balance preparation by the Contractor and trade subcontractors:
      i. Provide ceiling access as necessary for pre-demolition airflow measurements specified below.
      ii. Install all dampers and other balancing devices shown or specified and check to be sure they are properly installed, fully open, and in good working order.
      iii. Complete all punch list items that will affect balancing of the system.
      iv. Fully coordinate with electrical and HVAC controls subcontractors the readiness, correctness, and the safety of the electrical power and control systems before starting any equipment.
v. Start-up and test new and modified systems. Place all systems in automatic operation. Operate the systems for a minimum of 72 consecutive hours without shutdown with all equipment in good working order.

vi. Schedule work of other trades to eliminate system shutdowns once balancing is started, and assure uninterrupted access to mechanical equipment and conditioned spaces.

vii. Air Systems:
1. Clean interior of all plenums, air handler casings, and ducts.
2. Check that duct volume damper and fire smoke dampers are fully open. Verify that air filters are in place. Calibrate and adjust air filter gauges. Check for correct fan rotation.
3. Check for adequate motor horsepower to start and run fans.
4. Check for proper lubrication.
5. Check sheave alignment and belt tension at all fans.
6. Remove adjustable pitch pulleys from the motor shaft. Clean and lightly oil the shaft and pulley threads, and remount the pulley. Final adjustment shall be by the Test and Balance Agency.
7. Check fans for stable and quiet operation at design RPM.
8. Set sheaves to provide indicated capacities at specified static pressures. Furnish and install replacement sheaves as directed by the Test and Balance Agency during system balance.
9. Provide holes in drive guards that will permit tachometer readings without removing guards.

viii. Water Systems:
1. Comb heating and cooling coil fins and prove water flow to all coils.
2. Remove air from water systems.
3. Clean all system strainers. Remove temporary strainer liners.
4. Check that isolation valves, automatic control valves, and circuit balancing valves are 100 percent open.
5. Verify completion of pump alignment, pre-operating checks, and preliminary testing. See Standards included in 15500, “HVAC Piping.”

6. Testing and Balancing Activities
a. Require that all work conform to standard requirements and procedures contained in the AABC "National Standards for Total System Balance" and "Test and Balance Procedures", and recommended procedures contained in the ASHRAE HVAC Applications Handbook. Test and Balance Agency shall perform all recommended procedures, tests, measurements, and adjustments indicated in these standards, whether specified or not, as required for a total system balance.

b. Where the Project is to be completed in phases, require complete testing and balancing at the end of each phase of work, so that spaces may be occupied according to the Project Schedule.

c. Balancing Criteria and Requirements:
   i. Air inlets and outlets of 200 CFM or less shall be balanced to within plus ten percent to minus zero percent (10-0%) of design; larger inlets and outlets shall be balanced to within plus five percent to minus zero percent (5-0%) of design. Fans shall be balanced to within plus ten percent to minus zero (10-0%) percent of design. Temperature readings shall be accurate to within one half degree Fahrenheit (0.5°F). Water flow readings shall be accurate to within 5 percent. Pressure readings shall be accurate to within 0.5 psi for water systems and 0.01 in.w.g. for air systems.
   ii. Instruments shall have been calibrated within the last six (6) months and checked for accuracy prior to starting the balancing procedure. Make velocity readings with an instrument that does not require a separate timer.
iii. All readings, measurements, and observations shall be recorded on printed AABC data sheets and tabulated with appropriate calculations.

d. Air System Balancing:
   i. The intent is to obtain design CFM at all outlets and inlets with minimum possible fan speed and system static pressure, and with acceptable noise levels in occupied areas. At least one main zone volume damper and one branch volume damper in each zone shall be fully open at the end of balancing. Final position of manual dampers shall be plainly marked after balancing is complete.
   ii. Test and Balance Agency shall make special note wherever abnormal installed conditions (such as crimped flexible ducts, tight offsets, and unusual tap-ins or fittings) do not permit a proper air balance without increasing main duct static pressure or fan speed. Abnormal conditions shall be reported as early as possible, preferably during preliminary observations, and submitted with static pressure and airflow measurements that will permit analysis and identification of necessary corrective actions.
   iii. Test and Balance Agency shall make allowance for air filter resistance at the time of the tests. Air handling systems shall be balanced with the final (dirty filter) air resistance imposed using blank-off plates.
   iv. Test and Balance Agency shall fully balance variable air volume systems and equipment at scheduled maximum and minimum flow conditions.
   v. Test and Balance Agency shall make adjustments at diffusers and registers to prevent drafts at the occupant level in the space.
   vi. Positive or negative pressure relationships between supply and exhaust CFM shall be achieved in spaces wherever shown on the Drawings or required by Code. Required air pressure relationships are absolute and shall be met regardless of allowed tolerances for airflow adjustments.
   vii. Require that the final test and balance report include static pressure profiles of all balanced air handling systems, including static pressure measurements across fans, filters, main heating and cooling coils, sound traps, main duct modulating control dampers, in main and branch ducts near riser shafts, and upstream of variable air volume boxes. Include diagrams and/or drawings to document system static pressures.
   viii. Require that the following measurements be made at duct smoke detector locations:
      1. Differential pressure measurements across duct smoke detector sampling tubes.
      2. Velocity profiles with air velocity measurements at six-inch (6") intervals at sampling tube locations.
      3. Any other measurements requested by the Owner’s Representative or authorities having jurisdiction to ensure that duct smoke sensors are installed in accordance with their listing requirements.
   ix. Include detailed instructions in the Specifications or on the Drawings so that special balancing activities are addressed and included in the final test and balance report. These might include:
      1. The establishment of minimum outside air and exhaust airflows at air handling units with variable air volume or economizer controls.
      2. The establishment and calibration of maximum and minimum duct static pressure and airflow setpoints.
      3. The establishment of normal and default speed setpoints for variable frequency drives.
      4. Constant volume and variable air volume fume hood certification in accordance with UCB EH&S requirements, ASHRAE Standard 110, and other appropriate reference standards.
      5. Sound testing for HVAC noise in sensitive areas. Vibration measurements of rotating HVAC equipment.
6. Smoke control system testing shall include the detailed testing and adjustment of
airflows as required to attain floor pressurization and room pressurization required
to meet the code required door opening force and floor to floor pressure
differentials. This additional balancing is not possible to engineer on contract
documents and the scope must be clearly defined on documents.

e. Water System Balancing:
   i. Require that chilled and heating hot water mains and branches be adjusted to flow rates
      as shown on the Drawings or as required to obtain required thermal performance. Before
      adjusting system circuit balancing valves, verify that normal design differential pressures
      exist in water lines at heating and cooling coils. Prohibit the use of service isolation
      valves for balancing.
   ii. Require preliminary measurements and multiple readings of pump performance in
       accordance with requirements in Standards included in 15500, “HVAC Piping.” For
       systems in which pump impellers will be trimmed for efficient operation, require that
       final measurements be made after pump impellers have been ground and reinstalled.
   iii. The final test and balance report shall include design and measured flow rates and
       pressure drops at each point where design flow quantity is shown or scheduled on the
       Drawings, and water temperatures leaving and entering all coils when coils have had both
       air and water flows balanced.

f. Equipment Performance and Capacity Checks:
   i. Require that complete equipment performance documentation and test measurements be
      submitted in accordance with AABC "National Standards for Total System Balance" to
      demonstrate that all new and modified equipment is operating in accordance with
      scheduled performance criteria and manufacturer's published ratings. Where equipment is
      not performing in accordance with scheduled criteria or published ratings, analyze
      deficiencies and direct the Contractor to make appropriate corrections to allow equipment
      to perform efficiently and at required capacity.
   ii. Seasonal Checks: During the first year of operation, if the Owner’s Representative
       determines that heating or cooling capacities are not up to their expectation, require that
       the Test and Balance Agency provide additional system testing during periods of peak
       heating or cooling at no additional cost to the Owner. Based on the results of this testing,
       direct the Contractor to make appropriate corrections so that heating and cooling systems
       provide required capacities.

7. HVAC Controls Coordination
   a. Require that the Test and Balance Agency cooperate with HVAC controls installer and other
      trades in making HVAC control system adjustments necessary to accomplish the required
      sequence of operation.
   b. Where sequences require establishment of minimum and maximum airflows, multiple setpoints,
      reset schedules, or other variable conditions, the Test and Balance Agency shall provide all
      testing and balancing necessary to establish required setpoints. System performance shall be
      documented under all possible operating conditions.
   c. Clearly delineate aspects of the control system installation and performance to be checked or
      tested by the Test and Balance Agency. Activities will vary with each project, but may include:
      i. Temperature and pressure readings to verify that control devices are properly calibrated
         and that sensors are properly positioned to read intended temperatures and pressures.
      ii. Airflow measurements to verify control system setpoints at maximum and minimum
          airflows.
      iii. Temperature measurements to verify that room temperature sensors and thermostats are
          properly calibrated and installed to avoid erratic operation due to air diffuser short
          circuiting or cold walls.
iv. Room and building pressurization measurements to verify that lobbies, laboratories, odorous rooms, clean spaces, and other sensitive areas have the correct air balance and pressure relationships.

v. Automatic controllers and thermostats operate the correct control valves. Controller, thermostat, and control valve actions are correct.

vi. Setpoints meet the intent of the Sequence of Operation.

vii. System interlocks operate properly.

d. The final test and balance report shall include a checkout spreadsheet to document pertinent control system checking. Spreadsheet should include sensor and actual readings, device tag numbers, system, location, ranges, and other information.

8. Final Acceptance

a. At the time of final inspection, require the Test and Balance Agency to recheck, in the presence of the Owner’s Representative, specific and random selections of water and air quantities and other data as recorded in the final test and balance report. Measurement and test procedures shall be the same as approved for the work.

b. Selections for recheck should not exceed twenty-five percent (25%) of the total number tabulated in the final report, except that one hundred percent (100%) of air inlets and outlets in sensitive areas may be checked.

c. If random tests elicit a measured flow deviation of ten percent (10%) or more from that recorded in the final test and balance report in ten percent (10%) or more of the selected recheck stations, the report shall be automatically rejected. In the event the report is rejected, all systems shall be readjusted and tested, new data recorded, a new test and balance report submitted, and new inspection tests made, all at no additional cost or time to the Owner.

d. Final settings of all balancing valves, splitters, dampers, and other adjustment devices shall be permanently marked and locked in position and recorded by the Test and Balance Agency so that adjustment can be restored if disturbed at any time. Final balancing valve and damper positions shall be recorded in the final test and balance report.

23 09 00 Instrumentation and Control for HVAC

1. Heating and Ventilating Controls

a. Control systems for heating, ventilation and air-conditioning shall include provisions for fully automatic direct digital control by the Energy Management System (EMS). All controllers that activate pneumatic or electrically driven devices shall be as specified by or provided by EMS and shall be included in the Contract Documents. EMS devices shall include, but not be limited to: motor starter and speed controls, temperature sensors, start-stop stations, steam flow and condensate meters, status indicators, PE or EP switches and transducers.

b. Show control diagrams on the drawings. Bid documents shall include detailed sequences of operations tailored specifically for each piece of equipment specified in systems. General sequences of operations are not acceptable. Use selected manufacturer's catalog numbers to identify components. Include the final sequence of operation in the operation and maintenance manual submittal.

c. Specify clearly on contract documents which points are required to be hard wired to equipment and which points are allowed to be mapped through communication wiring (ie. BACNET communication). Typically start/stop, alarm, and setpoints are required to hard wired points to equipment. Variable frequency drives shall be hard wired to start/stop, speed reset, speed feedback, alarm, and fire/life safety interlocks. Other points such as amperage, output frequency, and drive temperature

d. Show any humidity control by means of a skeleton psychometric chart on the drawings.
e. Show a graphic chart on the drawings where control sequences are difficult to describe or specify. Indicate the position of valves, dampers, etc., or temperatures under variations in controlled or controlling conditions.

f. Indicate all design temperature and pressure settings on control diagrams. The Contractor shall initially set controls at these temperatures and pressures and then make any changes required to meet the actual operating conditions. Record all deviations from design settings on the Project Record Drawings.

g. Individual room heating and ventilating controls shall be conventional pneumatic, or direct digital control via the EMS, as determined by the building program.

h. Divide large open areas into separate zones for each exposure.

i. Where a number of rooms with similar exposures or heat gains are included in a single zone or where it may not be practical to install individual room controls, locate the zone thermostat in a common return or exhaust duct from the zone.

j. At animal rooms and similar hose down spaces, provide bulb-type, completely waterproof thermostats that can be hosed with high-temperature water or utilize an exhaust duct sensor.

k. Provide thermometers near each controlled point for setting of the control and checking its operations except at room thermostats.

l. Provide pressure gauges in main and branch air lines at each major pneumatic control device including EMS electric/pneumatic transducers.

m. Provide non-electric automatic modulating valves where single or double occupancy rooms are heated by under-window convectors. Provide pneumatic or EMS control for larger areas. Provide shutoff valves to isolate each convector.

n. Specify normally-closed-type heating control valves for any research area, such as animal, insect or plant rooms, to prevent overheating in case of air or control failure. Discuss questionable areas with Construction & Design (C&D).

o. See Division 1 for other specification requirements.

2. Control Air

p. For reliability, two (2) control air sources are preferred on large or complex control installation. These may be the typical control air compressor, with a reduced building air supply set to cut in automatically upon loss of control air. Where no building supply is available, consider two (2) smaller compressors with receivers, or with a single receiver. Size all receivers, pipes and valves, so that either or both compressors may be used. Building backup air shall be connected upstream of the refrigerated air dryers.

q. Provide a refrigerated air drier in the control air system between the compressor and receiver. Include size, type and operation in the drawings and specifications.

r. Where new large, complex or critical control systems are to be installed in an existing building, determine if the existing control air source is adequate and of acceptable quality. If there is doubt, provide a new control air compressor, with cross connection to existing.

s. Specify copper for all control air tubing in exposed areas, and in concealed areas where elevated temperatures might damage plastic air tubing. Plastic control air tubing is acceptable in other areas, with the following installation precautions:

i. Do not allow short radius bends.

ii. Do not allow plastic caps on copper tubing.

iii. Properly space supports to prevent sag.

iv. Tubing installed in plenums shall be type FR only.

v. Tubing routed in inaccessible areas shall be hard drawn copper.

vi. Pressure test control tubing at 35 psi.
1. Specify galvanized steel ductwork and plenums. Aluminum is acceptable if it complies with the requirements of the SMACNA Heating, Ventilating and Air Conditioning Duct Construction Standards.

2. Duct fabrication, installation and support shall conform to the requirements of SMACNA Heating, Ventilating and Air Conditioning Duct Construction Standards.

3. Support exposed ducts with rods bolted to duct angle stiffeners or to steel angle or channel cradles. Support vertical risers at each floor level with intermediate guide support midway between floor.

4. Provide factory-fabricated hardware for manual dampers, plenum doors and access doors as manufactured by Vent Fabrics or DuroDyne.

5. Provide grease hood exhaust ducts with welded grease-tight seams and joints. Pitch duct back to hood and provide for drainage.

6. Provide for water-tightness and moisture elimination in high-humidity exhaust ducts.

7. Outdoor ducts shall be sealed watertight and top of duct shall be sloped to prevent water pooling.

8. Provide capped instrument test holes on each side of heating coils, fans and units with duct connections. Location shall be visible and accessible for taking accurate measurements of static pressures and air velocities.

9. Labels:
   a. In mechanical rooms, label or stencil ducts leaving the mechanical room to identify the areas or rooms served.
   b. Label each duct connection to a fume hood with the exhaust fan number serving it, using one-inch (1") minimum height black lettering. Label each exhaust fan corresponding to the fan number in the construction drawings in a visible location with two-inch (2") minimum height letters of contrasting color. Where a fan serves more than one fume hood, list the rooms, using one-inch (1") minimum height black lettering.
   c. See Section 23 50 00: Central Heating Equipment for other label requirements.

23 33 00 Air Duct Accessories

23 33 13 Dampers

1. Show accessible manual volume dampers at major divisions in all duct systems to permit balancing of air quantities. Each supply outlet and each exhaust branch shall have a damper.

2. Provide locking quadrant-type damper operators. Provide standoff brackets to locate operators at outside surface of wrapped ducts.

3. Use supply or exhaust grille face dampers only for minor air balancing to avoid objectionable noise in occupied areas.

4. Fire dampers:
   a. Provide safe overhead access for maintenance personnel to each fire damper and fusible link (CalOSHA Title 8, 3270). Consider placement of damper actuators and links at floor level above damper separation for reduced costs and safe access.
   b. Provide fire dampers which are California State Fire Marshal listed and Underwriters' Laboratory (UL) listed.
   c. Provide access to each fire damper for maintenance and fusible link replacement.
   d. Provide access doors for visual inspection and maintenance of damper.
   e. Provide local fire/smoke damper power disconnect to allow for maintenance of individual dampers without de-energizing the entire circuit.
   f. Fire damper installation shall be in accordance with the listing agency.
g. Where fire/smoke dampers are located in main air conveying ducts where closure may cause damage to ductwork, provide pressure relief doors shown on drawings with pressure setpoints.

23 34 00 HVAC Fans

1. Fans
   a. Centrifugal fans should be specified for most applications. Select size and type of fan based on life cycle cost and noise level considerations. Selected fans shall have performance characteristics capable of future flow increases of at least ten percent (10%). Due to their high noise levels axial fans should not be specified without prior consultation with Construction & Design (C&D).
   b. Fans used in supply and return air applications with air quantities of 5000 cfm or greater shall be comprised of multiple wall-style plug fans for redundancy. Fans shall be equipped with individual backdraft dampers. Multiple variable frequency drives shall be provided for redundancy. Each fan in such a system shall be monitored with a current switch to alarm the energy management system of a fan failure (switch contacts shall be normally closed wired in series to indicate a single point general fan alarm). Fan monitoring shall be provided for each variable frequency drive.
   c. Select fans which meet Air Moving and Conditioning Association (AMCA) construction and capacity rating standards.
   d. Fans shall comply with section 01 60 00 General Product Requirements of these design standards.
   e. Provide flexible connections between fans and ductwork.
   f. Fan bearings shall have a minimum of 100,000 (L_{10}) hr life
   g. Provide safety guards described in this Division.
   h. Provide bearings described in this Division.
   i. General utility fans for exhaust applications shall be Cook or approved equal.

2. Fan Drives
   a. Provide safe overhead access for maintenance personnel to each fan drive (CalOSHA Title, 3270).
   b. Provide V-belt drives with ratings of not less than 150% of motor horsepower.
   c. Provide motors of five (5) horsepower and smaller and not more than two (2) drive belts with an adjustable pitch motor sheave. The midpoint of the adjustment range shall produce the specified fan revolutions per minute.
   d. Provide motors larger than five (5) horsepower and drives with more than two (2) belts with a sheave which produces the specified fan revolutions per minute.
   e. After testing the ventilating system, the Contractor shall make, without additional cost, one (1) change in the size of the non-adjustable sheave and belts to obtain the desired air quantities.

3. Variable Frequency Drives
   a. Specify only the following variable frequency drive (VFD) manufacturers to ensure compatibility with campus staff training and inventory: ABB, or approved equal. Discuss specification language with C&D Project Manager to comply with campus requirements.
   b. Warranty: All equipment and installation shall be warranted for a minimum period of twelve (12) months from the date of Final Acceptance. This warranty shall include all costs of repair during the warranty period including transportation and shipping costs.
   c. Standard Products: All materials and equipment furnished shall be new and of standard design and model. In addition, they shall be the manufacturer's latest standard design that is current at the time of delivery, except for such modifications from the manufacturer's standard product as may be required to conform to specification requirements.
   d. VFD System: Provide a complete variable frequency drive system.
      i. Each system shall consist of:
         1. A power input circuit breaker.
         2. A drive power unit safety disconnect (service switch).
         3. A rectifier.
4. Filter and inverter with regulator and controls (drive power unit).
5. Inverter with regulator and controller.
7. Transducers and instrumentation.
8. User input/output terminals.
9. A system control panel and system enclosure(s).

ii. The output waveform of the drive power unit shall be sine-coded, pulse width modulated.
iii. The systems shall be installed as variable speed controllers for existing induction motor driven fans.

e. Standards, Codes and References: Design, construction and fabrication shall be in accordance with good engineering practice and workmanship and in compliance with the following standards and codes as applicable.

1. National Electrical Manufacturers Association (NEMA).
2. Institute of Electrical and Electronic Engineers (IEEE).
3. Occupational Safety and Health Act (Cal/OSHA).
5. Underwriters' Laboratory (UL) or Electrical Testing Laboratory (ETL).

7. Drawings:

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<tr>
<td>8844B-E1-0</td>
<td>Typical control schematic for single motor variable frequency drive.</td>
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<td>Typical control schematic for dual motor variable frequency drive.</td>
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<tr>
<td>8844B-E3-0</td>
<td>Variable frequency drive control interface diagram.</td>
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f. Each variable frequency drive unit shall bear the approval sticker of a nationally recognized testing laboratory such as Underwriters' Laboratory (UL) or Electrical Testing Laboratory (ETL).

g. Submittals to the University shall include three (3) copies of the following items for each different size and/or model system:

i. Dimensional drawings showing all pertinent dimensions and total unit weights for the variable frequency drive system equipment.

ii. A complete set of drive power unit connection diagrams.

iii. A complete set of elementary and schematic drawings for all electric and electronic circuits.

iv. A complete set of wiring drawings showing schematics of each printed circuit board and all components both by circuit connection and position on board, and all component values.

v. A complete manual including all necessary installation, operation, and maintenance instructions.

vi. A recommended spare parts list and a parts price list.

h. General VFD requirements: The drive power unit shall be of sufficient capacity and shall provide a quality of output waveform to achieve the full rated output of the driven motors listed in Part 3. In addition, the variable frequency drive system shall include the following ratings and parameters.

i. Efficiency: Minimum drive unit efficiency shall be 94% at 100% speed and not less than 80% at 50% speed.

ii. Input Voltage: The input voltages shall be 3-phase, 240 or 480 volts +10%, -5%, 60 HZ±5%, as required by location.

iii. Rating: The drive unit rating basis shall be 100% continuous with a service factor of 1.0.

iv. Input Circuit Protection (main circuit breaker): A properly rated thermal-magnetic molded case circuit breaker or a circuit breaker/current limiting fuse combination that provides the short circuit protection required below, shall be provided on the incoming power line.
1. The circuit breaker shall be rated 200,000 amperes at 240 volts or 100,000 amperes at 480 volts interrupting capacity RMS for short circuit protection.
2. The circuit breaker shall be lockable in the off position and shall be interlocked with enclosure door, with provision for defeating the interlock.

v. Drive Power Unit: The variable frequency drive power unit shall consist of converter, filter and inverter sections.
   1. The converter section shall be a full wave, 3-phase diode bridge that shall provide a voltage source with output that is regulated and limited.
   2. The output of the converter shall feed a filter capacitor section.
   3. The inverter section shall convert the DC output to an approximate sine wave current waveform at an adjustable frequency.

vi. Bypass Equipment: By-Pass capability shall require the following equipment to be supplied as part of the variable frequency drive package to ensure a coordinated system:
   1. Two (2) AC motor controllers, with 115 volt coils, mechanically and electrically interlocked for inverter or bypass output.
   2. Inverter and bypass contactor control relays for transferring output from the inverter to the bypass and vice versa.
   3. Thermal motor overload devices with auxiliary contacts, wired into the output to provide motor overload protection in both inverter and bypass mode.
   4. Auxiliary contacts on the inverter and bypass contactors and control relays as per the drawings.
   5. Where the variable frequency drive is required to drive two (2) motors; two (2) pairs of controllers (four [4] total), each pair mechanically and electrically interlocked, and two thermal motor overload devices shall be provided.

vii. Control Power Transformer: A 120 volt control power transformer with primary and secondary protective fuses shall be provided for remote and local controls.

viii. Enclosure:
   1. The enclosure shall be a rigid wall-mounted or freestanding National Electrical Manufacturers Association (NEMA) 1 Type for indoor applications. NEMA 3R enclosures shall be specified for outdoor applications. Outdoor applications shall be installed with weatherproof doors covering readout panels which do not require the opening of the entire panel. Operation, maintenance and parts replacement shall be from the front of the unit enclosure. No access from the sides or rear of the panel shall be required. Replacement type filters shall be used on all ventilation openings. Changing of filters shall be done without the opening of any enclosure doors.
   2. The enclosure shall house all electrical and electronic components.
   3. The equipment shall contain drive data nameplate mounted inside the housing with the following information: input voltage, full load current, drive horsepower rating, service factor, frequency range, maximum output voltage, model number, serial number, and shop order number.

ix. Controls, Control Relays, Pilot Lights and Indicators:
   1. Panel mounted controls and pilot lights shall be National Electrical Manufacturers Association (NEMA) Type 13 oil tight.
   2. Pilot lights shall be push-to-test transformer type with 6.3 volt lamps.
   3. Control relays shall be industrial grade control type relays.
   4. Indicators shall be industrial type panel meters, digital or analog as indicated.
   5. All wires shall be marked on both ends with the number shown on wiring diagrams. Output terminals shall be continually numbered with no repetition. Wire markers shall be heat shrinkable or interlocking sleeve type.

i. Technical Requirements: Design Criteria and Features: The drive power unit shall provide the following:
i. Rated output voltage shall be 3-phase 208 or 480 volts, 60 Hz.

ii. Output frequency control variable over a 40:1 speed ratio range.

iii. Long term frequency stability shall be one percent (1%) or better for any given twenty-four (24) hour period.

iv. Speed regulation at the motor shaft shall be three percent (3%) or better with standard National Electrical Manufacturers Association (NEMA) Design B induction motor, without special slip compensation.

v. Overall rating shall be 150% of drive rating for one (1) minute.

vi. Electronic start into running motor protection.

vii. Auxiliary outputs prewired to terminals for purchaser's use:

1. A normally closed fault summary dry contact that opens on any variable frequency drive internal fault or AC power failure.
2. A 0 to 6 volt or 0 to 10 volt direct current output signal proportional to 0 to 150% speed.
3. A 0 to 6 volt or 0 to 10 volt direct current output signal proportional to 0 to 150% current output.

viii. The inverter regulator section shall include:

1. Adjustable current limit (60-110%).
2. Adjustable volts per hertz for output power (+/- 10%).
3. Adjustable minimum and maximum speed or frequency (0-100% and 100-0%).
4. Torque limit adjustable from 50 to 100% of full drive rating. When torque limit is exceeded, output frequency shall decrease until load is within continuous torque rating limit at which point the speed shall stabilize. If minimum frequency is reached before the torque is reduced to a safe value, then the inverter output shall de-energize within sixty (60) seconds. Operation with torque limit control engaged shall be visually indicated.

ix. The drive shall be capable of follower operation from a 0 to 10 volt direct current signal that may be either positive or negative and either grounded or ungrounded.

x. Sealed contacts for all switched regulator and reference signals.

xi. The door of each variable frequency drive power unit shall include a control panel consisting of:

1. Lockable input power disconnect handle (main circuit breaker).
2. Lockable drive power disconnect (service switch) that may be accessible only from inside the enclosure.
3. Off-hand-auto control select switch.
4. Bypass-inverter output selector switch.
5. Start in auto (computer control) push-button.
7. Power on indicating light.
8. Inverter fault indicating light.
10. Motor on bypass indicating light.
11. Speed or frequency meter (output, 3 digit LCD or LED digital, scaled 1 to 150%).
12. Ammeter (input current, analog only, scaled 0 to 150% of full load current).
14. Voltmeter (input line voltage, analog only, scaled 0 to 150% of nominal).

xii. Independently adjustable acceleration and deceleration rates extendible up to thirty (30) seconds, with torque limit override acceleration protection and regeneration protection during deceleration.

xiii. Selectable coast-to-stop or ramp-to-stop control.
xiv. "Normal-Test" switch that shall prevent closing of the bypass or inverter output contactors, to permit no-load on-line testing of variable frequency drive components. The normal-test switch shall be located inside the variable frequency drive cabinet, accessible to qualified maintenance personnel only.

j. System Protection: The following design, operation and maintenance features shall be incorporated in the drive power unit.

i. A disconnecting device shall be supplied to disconnect all drive power unit internal wiring from the input power supply. The device shall be operated by a door-mounted handle that shall be lockable in the off position and shall be mechanically interlocked with the enclosure door. The locking safety mechanism shall be defeatable to allow for opening the enclosure without de-energizing the equipment.

ii. The current limit capability of the converter section shall react sufficiently fast to protect against a sudden random short circuit at the output terminals of the converter section.

iii. The converter shall be provided with high speed, current limiting input line fuses to protect against internal faults.

iv. Phase-to-phase and phase-to-ground short circuit protection.

v. Additional protection shall be provided for:
   1. Input power failure.
   2. Phase current imbalance.
   3. Under-voltage.
   4. Incorrect phase rotation shall be provided.
      a. Transient suppression for protection of internal components from line and load transients.
   5. Ground fault.
   6. Electronic motor overload (IT) protection, adjustable from 60 to 100% of drive full load ampere rating.

vi. Heat sink temperature switches shall be supplied and an orderly shutdown shall occur on over temperature conditions.

vii. DC bus voltage clamp circuitry shall be provided to prevent damage due to AC line overvoltage. Excessive motor regenerative voltage shall not cause inverter to trip or damage components but shall decelerate motor to a safe operating mode.

viii. Instantaneous electronic overcurrent trip circuitry shall be provided for protection of inverter section power electronic devices independent of protective fusing. This circuitry shall include visual indication, in the regulator section, of any instantaneous overcurrent trip.

ix. The filter capacitors shall have automatic discharge circuitry that will cause discharge within approximately three (3) minutes after the drive system is de-energized.

x. The inverter section shall be provided with high-speed current limiting fuses to protect against internal faults.

xi. Inverter overload protection shall provide shutdown on an inverse time basis dependent on the extent of the overload.

xii. Two (2) second power outage ride-through capability: The inverter shall maintain constant volts per hertz at motor terminals during outage. Rundown time is determined by system inertia and losses only.

xiii. The inverter shall not trip due to supply system AC transient spikes when the bypass run mode or when OFF. The drive manufacturer shall provide electronic circuitry that prevents such a trip, or an electrically operated isolation Contractor on the supply side of the inverter.

k. System Test and Troubleshooting:

i. The variable frequency drive system equipment shall include a display for system malfunction identification and troubleshooting. At a minimum, the following indicators shall be provided:
   1. Overcurrent trip.
2. Overvoltage trip.
3. Torque limit.

ii. A diagnostic fault microprocessor shall be utilized to perform all diagnostic testing.

1. Mode of Operation: The system shall provide for operation as follows:
   i. **Off-Hand-Auto** control selector and Bypass-Inverter output selector switches:
      1. In **off** position there shall be no output from the variable frequency drive system. The inverter cannot be started and the bypass contactor cannot be closed.
         a. When moved to **off** from **hand** position, variable frequency drive system output shall cease, subject to the following: If the output selector switch is on bypass, the inverter output shall be disconnected and power to the fan motor shall derive from the bypass contactor and circuit.
         b. If the output selector switch is on inverter, the inverter shall immediately open.
      2. In **hand** position the fan motors shall run from bypass or inverter output, according to the setting of the output selector switch.
         a. If the output selector switch is on bypass, the inverter output shall be disconnected and power to the fan motor shall derive from the bypass contactor and circuit.
         b. If the output selector switch is on inverter, the inverter shall operate and power to the fan motor shall derive from the inverter. Speed shall be controlled by the front door-mounted speed control.
      3. In **auto** position the fan motors shall be controlled by remotely sourced computer-controlled inputs. The variable frequency drive system output shall be inverter or bypass, according to the setting of the output selector switch. The **on** signal shall be provided by momentary closure of a remote dry contact. The **off** signal shall be provided by momentary opening of a remote dry contact. Speed control shall be provided by a 0 - 10 volt analog signal.
         a. If the output selector switch is in **bypass**, the inverter shall be disconnected and power to the fan motor shall derive from the bypass contactor and circuit. Start-stop functions shall be remotely controlled.
         b. If the output selector switch is in **inverter**, the drive shall operate and power to the fan motor shall derive from the inverter. Both start-stop functions and speed set-point shall be remotely controlled.
         c. The inverter output frequency shall increase or decrease at the preselected rate when **on** or **off** signals are received or when changes in speed control are made while in both **auto** and **inverter** modes. When an **off** signal is received, the inverter contactor shall not open until the speed has ramped to near zero. When an **on** signal is received, the inverter contactor shall close before the speed is ramped up to the preset or input speed.
   4. When switching from **hand** to **auto** and vice-versa, when in **inverter** output, the control system shall be so configured that the drive shall not go through complete shut down while making any speed adjustments.

   ii. **Start** in **Auto, Push-button** Switch: This momentary contact switch shall functionally parallel the computer controlled **on** signal when the control selector switch is in **auto**. It shall provide for restarting the fan motor whether in bypass or inverter output mode.

   iii. **Normal-Test** Switch: This maintained contact switch shall disconnect the bypass and inverter contactor coils from control power when in **test** position to permit no-load testing and adjustment of variable frequency drive components.
1. Supply registers: Adjustable double-deflection type with opposed blade dampers. Do not locate where the air supplied is directed toward a fume hood face.
2. Diffusers: Adjustable pattern, blade type with opposed blade damper.
3. Return exhaust and transfer air grilles and registers: Horizontal or vertical fixed blade type for wall locations and 1/2" x 1/2" x 1/2" aluminum grid for ceiling locations with opposed blade dampers.
4. Minimum free area on any grille or register: 70% of face area or greater.
5. Coordinate finishes with the architect.

23 38 00 Ventilation Hoods

1. Fume Hood Exhaust Fans
   a. Up to 27" wheel diameter: Westinghouse Industrial Series 400 or equal with air handling wheel.
   b. Above 27" wheel diameter: Westinghouse series 8000, or equal, with backward inclined airfoil wheel.
   c. All fans shall have upblast discharge. Discharge shall meet Cal/OSHA requirements enumerated in CCR, Title 8, Section 5154.1.
   d. Provide bearings described in this Division.
   e. Install weatherproof housing over motor and drive where exhaust fans are exposed to weather.
   f. Protect interior of fan and wheel with coating as specified. Rebalance wheel after coating.
   g. Locate fans so that negative pressure exists in all fume hood ducts within the building. Where this is not feasible, discuss mitigating measures with Construction & Design (C&D).
   h. Provide neoprene-coated glass fiber flexible connections at duct connections to fume hood fans.
   i. Coordinate with the architect for vibration control and roof-mounting. The architect shall detail equipment curbs, supports at roof, roof penetrations, and flashing for roof-mounted equipment.

2. Duct System Design
   a. To reduce static and velocity pressure loss, turbulence and noise in the ventilating system, comply with the following:
      i. Do not use plenums for connecting fans or main ducts to multiple branch ducts.
      ii. Use properly designed transitions, radius turns, vaned miter elbows and/or extractors at changes in duct size and direction.
      iii. Provide sufficient duct-mounted volume dampers to properly balance the completed system.

3. Duct Air Velocities
   a. Size ducts for maximum selected velocity only at the fan connection. Duct size shall be immediately increased after this connection to minimize noise generation and static pressure required at fan. Reduce this velocity to the minimum acceptable as air quantity and pressure decreases in relation to distance from the fan using the equal friction method of duct design.

4. Makeup Air for Fume Hoods
   a. Provide adequate makeup and exhaust air for new fume hoods installed in existing buildings. Where the existing building system was not designed for fume hoods, and cannot be modified to handle the added requirements, or the existing exhaust duct system is not chemically-resistant, provide a new makeup and exhaust system. Where approved, a heating and ventilating unit may be provided to supply tempered makeup air to the room.

5. Fume Hood Ductwork
a. See Division 11 53 00: Laboratory Equipment.
b. Combine several hoods in a building into fume hood exhaust systems, with one (1) exhaust fan serving the system where permitted by code. All fume hoods on any one (1) exhaust system shall have the same supply fan. Because they operate continuously, consider these fume hood exhaust systems a part of the building heating and ventilating exhaust. Size fume exhaust ducts for a velocity consistent with design noise levels, duct static pressure and size limitations.
c. Where corrosive fumes are anticipated, construct ductwork of Plasite-coated black steel and drain back to fume hood.
d. Where most of the building exhaust system is via fume hoods, as in a chemistry building, consider making the exhaust system for all potential laboratory areas of coated, fume-type ductwork for future remodeling flexibility.
e. Where practicable, ducts shall be accessible for maintenance.
f. Install balancing dampers for fume hoods.

6. Canopy Hoods
   a. In general, canopy hoods are not acceptable for exhausting as hazardous vapors may be found in laboratories. Where feasible, locate kitchen hoods and equipment at wall rather than at island for better efficiency. Proposed canopy hoods shall be discussed with Construction & Design (C&D).

7. Industrial Exhaust Systems
   a. Design industrial exhaust systems for woodworking machinery, grinders, dust collecting, paint spraying or welding fumes, etc., with adequate provisions for entrainment and safe removal of any dangerous substances. Systems shall be designed in accordance with the recommendations of the Industrial Ventilation Manual published by the American Conference of Governmental Industrial Hygienists (ACGIH).

23 40 00 HVAC Air Cleaning Devices

1. Duct Access Panels and Doors
   a. Provide sufficient access panels to permit cleaning of interior of all duct systems. Pay particular attention at points where ducts contain or are directly connected to louvers, screens, turning vanes, coils, heating and ventilating units, etc., and at any point in grease hood exhaust duct where grease could accumulate.
   b. The following warning sign shall be stenciled in one-inch (1") high minimum, red letters on opening side (or both sides on walk-through) of access doors and panels between areas or in ducts where there is a positive or negative differential pressure above 0.5" WC:

   WARNING
   DOOR (OPENS) (CLOSES) ABRUPTLY
   UNDER (POSITIVE) (NEGATIVE) PRESSURE

   c. Provide an airlock vestibule entrance at any plenum where the pressure differential is a hazard to personnel using a single door.

2. Air Filters
   a. Building Ventilation
      i. All building ventilation air filters shall be the replaceable type. Use twenty-four by twenty-four inch (24" x 24") size unless otherwise approved by Construction & Design (C&D). The filter system shall be two-inch (2") HE-60 prefilters in front of 85% efficient bag filters. Filter frames shall be made from Kraftboard or equivalent to withstand exposure to moisture.
Air filters must carry a Maximum Efficiency Reporting Value (MERV) rating of eleven (11) or greater, as determined by the ASHRAE 55.2. air filter test.

ii. Provide louvers, screens, etc., as necessary to keep filters dry and free from debris. Discuss any special filtering requirements with Construction & Design (C&D).

iii. Clearly show selected filters on the drawings with actual number, efficiency, type and size of filter cells in each bank. Show total air quantity to be filtered. Do not leave selection of size and number to the Contractor.

iv. Provide a corrosion-resistant material or galvanized finish for all filter frames.

v. Limit height of filter bank to eight feet (8’-0”). Where a higher filter bank is unavoidable, coordinate with the architect for a permanent ladder and catwalk detailed and specified under the miscellaneous metals section.

vi. Provide a floor drain for wash-down in each filter plenum.

vii. Coordinate with electrical to provide non-incandescent illumination on each side of bank for servicing.

viii. Specify that the system shall not be operated during construction without the filters in place. Contractor shall be responsible for cleaning of ductwork if system is operated before building is clean and ductwork cleanliness is compromised. Where the filter static pressure at the time of balancing would adversely affect the results, specify that the Contractor shall replace the media before balancing or acceptance.

ix. Provide dial-type draft gauges for all filter banks, with scale range to suit static conditions anticipated. Provide shutoff cocks at all gauges to allow calibration. To assure proper operation and accurate draft readings, show the location of Pitot heads on the plans.

x. Provide a sign below each gauge giving clean and dirty readings anticipated with the installed filters.

b. Special Laboratory Exhaust

i. Provide special filtering for any laboratory exhaust, as required, that may contain radioactive, infectious or otherwise potentially hazardous materials. Discuss type and installation methods with Construction & Design (C&D) and Environment, Health and Safety (EH&S).

ii. Design and detail the filter bank leak-tight and sufficiently stiff to prevent excessive deflection at design airflow and static pressure.

iii. Design for ease and safety of periodic maintenance activity; contaminated filters shall be changed while wearing personal protective equipment.

3. Air Inlets and Exhausts

a. The building ventilation system outside air inlet shall be located away from ground-level pollution sources and building exhausts. Preferred location is high-up on the prevailing wind side of building (west side). Keep intakes away from loading docks, porte-cocheres and vehicular areas, parking lots and trash areas.

b. Exhaust potentially contaminated air vertically at least seven feet (7’-0”) above roof level at twenty-five hundred feet per minute (2,500 fpm) velocity for dispersion and dilution. Exhaust recirculatable-quality air at any point where the discharge will not be objectionable. Coordinate locations with the architect during early design stages. Early discussion of these locations with the architect and Construction & Design (C&D) will prevent later design changes.

c. Coordinate with the architect on louvered supply and exhaust performance data including free area ratio. Design for a velocity below manufacturer's recommended maximum to exclude rain.

d. Do not locate low louvers where air will blow on plants.

e. Do not locate louvers or grilles in corridor doors or walls with required fire ratings.

f. Provide louvers and screens at all ventilation air inlets. Screen exhaust outlets only where required for safety. Do not specify or show any screen with smaller than one-inch (1") minimum mesh.

g. Provide duct access from within the building for maintenance and cleaning of all louvered or screened openings from the inside.
4. HVAC Cleaning
   a. Coordination
      i. Coordinate schedule and requirements with Construction & Design (C&D).
      ii. Construction & Design (C&D) shall notify the building occupants of the work to be done, the
          schedule, the contact person in case of complaints, and the availability of protection covers
          (to be provided by the Contractor) for those who want them. Work shall be scheduled when
          the areas are unoccupied, whenever possible.
   b. Drawings
      i. Provide a current heating and ventilating plan showing all existing systems.
      ii. Show the fans, coils, ducts and outlets to be cleaned.
      iii. Access shall be provided to all duct interiors, coils, fans and dampers. Where new access
           doors are required, show the locations. Where ceiling access doors will be required,
           coordinate finishes and products for existing construction.
      iv. Coordinate with Construction & Design (C&D) for areas that require special protection and
          indicate these on the drawings.
      v. If more than one (1) supply fan is involved, define the areas served by each fan.
   c. Specifications:
      i. Determine and indicate the hours when the work may be performed, when the fans will be
         turned on and off, and who is responsible. Specify when the supply fan will be run in order
         to observe if any visible dirt is deposited in the areas served.
      ii. Duct cleaning shall use the negative pressure method which draws air away from occupied
          spaces as the ductwork is being cleaned to avoid contamination of occupied areas in
          building.
      iii. Access Doors
         1. Duct: Door shall be 20-gauge galvanized steel slide-gate type secured with parker
            screws and 1/2" flange to serve as handle and stop, or round galvanized steel spun
            into a round opening. Size as required by duct size.
         2. Ceiling: Select product suitable for existing finishes and fire ratings.
      iv. The Contractor shall conspicuously mark the initial setting of any air control devices that
          must be moved to properly clean the duct system. After cleaning, return each device to its
          original marked position and secure in place.
      v. Clean all ducts using an industrial-type vacuum cleaner. Inspect cleaning work in all
         portions of ducts. Remove, brush and vacuum supply diffusers or grilles, including damper
         or volume control, at completion of duct cleaning.
      vi. Clean all coils using an industrial-type vacuum cleaner on the entering air side of the coil
          and a high pressure air jet (fifty pounds per square inch [50 psi] minimum) blowing back
          from the leaving air sides. Continue until all passages are clear.
      vii. Before each section of duct, coils, fan and outlets is cleaned and before the system fan is
          turned on, cover each outlet with a filter. Filters shall be a minimum of 1/2" thick fiberglass
          filter mat covered and held in place with cheese cloth and duct tape or other appropriate
          method. The filters shall remain in place until the cleaning is completed and accepted.
      viii. After all outlet filters are in place and before leaving the building, turn on supply fan
           serving the area for one (1) hour maximum. The Contractor shall check all areas served by
           this fan for any visible dirt entering through loose or improperly installed outlet filters.
      ix. While fan is operating, the Contractor shall clean furniture, floors, and other surfaces
          showing visible dirt that has been discharged through loose or faulty outlet filters.
      x. Carefully place all removed dust and dirt in plastic trash bags, close and securely tie.
         Specify storage location and responsibility for disposal.
xi. The Contractor shall provide the University with protection sheets to be distributed by the University to the building occupants. Coordinate with Construction & Design (C&D) and specify the size and number to be provided.

xii. Bidding shall include a per-hour unit price for room cleaning exceeding contract requirements.

xiii. The Contractor shall prepare a checklist of all rooms and areas affected by the Project. The checklist shall be used to check room cleanup, furniture in original position, and outlet filters in place. The checklist shall be maintained by the Contractor's superintendent, for each work period.

xiv. Submittals shall include:
   1. Ceiling and duct access doors.
   2. Outlet filters.
   3. Filter fastening method.
   4. Protection sheets for furnishings.
   5. Fan system filters.
   6. Work schedule and number of workers.

d. Filters
   i. Replace all fan system filters. Clean supply and intake plenums, louvers, bird screens, and filter banks.
   ii. Replace worn, missing, or damaged filter frame gaskets.
   iii. Replace broken filter clips and change or adjust filter clips to fit the University's standard filters. Filter clips shall have wire loop end for securing filter frame.

23 50 00 Central Heating Equipment

1. Hot Water Heating Systems
   a. Provide for maintenance and repair work in the piping of hot water heating systems. Provide low point drains and high point vents, both constructed of ball valves with hose adaptors and hose caps. Provide a safe, accessible drain as required in this Division. Coordinate on location of drain.
   b. Provide manual air vents at high points in hot water piping systems. Show or specify a valve ahead of all automatic air vents to facilitate replacement.
   c. Show compound vacuum-pressure gauge and vacuum breaker on all hot water converters.
   d. All building hot water heating systems shall be design for six pounds (6 lbs) steam supply. Higher pressures are only acceptable for autoclave or distribution functions.

2. Water Heating (Steam)
   a. Where steam is available for water heating, provide a shell and tube heat exchanger (use plate type where applicable) meeting the following requirements:
      i. All components in the heating hot water system shall be rated to two-hundred fifty degrees Fahrenheit (250°F).
      ii. Heater: one hundred twenty-five pounds per square inch (125p/in²), ASME stamped steam heat exchanger.
      iii. Materials: Non-ferrous for all parts having contact with water; and ferrous, cast iron or steel for all parts having contact with steam or condensate.
   iv. Controls:
      1. Control temperature shall maintain hot water set point temperature within plus or minus three degrees Fahrenheit (+/-3°F) for all flows from two (2) gallons per minute through specified capacity.
      2. Provide a high limit control that will shut off steam supply to heat exchanger with a ten degree Fahrenheit (10°F) maximum rise of outlet temperature above set point.

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v. Provide each heat exchanger with the following:
   1. Compound pressure and vacuum gauge.
   2. Vacuum relief valve.
   3. Pressure relief valve on both steam and heating hot water systems prior to any means of heat exchanger isolation valves.
   4. Thermometers in hot water outlet and return lines.
   5. Drain valves (ball-type) with hose thread adapter to drain shell and tubes.
   6. Thermowells in hot water supply and return lines to suit temperature sensors specified or provided by the Energy Management Control System. Install calibration wells (self-sealing test connections) adjacent to each thermowell location.

vi. Design heater steam supply, condensate piping and trap to prevent coil flooding. Condensate lift is not allowed from heat exchanger or steam coils. Provide isolating valves, unions, and fittings, to permit easy removal of coils or heater.

3. Piping System Cleaning
   a. Steam and condensate piping shall be thoroughly flushed before placing in service, to remove dirt, rust, scale or other contaminants. Consult with Facilities Services to formalize cleaning procedures for each Project. All cleaning work shall be done with the inspector present.

4. Steam Pressure Regulators
   a. Where a building program requires more than one (1) pressure service, discuss the use of secondary regulators with Construction & Design (C&D).
   b. Provide steam pressure regulation and reducing stations in parallel pairs including unions, strainers, and gauges at both stations sized to match building feed line with adequate isolation valves to allow repair without interruption of building service. Include high, intermediate (if used) and low pressure gauges.
   c. Regulators shall be 3/4" minimum and two-inch (2") maximum size, for all design loads of 1,000 lbs steam per hour and greater. Provide the number of regulators required for estimated load.
   d. Locate regulators in a safe location, accessible without the use of ladders or staging.
   e. Provide rigging bar above pressure-reducing valves to facilitate repair and replacement.
   f. Detail the piping with effective unions or flanges, to permit easy removal of any regulator without disturbing other regulators or equipment. Do not provide bypasses at regulators. See Appendix A: Drawings for typical install details.
   g. Load Estimation:
      i. Average steam demand for all UC Berkeley campus buildings is 37 lbs of steam per hour per 1,000 square feet of gross area. If the estimated demand exceeds 40 lbs per hour discuss this with Construction & Design (C&D).
      ii. Do not add a warm-up factor to the estimated building demand as University buildings operate 24 hours per day. Additionally, do not size drip traps to include warm-up.

5. Water Treatment
   a. Untreated water shall not be used in testing heating, ventilating and air conditioning piping systems. Water used for pressure testing in system without circulating pumps operational shall be filled with pre-mixed water with acceptable levels of corrosion and biological inhibitors. Test results from this water shall be submitted for review and records.
   b. All circulating water shall receive chemical treatment as follows:
      i. Heating hot water and chilled water for corrosion and stabilization.
      ii. Condenser and cooling tower water for microbial growth, corrosion and stabilization.
   c. Discuss chemical feed devices with Construction & Design (C&D). Specify and detail approved chemical feed devices on the drawings.
d. The contractor shall notify the University and produce monthly water quality reports of water treatment of all systems.

6. Gas Fired Heating Units
   a. Provide gas-fired heating units with all necessary safety devices, including the following:
      i. Intermittent electric spark ignition with a thermocouple-energized device that will automatically shut off all gas flow to the main and pilot burners in the event that ignition is not achieved.
      ii. Electrically operated control valve that will close, shutting off all gas to the unit, in the event that the temperature in the heater should rise above a safe point.
      iii. Gas pressure regulator to maintain correct gas pressure at the burners.
      iv. Manual shutoff valve to shut off all gas service to the heating unit. This valve shall be a safe distance from the burners.
   b. Provide gas-fired steam boilers with safety devices described above. In addition, provide a low water alarm and fuel shutoff system similar or equal to McDonnell and Miller. Include manual and automatic reset, low water and high temperature controls, dual gas valves, and other code-required items.
   c. Separately vent each piece of gas-fired equipment. Size according to UMC.

7. Heating Coils
   a. Water is the preferred media for heating coils. Steam or electric heating coils shall receive prior approval from Construction & Design (C&D) and Facilities Services.
   b. Provide hot water heating coils with copper tubing and copper fins where the unit is capable of 100% outside air or aluminum fins for recirculating units with minimum outside air.
   c. If steam is selected, provide distributing type coils. Take particular care with the piping, trap and control installation details to prevent flooding of the coils with condensate.
   d. Heating coils shall have a maximum of twelve (12) fins per inch. Use of this spacing reduces early coating with airborne dust, eventual plugging and facilitates cleaning when necessary.

8. Bearings
   a. The installer of equipment having bearings of any type shall protect and properly lubricate the bearings before operation of the equipment. Give special attention to bearings in any equipment that has been delivered to the job site, or installed, in advance of completion.
   b. Motors
      i. Motors smaller than 1-1/2 horsepower driving mechanical equipment shall have bearings as normally furnished by the equipment manufacturer.
      ii. Motors 1-1/2 horsepower and larger driving mechanical equipment shall have regreasable ball or roller bearings with a grease filling and relief plug for purging during lubrication.
   c. Fans shall have enclosed, greasable, self-aligning ball bearings which are accessible for inspection, maintenance and lubrication.
   d. Heating and ventilating units shall have enclosed, greasable, self-aligning ball bearings that are accessible for inspection, maintenance and lubrication.
   e. For special equipment, obtain bearing requirements from Construction & Design (C&D).
   f. Bearing Lubrication
      i. Bearing lubrication points shall be both visible and safely accessible after installation of equipment.
      ii. Where extension pipes are needed to meet the above access requirement:
         1. Vent oil lubricated bearings and extend oil fill pipe to a suitable sight glass. Install at proper elevation to indicate oil level in bearing.
         2. Extend both supply and purge pipes for greasable ball bearings. Fit with proper lubrication fittings, and fill each pipe with proper lubricant before installing.

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g. Include the following requirements in the operations and maintenance manuals for each type of equipment with regreasable or oil-lubricated bearings:
   i. Equipment and its type of bearing.
   ii. Replacement number, name or size of bearing.
   iii. Recommend type of lubricant and lubrication period.
   iv. Proper belt tension on belt driven equipment and instrument for measuring it.

9. Machinery Guards
   a. Protect all moving equipment parts, such as belt drives and drive couplings, with guards and clearances as required by CalOSHA (Title 8, 3944 and Title 8, 4186).
   b. All accessible fan inlets or exhaust openings shall be covered with wire mesh guards. Size mesh to give 90% free area minimum, with two-inch (2”) maximum openings. Provide easily removable access panels of same material for bearing check, lubrication or tachometer readings.

10. Unions, Couplings and Nipples
   a. Show unions at all threaded connections to equipment, regulators, controls and steam traps that may have to be removed or replaced and at all points where necessary for the disassembly of piping for maintenance. Detail piping and unions to allow removal of equipment without springing pipe.
   b. Di-electric fittings are not permitted. Use six inches (6”) minimum of red brass for di-electric isolation between copper and steel components or other components with a potential for electrolysis.
   c. When specifying, or approving, grooved pipe with clamp couplings for piping, check or note that the following items are included:
      i. Proper gasket for anticipated operating temperature. In heating hot water systems, no grooved pipe systems are allowed, due to the high temperature of the campus steam system.
      ii. Recommended gasket lubrication.
      iii. Torque bolts to manufacturer's specifications.
   d. Threaded nipples shall be made of schedule 80 steel pipe or standard weight brass pipe.
   e. Threaded nipples used in high pressure steam systems shall be schedule 160 steel pipe.
   f. Specify reducing fittings wherever changes in pipe size occur. No bushings will be permitted. In steam systems, specify eccentric reducing fittings wherever necessary to provide free drainage of lines.
   g. Flanges in steam systems shall be specified with metal wound spiral gaskets similar to Flexitaulic style CG API 601 304SS with Grafoil fill gaskets.
   h. Studs and nuts used in steam applications shall be ASTM A193, B7 studs with ASTM A194, 2H nuts.

11. Flexible Pipe Sections
   a. Rubber flex joints are not permitted on heating hot water pumps. Use stainless steel braided flex joints.
   b. Corrugated metal hose with a braided cover is preferred as a flexible pipe section between vibrating equipment and piping systems.
   c. To prevent an improper application, include a schedule of the required flexibility in the contract documents listing the following:
      i. Application (pump, air compressor, etc.)
      ii. Media to be handled.
      iii. Temperature of media.
      iv. Operating pressure.
      v. Material.
      vi. Required live length for proper flexing of offset motion anticipated.
      vii. Detail the location and position (horizontal or vertical) required to allow offset motion anticipated.
viii. HVAC equipment shall be braced according to code and industry best practices. In addition, hard piping shall be utilized wherever possible.

12. Piping
   a. High pressure condensate and steam piping two inches (2”) and smaller shall be carbon steel, ASTM A53, Grade B, seamless, schedule 80 with forged steel socket welded fitting, 300#. Unions shall be 3000 lb. forged steel with stainless steel seats. Joints shall be socket welded.
   b. High pressure steam piping larger than two inches (2”) shall be ASTM A53, grade B, seamless, schedule 40 with butt welded fittings, 300 lb. flanges with carbon steel fittings.
   c. Low pressure steam piping two inches (2”) and smaller shall be carbon steel ASTM A53 , grade B seamless, Schedule 40 with 125 lb cast iron fittings. Schedule 80 shall be used for condensate applications.
   d. Low pressure steam piping for piping larger than two inches (2”) shall be Carbon steel schedule 40 Grade B seamless piping with butt welded fittings. Schedule 80 piping shall be used for condensate applications.

13. Miscellaneous Piping Products
   a. Gaskets for high pressure steam systems shall be Flexitaumatic Style CG,API601, spiral wound 304SS with Grafoil fill.
   b. Fittings for steam service over 15 psig larger than two inches (2”) shall be class 300 forged carbon steel weld neck flanges.
   c. Fittings for steam service over 15 psig for piping two inches (2”) and below shall be socket welded or Class 150 flanged. Screwed fittings on schedule 160 nipples are allowed at steam traps and related components such as strainers, unions and associated valves.

14. Valves
   a. Specify replaceable, packing-type gate valves for shutoff valves. Gate valves to be rising, stem-union bonnets. “O-ring” sealed ball valves are not permitted. Butterfly valves to be lugged-type.
   b. Show all valves on the drawings. Do not rely on a general note in the specifications or on the plans to install valves where or as required.
   c. Specify valves in accordance with the following valve standards.
   d. For steam and condensate service on systems over 15 psig, specify steam valves to be 800# forged steel O,S and Y gate valves with rising stem, bolted bonnet for all sizes, class 300. Steam strainers shall be forged steel for pressures over 15 psig.
   e. For steam pressures under 15 psig, valves two inches (2”) and under shall be class 150 screwed bronze gate rising stem, union bonnet and welded pipie shall utilize flanged O, S and Y ductile iron gate valves
   f. High pressure globe valves shall be 800 psig forged steel, bolted bonnet, threaded for sizes two inches (2”) or under.
   g. Check valves shall be 800 lb. forged steel screwed for sizes two inches (2”) and below and class 300 flanged for sizes above two inches (2”). Separation between low and high pressure will be at gate valve after steam trap and test tee assembly. Gate valve shall be 800lb rated when serving steam systems over 15 psig.

15. Traps, Returns, Condensate Receivers and Monitoring Equipment
   a. Steam piping to be graded toward a drip trap.
   b. Condensate-return piping to be graded to a condensate pump.
   c. No condensate lift will be allowed from a heat exchanger or steam coil.
   d. Arrange heat exchangers and coils to allow gravity return to a condensate receiver.
   e. High-Pressure drip traps to be piped to a flash tank prior to flowing into the condensate receiver.
   f. Steam trap assemblies to include:
i. High-side isolation valve constructed of 800# forged steel
ii. Strainer
iii. Union
iv. Steam trap
v. Union
vi. Test tee and test valve with plug
vii. Check valve
viii. Low side isolation valve constructed of 800# forged steel
g. See Appendix A: Drawings for typical details.
h. Directly following the steam condensate receiver assembly, each system shall have a hardness probe and controller for silica level monitoring.
i. Steam system gaskets to be metal type, Flexitallic or equivalent. See ASME B16.20.
j. Condensate receivers shall be equipped with a trapped overflow to prevent condensate back-up in steam system which could potentially damage steam consuming equipment.
k. Condensate return units shall be duplex type with each pump selected for maximum 30% operation.
l. Discharge from condensate return units with pumps shall be equipped individual inlet isolation valves and plug cock valves at each pump discharge for flow modulation.
m. Condensate receiver manufacturer shall be Bell and Gossett or equal, duplex type.
n. Heat exchangers shall be Bell and Gossett or equal.

16. Steam distribution valves (Utility Lines) shall be ANSI Class 300 steel gate valves with raised face flanged connections, rising stem (outside screw and yoke), and valves 6 inches or larger shall have a bypass/warm-up valve. Valves smaller than three inches (3”) shall have a screwed union bonnet. Condensate distribution valves shall be ANSI Class 150 gate valves with raised face flanged connections and rising stem (outside screw and yoke); valves smaller than three inches (3”) to have screwed union bonnet.

17. Isolating Valves
   a. Provide isolating valves in heating hot water, chilled water, steam, and other systems.
   b. Locate valves so that it is possible to isolate separate floors, separate wings, toilet rooms, machinery rooms and other natural subdivisions of the building.
   c. Provide isolating valves for laboratory piping at the branch connection to the main.
   d. Provide valves on each side of equipment to permit servicing or removal without draining system.
   e. Provide valves at all services left for future connections (tees, stubs, etc..) unless they are in a valved zone, or can be isolated by existing valves with minor loss of pipe contents when opened.
   f. Coordinate with Plumbing for the installation of a suitable drain at all drain valve locations.
   g. Provide system drain valves with 3/4” hose thread adapters at all low points.

9. Steam Traps
   a. Size all steam traps, in specifications or on drawings, by required capacities and pressure differentials.
   b. Specify impulse and thermodynamic type traps with stainless steel body and internal parts. Specify all other types equipped with renewable stainless steel valves and seats.
   c. Traps may be Armstrong, Bailey, Webster, Yarway, Sarco, Velan, or other equivalent or equal trap.
   d. Specify extra-heavy Schedule 80 pipe nipples for low pressure steam systems. Nipples in high pressure systems shall be Class 160. Use at least six inches (6”) of brass pipe between steam trap assembly low-side isolation valve and copper return piping.

10. Strainers

Adopted August 2015
a. Provide strainers ahead of all regulators, pumps, controls and equipment that could be damaged or rendered inoperative due to foreign matter in the piping. Size screen opening for degree of protection required by downstream equipment. Specify in each section the requirements for purging lines and cleaning strainers at completion before acceptance. Install full-size blow-down valve with nipple and cap.

11. Relief Valves
   a. Provide relief valves where required by code or to protect pressure vessels, equipment, or piping systems against dangerous pressure. The set pressure shall be indicated on the valve with a waterproof tag and have externally-operated lever lift handles. Pipe discharge to a visible location outside mechanical rooms and outdoors. The discharge of steam relief valves to be piped to a drip elbow.
   b. Specify ASME-certified relief valves to comply with The Boiler Code or The Unfired Pressure Vessel Code sized to handle full BTUh capacity of equipment served.
   c. Specify minimum capacity of steam pressure relief valve or valves to provide for full discharge of the capacity of the largest regulating valve without allowing the lower pressure to rise more than six percent (6%) above the highest pressure at which any valve is set. No relief valve will be required where a further reduction in pressure is made, unless such steam is for laboratory use. In such cases, the same rule will apply for the lower pressure.
   d. Show discharge piping of steam relief valves extended to open air, preferably through the roof or wall to a safe discharge area. Do not allow discharge into any room or area within the building.
   e. Show discharge piping from water relief valves extended to open safe drain with adequate capacity for anticipated maximum discharge.

12. Gauges and Thermometers
   a. Provide gauges and/or thermometers (not self-sealing test connections) in the following locations:
      i. Draft gauges around main building air filters.
      ii. Pressure gauges at all pressure reducing valves to indicate both high and reduced pressures.
      iii. Pressure gauges at all pump suction and discharges.
      iv. Thermometers on heating and domestic hot water systems to indicate supply and return temperature, including main building or tempering coils, five inch (5”) round bi-metal type.
      v. Thermometers on heating and ventilating systems to indicate temperatures at outside air inlet, tempered supply and cooled air if used.
      vi. Provide other gauges and thermometers wherever needed to give pressures and temperatures necessary or desirable for maintenance and troubleshooting.
   b. Pressure gauges shall have a range that will read mid-scale at normal operating pressure.
   c. Locate all thermometers and gauges so that they are both visible and readable from an accessible and safe location.
   d. Shutoff valves for steam system gages shall match specifications for system served. High pressure steam systems shall be equipped with 800 lb. forged steel gate valves, O,S and Y with bolted bonnet. Pressure gauges shall be equipped with pigtails. Shutoff valves for hot and chilled water system gages shall be ball valves. Needle valves or pet cocks are not allowed.

   a. Consider the installation of primary differential producers, such as venturi tubes or orifice plates, in main risers and branch lines of heating hot water, chilled water and cooling tower water systems. Discuss proposed locations and type with Construction & Design (C&D).
b. Indicate the calculated or required flow at each point where flow measuring devices are shown and specified.
c. Provide a thermometer well at each flow measuring device and provide two (2) thermometers to the University.
d. Include readout type balance valves for all coils and any branch lines where balancing may be required for accurate system balance. Require the Contractor to provide pressure-flow conversion charts in Operations and Maintenance (O&M) manuals for all models installed and one (1) gauge set.

14. Pipe Supports
   a. Support all pipe with common trapeze-type hangers where feasible. Coordinate design of pipe supports with the piping of different specification sections. Indicate which specification section provides the hangers.
   b. Specify pipe supports - do not leave to the Contractor's discretion. Take particular care with vertical pipe supports to allow for expansion and contraction. Support all risers from the floor at their base so that the weight is not carried at wall brackets or riser clamps.
   c. Do not allow valves or equipment to support the weight of any pipe.
   d. Provide special supports for plastic piping.
   e. Isolate all non-insulated copper and glass pipe by means of a felt-lined hanger or manufactured isolating item.
   f. Protect all insulated pipe from crushing at supports by means of a calcium-silicate isolation block.
   g. All concrete inserts for pipe hangers shall be hot-dipped galvanized and pull-tested in accordance with current code.
   h. Pipe support locations with resultant forces to the structure shall be required to be submitted for review and acceptance by structural engineer of record. All submitted documents shall be stamped and signed by a structural engineer licensed in the State of California.
   i. Pipe seismic bracing shall be calculated, designed, and submitted with detailed drawings indicating reaction forces to structure for review by the structural designer of record.

15. Condensate Meters
   a. Provide separate condensate meters with isolating valves and a valved bypass for each building using steam. Discuss the type and location with Construction & Design (C&D). Provide a meter with a valved bypass in the condensate return line ahead of the return pump.
   b. Condensate meters shall be rotary volumetric type, sized on the maximum estimated steam demand.
   c. Locate condensate meters in the mechanical room in an accessible location for reading and servicing.
   d. Where the estimated condensate volume is greater than 10,000 lbs per hour, discuss the type of metering with Construction & Design (C&D).
   e. For buildings with a peak design load greater than 2,000 pounds per hour provide an anubar steam meter in the low pressure steam supply line. Include a digital totalizer for local readout, and an analog output flow signal connected to the Building Energy Management System (EMS).

16. Motors
   a. Determine the environment and operating conditions such as dusty, wet, damp, high temperature, continuous or intermittent operation, starting torque, etc., and specify a motor with frame and characteristics to meet those conditions. Motors which are controlled by the Energy Management Control System shall be rated for intermittent service. All motors shall be premium efficiency models. Consult with Facilities Services to obtain minimum requirements. Provide a table on
construction drawings listing required minimum efficiency for each motor size, 1/2 horsepower and larger.

b. Voltage
   i. Motors smaller than 3/4 horsepower shall be single phase, 60 cycle, with 115 volt rating for 120 volt service and 200 volt single voltage rating for 208 volt service.
   ii. Motors 3/4 horsepower and larger shall be three phase with the following requirements.
      1. Single voltage rating for 208 volt service.
      2. A 230/460 voltage rating or 460 volt single voltage rating for 480 volt service for motors smaller than 125 horsepower.
      3. Single voltage rating for motors 125 horsepower and larger.

c. Specify bearings as indicated in this division.

17. Compression Tanks
   a. Label the tank with proper air charge
   b. Sealed diaphragm-type tanks are acceptable.
   c. Expansion tank(s) shall be equipped with isolation valves with lockshield protection.

18. Identification Of Pipes and Equipment
   a. Identify all piping in accordance with pipe and conduit identification standards in Appendix A: Drawings.
   b. Identify all equipment, including the following, with printed plastic or vinyl labels using the following designation that shall be used on the construction drawings.
      1. CT = Cooling Tower
      2. CA = Air Compressor
      3. Cs = Control Systems (Instruments)
      4. Gb = Gas Boilers (Natural Gas Fired) (Heaters)
      5. B = Boilers (Heating Plant Steam Generators)
      6. HX = Heat Exchanges (Hot Water Heaters)
      7. PV = Pressure Vessels (Air Receivers, Etc.)
      8. PE = Pool Equipment
      9. M = Meters (Gas, Water, Air, Etc.)
      10. MH = Manhole (Give Location And Equipment)
      11. O = Other Than What Is On This Card
      12. CP = Condensate Pump
      13. HP = Heating Pump (Hot Water)
      14. SP = Sump Pump
      15. VP = Vacuum Pump (Labs)
      16. WP = Water Pump
      17. EF = Exhaust Fan
      18. HF = Hood Fan
      19. SF = Supply Fan
      20. F = Filter (Air)
      21. AB = Absorber Chiller
      22. AC = Air Conditioner (Mechanical)
      23. RF = Refrigeration
   c. Clearly show and label on the drawings all main sectionalizing and isolating valves so that maintenance personnel can easily identify them in an emergency. This need not include small valves in which their use is evident in rooms, labs, or by equipment served. Numbered tags with corresponding lists shall not fulfill labeling the requirements of this Division.

19. Insulation for Duct, Plenum and Pipe

Adopted August 2015
a. Provide insulation on piping, ducts and equipment as required by the insulation standards in this Division. Do not insulate pipe unions.

b. Specify thermal insulation for ventilation ducts and plenums only where the design air temperature in the duct is below sixty degrees Fahrenheit (60°F) or above eighty degrees Fahrenheit (80°F). Do not specify insulation for ducts supplying air above sixty degrees Fahrenheit (60°F), exposed and within the controlled space or area.

c. Specify sound-attenuating devices with clean-out doors where noise from fans or equipment may be objectionable. Any insulation inside ducts shall be adequately sealed to prevent erosion.

d. Discuss other spaces requiring special ventilating acoustical treatment, such as music rooms, language labs, speech, etc., with Construction & Design (C&D).

20. Noise and Vibration Control

a. Comply with the following standards for design:
   i. Health Hazard: Refer to most recent CalOSHA rules regarding maximum noise level for repeated and/or long exposures.
   ii. Non-Health Hazard: The following guides and standards shall be used for design:
      1. ASHRAE Guide and Data Book.
      2. AIHA Industrial Noise Manual.
      4. Speech Interference Level (SIL): noise levels that produce interference with normal and effective conversation for various activities.
      5. Noise Criteria Curves (NC Curves): maximum permissible noise level for each frequency band for various conditions.

b. Provisions for monitoring noise levels:
   i. Where the noise level of an area is critical, such as a lecture room, study area, music room, private office, design for and indicate on the drawings the maximum decibel rating.
   ii. Where a maximum noise level is designed for an area, or equipment, specify test method, test conditions and person(s) responsible for the tests and documentation of results.

c. Design standards for noise reduction:
   i. Coordinate location of mechanical equipment in early design stages with the architect and the acoustical consultant (if one is retained).
   ii. Select and specify equipment having quiet operating characteristics at its design capacity and speed. Avoid installation in, near, or on the roof above, an occupied area. Configure and size ducts and piping to have velocities below noise producing levels.
   iii. Pay particular attention to vibration-producing equipment. Coordinate with structural in the early design stages.

d. Sound attenuation and isolators:
   i. Specify sound attenuation measures for ducts, pipes and equipment, if required, to meet each specific condition.
   ii. Where the equipment manufacturer recommends the use of vibration isolators, or the equipment and location indicates its need, specify isolators by size, type, and manufacturer. Specify 1" average deflection for spring type isolators. Application where sound generated is an issue shall incorporate two inch (2") deflection isolators.
   iii. Provide sound absorbing pads between equipment and structure where equipment is to be installed without vibration isolators, such as pumps, compressors, vacuum pumps, etc.
   iv. Place flexible sections in all connections between vibration producing equipment and the building system it serves.
a. Cooling water from an industrial system or cooling tower does not require double check valves at equipment connections.

b. Chillers shall use R-134A refrigerant.

c. Chillers specified shall use condenser water flow modulation to control refrigeration system head pressures.

d. Chillers shall be magnetic bearing high-efficiency type. Manufacturer shall be Multistack or approved equal.

e. Designer shall provide analysis of chiller systems proposed to determine the most efficient system considering maintenance energy consumed in the Berkeley local climate. Discuss type of system proposed with UC Berkeley Construction and Design prior to system design.

f. Where cooling water is supplied from a domestic cold water system, provide an approved backflow prevention device, installed before the point of connection to the equipment.

g. Pipe domestic or industrial cooling water waste to the sanitary system. For cooling water requirements, see Division 11.

h. Where cooling water with a high degree of purity is required for computer rooms, electron microscopes, or other sensitive equipment, provide a closed loop system with a plate-type heat exchanger or a separate refrigerated system. Discuss with Construction & Design (C&D).

2. Cooling Coils

a. Provide chilled water cooling coils with copper tubing and copper.

b. Provide a condensate drain pan piped to drain for all cooling coils. Ensure that the drain pan is adequately pitched toward the drain to prevent standing water in the pan. Show a detail of the drain pan and drain lines where static pressure of the system may affect drain performance.

c. Coil casings and drain pans shall be coated galvanized steel or stainless steel.
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UC Berkeley has standardized, through a bid process, a building automation system built on the Automated Logic Control (ALC) platform for HVAC system control and monitoring. The ALC platform replaces the previous Barrington Systems platform, the former campus standard. Any Project that installs or alters a building automation system for HVAC, lighting or other building systems shall fully integrate with the existing campus infrastructure. Project teams must contact the Facilities Services Energy Management Systems Shop (http://realestate.berkeley.edu/what-we-do/facilities-services) for specifications and requirements related to the ALC platform and determination of building automation system to be used based upon extent of remodel or new building construction.
1. Code Compliance
   a. Work and materials shall comply with the latest rules of applicable codes and regulations including, but not limited to, the following:
      i. California Electrical Code
      ii. California Title 8, Chapter 4 California Occupational Safety and Health Act (COSHA).
      iii. NFPA No. 70 - National Electric Code (NEC).
      v. NESC - National Electrical Safety Code
      vi. All other applicable Federal, State and local laws and regulations.
   b. Code compliance is mandatory. Nothing in the Drawings and Specifications permits work not conforming to these codes. Where work is shown to exceed minimum code requirements, comply with Drawings and Specifications.
   c. No work shall be concealed until after it is inspected and approved by the proper authorities. If work is concealed without inspection and approval, the Contractor shall be responsible for all work required to open any concealed areas, and to restore them to their pre-construction condition in addition to all required modifications.

2. Green Building

3. Safety and Indemnity
   a. Safety: The Contractor shall be solely and completely responsible for conditions of the job site, including safety of all persons and property during performance of the Work. This requirement applies continuously and is not limited to normal working hours.
   b. No act, service, drawing review or construction review by the University’s Representative is intended to include review of the adequacy of the Contractor’s safety measures, in, on, or near the construction site.

4. Material Approval
   a. The design, manufacture and testing of electrical equipment and materials shall conform to or exceed latest applicable National Electrical Manufacturers Association (NEMA), Institute of Electrical and Electronics Engineers (IEEE) and American National Standards Institute (ANSI) standards.
   b. All materials shall be new and bear Underwriters’ Laboratories, Inc. (UL) label. Materials that are not covered by UL testing standards shall be tested and accepted by an independent testing laboratory or a governmental agency, which laboratory shall be acceptable to the University’s Representative and code enforcing authority.

5. Coordination
   a. Division 23: HVAC and Division 26: Electrical, shall provide coordination for a complete installation of equipment and components to produce a proper, fully operational system.
   b. Coordinate work with other trades to avoid conflict and to provide correct rough-in and connection for equipment furnished under trades that require electrical connections. Inform Contractors of other trades of the required access to and clearances around electrical equipment to maintain serviceability and code compliance.
c. Verify equipment dimensions and requirements with provisions specified under this Section. Check actual job conditions before fabricating work. Report necessary changes in time to prevent needless work. Changes or additions subject to additional compensation, which are made without written authorization and an agreed price, shall be at the Contractor’s risk and expense.
d. Participate in the preparation of coordination drawings that are to be used by other trades for work coordination prior to start of any work. At a minimum, coordinate information related to the size, elevation, routing, and clearance requirements of electrical equipment and wiring to be installed under Division 26: Electrical, prior to installation or work. Special attention shall be given to areas containing work of many trades, with special attention paid to avoiding any situation where areas, appliances or installations that may require maintenance access are blocked or otherwise made inaccessible by the work of another discipline.

6. Acceptance Demonstration
   a. Upon completion of the work, at a time to be designated by the University, the Contractor shall demonstrate the operation of the installation including any and all special items installed by the Contractor or installed under the Contractor’s supervision. Allow an appropriate amount of demonstration time as determined by C&D Project Manager and UCB Electrical Engineer and Facilities Services Electrical Shop.
   b. This demonstration by the Contractor is in addition to the general commissioning requirements set forth in Division 01 91 13.

7. Arc Flash Study
   a. In addition to the NEC required short circuit and coordination study, an arc flash study, in accordance with NFPA-70E, shall be performed. The completed one-line drawings of the arc flash study shall be provided to the Campus Electrical Engineer in the most recent version of SKM PowerTools for Windows. Firms or engineers who which to substitute an equivalent software application must seek approval of the Campus Electrical Engineer prior to the commencement of work. Not all Arc Flash Hazard Analysis software is compatible with existing campus modeling.”.
   b. Based on the results of that study, field labeling shall be performed on all switchboards, panel boards, industrial control panels and motor control centers in the work. Field labeling must comply with the required arc flash study according to NFPA-70E.

8. Wire Connectors
   a. For CTs, PTs, control, protection, etc, use only terminal blocks. No splices are allowed.
   b. For wires size #8 AWG and smaller: insulated pressure type (with live spring) rated 105 deg. C, 600V, for building wiring and 1000V in signs or fixtures; Scotchlok, Ideal, or equal.
   c. For wires size #6 AWG and larger: compression type with tape insulation; 3M #33, Plymouth, or equal.
   d. Outdoors and below grade: All sizes to be compression type with heat shrink style watertight splice covers; Raychem CTE series, T&B “shrinkon” series, or equal.

9. Terminal Cabinets
   a. Fabricate from code-gauge steel with flush latch and concealed hinge. Minimum size shall be twenty inches (20”) wide by twenty-four inches (24”) high by six inches (6”) deep. Finish shall be American National Standards Institute (ANSI) 61 light gray enamel.
   b. Provide inside terminal cabinet and terminal strips, two terminal points for each wire within the terminal cabinet. Provide engraved rigid plastic nameplate on cabinet face as to system, e.g. “Fire Alarm Terminal Cabinet.”
10. Distribution Panels  
   a. Bus shall be copper. Aluminum is not allowed. Power panel boards shall be dead front, totally  
      enclosed, convertible type, with circuit breakers. See 26 27 00: Low-Voltage Distribution Equipment  
      for additional requirements.  
   b. All spaces shall be furnished with breaker mounting hardware.  
   c. Provide a grounding bus in all distribution panel boards. The grounding bus shall be easily  
      distinguishable from the neutral bus.

11. Equipment Mounting and Support Hardware  
   a. Steel channels, bolts, washers, etc., used for mounting or support of electrical equipment shall be  
      galvanized type. Where installed in a corrosive environment stainless steel hardware shall be used.

12. Handholes  
   a. Use concrete or steel covers. There shall not be more than one (1) extension box on any handhole.  
      Box must have base rock in the bottom at least two inches (2”). Conduit shall be bonded and  
      extended five inches (5”) above base rock.  
   b. Maintain adequate space for conductors between top of conduits and bottom of cover to avoid  
      abrasion of insulation.

13. Basic Materials and Methods:  
   a. Specify 600 volt copper NEC standard conductors with Underwriters' label, for secondary power and  
      light distribution. Color coding, application and types as listed below. Deliver to job in unbroken  
      packages.  
   b. Requirements for copper conductors only:  
      i. Color coding shall be as follows:

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Phase</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>N</th>
<th>Ground</th>
</tr>
</thead>
<tbody>
<tr>
<td>120/240</td>
<td>1 0 3W</td>
<td>black, red</td>
<td>none</td>
<td>none</td>
<td>white</td>
<td>green</td>
</tr>
<tr>
<td>120/208</td>
<td>3 0 4WY</td>
<td>black</td>
<td>red</td>
<td>blue</td>
<td>white</td>
<td>green</td>
</tr>
<tr>
<td>120/240</td>
<td>3 0 4W</td>
<td>black</td>
<td>orange</td>
<td>blue</td>
<td>white</td>
<td>green</td>
</tr>
<tr>
<td>277/480</td>
<td>3 0 4WY</td>
<td>brown</td>
<td>yellow</td>
<td>purple</td>
<td>gray</td>
<td>green</td>
</tr>
<tr>
<td>480</td>
<td>3 0 3W</td>
<td>brown</td>
<td>yellow</td>
<td>purple</td>
<td>none</td>
<td>Green</td>
</tr>
</tbody>
</table>

Note: Orange is reserved for Delta installations that have a “stinger”.

   ii. Provide type THWN or THHN wire and cable #4/0 AWG size and smaller in dry locations.  
   iii. Provide type THWN wire and cable larger than #4/0 AWG size in wet locations.  
   iv. Provide type RHW, THW or XHHW wire and cable larger than #4/0 AWG size installed in  
      damp locations or in concrete in contact with the ground.  
   v. Do not use conductors smaller than No. 12 AWG for lighting or receptacle circuits.  
   vi. Low voltage wiring shall be No. 14 AWG size or larger.  
   vii. Fire alarm detector wire shall be type TFN, 18 AWG SBC MAX OPER V. 600 solid or  
      maximum of seven (7) strands. Fire alarm annunciator lamp wires may be No. 20 AWG if  
      cabled.  
   viii. Wire pulled in flexible metal conduit shall be stranded when flexibility is required.  
   ix. Specify separate ground conductor as being mandatory in all branch receptacle circuits.  
   x. Specify copper bus duct with silvered joints.  
   xi. High voltage cable (4160 volt and 12000 volt systems) shall be 5KV and 15KV, EPR type,  
      with 133% insulation and shall be warrantied for forty (40) years. Specify Kerite and Okonite  
      cable or equal, minimum 4/0 size.
c. Wire Joints and Connections
   i. Specify all connections to circuit breakers, switches and joints in wires as follows:
      a. Connections to Circuit Breakers and Switches: No. 12 wire; formed around binding
         post or screw. No. 10 and No. 8 wire; Buchanan Termend, or equal, locking tongue
         lug. No. 6 wire and larger-Burndy Qiklug Type QDA, Penn Union, or equal, round
         flange solderless lug.
      b. Connections to Fixtures: Make circuit wiring connections to fixture wire with
         insulated electrical spring connectors. Threaded-type wire nuts, porcelain or bakelite
         are not acceptable.
      c. Wire Joints: No. 6 and larger; Burndy Type QPR, Penn Union, or equal. No. 8 and
         smaller - pigtail splices as described below, or made with insulated electrical spring
         connectors.
      d. Where underground and high moisture area connections are required to be insulated,
         use approved moisture-proof epoxy resin splicing kits.
      e. Insulate uninsulated solderless connections for wires to the same insulation values as
         the conductors.

d. Outlets
   i. Use cast metal conduit bodies with threaded hubs for outlets in exposed wet and/or hazardous
      locations, in vaults and/or manholes; and sheet steel boxes with sherardized or galvanized
      finish in concealed locations.
   ii. Sheet Steel Boxes: Standard one-piece knockout boxes of the shape best suited to the
       particular location and of sufficient size to contain all wires and connections without
       crowding. Where outlets are installed in concrete slabs, use concrete type boxes of depth
       sufficient to avoid interference between reinforcing bars and conduit runs, and to keep such
       conduit runs in proper place in slabs. Do not use boxes less than four inches (4") square and
       two and one-eighth inches (2-1/8") deep except for concrete ceiling outlets, which may be
       four inches (4") octagonal.
   iii. Cast-Metal Conduit Bodies: Crouse-Hinds condulets, Appleton unilets, or equal. Arrange
        boxes with threaded connections for rigid conduit. Provide all conduit boxes with suitable
        covers and gasket for all exterior and/or moist locations and in vaults and/or manholes.
   iv. Support all boxes with approved box support brackets (side box fastening is not acceptable).

e. Receptacles and Caps
   i. Specify receptacles and caps in accordance with National Electrical Manufacturers
      Association (NEMA) standards. Where weatherproof mounting is required, mount in a cast
      metal conduit fitting and cover with gasketed, spring type, door. See this division for ground
      fault protection requirements.
   ii. Specify hospital-grade receptacles for patient contact areas.
   iii. Colors and finishes for receptacles shall be as specified as selected by the architect.
   iv. Specify the height of each outlet as fifteen inches (15") above floor to conform with
       accessibility requirements or as indicated on the drawings.
   v. Receptacle circuits shall not be dependent upon device connections for continuity except
      circuits that are terminated at the receptacle.
   vi. Install receptacles in mechanical rooms and at roof mounted equipment so that no piece of
       equipment is more than twenty-five feet (25'-0") from a receptacle.
   vii. Provide special receptacles as required by specific equipment.
   viii. Identify all receptacles connected to emergency power.

f. Tumbler Switches
   i. Specify quiet type flush mounted wall type tumbler switches rated at 20 amperes, 120-277
      volt AC, screw terminals. Specify color and finish as selected by the architect.
   ii. Attach to each switch yoke used on 277 VAC, a one-inch (1") diameter red tag reading
       “Caution - 277 VAC”. Tag shall not be metal or metal edged.
g. Cover Plates
   i. Provide commercial quality. Color and finish for plates, switches and receptacles shall be
      specified as selected by the architect (coordinate with the architect).

h. Painting
   i. See 09 90 00: Painting and Coating.

i. Electrical Equipment Identification
   i. See 26 05 00: Common Work Results for Electrical (Materials and Methods, Section 24).

j. Alarms Identification
   i. Whenever a warning system with visible or audible alarm is installed for any reason, a sign
      containing the following information shall be posted below it (See 28 31 00: Fire Detection
      and Alarm for fire alarms):
      1. Cause of the alarm.
      2. Instructions or procedure to follow.
      3. Person(s) to contact. This shall be provided by Construction & Design (C&D).
      4. Telephone number(s). This shall be provided by Construction & Design (C&D).

14. Electrical Vaults
   a. Vaults close to buildings and 12.47 kV switching stations shall have a sump pump, light and service
      receptacle
   b. Use round manhole covers of cast iron construction. Cover to be marked “UC Electrical” with the
      manhole number provided by Facilities Services
   c. Duct banks leading to and from each vault to contain, at a minimum:
      i. Three (3) five inch (5”) conduits (two for 12.47 kV use, one spare)
      ii. Two (2) two inch (2”) conduits (low voltage control circuits)
      iii. One (1) one and one-quarter inch (1¼”) conduit (power conduit for items listed in A, above)
   d. Conduits for the items in A, above shall be three-quarter inch (¾”) rigid PVC. Boxes shall be
      malleable iron, Appleton or equal.

15. Main Electrical Room
   a. Vacuum Break Selector Switch(es), 12.47 kV tap blocks (if any) and medium voltage switches shall
      be in a fenced area with a lockable gate, separate from any low-voltage equipment
   b. Maintain at least seven feet (7’) of clearance in front of the Vacuum Break Selector Switch. The
      switch shall be smooth and level.
   c. Provide two (2) means of egress from the medium voltage equipment area. The clearance width of
      these egresses shall be at least twenty-four inches (24”)

16. Special Requirements for Medium Voltage Systems
   a. In all manholes, vaults and electrical rooms, exposed medium-voltage cable shall be wrapped with
      arc-proofing (fireproofing) tape.
      i. Strips of fireproofing tape approximately one-sixteenth of an inch (1/16th”) thick by three
         inches (3”) wide shall be wrapped tightly around each cable spirally in a half-lapped
         wrapping, or in two butt-joined wrappings with the second wrapping covering the joints in
         the first. The tape shall be applied with the coated side toward the cable and shall extend one
         inch (1”) into the ducts. To prevent unraveling, the fireproofing tape shall be random
         wrapped the entire length of the fireproofing with pressure-sensitive glass cloth tape.
         Application of fireproofing tape over multiple conductors of the same circuit is acceptable.
         Ten feet (10’) before entry to equipment, fireproofing tape shall be applied to each single
         conductor to facilitate termination.
   b. In all locations where medium-voltage cable enters or leaves a conduit, the conduit shall be sealed
      with copper mesh and polyurethane foam. Spare conduits in the vicinity of medium voltage conduits
      shall be sealed similarly.
c. All conduits that contain medium voltage cables inside of buildings shall be constructed of rigid galvanized steel. Appropriate grade PVC may be used in concrete work when encased within a rebar cage.

17. Special Requirements for Energizing Electrical Systems

a. Scope:
   i. The following requirements are for the cabling, Trayer switches, high-voltage transformers, load interrupter switches, main switch gear, and manholes.

b. Electrical power studies such as short circuit, coordination and arc-flash studies shall be performed and submitted to the UC Berkeley Electrical Engineer for review at least two (2) weeks prior to energizing.

c. Electrical equipment shall be tested, the trip settings properly adjusted, and the report documenting such submitted to the UC Berkeley Electrical Engineer for review at least two (2) weeks prior to energizing.

d. The 12.47 kV fuses for Trayer switches and/or load interrupters shall be sized according to the power system study.

e. The following is a typical list that shall be tested by a NETA certified testing company:
   i. 15 kV cables
   ii. Trayer switch(es)
   iii. 12 kV load interrupter switch(es)
   iv. Power transformer set for 12.3 kV
   v. Main switchboard(s), including any ground fault performance testing (per NEC 230-95[c])
   vi. Circuit breaker testing
   vii. Meter and relay testing

f. Any problems found by the testing company shall be corrected immediately.

g. The equipment shall be thoroughly cleaned before energizing.

h. All required inspections shall be completed before energizing.

i. Outdoor equipment or equipment in areas subject to condensation shall be equipped with heaters. Heaters to be connected to power source, with thermostats set to approximately sixty-eight degrees Fahrenheit (68°F).

j. Areas around equipment shall be clear and free of debris or storage.

k. Areas around high-voltage equipment shall be secured, accessible to UC Berkeley High-Voltage Electricians at all times. Locks shall be provided by UC Berkeley.

l. Breakers, switches and cabinet doors must be lockable, in compliance with OSHA lock-out, tag-out requirements.

m. Arc flash and identifying labels shall be installed as required by relevant sections of these standards.

n. All empty conduits shall be covered by copper mesh and polyurethane foam.

o. Check all manholes for:
   i. Grounding
   ii. Racking
   iii. Labels
   iv. Fire tape on all wires
   v. Ladders installed
   vi. Lights, plugs, pumps, sump discharge
   vii. Cleanliness
   viii. Boxes in manholes shall always be at forty-eight inches (48") or one foot (1’-0") above the highest conduit in the manhole.

p. All equipment shall be in a de-energized state, verified by a UC Berkeley High-Voltage electrician.

q. Clearances for all equipment shall be verified

r. All keys, breaker lifts, wrenches and/or special tools shall be turned over to UC Berkeley High-Voltage electricians before the equipment is energized.
s. Lockable fencing for separate high-voltage equipment shall have the swing of doors/gates painted on the floor.

18. Special Requirements for Connection of Temporary Power for Construction Projects
   a. Any temporary tie-ins to the campus 12.47 kV system shall be performed in such a way as continuous power is maintained should either the “A” leg or “B” leg of the system be de-energized. In most cases, this will require a 12 kV vacuum break selector switch.
   b. Temporary power equipment (vacuum break selector switches, transformers, etc.) shall be installed so that sufficient clearance exists for safe operation of the equipment.
   c. Temporary power equipment (vacuum break selector switches, transformers, secondary distribution switchboards, etc.) shall remain accessible to UC Berkeley High-Voltage electricians but secured from non-electrical construction personnel and the public.
   d. A full complement of spare fuses shall be available for all temporary power equipment.
   e. All equipment utilized for temporary power shall meet NEC, NEC, ANSI and other standards specified in this Division.
   f. All switches shall be lockable in the “off” position.
   g. All switches and circuits shall be labeled with designated circuit number and function.
   h. All power derived from the campus power system shall be metered with a utility-grade kilowatt-hour meter. A UC Berkeley meter reader shall have access on a monthly basis so the meter may be read.
   i. If any UC equipment is utilized for temporary power, it must be tested before it is returned to the University. Any damage shall be paid for by the Contractor.

19. Special Requirements for Connection of Temporary Generators During Power Outages
   a. Any generator tie-ins to campus or building power distribution centers on a temporary basis shall be performed in conjunction with UC Berkeley electricians and inspected by UC Berkeley Inspection Services.

26 05 19 Low-Voltage Electrical Power Conductors and Cables

1. Materials:
   b. Insulation: THWN for wet or underground locations and THHN for dry or damp locations. Other insulation may be specified, depending on use.

2. Installation Of Wires
   a. Pull no wire into any portion of the conduit system until all construction work which might damage the wire has been completed.
   b. Install all wire continuous from outlet to outlet or terminal to terminal. Splices in cables when required shall be made in handholes, pull boxes or junction boxes. Make branch circuit splices in outlet boxes with six inches (6”) of correctly color-coded tails left in the box.
   c. Splices in wires and cables shall be made utilizing materials and methods in keeping with current code and industry best-practices.
   d. All cables and wires passing through manholes and handholes shall be full looped inside the manhole and handhole and supported in accordance with design. No cables or wires shall be in contact with the floor of the manhole.
   e. Make all ground, neutral and line connections to receptacle and wiring device terminals as recommended by the manufacturer. Connect branch circuit grounding conductor to the metal box with a green machine screw. Sheet metal screws are not acceptable. Provide separate ground jumper from outlet box to ground terminal of devices.
f. Code-size, green groundwire shall be installed in all raceways, secured using approved methods to each pole box, junction box, and equipment housing. Number 12 THHN stranded minimum. Green tape is acceptable for identification on number 4 and larger.

g. All neutrals in branch circuits must comply with code provisions for non-linear loads.

h. Megger testing of all feeders is required. Test shall be done in the presence of the University Representative. A 500 volt megger shall be used on wire and cable rated for 600 volts.

i. Provide wire markers for all new conductors in any box, indicating circuit numbers. Neutral conductor shall be marked with the circuit number(s) it is sharing. The junction boxes themselves shall also be marked with the panel name and circuit number(s). Labels shall be printed, fade- and weatherproof plastic or vinyl.

j. Conduits containing cables entering buildings below grade shall be sealed using appropriate sealants to prevent rodents from entering the building.

3. Wire Color Code

a. Color code all conductors. Wire sizes #6 AWG or smaller shall have integral color coded insulation. Wire sizes #4 AWG and larger may have black insulation but identified by color coded electrical tape at all junction, splice, pull, or termination points. Color tape shall be applied 1/2 lap to at least six inches (6”) of conductor.

b. Color Code wires as follows (confirm with University’s Representative):

<table>
<thead>
<tr>
<th>Conductors</th>
<th>120/208 Volts</th>
<th>277/480 Volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase A</td>
<td>Black</td>
<td>Brown</td>
</tr>
<tr>
<td>Phase B</td>
<td>Red</td>
<td>Yellow</td>
</tr>
<tr>
<td>Phase C</td>
<td>Blue</td>
<td>Purple</td>
</tr>
<tr>
<td>Neutral</td>
<td>White</td>
<td>White or Gray</td>
</tr>
<tr>
<td>Ground</td>
<td>Green</td>
<td>Green</td>
</tr>
</tbody>
</table>

Note: Orange is reserved for Delta installations that have a “stinger”.

c. Color coding of wires used for signal and communication systems are specified under the respective sections for these systems.

4. Mounting Heights Of Devices

a. Specify the height of each outlet to meet ADA requirement or as indicated on the Drawings.

b. Install all receptacles uniformly; Twist lock and power receptacles, ground up; If horizontally mounted, neutral up; or as directed by architect.

5. Connections To Equipment

a. General:

i. Furnish and install required power supply conduit and wiring to all equipment. See below for other wiring required.

ii. Mount all motor starters and provide all power wiring to them, including those furnished under other sections of specifications.

iii. Furnish and install all magnetic motor starters that are shown on the electrical drawings or specified under other Divisions to be furnished under this Division of work. Verify equipment nameplate ratings prior to installation and furnish adequately rated starters for the loads.

iv. Furnish and install manual thermal protection for all motors not integrally equipped with thermal protection.

v. Furnish 120-volt power to each control panel and time switch requiring a source of power to operate.
b. Heating, Ventilating and Air Conditioning Equipment:
   i. Line and low voltage temperature control and interlock wiring and conduit and required connections thereto are a part of other Divisions unless specifically shown or noted on the electrical drawings to be furnished under this section.
   ii. Provide 120-volt power supply to temperature control panels furnished and install under other Divisions of work.

c. Plumbing and Other Contractor-Furnished and University-Furnished Equipment:
   i. All required power and control conduit, wiring and connections are included under this section of the work.
   ii. Control sensing and alarm devices shall be furnished under the respective section of the contract supplying the equipment unless noted otherwise. Where these are located in pipes, ducts, vessels, tanks, etc., they shall be mounted in place by the Contractor furnishing the devices. All others shall be mounted under this section of the Work.

d. Control Panels:
   i. Control panels for packaged equipment shall be furnished under the respective Section of the contract supplying the equipment unless otherwise noted.
   ii. Installation and connection of the control panels shall conform to the general identification and labeling requirements of circuits and wiring provided by this Division.

26 05 19.23 Manufactured Wiring Assemblies

1. Metal Clad (MC) type cable is allowed in concealed locations (within walls, floors and ceilings) for branch circuits only.

26 05 33.13 Conduit for Electrical Systems

1. Conduits And Other Raceways
   a. Provide fittings and accessories approved for the purpose and equal in all respects to the conduit or raceway. Conduit connectors and couplings shall be compression type.
      i. Rigid Steel: Hot-dipped galvanized or PVC coated.
         1. Steel compression locking ring type fittings can be used in damp or wet locations.
         2. Steel setscrew type fittings are acceptable in dry locations.
      iii. Plastic: Schedule 80 PVC (or Schedule 40 PVC when encased in concrete), approved for use as non-metallic raceway for 90 deg. C conductors. Carlon, CertainTeed, Kraloy, or equal.
      iv. Wireway: Code gauge steel, with knockouts and hinged cover. Corrosion resistant gray baked enamel finish.
         1. Wireway smaller than wire mold brand 700 are not acceptable.
         2. Wireway with preassembled devices installed are not acceptable, i.e. 2000 and 2200 wiremold brand wireway.
      v. Flexible conduit (flex): Galvanized spiral steel is only permissible with Facilities Services pre-approval. Liquid-tight type (preferred) shall have protective PVC jacket.
      vi. All field-manufactured joints shall be coated to maintain surface continuity.
      vii. Paint conduits only if required for aesthetic purposes.

2. Specify rigid steel, galvanized, or sherardized conduit. Aluminum may be specified for rigid conduit larger than 1-1/4” IPS in dry locations, provided suitable precaution is taken against physical damage during construction. Non-metallic conduit and intermediate metal conduit are allowed underground in a concrete envelope.
3. In general, enclose underground conduits and ducts in a red-dyed (high voltage only) concrete envelope. Duct banks shall have steel reinforcing bars of proper size and spacing. Trenching, backfilling and concrete work shall be completed commensurate with the specifications pertaining to that section of the work. Use plastic conduit for Main Power and Telephone Underground Feeders, or if directed by Construction & Design (C&D), rigid steel conduit, protected with plastic tape wrap or plastic coat in thickness as specified in lieu of concrete envelope. Specify factory wrapping or .020” thickness, 1/2 tape width overlap if field wrapped.

4. Use rigid conduit with threaded couplings in concrete slab or wall construction. Electrical metallic tubing with insulated throat connectors may be used in furred spaces and areas not subject to damage and in sizes not over two inches (2”). Specify steel compression locking ring type connectors for wet locations. Set screw or indenter type fittings are not acceptable for dry locations.

5. Use flexible steel conduit for connection to all movable motors and to vibration producing equipment. Specify sufficient length to provide for anticipated movement and to prevent transmission of any vibration to the building. Use flexible steel conduit for light fixtures in suspended ceilings. Specify use of liquid-tight flexible conduit for all damp or wet locations. Flexible steel conduit may be used on rehabilitation work only where rigid conduit is not possible or practical to install. Discuss all proposals for this use with Construction & Design (C&D). Install code compliant equipment ground in all flexible conduit.

6. Keep conduits within the furring lines established on the architectural drawings, unless conduits are shown exposed.

7. Provide all necessary sleeves and chases required where conduits pass through floors or walls. Seal all openings with approved fire stopping material to maintain integrity of wall or floor being penetrated. Finish shall match adjacent surfaces after installation.

8. Do not locate conduit in the following construction:
   a. In concrete slab where conduit has an outside diameter greater than one-third (1/3) of slab thickness.
   b. In a concrete slab less than 3-1/2” thickness. Local offsets are an exception.
   c. Between concrete slab reinforcing steel and bottom of slab.

9. Install seal fittings on conduits penetrating walls of cold rooms.

10. Run all exposed conduits parallel to building walls and ceilings.

11. Support conduit runs to the structure with clamps, hangers, or a trapeze, spaced according to code requirements. Conduit raceways shall not be supported by other building piping systems.

12. Support vertical conduit runs by means of adequate clamps at each floor, or as required by code.

13. Use 3/4” minimum conduit size for power wiring. Switch legs may use 1/2” size.

14. Conduit Hangers
   a. For individual conduit runs not directly fastened to the structure, use rod hangers that shall be supported independent of ceiling and equipment supports.
   b. For multiple conduit runs, use trapeze type structural channel conduit support designed for maximum deflection not greater than 1/8 inch.

15. Conduit Support
   a. EMT: Vertical unsupported runs are not acceptable.
b. Rigid Conduit: Vertical unsupported runs maximum five feet (5’-0”). Runs shall be securely fastened at both top and bottom.

c. Surface Mounted Conduit: When subject to mechanical damage shall be clamped every five feet (5’-0”).

d. In new construction, conduits installed inside of walls shall have UL or equivalent approved clamp supports. No twisted wire allowed.

e. Provide additional support as required to make secure.

16. Installation Of Conduits:

a. General:

i. Run all conduits concealed unless otherwise noted or shown.

ii. Run exposed conduit parallel to or at right angles to center lines of columns and beams.

iii. Penetrations shall be at right angles to slab surfaces.

iv. Install conduits above ceilings to avoid obstructing removal of ceiling tiles, lighting fixtures, air diffusers, access openings, etc.

v. Conduits shall not cross any duct shaft or area designated as future duct shaft horizontally.

vi. Conduit risers when allowed in the duct shaft shall be coordinated with Mechanical work to avoid any conflict.

vii. For indoor and outdoor, install 1/8 inch diameter yellow polyline pull line and true tape in all conduits provided under this contract that are intended for future use, Tag pull lines for item served.

viii. Provide all boxes where shown or as required to limit any conduit run to a maximum of the equivalent of three (3) ninety-degree (90°) bends. Avoid U-bends.

ix. Where appropriate and where space permits, always use full size condulets.

x. The installation of surface raceways shall provide proper access to any and all junction boxes in the wall or surface mounted by mounting and mechanically securing an extension adapter box or extension ring over the concealed box. Full access to the concealed box opening shall be maintained.

xi. No more than one (1) extension box shall be added to an existing or new junction box.

b. Conduit Supports:

i. Support conduits with UL listed steel conduit supports at intervals required by the NEC. Wires or sheet metal strips are not acceptable for conduit support. Use conduit hangers for all conduits not directly fastened to the structure and for all multiple conduit runs. Provide seismic bracing for all conduit racks using structural channel approved for the purpose.

ii. Conduits shall not be attached to ceiling support wires.

iii. Avoid attaching conduit to fan plenums. When it is necessary to support conduit for the fan plenum, provide a length of liquid-tight flexible conduit between the portion attached to the fan plenum and portion attached to the building to minimize transmission of vibration to the building structure.

C. Conduit Penetrations: All underground conduits and ducts two-inches (2”) and larger shall be proven clear by pulling through a mandrel 0.25 inch smaller than the inside diameter.

i. Penetrating foundation wall below floor slab: Install conduit in conduit sleeve or block-out with minimum one-inch (1”) space around the conduit.

ii. Penetrating basement perimeter wall: Conduit shall be cast in concrete or installed in sleeve or block-out. Seal penetrations watertight with sealant approved in advance by Facilities Services.

iii. Penetrating slab on grade: Cast in concrete.

iv. Penetrating concrete floor slab above grade: Install conduit in conduit sleeve or block-out or in core drilled hole. Seal penetrations with sealant.
v. Conduits penetrating fire rated walls and floors shall have the penetrations sealed to preserve the “F” and “T” ratings. All products shall be approved by the Designated Campus Fire Marshal (DCFM) for the specific application.

vi. Penetrating roof or exterior wall: Avoid penetrating the roof or exterior wall where possible.

vii. Where penetrations are necessary, the building weatherproof integrity shall be preserved.

viii. Penetrating sound insulated or fan plenum wall: Install conduit in sleeve and seal penetration.

ix. Penetrating Non-Fire Rated Dry Wall: Conduit sleeves are not required. Penetrations shall be sealed prior to painting. Penetrations made after wall finish is applied shall be as small as possible and provided with escutcheons, one (1) on each side of the wall.

x. Penetrating Suspended Ceiling: Cut hole as small as possible to permit conduit penetration. Provide escutcheon for each conduit below ceiling.

26 05 33.16 Boxes for Electrical Systems

1. Outlet Boxes, Junction And Pull Boxes
   a. Outlet boxes: Hot-dipped galvanized of required size, four inches (4”) square, minimum, for flush mounted devices and lighting fixtures. Cast type with gasketed covers for outdoor or wet locations.
   b. Junction and pull boxes: Use outlet boxes with appropriate covers (with gaskets if used outdoors) as junction boxes. Larger junction and pull boxes shall be fabricated from sheet steel, sized according to code, with screw-on covers, finished with gray baked enamel

26 05 36 Cable Trays for Electrical Systems

1. Cable Trays
   a. Ventilated ladder type with four-inch (4”) minimum loading depth, nine-inch (9”) rung spacing, made of galvanized steel. Width as shown on Drawings. NEMA load/span class designation:
      i. 12-inch wide trays: 12A (50 lbs. at 12 inch span)
      ii. 18-inch and 24-inch wide trays: 12B (75 lbs. at 12 inch span.)
   b. Trays shall be galvanized after fabrication.
   c. Tray side hangers shall be turned out to avoid abrading cables.
   d. Fittings and accessories shall be hot-dipped galvanized finish and shall be provided to form a complete raceway system. When installed in a corrosive environment, stainless steel shall be used.
   e. Bends, tees, and crosses shall provide cables with a smooth bending radius without diminishing the cable-laying capacity of tray.
   f. Provide seismic bracing for all tray runs and supports. Supports shall be structural channel approved for the purpose.

26 05 53 Identification for Electrical Systems

1. Identification and Signage, Electrical Equipment Identification
   a. Provide signing and/or marking as follows for existing work in cable boxes and for all new work provided.
   b. Raceway Entrances: Apply a stenciled label on the wall to identify the destination of raceways. Use building name, equipment name, manhole number, or cable box number.
   c. Feeders: Provide and apply suitable permanent feeder tags with correct name to each Feeder and apply cable phase marker to each cable.
   d. Cable Boxes and Equipment Vaults: Provide markings showing box or vault number. Cable Box and vault covers shall be identified as “Electric.”
   e. Pad Mount Transformers: Provide and apply lamacoid nameplate and lamacoid warning signs for each transformer.
   f. Service Distribution Panels: Provide and apply lamacoid nameplate at each meter.
2. Standards and Codes

3. Engraved Bronze Plates
   a. Box Markers: Bronze plate, machine engraved with box designation in 3/8-inch high capital letters. Marker attached with epoxy adhesive to the cover.

4. Engraved Lamacoid Plates
   a. Nameplates: Plastic lamacoid plate, two (2) layer 1/16th inch minimum thickness, machine engraved with white lettering, all caps, on black background. Lettering 3/8ths inches high.
   b. Warning Signs: Plastic lamacoid plate, two (2) layer, 3/16ths inch minimum thickness, machine engraved with white lettering, all caps, on red background. Lettering two-inches (2”) high.
   c. All plates shall be affixed using long lasting adhesives.

5. Stencils

6. Phase Markers
   a. Cable Phase Markers: Brady, Seton, or equal with clear plastic over wrap-to-wrap 1 to 1-1/4 times (minimum) around cable. Label colored per color-coding with phase letter printed one-inch (1”) high.

7. Wire Markers
   a. Slip-on Wire Markers: Brady, Seton, or equal, PVC wire marker with permanent machine printed or embossed lettering.

8. Plastic Signs
   a. Heavy-duty plastic or PVC with printed letters, self-adhesive back, for outdoor application; Brady, Seton, or equal.

9. Arc Flash Labels
   a. All labels shall be made of chemical resistant vinyl.

10. Distribution Equipment
    a. The Contractor shall identify all switchboards, separately-mounted circuit breakers, panel boards, motor starters, motor control centers (MCC) disconnect switches, relays, relay control cabinets, and all apparatus used for the operation or control of power circuits, appliances or building support equipment, by means of descriptive engraved nameplates specifying the equipment being controlled and panel and circuit # feeding same.
    b. Specify fade- and weatherproof plastic or vinyl labels and a permanent method of securing to the equipment.
    c. Use red nameplates on all emergency equipment. Do not use adhesives for this purpose.

11. Machinery and Equipment
    a. Identify all motors driven and other pieces of electrically-operated building support equipment, (pumps, fans, etc), with 3/4-inch minimum height painted stencil or self adhesive letters / numbers.
    b. Labels should reflect designated titles given on prints or by Engineer.
    c. Color to contrast with background color.
12. Controls and Appliances
   a. Disconnect switches, separately mounted motor starters, relays shall be labeled with P-Touch or equal identifying labels specifying the equipment being controlled and panel and circuit # feeding same.

13. Devices, Fixtures and Appliances
   a. Provide permanent P-Touch or equal identifying labels on all lighting switches, convenience and special purpose receptacles and permanently installed / hardwired appliances and junction boxes to show panel and circuit number to which the device is connected.
   b. This includes remote or un-switched equipment, such as local exhaust fans, hand dryers, exit and emergency lighting, photo cells, exterior light fixtures, etc.

14. General, Miscellaneous
   a. Junction boxes shall be marked to indicate circuits that are contained within. Junction boxes may be marked with a permanent marker on the box cover.
   b. Identify all telephone and signal outlets with P-Touch or equal identifying labels.
   c. Identify remote control switches by engraving descriptive markings on flush plates.
   d. Labels shall be fade- and waterproof plastic or vinyl. Submit sample labels systems to the engineer or Campus representative before installing.

23 05 83  Wiring Connections

1. General Conditions:
   a. Cables shall be looped in all pullboxes.
   b. Before making any low voltage connections that require power interruption to existing facilities notify the University at least eleven (11) working days in advance. Service interruptions shall be performed by the Facilities Services Electrical Shop.
   c. Install wiring in raceways, unless specifically shown otherwise.
   d. Sizes for conduits, unless specifically shown otherwise, are determined by the National Electrical Code (NEC).
   e. Minimum indoor conduit size shall be ¾-inch from the panel to the first distribution box.
   f. Minimum one inch (1”) PVC coated steel or PVC only for outdoor and underground installations.
   g. Electric conduit or ducts shall be at least ten feet (10’-0”) from steam lines unless engineered to prevent heat damage.

2. Conduit shall be rigid steel, EMT, or PVC as follows:
   a. Above ground: Use rigid steel or EMT. EMT shall not be run below four feet (4’-0”) in height unless mechanically protected (example: inside a wall).
   b. Damp and wet locations including outdoor service yards and on roof: Rigid steel or EMT. In manholes use rigid steel.
   c. Hazardous Locations: Rigid steel conforming to NEC requirements.
   d. Locations Subject To Mechanical Injury: Rigid steel only.
   e. In Concrete Walls or Block Walls: Rigid steel only.
   f. Dry Locations Not Subject to Mechanical Injury: EMT, or rigid steel conduit.
   g. Underground: Use rigid steel or PVC. Rigid steel conduit in direct contact with earth shall be double-wrapped with 3M 10-mil tape or equal.
   h. PVC conduit 1-1/2-inch size and smaller shall be installed on two inches (2”) of sand base and covered by two-inches (2”) of sand backfill. In unpaved areas provide a two-inch (2”) concrete cap. Multiple runs shall maintain three-inch (3”) minimum separation between runs. Larger than 1-1/2-inch conduit, install two-inch (2”) sand base and cover by three-inch (3”) minimum concrete envelope.
3. Under Buildings or Building Slab: Use rigid steel or plastic conduit.
   a. Install PVC conduit on a two-inch (2") sand base and cover with two inches (2") of sand backfill. Maintain three-inch (3") minimum separation between runs. Do not install plastic conduit in rock base.
   b. Underground conduit entering building shall be provided with one ten-foot (10'-0") section of rigid steel conduit at the point of penetration of the foundation, footing or basement wall, with approximately equal lengths inside and outside building line. Rigid steel conduit in direct contact with earth shall be double-wrapped with 3M 10-mil tape or equal.

4. Make all risers to grade with rigid steel conduit and rigid steel elbow fittings only. Risers to begin eighteen inches (18") below grade and extend sixteen inches (16") above grade. Encase in concrete underground portion of steel conduit or fittings. Burial depth of conduits shall be as follows:
   a. Concrete encased: Twenty-four-inch (24") minimum for 600V or lower systems to top of concrete encasement. Thirty-six-inch (36") minimum for systems above 600V.
   b. Concrete capped: Twenty-four-inch (24") minimum to top of conduit.
   c. Conduits without concrete encasement or cap: Twenty-four-inch (24") minimum to top of conduit.
   d. When installed under buildings, the above minimum depth shall be six inches (6") below bottom of floor slab.

5. Use flexible conduits (Liquid-tight type preferred), with a three feet (3'-0") maximum length in the following applications and install a code sized ground.
   a. Recessed lighting fixtures.
   b. Motor connections.
   c. Connection between fan plenum and structure.
   d. At expansion joints.
   e. At transformers and other equipment which produces vibration.
   f. At damp and wet locations or where exposed to weather, flexible steel conduit shall be liquid tight.
   g. For renovations only, in inaccessible locations. 3/4 inch minimum for connections to existing panels. 1/2 inch conduit permitted for branch circuits. Connect to EMT or rigid conduit within six feet (6'-0") of inaccessible location.
   h. Corridors and corridor ceilings: three-quarter inch (3/4") minimum conduit diameter.

6. See 26 05 19.23: Manufactured Wiring Assemblies for restrictions on the use of Metal Clad (MC) type cable.

26 08 00 Commissioning of Electrical Systems

1. Testing
   a. Apply insulation integrity tests also to all feeders and subfeeders. Make such tests with a Megger capable of ringing through at least one hundred mega-ohms (100 m-ohms) and with a maximum applied voltage of five hundred volts (500 V).
   b. The resistance between conductors and between conductors and ground shall not be less than the values required by code.
   c. After the installation is complete, take voltage and ampere readings at the mains of each panel with all connected equipment turned on. Correct any phase unbalance shown from these tests. Check all circuits to insure that each circuit is connected to the proper neutral. Comply with code for insulation resistance.
   d. Meter Wiring Verification: The Contractor shall engage an independent firm, or individual, with the proper equipment and qualifications necessary to perform the following work:
i. Verify that the meters are properly connected, with due attention to phase and direction of rotation.

ii. Verify that the proper multiplier, if any, appears on the nameplate.

iii. Verify that the registered KWH and KVARH of the system, if included, is within the accuracy of the factory tolerance. Perform this work after installation and energizing of the switchboard or motor control center on which the meters are mounted and before final acceptance of the electrical portion of the contract. Demonstrate verification of the work in the presence of the architect. Furnish written certification to the University.

e. Fire alarm tests shall be witnessed by the Designated Campus Fire Marshal (DCFM).

f. Specify that before final acceptance of the Project can be made, the Contractor shall submit Form NFPA 72D, Fire Alarm System Certification and Description, signed by a factory certified technician. Certify that the fire alarm system has been installed, tested and will function in accordance with the manufacturer's specifications and the State Fire Marshal's requirements.

g. Specify acceptance testing for electrical power distribution equipment and systems in accordance with the National Electrical Testing Association acceptance testing specifications. Test shall include but is not limited to the following:

i. Power and distribution transformers.

ii. Medium voltage circuit breakers and switches.

iii. Adjustable-trip low voltage power circuit breakers.

iv. Metal-enclosed switchgear.

v. Protective relays and associated current and potential transformers.

vi. Switchgear instrumentation.

vii. Cables rated over 600 volts.

viii. Grounding systems.

ix. Ground fault systems.

tax. Automatic transfer switches and other emergency devices.

xi. Generators.

26 10 00  Medium-Voltage Electrical Distribution

1. Overview

a. Electrical power is distributed around the Berkeley campus at 12.47 kV. There are a total of seven (7) switching stations on campus that operate at 12.47 kV. All switching stations are of double-ended configuration with A side and B side busses, and a tie breaker. The switching stations consist of 12.47 kV vacuum circuit breakers. The breakers and switchgear have a seven hundred fifty Megavolt ampere (750 MVA) short circuit rating.

b. With several exceptions, where voltage drop and/or load considerations require larger cable sizes, the feeders from the switching stations to the building load groups are #4/0 American Wire Gauge (AWG) copper. Assuming 100% load factor and three (3) circuits per duct bank, the #4/0 AWG cable is capable of delivering five Megavolt amperes (5 MVA). In general and by design, each set of #4/0 AWG feeder cables serves approximately five (5) major buildings with connected loads not exceeding 5 MVA.

c. The cables linking the switching stations and the feeder cables to buildings have copper conductors, 133% ethylene propylene rubber (EPR) insulation, copper tape shields and PVC jackets. A service life of forty (40) years is expected.

d. The redundancy of the double-ended switching stations is extended to the major buildings. Through a fused vacuum selector switch installed in the building transformer vault (preferred location) or in an adjacent manhole (not acceptable for future installations), all building transformers (with a very few exceptions) have access to two (2) feeders. Each transformer may be fed from either the A side or from the B side of the switching station bus. By using the selector switch, the building transformers can be fed by an alternate feeder in case of a cable fault. The selector switches can be
used to balance the loads on the A and B sides of the switchgear. The selector switches are of the "make before break" design so that selection can be made with no power interruption.

e. Immediately ahead of each transformer with a medium voltage primary there shall be a visible means of disconnect. This may be either a load break air switch or an alternative approved by the campus electrical engineer.

f. Building electrical systems shall be 480/277 volts, 3 phase, 4 wire and/or 208/120 volt, 3-phase, 4-wire for lighting and power unless otherwise directed by the Utilities or Electrical shops of Facilities Services.

g. Connection to the existing Campus electrical system shall be coordinated with Facilities Services Utilities shop.

2. Standards and Codes
   a. Work and materials shall be in compliance with and according to the requirements of the latest revision of the following standards and Codes:
      i. National Electric Code latest with California Amendments (CEC)
      ii. California Code of Regulations, Title 8
      iii. State of California Public Utilities General Order 95
      iv. State of California Public Utilities General Order 128
      v. National Electrical Safety Code (NESC)


3. Medium Voltage Cable
   a. Medium voltage cable (4160 volt and 12000 volt systems) shall be shielded 15KV, EPR type, with 133% insulation rated for conductor temperatures of one hundred and five degrees Celsius (105°C) continuous and one hundred twenty degrees Celsius (120°C) emergency, and shall be warranted for forty (40) years when installed in accordance with the manufacturer's requirements. Cable shall be shielded with copper tape and jacketed over shield. Specify Kerite and Okonite cable or equal, minimum 4/0 size.
   
   b. Conductor Size For Underground Distribution:
      i. 12KV Distribution Loop-2-#750 mcm copper
      ii. Building Feeder--1-#4/0 copper

4. 15 KV Cable Splices
   a. Types: .Splice kits shall be of the heat-shrinkable elastomeric type or other separable connector elbow type.
   b. Materials: Cable splice kits shall contain materials that are completely compatible with the conductors, insulations, shields, and jackets and which are approved by the cable manufacturer.
   c. Cable splices shall be suitable for continuous immersion in water.
   d. Cable splice kits shall be the standard product of a single manufacturer. Manufacturer shall be:
      i. Heat-Shrinkable Splice: Raychem HVS-15205 Series or equal
      ii. Separable Connector Elbow Splice: Elastimold 655LR Series or equal

5. Medium Voltage Separable Connectors
   a. Provide ESNA-type connectors with insulated bushings. Elastimold (Non-Load Break). Provide capacitance test point. Connectors shall satisfy requirements of IEEE 386 and shall be designed for use with the specific cable and type of installation required. The manufacturer shall provide all
components and at least three (3) copies of complete directions for assembling, and putting the unit into service, (two [2] of which shall be submitted for record).

b. Stress Cones (Raychem) shall be required at switchgear, etc.

6. Distribution and Installation
   a. See Special Requirements for barricades at trenches and for utility shutdowns and scheduling. See Divisions 1, 2 and 33 for additional electrical requirements including route approval, service locations, demolition, excavation scheduling, and backfill requirements.
      i. The campus underground primary system is 12.47 kV Delta. Unless otherwise noted, all new campus electrical systems shall be 12.47 kV.
      ii. New building projects shall include the installation of two (2) feeders, the splicing into the campus distribution system, and a feeder selector switch. If the local distribution system does not have the needed capacity, the Project shall also include the installation of the feeders to the substation and the feeder switches in the substation. If a building is being replaced with a new building, feeders and substation switches may be reused if they are adequate. The Project shall also include the installation of a new duct bank if spare conduits are not available in existing duct banks.
      iii. High Voltage Duct Banks: Duct banks containing 4160 volts or higher may include conduits for other services such as communication, computer, fire alarm, and street lighting units, provided they terminate in separate hand-holes and they DO NOT run through the high-voltage manholes.
      iv. High Voltage Equipment Rooms: High voltage electrical rooms shall be dedicated to high voltage equipment and their accessories ONLY. Separate rooms shall be provided to include utilities such as telephone, energy monitoring and communication equipment.
      v. Mechanical equipment and piping shall not be installed inside or run through high voltage electrical rooms.

7. Building Electrical Distribution
   a. The campus building electrical distribution system standard is 120/208 or 277/480 volts, 3-phase, four-wire, for lighting and power, unless otherwise directed by Construction & Design (C&D).

8. Main Switchboard
   a. Main switchboards shall be copper bus units for metal clad switchgear, draw-out type air-breakers or molded case circuit breakers.
   b. Where ground fault protection is required by the NEC or these guidelines, main distribution feeder circuit breakers shall be equipped with ground fault protection. See additional requirements in this Division. The coordination study shall establish pick-up settings for a coordinated building system. Protection shall also be included for phase-to-phase arcing faults.
   c. All applicable requirements in this Division also apply to switchboards.

9. Metering Equipment
   a. See Division 33 05 00: Common Work Results for Utilities, Subsection 10: Utility Metering.

10. Motor Disconnect Switches
    a. Specify heavy duty HD disconnect switches. Thermal overload type switches may act as a disconnect where used to protect small single-phase motors.

11. Distribution Panels
    a. The bus shall be copper, no aluminum allowed. Power panelboards shall be dead front, totally enclosed, convertible type, with circuit breakers. See this Division for additional requirements. All
spaces shall be furnished with breaker mounting hardware. Provide a grounding bus in all distribution panel boards. The grounding bus shall be easily distinguishable from the neutral bus.

12. Lighting and Receptacle Panel Boards
   a. Specify general purpose 20 AMP minimum bolt-on circuit breakers for 120/208 and 277/480 volt panel boards, Eaton, General Electric, or equal. Minimum interrupting capability shall be 10,000 amperes for 120/208 volts and 14,000 amperes for 277/480 volts. Confer with the Campus Electrical Engineer for available fault current levels.
   b. Provide main circuit breakers in panel boards unless directed not to do so by Construction & Design (C&D). When more than one panel board is fed by the same feeder, provide a main circuit breaker in each panel board.
   c. Locate all busses in the rear of the panel board cabinet. Mount circuit breakers on suitable supporting members at the front of the cabinet and connect with suitable straps or lugs to the bussing in the rear of the cabinet. Individual circuit breakers shall be removable from the cabinet without disturbing the bussing in any way. Specify door-in-door arrangement. Adjustable trim clamps are not acceptable. Surface mounted panel boards may have the front mounted on a piano hinge on the right side, with double locked doors.
   d. Specify all locks on panel boards in a single building so that all the outer locks of the door-in-door assembly are keyed alike and all the inner locks of the door-in-door assembly are keyed alike, but different from the outer locks.
   e. Detail the layout and dimensions of special-sized panel boards on the drawings.
   f. Labels shall be fade- and waterproof plastic or vinyl and permanently attached.
   g. Show three (3) one-inch (1”) spare conduits from panel boards to the accessible space above furred ceilings, to allow for use of spare circuits or spaces provided in the panel boards. Spare conduits shall be capped off in the accessible space above furred ceilings.
   h. The percentage of spares and spaces in panel for future growth shall be twenty percent (20%). Provide hardware and bus taps for the installation of future breakers in spaces provided in panel board.
   i. Specify bolted copper bussing. No aluminum allowed.
   j. The Contractor shall balance phases during normal building operation.

13. Ground Fault Protection
   a. Specify ground fault circuit interruption (GFCI) receptacles for circuits serving wet or hazardous areas including outdoor branches, bathrooms and laboratories with sinks. Discuss with Construction & Design (C&D) for other potential hazardous areas.

14. Electrical Rooms
   a. Lighting in the main electrical room shall be on emergency power circuit where emergency power is available, or a batter backup fixture where not.
   b. At least two (2) one-hundred twenty volt (120V), twenty amp (20A) duplex receptacles, fed from different circuits shall be in main electrical room, on the emergency power circuit where emergency power is available.

15. Medium Voltage Transformers, Selector Switches, And Load Interrupter Switches
   a. Indoor Locations: Specify transformers as dry type, three phase, 60 cycle, primary and secondary voltages as required, with two (2) full capacity 2.5% taps above and two (2) 2.5% full capacity taps below rated voltage. Transformers shall operate under full load with noise level not to exceed American National Standards Institute (ANSI) and National Electrical Manufacturers Association (NEMA) standards. Transformers shall have 220°C insulation, 115°C rise. Primary shall be 95 KV BIL. Enclose primary terminals. Extend secondary terminals through the case by means of silvered copper bus bars, include lugs and bolts for cable termination. Check these details with Construction
& Design (C&D). Design and build transformers in accordance with National Electrical Manufacturers Association (NEMA), ASA and AIEE standards with minimum of four percent (4.0%) impedance.

b. Outdoor Locations: Specify transformers as liquid-filled. Liquid to be less flammable as determined by Underwriters Laboratory (UL) and FM Global. Liquid shall be biodegradable. Transformers to be 95kV BIL primary and 30kV BIL secondary. Temperature rise to be fifty-five degrees Celsius (55°C).

c. Final selection shall be based on building use, available space, energy losses, maintenance and first cost. Conduct life cycle analysis to select optimal transformers. Discuss these items with Construction & Design (C&D) and the UCB Electrical Engineer for approval of the final selection before preliminary drawings are started.

d. Factory Tests shall include the following:
   i. Resistance measurement
   ii. Ratio Test
   iii. Polarity and phase relationship test
   iv. No load loss at rated voltage
   v. Exciting current at rated voltage.
   vi. Impedance and load loss
   vii. Quality control impulse

e. Buildings with critical loads shall utilize double ended unit substations.

f. The medium voltage selector switch(es) shall be located in the building in the same vicinity as the building transformer(s). Medium voltage selector switches shall not be located in manholes.

g. Test results shall be furnished to the UCB Electrical Engineer.

h. For indoor installations use a Vacuum Break Selector Switch which shall feed an air switch before the transformer. See Appendix A: Drawings for typical details and specifications.

i. For outdoor installations use a Vacuum Break Selector Switch with a visible break and eliminate the air switch.

j. Place all main electrical equipment serving a project or building such as primary switch, transformers and main switchboard in a separate room or vault, which will be accessible only to qualified electrical personnel. Do not locate other equipment in this room. Follow code strictly in the design and provide adequate and legal working space and clearances. Pay attention to accessibility at the rear of the switchboard.

k. Seismic Bracing and Mounting: Provide calculations stamped and signed by a registered civil or structural engineer which certifies that the equipment construction and the manufacturer's recommended method of mounting shall comply with Title 24 seismic requirements. Documentation shall show anchors, bolt sizes, quantities and embedment.

l. Building Low Voltage Main Circuit Breakers and Tie Breakers (where applicable) shall be Draw-Out Type.

m. All medium voltage switch & transformer equipment and installations shall be approved by the UCB Electrical Engineer.

16. High Potential Tests (New Cables Only)
   a. After cables are installed, a high potential test shall be performed on each conductor. An initial voltage shall be applied and increased in no less than five (5) uniform steps up to the maximum test voltage. The minimum time at each step shall be no less than required for test current to stabilize. The high potential test shall be a DC test. If the applied voltage is interrupted at any time during the test on a conductor, the test shall be started again from the beginning. Hold final voltage for ten (10) minutes.
b. Test Potentials shall be as follows (Unless recommended otherwise by the manufacturer):

<table>
<thead>
<tr>
<th></th>
<th>Nominal Cable Rating</th>
<th>DC Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Voltage</td>
<td>15KV</td>
<td>15KV</td>
</tr>
<tr>
<td>Final Voltage</td>
<td>15KV</td>
<td>55KV</td>
</tr>
</tbody>
</table>

c. Reports of voltage test results shall be submitted for review with three (3) copies of each report prepared in the following format and detail:
   i. A separate 8-1/2 by 11-inch report sheet shall be prepared for each separately tested section of high voltage cable.
   ii. Each report shall be headed with the project identification.
   iii. The following additional data shall appear on each report sheet:
       1. Date
       2. Name of operator performing the test
       3. Name of company employing the operator
       4. Section of cable tested
       5. Type of cable insulation
       6. Cable length
       7. Nominal rating of cable
       8. Cable manufacturer and product identification
       9. Size of conductor
      10. Identification of test equipment
      11. Test type
   iv. The test results shall be plotted on a log-log graph and shall have microamperes on the left and kilovolts across the bottom. The graph shall also provide a current vs. time test to be recorded in one (1) minute intervals after the final test voltage has been reached.
   v. Each test report shall be signed by the operator of the test equipment.
   vi. Each report sheet shall be endorsed by the Contractor or its authorized representative.

17. Selector Switch Insulation Resistance Tests
   a. Electrical insulation resistance tests shall be made by the Contractor in the presence of the University's Representative for all new selector switches using a constant voltage megger capable of measuring 2,000 megohms. Tests shall be made between phase conductors and grounded phase conductors. Insulation resistance shall not be less than 750 megohms. Additionally, the vacuum bottles shall be high-potential tested across the open contacts. The voltage shall be 30kv d.c. and shall be held for one (1) minute. Maximum leakage shall be two (2) micro-amps per bottle. The Contractor shall furnish the University's Representative with a record of all insulation resistance measurements.

18. Raceway Types Required
   a. All raceways for medium voltage cable run underground shall be installed with spacers and encased as specified in this section.
   b. Concrete Encased Raceway: PVC Type 40 duct.
   c. Exposed in Vaults and Elsewhere: Rigid Steel conduit or racks or cable trays.
   d. Low voltage wiring in areas where there is medium voltage shall be run in rigid steel conduit.

19. Concrete Duct Bank Construction
   a. Provide plastic spacers at a maximum of ten feet (10'-0'') on center to maintain three inch (3'') spacing between conduits.
   b. Anchor the conduits to prevent floating during the concrete pour as specified by the design engineer.
   c. Construct a re-bar cage for reinforcement of concrete. The design engineer is to specify cage to suit site conditions.
d. 12KV duct banks to include red dye. See Appendix A: Drawings for typical duct bank cross section.
e. Provide a three-inch (3”) wide yellow “Electric Line,” T&B, Westline or equal plastic warning tape six inches (6”) above duct bank. Provide one (1) warning tape for each twelve-inch (12”) width of concrete duct bank or fraction thereof. Minimum ground cover for concrete duct bank shall be two feet (2'-0”).

20. PVC Conduit
   a. End Bells: PVC type 40.
   b. Elbows: Factory made. Use a minimum radius of sixty inches (60”) or as required by the cable manufacturer or design engineer for medium voltage cable raceways.
   c. Schedule 40 PVC shall not be installed exposed under any conditions.

21. Rigid Steel Conduit
   a. All Bends: Factory made, minimum radius of six (6) times trade size or as required by the cable manufacturer or design engineer.

22. Encasement
   a. Raceways with Medium Voltage Cables or Intended for Medium Voltage Cable: Reinforced red concrete.
   b. Over Rebar: Three inches (3”) of concrete, minimum.

23. Grounding
   a. Description Of Work
      i. The grounding system shall provide this major function:
         1. A connection to earth for the system derived neutrals, for the service equipment enclosures, and for the distribution cable-shield drain wires.
   b. Main Ground Bus
      i. Terminate system grounding conductors, including transformer neutral, U-fer, building steel, water piping, and concrete encased electrode, at an accessible bus adjacent to the main service. This bus shall be used for grounding of telecommunications and related systems. Supplementary grounding systems shall be bonded to the Main Ground Bus. Ground rods that are not connected to the main Ground Bus are not permitted.
   c. Made Electrodes
      i. Made Electrodes shall have a resistance of five (5) ohms or less.
   d. Branch Circuits And Feeders
      i. Provide a code sized, green insulated, equipment grounding conductor within every branch circuit and feeder raceway. Bond the grounding conductor to grounding terminals and metallic enclosures.
         ii. All distribution panels shall contain a ground bus.
   e. In the core campus area, install a 2/0 copper conductor (or larger) in all HV duct banks. The 2/0 conductor shall be attached to the ground rods placed in the duct bank system. Ground rods shall be installed in splice locations and all equipment and material in these locations shall be bonded to the 2/0 copper cable.
   f. Duct bank design shall be by an engineer and include provisions for pulling tension and sidewall pressure limits given by the cable manufacturer. Cable guarantee is only valid if manufacturer’s installation requirements are followed and documented.
   g. Refer to Appendix A: Drawings for Typical Duct Bank Cross Section
1. **Scope**
   a. Medium Voltage load interrupters shall be used in indoor locations only.

2. **References**
   a. The medium voltage load interrupter switchgear and all components shall be designed, manufactured and tested in accordance with the latest applicable standards including the following:
      i. ANSI/IEEE C37.20.3
      ii. ANSI/IEEE C37.20.4
      iii. ANSI C37.22
      iv. NEMASG5
      v. NEMASG6
      vi. CSA22.2 No.3I-M89
      vii. EEMAC G8-3.3
   b. Listing by Underwriters Laboratories Inc. (UL) or Canadian Standards Association (CSA) shall be provided for 5 kV or 15 kV class medium voltage load interrupter switchgear.

3. **Qualifications**
   a. The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of the California Building Code (CBC) through Zone 4 application. Guidelines for the installation consistent with these requirements shall be provided by the switchgear manufacturer and be based upon testing of representative equipment. The test response spectrum shall be based upon a five percent (5%) minimum damping factor, CBC: a peak of 2.15g's, and a ZPA of 0.86g's applied at the base of the equipment. The tests shall fully envelop this response spectrum for all equipment natural frequencies up to at least 35 Hz.
   b. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards:
      i. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a civil engineer licensed in the State of California. Mounting recommendations shall be provided by the manufacturer based upon approved shake table tests used to verify the seismic design of the equipment.
      ii. The equipment manufacturer shall certify that the equipment shall withstand and function following the seismic event, including both vertical and lateral required response spectra, as specified in the above codes.
      iii. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

4. **Operation and Maintenance Manuals**
   a. Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component. Provide three (3) hard copies and one electronic copy (PDF format on CD, DVD or Blu-Ray disc, as appropriate for file sizes).

5. **Manufacturers**
   a. Acceptable Manufacturers:
      i. Cutler-Hammer
      ii. General Electric
      iii. Siemens
b. The listing of specific manufacturers above does not imply acceptance of their products, especially those that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting requirements of these Design Standards.

6. Ratings
   a. Switchgear assembly ratings shall be as follows:

<table>
<thead>
<tr>
<th>Rating</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal System Voltage</td>
<td>12.47 kV three-phase three wire</td>
</tr>
<tr>
<td>System Grounding</td>
<td>1000A @ 12.47 kv available</td>
</tr>
<tr>
<td>Available System 3-Phase Short Circuit</td>
<td>25 kA Symmetrical Current</td>
</tr>
<tr>
<td>Maximum Design Voltage</td>
<td>15 kV</td>
</tr>
<tr>
<td>BIL</td>
<td>95kV</td>
</tr>
<tr>
<td>Main Cross Bus Continuous Current</td>
<td>600A</td>
</tr>
<tr>
<td>Main Cross Bus Momentary Current (10 Hz)</td>
<td>40 kA Asymmetrical</td>
</tr>
<tr>
<td>Main Cross Bus 2-Second Current</td>
<td>25 kA Symmetrical</td>
</tr>
<tr>
<td>Non-Fused Switch Fault close (3 times, minimum)</td>
<td>40 kA Asymmetrical</td>
</tr>
<tr>
<td>Non-Fused Switch (Continuous and Load Break)</td>
<td>600 Amperes</td>
</tr>
<tr>
<td>Fused Switch Fault close</td>
<td>100 kA Asymmetrical</td>
</tr>
<tr>
<td>Fused Switch Maximum (Continuous / Load Break)</td>
<td>600 Amperes</td>
</tr>
</tbody>
</table>

7. 15 KV Construction
   a. The metal-enclosed load interrupter switchgear shall consist of deadfront, completely metal-enclosed vertical sections containing load interrupter switches and fuses (where shown) of the number, rating and type noted on the drawings or specified herein.
   b. The following features shall be supplied on every vertical section containing a three-pole, two-position open-closed switch:
      i. A large, eight inch by sixteen inch (8” x 16”) high-impact viewing window that permits full view of the position of all three switch blades through the closed door.
      ii. The window shall not be more than fifty-eight inches (58”) above the switch pad level to allow ease of inspection.
      iii. The door shall be interlocked with the switch so that:
            1. The switch shall be opened before the door can be opened.
            2. The door shall be closed before the switch can be closed.
      iv. A hinged grounded metal barrier bolted closed in front of every switch to prevent inadvertent contact with any live part, yet allow for a full-view inspection on the switch blade position.
      v. Provision for padlocking the switch in the open or closed position.
      vi. Green OPEN, Red CLOSED switch position indicators with the words "Open" and "Closed."
      vii. A hinged cover with rustproof quarter turn nylon latches over the switch operating mechanism to discourage casual tampering.
      viii. The Switch shall be removable as a complete operational component.
   c. Vertical section construction shall be of the universal frame type using die-formed and bolted parts. All enclosing covers and doors shall be fabricated from steel whose thickness shall be equal to or greater than those specified in ANSI/IEEE C37.20.3. No other removable hardware for covers or doors shall be thread-forming type. To facilitate installation and maintenance of cables and bus in each vertical section, a split removable top cover and split removable rear covers with rustproof nylon handles or pad-lockable hinged rear door held closed by bolts shall be provided. A G90 grade galvanized base shall isolate equipment from contact with the concrete pad providing protection from rust. Heavy-duty hot dipped galvanized anchor clips shall be provided to anchor the switchgear to the concrete pad.
d. Each vertical section containing a switch shall have a single, full-length, flanged front door and shall be equipped with two (2) rotary latch-type pad-lockable handles. Provision shall be made for operating the switch and storing the removable handle without opening the full length door.

e. Each load interrupter switch shall have the following features:
   i. Three-pole gang-operated mechanism.
   ii. Manual quick-make/quick-break over-toggle-type mechanism that does not require the use of a chain or a cable for operation, and utilizes a heavy-duty coil spring to provide opening and closing energy.
   iii. The speed of opening and closing the switch shall be independent of the operator, and it shall be impossible to tease the switch into any intermediate position under normal operation.
   iv. Separate main and break contacts to provide maximum endurance for fault close and load interrupting duty.
   v. Insulating barriers between each phase and between the outer phases and the enclosure.
   vi. A maintenance provision for slow closing the switch to check switch blade engagement and slow opening the switch to check operation of the arc interrupting contacts.

8. Bus
   a. All phase bus conductors shall be silver-plated copper.
   b. Ground bus conductor shall be silver-plated copper and be directly fastened to a galvanized metal surface of each vertical section, and be of a size sufficient to carry the rated (2-second) current of the switchgear assembly.

9. Bus Insulation System
   a. All bus shall be supported utilizing a High Strength and High Creep, finned support providing fourteen inches (14") of creep distance between phases and ground.
   b. All standoff insulators on switches and fuse mountings shall be Glass Polyester.

10. Wiring/Terminations
    a. One (1) terminal pad per phase shall be provided for attaching the contractor-supplied cable terminal lugs for a maximum of two (2) conductors per phase. Sizes shall be indicated on the Drawings. Sufficient space shall be allowed for the contractor supplied electrical stress relief termination devices.
    b. Small wiring, fuse blocks and terminal blocks within the vertical section shall be furnished and indicated on the Drawings. Each control wire shall be labeled with wire markers. Terminal blocks shall be provided for the Owner's connections to other apparatus.

11. Fuses
    a. Fault protection shall be provided by fuses with continuous ratings shown in the Contract Documents.
    b. The fuses shall be Cutler-Hammer CLE current limiting type or equivalent. Furnish three (3) spare fuses for each fused switch. Fuse/switch integrated momentary and fault close ratings specified shall be verified by test and UL and CSA certified.

12. Accessories
    a. Key interlocks, if applicable, shall be shown on the Drawings.
    b. 12 kV distribution class surge arresters shall be connected at the incoming terminations and securely grounded to the metal structure.

13. Indoor Enclosures
    a. Enclosures shall be constructed per IEEE/ ANSI C37.20.3 indoor specifications, meeting or exceeding NEMA 1.
b. Each vertical section shall be ventilated at the top and bottom, both front and rear, to allow airflow to provide cooling and to help prevent buildup of moisture within the structure.

14. Outdoor Enclosures
   a. Medium Voltage Air Switches shall not be installed outdoors.

15. Nameplates
   a. A nameplate shall be mounted on the front door of each switch vertical section. This requirement shall be shown and detailed on the Drawings.

16. Finish
   a. Prior to assembly, enclosing steel shall be thoroughly cleaned and phosphatized. A powder coating shall be applied electrostatically and fused-on by baking in an oven. The coating is to have a thickness of not less than 1.5 mils.
   b. The finish shall have the following properties:

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact resistance (ASTM D-2794)</td>
<td>60 direct/60 indirect</td>
</tr>
<tr>
<td>Pencil hardness (ASTM D-3363)</td>
<td>H</td>
</tr>
<tr>
<td>Flexibility (ASTM D-522)</td>
<td>Pass 118-inch mandrel</td>
</tr>
<tr>
<td>Salt spray (ASTM Bl17-85 [20])</td>
<td>600 hours</td>
</tr>
<tr>
<td>Color</td>
<td>ANSI 61 gray</td>
</tr>
</tbody>
</table>

17. Factory Testing
   a. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.
   b. The manufacturer shall provide three (3) certified copies of factory test reports.

18. Field Quality Control
   a. The services of a qualified factory-trained manufacturer's representative shall assist the Contractor in installation and start-up of the MVS equipment for a period of one working day per switch. The manufacturer's representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, corrections and adjustments, and testing of the assembly and components contained therein.
   b. The Contractor shall provide three (3) copies of the manufacturer's field start-up report.

19. Manufacturer's Certification
   a. The Contractor shall provide a qualified factory-trained manufacturer's representative who shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.
   b. The Contractor shall provide 3 copies of the manufacturer's representative's certification.

20. Training
   a. The Contractor shall provide a training session for the Owner's Representatives for one (1) workday (eight [8] hours) at a jobsite location determined by the Owner.
   b. The training session shall be conducted by a manufacturer's qualified representative and consist of instruction on the assembly, switches and major components.
21. Installation
   a. The Contractor shall install equipment in accordance with the manufacturer's recommendations and the Contract Drawings.
   b. All necessary hardware to secure the assembly in place shall be provided by the Contractor.

26 13 19  Medium-Voltage Vacuum Interrupter Switchgear

1. General
   a. Units shall be rated as follows.
      i. 15KV nominal. 95KV BIL across open contacts. 125KV BIL phase to phase and phase to ground. 50,000 amps interrupting current. 600 amps loadbreak for 10,000 times without need for maintenance.
      ii. Switches shall be three-way: Two-ways switched and fused; one-way non-switched and non-fused. The switched and fused ways shall be incoming circuits. The non-switched and non-fused ways shall be the outgoing circuit.
      iii. Fused circuits are either 50 amps max or 200 amps max continuous as determined by fuse wells specified. External hardware of fuse wells shall be stainless steel.
      iv. Enclosures shall be of #304 stainless steel and shall be totally submersible whether located outdoors, indoors, or in a subsurface vault.
      v. Units without pad-mounting cable enclosures shall be supplied with a hot dip galvanized stand beneath them whether the bushings are on the top or the side to properly locate height of bushings and protect the switch tank from cathodic corrosion should assemblies be submerged in water.
      vi. Switches shall be designed for use on a primary selective system with a fault level of 50,000 amps. Switches shall be able to be operated independently to allow paralleling of feeders without power interruption. Switches shall have vacuum contacts and be rated to interrupt 600 amps 10,000 times with no maintenance required.
      vii. Switches shall be arranged for one (1) outgoing feeder.
      viii. Vacuum switches shall be completely assembled and factory filled with liquid insulation.
      ix. All units shall be factory filled with Alpha 1 flame resistant insulation.
      x. In order to remove the 12.47 KV fuses, it shall only be necessary to open the switch immediately ahead of the fuses. It shall be possible to replace any fuse without totally de-energizing the switch. Fuses shall not become energized during withdrawal.

2. Construction
   a. Vacuum switches shall be enclosed in all welded Type 304 corrosion resistant stainless steel tank completely welded using ANSI 308 filler to maintain corrosion resistant properties. Each assembled switch shall be found free from leaks. Switch shall be capable of being mounted in vertical or horizontal configuration depending on space availability.
   b. Vacuum switches shall be hermetically sealed in the tank enclosure and filled with insulating medium.
   c. For all switches with dry well fuses, termination shall be six hundred amp (600A) non-loadbreak on the line side and two hundred amp (200A) on the load side. Terminations on the load side shall be of the universal bushing well-type that can accommodate a loadbreak connector.
   d. For all switches with wet well fuses, line and load side terminations shall be six hundred amp (600A) non-loadbreak.
   e. The Contractor shall verify all cable diameters and provide elbow connectors, bushing inserts and all necessary material for connections to the switch.

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f. Loadbreak elbow connectors shall be Elastimold complete with test points, hold-down bail assembly, and all necessary component parts required for the specified cable.

g. Dead end receptacles shall be Elastimold 270DR equal for 200 amp receptacles and Elastimold K600DRTP or equal for 600 amp. Provide six (6) 270DR receptacles and twelve (12) K600DRTP to the University’s Representative.

h. Stand-off plugs shall be Elastimold 271SOP or equal. Provide two (2) loadbreak and two (2) deadbreak junction kits to the University’s Representative.

   a. The direction of operating of a manual operating handle shall be apparent. Handles shall turn clockwise to close, counter-clockwise to open; or “in” to close and “out” to open.
   b. A vacuum switch mechanism shall be designed so that operation does not require any special skills and closing and opening speeds of the contacts are independent of the speed at which the operating handle is operated.
   c. Manual operating handles shall be capable of being padlocked in the open and in the closed positions.
   d. A switch shall be designed so that switching of feeders can be done without any interruption of power.
   e. Provision shall be included for later addition of remote operators.

4. Insulating Medium
   a. Insulating medium shall be Alpha 1 type insulating fluid for all locations.

5. Switch Nameplate
   a. Nameplate shall contain a single line representation of the internal connections and devices within the switch.

6. Labels/Nameplates For Each Switched Way
   a. Engraved nameplates, sized two inches (2”) by five and one-half inches (5.5”), black with white letters are required. Nameplates shall be securely fastened on each switched way.

7. Spare Fuses
   a. Supply six (6) spare fuses in addition to the six (6) fuses necessary for normal operation. If there are two (2) or more switches with identical fuse sizes, six (6) spare fuses shall be sufficient.

8. Specific Types
   a. There are six (6) different types of Vacuum Break Selector Switches that are in service on the campus at this time. Any installation requiring a Vacuum Break Selector Switch must use one of the following:
      i. Below grade submersible switches for transformers rated at 750 KVA or smaller.
      ii. Below grade submersible switches rated at 3,000 KVA.
      iii. Indoor vault mounting switches for transformers rated 750 KVA and smaller.
      iv. Indoor vault mounting switches for transformers rated up to 3,000 KVA.
      v. Outdoor pad-mounted switches for transformers rated at 750 KVA or smaller.
      vi. Outdoor pad-mounted switches for transformers rated up to 3,000KVA.
   b. It is not acceptable to install Vacuum Break Selector Switches in manholes.
   c. For detailed description for each of the above applications, see the UCB Electrical Engineer.

9. Multiple Switches In One Building
   a. For situations where more than one switch is required in a building, the incoming 12 kV circuits shall be connected to junction blocks, one per phase, with one set of blocks for the 12 kV “A”
circuit, and one set of blocks for the 12 kV “B” circuit. The 12 kV circuits shall then split at each junction block in order to feed each switch as required. It is not permissible to double-stack elbows on the Vacuum Break Selector Switches.

b. Junction blocks to be rated at 15 kV, 600 amp. Junction blocks to utilize copper contacts.

c. Junction blocks to be Elastimold 675J or equal.

10. Installation

a. Switches with wet-well fuses that are mounted on a stand shall not be mounted on a housekeeping pad. Stands shall be anchored directly to the concrete floor. The floor shall be constructed of reinforced concrete.

b. Switches with dry-well fuses shall be mounted on a housekeeping pad. The housekeeping pad shall be constructed of reinforced concrete.

c. Cable installation: Incoming “A” circuit to be connected at left side of switch; incoming “B” at right.

26 13 26 Medium-Voltage Metal-Clad Switchgear

1. Metal Clad Switchgear

a. This section applies to medium voltage 750 MVA switchgear that will be installed on the main campus. In order to match the switchgear and circuit breakers found in the 12kv switching stations, any additional switchgear and breakers must be manufactured by Powell Electrical Manufacturing, Inc. This will ensure compatibility of parts, accessories, maintenance tools, and operator's familiarity. The switchgear and circuit breakers shall meet the specifications outlined below. For complete specifications for arc resistant switchgear, see the UCB Electrical engineer.

2. General

a. The intent of this specification is to have the manufacturer furnish the equipment and material specified herein complete and operable.

b. All standard accessories to the equipment specified shall be supplied even if not specifically mentioned in this specification.

c. Material used in the fabrication of the specified equipment shall be new, unused, and of the highest quality available.

3. Scope

a. Furnish metal-clad switchgear as detailed below.

b. Any drawings or data sheets attached shall be considered part of this specification.

c. The equipment shall be complete and operable.

d. Provide production tests and inspections as detailed below.

e. To reasonably prevent the possibility of shipping damage, the manufacturer shall prepare the equipment for transportation to the jobsite and monitor the load out of this material.

f. It shall be the responsibility of the manufacturer to furnish all material, connections, splices, links, special tools, and information required to completely reassemble the switchgear in the field or to facilitate the installation of the switchgear when performed by an electrical contractor.

g. Guarantee the performance of the switchgear during a reasonable warranty period. This warranty shall, at a minimum, cover the equipment for eighteen (18) months from the time of shipment or twelve (12) months from date of energization whichever occurs first.

h. Supply all drawings, documentation, and information detailed below.

4. Applicable Codes and Standards

a. The applicable codes and standards listed below shall be considered as part of this requirement.

b. The latest revision in effect at time of contract issuance shall apply for all standards referenced:

i. National Electrical Manufacturers Association (NEMA)
ii. Institute of Electrical and Electronic Engineers (IEEE)
iii. National Electric Code (NEC)
iv. American National Standards Institute, Inc. (ANSI)
   1. ANSI C37.04
   2. ANSI C37.06
   3. ANSI C37.09
   4. ANSI C37.20.2
v. Underwriters Laboratories (UL)
c. It shall be the manufacturer's responsibility to be knowledgeable of these standards and codes.

5. Service and Environmental Conditions
   a. Unless otherwise specified, this equipment is intended for use in ambient temperatures that do not exceed a maximum of forty degrees Celsius (40°C [104°F]) or a minimum of negative thirty degrees Celsius (-30°C [-22°F]).
   b. Construction shall be for indoor or outdoor installation as specified.

6. Basic Construction
   a. The equipment supplied shall be of metal-clad construction using welded, industrial-riveted, or bolted sheet steel. The construction shall be self-supporting and free standing. All metal work shall be free from burrs and sharp edges.
   b. The equipment shall be suitable for industrial or utility service and constructed with an enclosure as specified on the drawings or data sheets.
   c. Each front and rear compartment door shall be provided with a formed steel hinged door with hand operated door latches. Each door shall have provisions for padlocking.
   d. The switchgear shall be capable of extension from either end at a future date without modification to existing structural members.
   e. It shall be the manufacturer's responsibility to coordinate all necessary alignment and interconnection between component sections. The entire assembly shall be electrically and mechanically assembled into one single line-up prior to final inspection and shipment.
   f. The equipment shall be shipped complete, without missing components or "ship shorts".
   g. Purchaser may waive this requirement upon request prior to shipment.
   h. Shipping sections shall be as specified by UCB in the design.
   i. Power circuit breakers shall be shipped and packaged separately from the switchgear structure unless equipment is installed within a PCR (Power Control Room), in which case the bottom located circuit breakers shall be shipped in place.
   j. Louvers may be provided in the switchgear for ventilation or cooling purposes. These openings shall be filtered upon request to retard the entrance of dust. Filters shall be easily removable for maintenance. Louvers and filters, when present, shall be located on the front and rear doors.
   k. The depth of the finished equipment shall be sufficient to allow for entrance, bending, and termination of power cables. Individual units shall be provided for top or bottom entrance as specified. A minimum of twenty-six inches (26”) of clearance between terminal pads and the cable entrance shall be provided.
   l. Each switchgear cubicle shall have, at a minimum, 11-gauge sheet steel side panels. This provides two (2) steel sheets between adjacent sections so as to minimize the chance of fault propagation between sections.
   m. Power circuit breakers and voltage transformer assemblies shall be drawout construction to provide maximum operator safety.
   n. Safety interlocks and barriers as required by ANSI standards shall be provided to prevent personnel from inadvertent exposure to the bus while the switchgear is energized.
o. A continuous silver plated copper ground bus measuring five inches by two inches (5" x 2") shall be
provided for the full length of the switchgear assembly. The ground bus shall be capable of carrying
the rated short circuit current of the installed circuit breakers for a minimum of two (2) seconds.
p. In order to minimize condensation, each cubicle shall have a space heater.
   i. Space heaters for each switchgear bus section may be wired with other space heaters in
      parallel and shall be provided with a single adjustable thermostat to maintain cubicle
temperature at desired levels.

7. Power Circuit Breakers
   a. The power circuit breakers shall be electrically operated, three-pole, drawout type. The interrupting
      medium shall be vacuum.
   b. The circuit breakers shall have an ANSI rating structure based on a K factor of 1.0 and interrupting
      rating of 36kA at 15kV.
   c. The basic insulation level (BIL) of the power circuit breakers shall be not less than 95kV for 15kV
      applications.
   d. The continuous current capacity of each power circuit breaker shall be 1200A, 2000A, or 3000A as
      indicated on the drawings or data sheets.
   e. Primary line and load connections shall be self aligning.
   f. The drawout mechanism shall hold the power circuit breaker rigidly in the fully connected position.
   g. The drawout mechanism shall require less than twenty-five (25) turns to move the circuit breaker
      from the connected to the disconnected positions.
   h. Each circuit breaker will have four (4) wheels to allow for easy maintenance and movement.
   i. No lift truck, rails, ramps, channels, or transport device of any kind shall be required in order to move
      a circuit breaker from floor level to the fully connected position in a one-high structure or the bottom
      located circuit breaker in a two-high structure.
   j. Interlocks shall be provided to prevent the circuit breaker from disconnecting from the main bus
      stabs unless the circuit breaker is open.
   k. The power circuit breaker ground connection shall be capable of carrying the short circuit rating of
      the circuit breaker for a minimum of two (2) seconds and must also be capable of withstanding the
      peak current value (or 2.7 times the rated short circuit current) of the circuit breaker.
   l. A grounded metal shutter system shall automatically cover the line and load stab connections when
      the circuit breaker unit is moved to the disconnected position. The shutter shall be pad-lockable in
      the closed position.
   m. Auxiliary contacts to provide circuit breaker element position indication (Truck Operated Cell
      switch or TOC) and to provide circuit breaker contact position (Mechanism Operated Cell switch or
      MOC) shall be available when specified. Both switch operator and switch shall be visible and
      accessible from the front of the low voltage compartment when the circuit breaker is in the fully
      connected position.
   n. The circuit breaker operating mechanism shall be completely trip free both mechanically and
      electrically. Mechanical tripping of a closed circuit breaker shall be possible with the front cubicle
      door closed.
   o. Control power and control circuit wiring shall be connected to the power circuit breaker by means of
      a sixteen (16) pin front connected umbilical cord and plug. This plug shall be mechanically
      interlocked. The plug shall not be removable while the circuit breaker is in the connected position.
      The circuit breaker shall not be inserted without the plug in place.
   p. For operator safety, the circuit breaker shall have provision for padlocking it in the disconnected
      position.
   q. Each circuit breaker shall have a mechanical operations counter.
   r. Each circuit breaker shall have an easily accessible means for contact wear indication.
s. A steel interference plate shall be mounted in the bottom of each circuit breaker cell assembly which only allows a higher rated circuit breaker (voltage, current, interrupting rating) to be inserted into a lower rated cell assembly.

t. Control power to be 125 volts d.c. trip, close, and spring charging motor

8. Power Bus
a. All bus bars shall be copper.
b. The main power bus shall be silver plated along the entire length to a thickness between 0.0001 inches and 0.0005 inches.
c. The entire bus, except for terminations, shall be completely isolated with metal barriers and insulated as required by ANSI Standards.
d. The main power bus shall be supported on molded cycloaliphatic epoxy insulators and mechanically braced to withstand stresses resulting from current values equivalent to the close and latch rating of the largest circuit breaker in the assembly.
e. Molded cycloaliphatic epoxy inserts are required whenever the bus passes through a barrier of any type on 15 kV applications.
f. Bus joints shall be made with sufficient bolts and torqued to preserve initial contact pressure over the service life of the equipment. Bolts that are torqued to appropriate levels at the factory shall be identified with paint markings. Bolts shall be rated Grade 5 and plated for corrosion resistance.
g. Power bus orientation shall be A-B-C top to bottom, front to back, and left to right when viewed from the front of the switchgear.

9. Instrument Transformers
a. Current Transformers (CT)
   i. Current transformers shall be installed so that they can be easily maintained or replaced from the front of the switchgear without entering the power bus or cable termination compartments. Unless specified otherwise, the polarity marking shall be toward the circuit breaker.
   ii. Each current transformer shall be rated to withstand the thermal and mechanical stresses imposed by the short circuit rating of the applied circuit breaker.
   iii. The secondary termination of current transformers shall be on a shorting terminal block.
   iv. Current transformers shall have a rated five (5) ampere secondary current unless otherwise specified.
   v. Metering and relaying accuracy classification shall be as specified in the data sheets and shall be suitable for the connected burden.
   vi. Current transformers, when installed, shall be fully rated for the appropriate voltage class. Current transformers with 600 volt insulation levels may be used if installed with fully rated insulation barriers such as around primary disconnect bushing assemblies.
b. Voltage Transformers (VT)
   i. Voltage transformers and associated fuse assemblies shall be installed in drawout assemblies so that they may be readily disengaged from the power bus.
   ii. When moved to the withdrawn position, the transformer drawout unit shall automatically ground the transformer primary windings and the fuses. A visible indication of positive ground shall be required. The ground may be a momentary or sweeping action that occurs as the unit moved out of the connected position.
   iii. Voltage transformers shall have 120 volt secondaries unless otherwise specified.
   iv. Voltage transformers shall have an accuracy rating comparable to the metering equipment and a burden capacity equal to twice the initial load.
   v. Current limiting fuse protection shall be provided on the primary side of each voltage transformer.
vi. Voltage transformers shall be designed to withstand the basic impulse level of the switchgear.

c. Control Power Transformers (CPT)
   i. Control power transformers shall be fixed mounted for sizes above 15 kVA with the primary current limiting fuses mounted in a drawout unit.
   ii. When moved to the withdrawn position, the fuse drawout unit shall automatically ground the fuses. A visible indication of positive ground shall be required. The ground may be a momentary or sweeping action that occurs as the unit moves out of the connected position.
   iii. Each control power transformer shall have a secondary molded case circuit breaker interlocked with the drawout assembly so that the load is disconnected prior to drawout.
   iv. All control power transformers shall be provided with two (2) 2.5% taps above and below rated voltage.
   v. Secondary winding shall be 120/240Vac, single phase, 60Hz, 3 wire unless otherwise specified.

10. Control and Secondary Wiring
   a. Control wiring shall be SIS type #14 AWG, 41 strand extra flexible, stranded copper or larger.
   b. Current transformer secondary wiring shall be SIS type #12 AWG, 65 strand, extra flexible, stranded copper or larger.
   c. Current transformer secondary wiring shall terminate on shorting type terminal blocks.
   d. All control wiring shall be UL listed and shall have a VW-1 flame retardant rating.
   e. Exposed wiring shall be suitably protected against contact with sharp edges. Throughout the assembly it shall be neatly bundled and secured with nylon wire ties. Where control wiring passes from cubicle to door it shall be wrapped with suitable protection so as to prevent damage. Holes cut to allow control wires to pass from cubicle to cubicle shall have a grommet for protection.
   f. Splicing of control wire is not permitted. Control wiring must be a continuous length from terminal to terminal.
   g. Each control wire shall be marked at both terminations to agree with wiring diagrams. Plastic wire markers of either the slip on or heat shrink variety shall be provided.
   h. Control wires leaving the cubicle of origin shall first terminate on a terminal block. No control wire may leave a cubicle directly from any other device.
      i. Space heater circuits, if included, are an exception.
   i. Where possible, a minimum of ten percent (10%) spare terminals shall be provided in each cubicle.

11. Meters, Switches, And Relays
   a. Indicating meters shall be one percent (1%) accuracy, four inch (4") square switchboard type, with taut band suspension unless otherwise specified.
   b. Control switches shall be rotary cam type with engraved face plates.
   c. Ammeter and voltmeter transfer switches shall have an off position and shall be provided with knurled knob handles.
   d. Selector type control switches (Auto-Manual or Hand-Off-Auto) shall have oval handles.
   e. Circuit breaker control switches shall have pistol grip handles.
   f. Protective relays shall be of the type, model, and manufacturer specified by UCB.
   g. Current and voltage test plugs for field monitoring and maintenance shall be provided when specified.
   h. Indicating lights shall be provided as shown on the control schemes. Lamps shall be replaceable from the front of the switchgear without opening the cubicle door. Lamps shall be of the LED type.

12. Nameplates
   a. Laminated, plastic, engraved nameplates shall be provided and mounted by stainless steel screws or rivets.

Adopted August 2015
b. Identification nameplates shall be black with white letters, caution nameplates shall be yellow with black letters, and warning nameplates shall be red with white letters.

c. Each externally visible device or component shall have an identification nameplate. Lettering shall be, at a minimum, 5/32 inches in height.

d. Each internal device or component shall have an identification marking.

13. Finishes

a. All steel structure members shall be cleaned, rinsed, and phosphatized prior to painting.

b. The coating process shall be an electrostatically applied polyester powder with a final baked on average thickness between 1.5 and 4.0 mils.

c. Standard exterior finish shall be ANSI 61 light gray.

d. Finish shall have a minimum pencil hardness of 2H as tested per ASTM 03363.

e. Finish shall pass the ASTM 81 17 salt spray test for a minimum of 1000 hours.

f. Finish shall pass impact testing per ASTM 02794 with minimum values of 160 in-lb. For direct impact and 120 in-lb. for reverse impact.

g. Test reports for compliance with the above requirements shall be available upon request.

14. Inspection And Testing

a. Each circuit breaker shall be tested for proper adjustment and operation prior to shipment. The circuit breaker shall be given a minimum of one hundred (100) mechanical operations. Test reports shall be available upon request.

b. Each vacuum interrupter shall receive a vacuum integrity test by means of the system AC high potential test prior to shipment.

c. Each circuit breaker shall have a contact-timing and contact-motion velocity test.

d. Each circuit breaker shall be identified with an individual serial number permanently mounted on the breaker by means of a metal nameplate.

e. The Manufacturer shall maintain permanent records of each circuit breaker produced and the production test results.

f. The component bill of material shall be checked for proper quantity, description, and part number.

g. Physical dimensions shall be checked against approved drawings.

h. Equipment shall be subjected to a primary current injection procedure to determine proper operation of all current sensitive components.

i. Equipment shall be subjected to a primary voltage injection procedure to determine proper operation of all voltage sensitive components.

j. Complete assembly shall have a low frequency withstand (an AC high potential) test performed to assure insulation system integrity.

k. The Manufacturer shall have in place a system of recording, correcting, and verifying resolution of discrepancies discovered during the inspection and testing process. The manufacturer shall be ISO 9001 certified.

l. Certified production test reports indicating satisfactory completion of all inspection and test procedures shall be available upon request.

m. Upon request the equipment shall be made available for inspection prior to shipment.

n. Production tests shall be performed in accordance with ANSI standards C37.20.2 and C37.09.

o. Test reports for design tests shall be available upon request.

15. Documentation

a. Drawings

i. Prior to fabrication, the following drawings shall be submitted by the manufacturer for approval:

1. Front elevation view.

2. Single Line diagram.
3. Base plan including mounting details, cable entry area, and door swing requirements.
4. Cross section view of each different section.
5. Three line diagram.
6. Component bill of material indicating quantity, description, and part number.
7. Control or schematic diagram for each different unit.

ii. Following the return of approval drawings the manufacturer shall prepare and submit wiring diagrams indicating physical location of secondary control components and the appropriate wiring connections. Each control wire shall be labeled. Copies of these drawings shall be submitted to the Owner’s Representative upon completion.

iii. After the return of approval drawings or after any change made to previously approved drawings, the manufacturer shall submit a record copy of any and all drawings that contained revisions.

iv. After completion of the inspection and testing procedures, the manufacturer shall submit a complete set of "As Built" drawings. These drawings shall function as a record of the final construction of the equipment at the time it left the factory.

v. Drawings may be provided in any of the following forms as requested by UCB:
   1. Full size plotted reproducible drawings size as required. "D size" measuring approximately 34" x 22", "C size" measuring approximately 22" x 17", "8 size" measuring approximately 17" x 11", or "A size" measuring approximately 11" x 8".
   2. Three (3) reduced photocopies of original plotted drawings.
   3. Digital files in AutoCAD 2009 (.dwg) or later format.

vi. Each drawing prepared by the manufacturer shall show, at a minimum, the UC Berkeley Project Name, UC Berkeley Project Number, jobsite location, purchase order or contract number, and equipment identification number in addition to any information required by the manufacturer.

b. Operating and Maintenance Manuals
   i. At time of shipment, the manufacturer shall provide six (6) copies of the operating and maintenance instructions for all major components contained in the switchgear assembly.
   ii. Manuals shall contain a table of contents to allow for easy reference.

c. Spare Parts List
   i. Upon completion of the engineering phase, a quotation for one (1) year's recommended spare parts shall be submitted.

d. Spare fuses - medium voltage
   i. Two sets of spare fuses shall be provided for each type of fuse included in each switchgear line-up provided. This would normally require three (3) P.T. fuses and two (2) control power transformer fuses.

e. Accessories
   i. Breaker Truck
   ii. Breaker Test Panel
   iii. Ground and Test Device with cables
   iv. Breaker Racking Tools and Accessories

26 20 00  Low-Voltage Electrical Transmission
26 27 00  Low Voltage Distribution Equipment
26 27 16  Electrical Cabinets and enclosures

1. Lighting And Receptacle Panel Boards
   a. Specify general purpose 20 AMP minimum bolt-on circuit breakers for 120/208 and 277/480 volt panel boards; Eaton, General Electric, or equal. Minimum interrupting capability shall be 10,000
amperes for 120/208 volts and 14,000 amperes for 277/480 volts. Confer with the Campus Electrical Engineer for available fault current levels.

b. When more than one panel board is fed by the same feeder, provide a main circuit breaker in each panel board.

c. Locate all busses in the rear of the panel board cabinet. Mount circuit breakers on suitable supporting members at the front of the cabinet and connected with suitable straps or lugs to the bussing in the rear of the cabinet. Individual circuit breakers shall be removable from the cabinet without disturbing the bussing in any way.

d. Specify door-in-door arrangement. Adjustable trim clamps are not acceptable. Surface mounted panel boards shall have the front mounted on a piano hinge on the right side, with double locked doors.

e. Specify all locks on panel boards in a single building so that all the outer locks of the door-in-door assembly are keyed alike and all the inner locks of the door-in-door assembly are keyed alike, but different from the outer locks.

f. Detail the layout and dimensions of special-sized panel boards on the Drawings.

g. Specify permanent, fade- and weatherproof plastic or vinyl labels for panel boards surfaces and components.

h. Each panel board shall contain three 1-inch spare conduits from panel boards to accessible space above furred ceilings, to allow for use of spare circuits or spaces provided in the panel boards. Spare conduits shall be capped off in accessible space above furred ceilings.

i. Percentage of spares and spaces in panel for future growth shall be thirty percent (30%). Provide hardware and bus taps for installation of future breakers in spaces provided in the panel board.

j. Specify bolted copper bussing. No aluminum allowed.

k. The Contractor shall balance phases during normal building operation.

l. Panel boards shall contain a panel schedule located in a door mounted plastic pouch. The schedule shall contain the following information:

   i. Panel type.
   ii. Building in which panel board is located.
   iii. Location of panel.
   iv. Panel board manufacturer.
   v. Panel bus bracing or interrupting capacity (KAIC).
   vi. Panel board voltage rating.
   vii. Panel board amp rating.
   viii. Feeder wire size.
   ix. Neutral size.
   x. Ground size.
   xi. Conduit size.
   xii. Branch circuit interrupting capacity (KAIC).
   xiii. Branch circuit breaker type.
   xiv. Main breaker type, ampacity, and interrupting capacity (KAIC).
   xv. Wire size, phase, and description of each circuit.
   xvi. Special breaker types such as GFI shall be noted.
   xvii. Identification of PNL and BRK feeding the new PNL.

m. Please refer to Appendix A: Drawings for a sample Panel Board Schedule:

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26 27 26     **Wiring Devices**

2. Corridor Receptacles

   b. In all new buildings and building remodels, provide in all new corridors dedicated 20-amp, 120-volt circuits to feed corridor 20-amp duplex receptacles only. Spacing shall be no more than fifty feet
The maximum distance from any end wall shall be twenty-five feet (25′-0″). The maximum number of outlets per 20-amp circuit shall be six (6).

3. Wiring Devices
   a. Wall (Local) Switches: Totally enclosed, AC rated, premium industrial specification grade, ivory, or match existing finish. 120/277V, 20 amps. Leviton (catalog numbers), Sierra, Hubbell, or equal.

   | Single Pole Switches | #1221-2 I | 20 amps | 277V |
   | Two Pole Switches    | #1222-2 I | 20 amps | 277V |
   | Three Pole Switches  | #1223-2 I | 20 amps | 277V |

   b. Dimmers: Commercial grade, 120V, 2000 watt or 20 amps minimum rating. Lutron, or equal is campus standard for all dimming systems.
   c. Duplex Convenience Receptacles: premium industrial grade 3-wire grounded, nylon face, rated 20 amps, 125V. All receptacles connected to the emergency circuit shall have red colored outlets, and red metal cover plates. All receptacles incorporating an isolated grounding conductor connection shall be identified by an orange triangle located on the face of the receptacle. All other devices shall be ivory or match existing face.
   d. Ground Fault Circuit Interrupter (GFCI) receptacles: 3 wire grounded, ivory, or match existing finish, rated 20 amps, 125V, Hubbell, Leviton or equal. Provide waterproof lift cover for outdoor installation.
   e. Exterior lighting shall be on photocell control, used in conjunction with a lighting contactor. A bypass spring-wound timer with “hold” feature shall be installed to enable trouble-shooting.
   f. For exterior outlets in plazas or patios, electricity output shall be denied via a timer or switch between 10pm and 6am.

26 28 00 Low-Voltage Circuit Protective Devices

27 28 16.13/16 Enclosed Switches and Circuit Breakers

1. Circuit Breakers
   a. Provide molded case circuit breakers conforming to Underwriters’ Laboratories, Inc. (UL) 489:
      i. Breaker shall be thermal-magnetic type or micro processor based; General Electric, Cutler Hammer, Siemens or Square D.
      ii. Adjacent poles shall be connected to phases A,B,C, respectively.
      iii. Minimum symmetrical interrupting current rating shall be as indicated on drawings.
      iv. Connectors shall be designed for use with copper conductors.
      v. Mounting shall be “bolt-on” type, removable without disturbing any other breaker.

2. Safety Disconnect Switches
   a. Heavy duty type, 600v, HP rated for motors, standard enclosure indoors and weathertight outdoors; fused or non-fused as required; General Electric, Square D, or equal.
   b. All disconnect switches shall be National Electrical Manufacturers Association (NEMA) Type HD; lockable in the “OFF” position. Switches shall have a dual cover interlock to prevent unauthorized opening of the switch door when the handle is in the “On” position, and to prevent closing of the switch mechanism with the door open. Provide defeater mechanism to bypass this mechanism.
1. General Requirements
   a. Gutter-mounted motor control centers consisting of starters and fused switches are not acceptable. Provide circuit protection in the form of circuit breakers mounted in suitable panels. Provide safety disconnect switches per code at all remote motor locations. Motor starting controls may be centralized in a single panel if a sufficient number is involved. Comply with requirements of the Energy Management Control System for wiring, fusing, and related work.
   b. For motor control centers serving loads at voltages above 120 volts, use 120 volt control circuit furnished by a control transformer within the motor control center and connected to the bus. Motor control centers shall be General Electric, Allen-Bradley, Westinghouse, or equal.
   c. In buildings with large equipment power demands, limit building restart load after power interruptions. Use three (3) wire protection on all large motors such as supply and exhaust fans and other equipment susceptible to damage from automatic restarts. Discuss which motors should have this type protection with Construction & Design (C&D).
   d. Motor starters for critical applications require solid state overload relays with single-phase protection. Without single-phase protection, motors will burn out when source power loses a phase. The solid-state type overload relay provides both of these protections since it monitors the actual current the motor is drawing with built-in phase loss protection.
   e. Motor starters for non-critical applications may utilize thermal overload heater-type relays.

2. Description
   a. Each individual mounted motor starter and starters mounted in Motor Control Centers shall be National Electrical Manufacturers Association (NEMA) or International Electrotechnical Commission (IEC) rated.

3. Individual Mounted Starters
   a. Control Voltage shall be 120VAC. Individual mounted starters shall have control transformer within the enclosure unless motor voltage is 120VAC. Control circuits shall be disconnected when the disconnecting means is in the open position (Ref. 99 NEC 430-71 and 430-74), a minimum of two (2) control circuit disconnect contacts shall be provided; one for the starter and one for other circuits fed through the starter auxiliary contact. Common control circuits for multiple buckets and/or controllers are not acceptable.
   b. All three-phase motor starters shall be individually mounted and/or in MCCs.
   c. Auxiliary Contacts: Each starter to have a minimum of two (2) NO and two (2) NC auxiliary contacts with provision to add a minimum of two (2) more.
   d. Overload Relay: Electronic Solid State type, with phase loss protection, short circuit protection, and FLA adjustable trip over 2:1 range. Thermal overload, heater-type relays may be used as an alternative, with UC Berkeley Campus Electrical Engineer pre-approval.
   e. Start/Stop: Standard configuration shall be 3-wire start/stop mounted in cover. Refer to Division 25: Integrated Automation for more details. In special circumstances, H-O-A may be required. Consult with UCB Owner’s Representative.
   f. Pilot Light: Provide with RED and GREEN pilot lights mounted in the cover. The pilot light lamp shall be LED type. RED means motor on and GREEN means motor off.
   g. All starters shall have disconnect switches.

4. Manufacturer and Vendor
   a. Starters with Electronic Overload Relays:
      i. Manufacturers:
1. Siemens
2. Cutler Hammer
3. Allen Bradley
4. General Electric
5. Schneider/Square D

b. Separately Mounted Starters:
   i. Starters for fractional horsepower 120V motors shall be manual type unless shown otherwise, equipped with built-in overload protection and pilot light:
   ii. Manufacturers:
       1. Siemens
       2. Cutler Hammer
       3. Allen Bradley
       4. General Electric
       5. Schneider/Square D

c. Pilot Lamps, LED Type:
   i. Manufacturer:
       1. Ledtronics, Inc., or equal.

26 29 23 Variable-Frequency Motor Controllers

1. Scope Of Work
   a. These guidelines define the minimum performance requirements for Variable Frequency Drive (VFD) assemblies for use on a standard NEMA Design B induction motor.

2. Information Required Of Bidders
   a. Bidding Documents shall require each bidder to provide names, addresses and phone numbers of not less than ten (10) existing installations in the immediate geographical area.
   b. Each bidder shall list any exceptions to these guidelines. If no departures are listed with the bid, the Contractor shall be bound by the Specifications.

3. Warranty/Guarantee
   a. The VFD shall be warranted against defects in material and workmanship for at least one (1) year after Project acceptance.
   b. Additional warranty coverage shall be available in the form of an annual service agreement at an annual fee based on the capacity of the VFD.

4. Quality Assurance
   a. Each VFD shall be designed and manufactured in accordance with the latest revisions of the following applicable codes and standards:
       i. Institute of Electrical and Electronic Engineers (IEEE).
       iii. American National Standards Institute (ANSI)
       iv. Underwriters Laboratory, Inc. (UL)
       v. UL Standard 508, Electrical Industrial Control Equipment
       vi. Canadian Standards Association (CSA)
       viii. National Electrical Manufacturer’s Association (NEMA) ISC 6, Enclosures for Industrial Controls and Systems.
   b. The VFD shall be UL listed, as one (1) entire assembly, and bear the UL label.
   c. Circuit boards shall be completely tested and burned-in prior to assembly into the completed VFD.
d. The VFD manufacturer shall have a failure analysis laboratory to evaluate the failure of any component.
e. A site-specific preliminary harmonic analysis, showing total voltage harmonic distortion (THD) and total current harmonic distortion without additional external devices or external filters shall be submitted by the VFD manufacturer for approval by the Owner’s Representative. Power quality shall be a key factor when reviewing a proposal. Preliminary analysis shall be accepted by UCB prior to drive purchase. Compliance shall be empirically verified by the VFD manufacturer with onsite field measurements of the harmonic distortion at the point of common coupling with and without VFD’s operating. The building distribution transformer(s) shall be the point of common coupling. In the event that field measurements demonstrate that harmonic distortion exceeds the levels claimed by the VFD manufacturer, the VFD manufacturer shall provide and install (at no additional cost to the University) the equipment required to reduce harmonic distortion to acceptable levels.

5. Manufacturers
   a. The following VFD manufacturers shall be considered to be of acceptable quality. Certain models by the following manufacturers may or may not meet the requirements of these specifications. Consult with UC Berkeley Electrical Engineer.
      i. Asea Brown Boveri (ABB)
      ii. T. B. Woods
      iii. Toshiba
      iv. Safetronics
      v. Danfoss Graham

6. General Requirements
   a. The VFD shall be of an advanced Pulse Width Modulation (PWM) type capable of achieving full motor performance with no derating of motor output due to current waveform distortion. The VFD shall be capable of operating multiple motors in parallel with the ability to switch motors on and off independently via external contactors. In addition, the VFD shall include the following ratings, adjustments, and parameters:
      i. Power Unit Rating: one hundred percent (100%) continuous, one hundred ten percent (110%) intermittent for one (1) minute when previously operating at full load.
      ii. Minimum Efficiency: ninety percent (90%) at maximum output; eighty-five percent (85%) at fifty percent (50%) output
      iii. Rated Input Voltage: 480V, 3 phase, 60Hz and 208V 60Hz available.
      iv. Output Voltage: 0-480V or 0-230V 60Hz.
      v. Allowable Wire Length to Motor: 200 ft. (unless VFD schedule shows greater wire length)
   b. The VFD shall be capable of operating in the following service conditions:
      i. Ambient Temperature: 0 to 40 degrees C (32 to 104 degrees F)
      ii. Relative Humidity: 0 to 95 percent, non-condensing.
      iii. Elevation: 0 to 3300 feet (100 meters) above MSL.
      iv. AC line Voltage Variation:
         1. 480 V: Minus 5 percent to plus 10 percent; 58-62 Hz.
         2. 208 V: Minus 5 percent to plus 10 percent; 58-62Hz.
      v. Singularly, each VFD shall produce a maximum of three percent (3%) harmonic voltage distortion (THD) without additional external devices or external filters, and simultaneous operation of multiple VFD’S shall not add more than five percent (5%) total harmonic voltage distortion back to the bus when measured at the point of common coupling without additional external devices or external filters. The building distribution transformer(s) shall be the point of common coupling.
7. Adjustments - Auto, Manual, Bypass
   a. The VFD shall operate in the AUTO or MANUAL modes and, as a minimum, shall include the following front panel mounted switches and indicators:
      i. Local/Remote switch.
      iii. Manual allowing speed control.
      iv. Run/Stop Switch.
      v. Fwd/Rev Switch.
      vi. Power on and run indicator.
      vii. Fault indication including: current limit, overvoltage, undervoltage, overload, or thermal motor protection.
   b. The VFD shall have provisions to lock out unauthorized access to alter or reprogram the VFD’s setpoints.

8. Control Requirements
   a. The VFD shall be capable of operation with either a two-wire maintained contact motor control circuit or a three-wire start/stop momentary contact motor control circuit. In addition, the VFD must accept the inputs and provide the outputs listed below:
      i. Communicator to DDC, interface with BACNET.
      ii. Analog Input: 0-LOVdc, 0-20mA, 4-20mA, 20-0mA or 20-4mA. Linearity deviation between control signal and motor speed: Plus or minus one percent (1%) of rated motor speed.
      iii. Digital Inputs: Four (4) each programmable for reset, start, stop, quick stop, change to preset speed, change parameter set, increase speed, decrease speed, current limit over ride.
      iv. Analog Outputs: Four (4) each programmable to provide 0-20mA or 4-20mA proportional to frequency, torque, current or power (Kw.)
      v. Digital Outputs: Two (2) each programmable to indicate ready, run, trip, current above preset, frequency above preset, or electronic thermal overload.

9. Manual By-Pass
   a. A manual bypass device shall be provided for all VFDs that control motors used in any of the following circumstances: 1) Ventilation in laboratories; 2) Ventilation in animal laboratories or rooms; and motors fed from wire size #8 and larger. In terms of horsepower, that means that 460 volt motors 25 hp or larger require a by-pass device. Similarly, 208 volt motors 15 hp or large require a by-pass device.
   b. Manual transfer to line power shall be via 3 contactors sized for applicable voltage and motor current. One contactor shall be between the VFD output and the motor. The second shall be between the by-pass power line and the motor, providing across-the-line starting. The third contactor shall be between the line voltage and VFD input. Transferring load via contactors shall disconnect VFD inputs from line voltage and outputs from the motor, thus providing the ability to safely trouble shoot and test the VFD while operating in the by-pass mode. A fused disconnect switch is required. By-pass and VFD output contactors shall be electrically and mechanically interlocked to prevent both being closed at the same time. Include motor thermal overload protection in bypass and VFD modes.
   c. Door mounted status lights shall include power on, drive, and by-pass.
   d. Provide a terminal strip for connection of fire, smoke contacts, external start command, and VFD control signal. All external interlocks shall function in hand, auto, or by-pass. External start/stop signal shall be functional in auto and by-pass modes.
   e. 120VAC control power to be supplied by a fused transformer.
   f. Manual by-pass and accessories to be furnished and mounted by the VFD manufacturer.
10. Automatic By-Pass With Magnetic Contactors
   a. In rare applications, such as critical service pumps with no secondary pump for backup, the VFD shall be specified with automatic bypass. The automatic bypass shall include all of the features specified in the manual bypass plus the following additional feature:
      i. Output from the VFD run contact shall control the contactors so that a VFD failure shall automatically transfer the motor to across-the-line starting.

11. Start-Up Commissioning
   a. The manufacturer shall provide start-up commissioning of the VFD and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. The commissioning personnel shall be the same personnel that will provide the factory service and warranty repairs at the Owner’s site. Sales personnel and other agents who are not factory certified technicians for VFD field repair shall not be acceptable as commissioning agents.
   b. Start-up services shall include checking for proper operation and installation of the VFD, its options and its interface wiring to the building automation system. At a minimum, this service shall include:
      i. Verification of wire terminations to the VFD and its optional circuitry.
      ii. Up to one (1) hour per drive of operator training of operation and service diagnostics at the time of equipment commissioning.
      iii. Measurement for verification of proper operation on each of the following items:
          1. Motor voltage and frequency. Verify proper motor operation.
          2. Control input for proper building automation system interface and control calibration.
          3. Calibration for the following set points (and adjust as necessary): minimum speed, maximum speed; acceleration and deceleration rates.
      iv. Three hard copies and one electronic copy (PDF format) of all Operation and Maintenance Manuals shall be provided for each unit.

12. Shaft Grounding
   a. Shaft Grounding on all VFDs is required.
   b. Modern AC or DC variable speed motors have been shown to develop an electrical potential between the shaft and the frame of the motor. There are two different approaches to shaft grounding depending on whether the installation is new, or a retrofit. For new motor installations, a shaft grounding ring shall be factory installed. The ring is installed behind the end plate to keep it protected from the environment. An example of this installation is the Baldor Super-E motor.
   c. For retrofits of existing motors, the following shall be installed:
      ii. Manufacturer: Shaft Grounding Systems, Inc., or equal.
      iv. Trade Name: Shaft Grounding System.
      v. Manufacturer Code Identification: See specific model number.
      vi. Materials: The products manufactured by Shaft Grounding Systems contain only stable materials commonly used within industry. These are not believed to constitute a hazardous material under Office of Safety and Health Act (OSHA) regulations.
      vii. Brushes: Specifically developed proprietary carbon compounds are used in Shaft Grounding Systems to ensure sustained performance. At present, the brush wear life expectancy is from three (3) to five (5) years based upon data obtained from running these brushes for over two (2) years in continuous industrial applications.
      viii. Seals: In systems designed for wet, or severe, environment applications, the brush contact area is sealed to keep contaminants from entering the Shaft Grounding System. The proper use of Shaft Grounding Systems will generate very small amounts of particulate wear products. In systems designed for Clean Room use, the wear products are contained within a special enclosure within the Shaft Grounding System. This makes the clean room systems
suitable for use in all Clean Room air handling applications. The wear products are from the carbon based electrical brush and the bronze material upon which the brush makes contact.

ix. Performance: The Shaft Grounding System is designed to reduce shaft voltage levels to less than three (3) volts typically required for current to pass through bearings. Shaft voltages without Shaft Grounding Systems typically range from three (3) to thirty (30) volts, or higher.

26 30 00 Facility Electrical Power Generating and Storing Equipment
26 36 00 Transfer Switches
26 36 23 *Automatic Transfer Switches*

1. Transfer Switch Shall:
   a. Have a full rated neutral with lugs for NORMAL, EMERGENCY and LOAD neutral conductors inside cabinet (4-pole with a switched neutral).
   b. Be equipped with direct acting linear operators for simple, reliable and fast acting during automatic operation.
   c. Be factory equipped with the programmed transition delay feature. This feature shall provide a field adjustable time delay during switching in both directions, during which time the load is isolated from both power sources, to allow residual voltage of motors or other inductive loads (such as transformers) to decay before completing the switching cycle. The programmed transition feature shall have an adjustable time of 0 to 7.5 seconds minimum.
   d. Have signal before transfer contacts, adjustable from 0.1 to 10 seconds, to send a signal to elevators or other controls prior to transfer.
   e. Have a bypass/isolation feature to allow racking out of the ATS for inspection and service without interruption of electrical service. This requirement may be waived in smaller, non-critical and non-research facilities. Consult with Campus Electrical Engineer.

2. Front Panel Devices
   a. Provide devices mounted on front of main cabinet door consisting of switch position indicator lights, white NORMAL, amber EMERGENCY, normal source available green, emergency source available red, and key operated switch to provide the following positions and functions.
      i. TEST: Simulated normal power loss to control unit for testing of generator set, including transfer of load.
   b. Provide ammeter, voltmeter, and frequency meters.

3. Manufacturer
   a. Suggested Manufacturer: Cummins-Onan Power Generating Systems, ASCO, Russelectric, or equal.
1. Lighting Luminance
   a. The Project shall meet the current requirements of Title 24 2013. The Owner's Representative shall submit documentation of this compliance.
   b. General illumination levels shall be based on the latest standards published by the Illuminating Engineering Society of North America. Consult with Construction & Design (C&D) for certain areas where lower illuminance is acceptable for energy savings. Lighting calculations shall be based on actual predicted reflectances in coordination with the architect and/or landscape architect. Where actual reflectances cannot be determined, use realistic maintained average values for ceiling, wall, and floor reflectances. The designer shall submit calculations and documentation of target luminance.
   c. Suggested values for maintained average illuminance readings in typical spaces are as follows:
      i. Classrooms - 30 fc.
      ii. Offices - 30 fc.
      iii. Laboratories - 50 fc.
      v. Pedestrian pathways and plazas - .5 fc
      vi. Fire Marshal-designated building entries and entry paths – 1 fc
      vii. Consult with the annual Campus Safety Guide prepared by the UCPD concerning designated night time walking routes or with the Campus Landscape Architect.
   d. The Illuminating Engineering Society (IES) light levels recommended in its Lighting Handbook shall be used as a guide for campus outdoor lighting. Campuses shall also consider IES activity levels (high, medium, and low) in the design of lighting in open parking facilities. These activity levels reflect both vehicular and pedestrian activity. In open parking situations, the majority of a campus' activities are categorized as "low activity" ("Educational Facility Parking"). However, there may be some open parking situations that are classified as "Medium Activity" (residential complex parking or cultural, civic, or recreational events).
   e. Local blackboard lighting is normally undesirable. General lighting may be concentrated near blackboards for increased vertical illumination.
   f. Entire building lighting (or portion thereof) may be controlled by a combination of timeclock, occupancy sensors, and photosensors integrated with a building lighting management system, by Wattstopper or equal. See Appendix A: Drawings for typical schematic diagram.
   g. Photocell shall be mounted at a workable height and location.

2. Green Building
   a. This section may allow for LEED-CL v2.0 credit in the following categories: SS 8, EQ 6.1, and ID1.

26 51 00 Interior Lighting

1. Circulation Area Lighting:
   a. Stairwell fixtures shall be easily accessible for maintenance and shall provide illumination in accordance with current IES recommendations.
   b. Provide emergency egress lighting in each stairwell and corridor to meet minimum light level and duration requirements as required by the latest edition of the California Building Code.
   c. Locate light switches for lobbies, corridors, stairwells and similar circulation areas to accommodate persons entering or leaving the building at night. Locate switches to turn on lights ahead and turn off lights behind as the person moves through the building. Provide an automatic switch at each elevator landing to control corridor lights to meet this requirement per elevator code requirements.
   d. Design corridor light circuits so that a small number can be left on for night service and for extended building shutdowns, such as the winter holiday/energy curtailment period. This typically requires an
active fixture at each change of corridor direction. The non-active fixtures shall be circuit to be controlled by a timeclock, photocell, or Lighting Management System.

e. Provide appropriate circuiting and either photoelectric, timeclock, or Lighting Management System switching for daylighted portions of circulation areas, so that fixtures in these areas will normally be off during the daytime.

26 51 13 Interior Lighting Fixtures, Lamps and Ballasts

1. Lighting Fixtures:
   a. Select lighting fixtures on the basis of energy efficiency, function, ease of maintenance, and aesthetic requirements. Coordinate the energy requirements of these guidelines, general fixture type, daylighting, and probable surface materials in the schematic design stage. The fixture selection, layout, power density calculations, and illuminance calculations shall be checked by the Design Consultant.
   b. Indirect lighting fixtures, or other approved low illuminance fixtures are desirable in spaces with computer monitors.
   c. Fixtures with four or more fluorescent lamps shall not be specified because of their inherent inefficiency. Consider fixtures manufactured with LED lamps or specular metal reflectors to improve efficiency.
   d. Fluorescent fixture lenses shall be clear virgin acrylic, conical-prism, injection-molded.
   e. Fixtures for special close work tasks shall illuminate the task area only.
   f. Support all lighting fixtures to resist both gravitational and seismic forces in compliance with code requirements. Additionally, comply with other seismic requirements in this Division as applicable.
   g. When mounting fluorescent fixtures to existing ceiling junction boxes, the junction box shall be accessible without removal of the fixture.
   h. Do not mount fixtures against combustible surfaces without approved spacers as listed in the UFC, the NEC, and the CBC.
   i. Provide a grid, screen, panel, acrylic lens, or other device, to prevent a dislodged lamp from falling out of the fixture.
   j. Fixtures shall be clearly and permanently marked with the UL label and the manufacturer's name and model number.
   k. Provide local switching in all rooms except for special cases such as auditoriums, libraries, and theaters. Central switching for such spaces shall comply with code requirements and approved by the Facilities Services Utilities and Engineering Shop. Programmed control of lighting must be accomplished by means of campus EMS, or by dedicated Lighting Management System by Wattstopper, or approved equal.
   l. To conserve energy, switch all areas separately, and provide convenient switches for areas with different use patterns. Consider occupancy sensors for classrooms, circulation areas, lounges, and other spaces in which occupants do not feel ownership and are likely not to turn off the lights.
   m. Check and coordinate lighting fixtures with other ceiling elements including fire sprinkler layouts, mechanical diffusers, grilles, speakers, smoke detectors, clearances to structure, insulation, ductwork and piping with the architect and mechanical engineer. Obtain approval from the Campus Fire Marshal for the combined system.
   n. In remodel work that involves significant light fixture replacement, require the contractor to provide the University with copies of fixture invoices, to facilitate the University's applications for rebates from PG&E.

2. Lamps:
a. Exceptions to the following standards shall be approved prior to the start of the design phase by Facilities Services Electrical Shop.
b. Specify LED, fluorescent or metal halide lamps unless otherwise approved.
c. The standard fluorescent tube is a four foot (4’-0”) , 4100 Kelvin color temperature, bi-pin, 28 Watt T-8 lamp, 35,000 hour minimum lifetime at twelve (12) hours start. The use of four-foot (4’-0”) T5 lamps is prohibited. Use of T-5 lamps is limited to compact fluorescent recessed cans, and wall sconces.
d. LED lamps shall be used whenever possible in place of incandescent or compact fluorescent lamps, and shall be used whenever possible in place of high intensity discharge lamps, with similar color temperature and illuminance.
e. High Intensity Discharge (to be used only when an LED fixture is not feasible):
   i. Use of mercury vapor lighting fixtures is prohibited.
   ii. Metal halide lamps shall be coated type.
   iii. High-pressure sodium lamps, unless otherwise approved in writing, shall be used only in areas of non-critical viewing tasks such as parking lots. Use color-corrected lamps where possible.
   iv. Specify Venture, GE/Sylvania, Phillips or equal.
f. All lamps shall be new and properly operating at the time of acceptance of the electrical work.

3. Lamp Ballasts:
   a. Ballasts for T-8 lamps shall be high-frequency solid state, high-power factor, class A with auto-resetting built-in thermal protection, such as manufactured by Universal Triad, Osram Sylvania, Advance, or approved equal. Program start ballasts shall be specified in spaces with occupancy sensors. Note: A lower factor ballast may be selected for use in particular spaces that require lower illuminance.
   b. Ballasts shall be quiet operating, with provision for easy removal of defective or noisy units. Specify A sound rated ballasts, except as otherwise approved.
   c. Ballasts shall meet State of California standards in effect for the Project and other national standards if applicable to electronic ballasts. In addition, ballasts shall be UL-listed.
   d. Ballasts for metal halide shall be pulse start, unless otherwise noted in these standards.

26 52 00 Emergency Lighting

1. Emergency Lighting Systems
   a. In addition to code requirements, install emergency lighting systems where required for personnel safety. Provide central battery or engine generator type or separate battery-powered portable type depending on the application. Discuss with Construction & Design (C&D).

2. Emergency Exit Signs
   a. Signs shall be Light Emitting Diode (L.E.D.) exit sign by Hubbell Prescolite or equal.
   b. ADA compliance
      i. A tactile sign stating EXIT and complying with ICC A117.1 shall be provided adjacent to each door, no more than four inches (4”) from the door jam, to an egress stairway, an exit passageway, or the exit discharge.
      1. Mount sixty inches (60”) above floor to centerline.
      2. Braille must be grade two (2) or better.
   c. Visibility compliance
      i. Green on White background will be the standard for all Exit Signage installed.
      ii. Routes must be marked every one hundred feet (100’-0”) with illuminated lighting.
iii. Minimum luminance must be fifty (50) lux on the face of the sign and 1 ft-candle (10 lux) at any point, .1 ft-candle at the floor level. Levels may decline by no more than 60% over the 1.5 hour minimum lighting period.
iv. Signs shall be no more than two hundred feet (200'-0") apart in a corridor.
v. Signs shall be clearly visible along the exit route.
vi. No other high visibility signs may be located in proximity the Exit signs.
vii. Signs may flash upon activation of Fire Alarm.

d. Code applications
   i. An Exit sign shall be at every exit door.
   ii. Directional Exit signs are required at intersection of all corridors, exits to stair and exits to ramps.
   iii. Signs shall be of Non-flammable material.
   iv. Areas directly outside of Exit Discharge must be illuminated.
   v. Exit Discharge must be illuminated, with emergency lighting, when building is on emergency power.
   vi. Illuminated signs shall be UL924 listed.
   vii. Exit Signs are not required for any room or building having an occupant load of fifty (50) or less.
   viii. All supplied exit signs shall include a self-test feature to auto run required monthly and annual system tests and provide visible indication (LED) that tests have run and are successful.

e. “No Exit” Door Sign requirements:
   i. Doors located close to egress doors that can be mistaken for an exit must be identified as “NO EXIT”.
   ii. Code requires the “No” to be at least two inches (2") high and the “Exit” to be at least one inch (1") high so the occupants will focus on the “NO” and not the “EXIT.” Furthermore, “NO” must be proportionally twice as high as the word “EXIT” on “NO EXIT” signs.

26 56 00 Exterior Lighting

1. General:
   a. For landscape development, include a conduit system to an exterior electric hand hold and provide panel board circuits in the building for landscape lighting. Consult with Construction & Design (C&D) for sizing and location.
   b. Outdoor lighting to be on emergency power wherever available.
   c. Use clear globe with phosphorous lamps or frosted globe with clear lamps as approved by UCB Landscape Architect.
   d. Integrally designed architectural lighting or free standing pedestrian lighting is preferred around structures. Wall pack lighting is not preferred, but where necessary they shall use metal halide lamps. All light fixtures shall include cut-off shields as needed to prevent light trespass into neighboring off-campus areas.
   e. Use Type 5 reflectors for general lighting and Type 3 reflectors for pathway lighting.
   f. Street and path lighting shall be on staggered circuits to ensure that any two (2) adjacent fixtures will be on different circuits. All pole lights shall be individually fused.
   g. Lighting circuits shall be activated and deactivated by a photoelectric cell which controls a lighting contact. A by-pass with spring wound, twelve (12) hour timer shall be installed to enable troubleshooting. Brand: Intermatic, Model: FF12HHC, Description: 12 Hour Time Limit with Hold. See Appendix A: Drawings for a typical schematic detail.
   h. Conduit size shall be 1-inch minimum. Materials shall be as follows.
     i. Rigid conduit, wrapped or PVC coated.
     ii. PVC, Sch 80 meeting proper depth requirements by NEC.
iii. High Density Polyethylene (HDPE)
   i. Minimum wire size shall be #8 AWG copper stranded wire between the source and the first pole and between poles.
   j. Lights for dumpster areas shall be operated by motion detectors.
   k. Subgrade installed uplights gradually develop moisture issues and are difficult to maintain.
   l. Uplights mounted above grade are preferred.
   m. Distance between lighting and vegetation shall not be less than five feet (5’-0”).
   n. Pedestrian area lighting shall be downlit.
   o. For ornamental/architectural lightings of historical buildings and lights in fountains, consult with the Campus Landscape Architect.
   p. Shoebox luminaries are acceptable at parking lots off of the central campus.

2. Lamps:
   a. 5000K post top retrofit system, type 3 or 5, distribution, 5,000K. Philips Lighting or approved equivalent.

3. Fixtures:
   a. Sentry Electric Corp #SBP-175HM-PTA-120-BT (III or V depending on refraction) – Fcast aluminum decorative luninaire, black finish, polycarbonate diffuser globe with installed Philips Lighting, 5,000K LED, and 3” post yoke or approved equivalent.

26 56 13 Lighting Poles and Standards

1. Cast iron fluted poles shall be thirteen feet (13’-0”) high, Sentry pole SC120-AYN-13 as supplied by Sierra West Sales located in Hayward, CA. This is a special casting for the University of California, Berkeley campus. Factory prime and paint on site to campus standards (“Elephant Breath Gray”). Set concrete footings flush with grade in paved areas. Footings shall be twenty-two inches (22”) in diameter by forty-eight inches (48”) deep. For double-headed lights, use Sentry decorative cross arm model: SAL-T-Black. Use of other materials as aluminum or polycarbonate may be allowed as approved by the Campus Landscape Architect.

2. Post spacing shall ensure sustainable, required application head to head foot-candle coverage.

3. Hand holes are sufficient at each pole. In areas where the distance between poles exceeded one hundred feet (100’-0”), concrete pull boxes shall be installed.

4. Conduit runs to contain a proper sized grounding conductor. The grounding conductor shall be bare and bonded to each pole. Ground the circuit at the source panel.

5. Each pole shall have a water-tight in-line fuse.
The specifications for communication systems and its support infrastructure are detailed in the Information Services & Technology (IS&T) Telecommunication Standards (http://ist.berkeley.edu/telecom/nsd/pm-sd/standards). Questions regarding their implementation should be directed to cns-projects@berkeley.edu.

For any work that affects telephone systems, consult the Campus Wired Phone Policy: http://campuspol.berkeley.edu/policies/wiredphones.pdf
1. General Information
   a. The following pages provide a general specification format for card access control systems being installed on the Berkeley campus. The Specification format provides areas for a user to insert appropriate details for the specific installation. Most of this detail will be provided through analysis of the UC Police Department Crime Prevention Security Survey of the area to be controlled.
   b. All card access control systems interconnected to the University of California Police Department (UCPD) must meet the technical requirements of this Specification to provide required stability, and compatibility required for interconnect to the Police Department's computer.
      i. Description: Provide general description of project in this section.
      ii. The Contractor shall be an authorized dealer for Software House hardware and Hughes Identification Devices, and be thoroughly familiar with all aspects of the access control hardware.
      iii. Coordinate final devices with the architect's hardware consultant.
      iv. The Contractor shall be thoroughly familiar with the operation of the CCURE System 1 Plus access control software manufactured by Software Housing of Cambridge, MA.
      v. Coordination with Management: All work on systems described herein shall be completed in coordination with building management and University of California Police Department Crime Prevention Bureau personnel to provide a consistent level of service. Coordinate closely with the University Project Manager to obtain latest system requirements, to develop scope of work, and to obtain list of pre-approved vendors.
      vi. University of California Representatives and On-Site Inspections:
          1. Questions on content of this Specification, bid variance or other modifications, all required responses and submittals shall be directed to the University Project Manager.
          2. Arrangements for on-site inspections and for answers to technical questions related to equipment or specifications for installation, modification, or repair work to be performed as part of this contract shall be directed to the University Project Manager who will coordinate with the University of California Police Department.

2. Automated Access Control Equipment
   a. Description:
      i. This chapter describes acceptable automated access control hardware for use where such hardware is referenced hereafter in this Specification.
      ii. The system shall operate on a proximity principle where card insertion in a reading device is not required.
      iii. All access devices are to be mounted per ADA height requirements.
   b. Equipment Performance:
      i. The access controller shall be an intelligent access control and alarm monitoring microprocessor based unit. It shall accommodate the following functions at a minimum:
         1. Eight (8) external card reading sensors.
2. Eight (8) supervised general purpose input points.
3. Sixteen (16) supervised input points.
4. Eight (8) programmable relay output points.
5. Direct connect or dial-up communication mode.
6. The approved panel shall be the Software House Istar Pro.

ii. Proximity Card Reading Sensors:
1. The proximity card reading sensors shall be vandal-proof and weatherproof sealed solid state units having no slots or other openings.
2. It shall read the ID credential when it is held within 4 - 5.5² (10 - 14 cm) of its surface and transmit this unique ID to the proximity card reader module.
3. Readers to be installed per manufacturer’s specifications; some readers cannot be mounted on metal.
4. The sensors shall be designed to operate properly within the temperature range of -22 to 150 degrees F (-30 to 65 degrees C) and within a relative humidity range of 0 - 95% noncondensing. No special housing or treatment shall be required for outdoor use.
5. Physical damage, including breaking open of the sensor housing, shall not allow a perpetrator access to any circuitry which would allow the system to be compromised.
6. Transmission of any frequency (or set of frequencies) in the sensor at any power level shall not compromise the system.
7. Presentation of an invalid set of frequencies (such as would occur if a perpetrator were attempting to pick the system) shall temporarily disable the sensor - thus eliminating the possibility of sweeping the system and finding a valid combination.
8. The approved proximity card reader shall be HID R-class Multi-tech reader or Software House Multi-format proximity reader, whichever is most appropriate for the application.

iii. Elevator Controlled Units:
1. The Contractor shall use self-supporting Software House approved elevator traveler cable.
2. There shall be a totally functional elevator override system for Fire Department or service use.
3. The elevator shall be installed to shut itself down during a fire alarm, with no instructions from the system computer.
4. For non-secure buildings, the system shall be hard-wired into the fire system panel to automatically unlock doors during a fire alarm.

iv. Proximity Command Key:
1. The ID credential shall be a credit card size passive component with the coding technique contained inside: i.e., not visible from the outside.
2. It shall be warranted for at least fifteen (15) months under normal use conditions.
3. Each key shall contain a number not shared with any other key in that system.
4. Proximity card formats are 26-bit Wiegand and Corporate 1000, issued by the Cal-1 Card Office.

v. Modems:
1. Modems are not permitted. Card access panels shall communicate via IP addressing.

vi. Housing: All equipment shall be housed in a local door junction box, with a key lock

vii. Power Modules:
1. The power modules shall provide for converting the available commercial power to the power required by the proximity card readers, as well as power on/off switching, fault protection, and power on indication. The wiring between the power module and the powered device(s) shall be integral and require only a plug in connection.

viii. Locking Hardware
1. All locking hardware shall have rim mount strikes.
2. Locking hardware shall accommodate a small format interchangeable (sfic) keyway.
3. All locks shall default to fail secure, upon loss of electrical power.

c. Wiring Requirements:
1. All access control wiring of size 18 gauge or smaller shall be stranded copper or tinned copper wire to minimize risk of breakage from movement or impact by a foreign object. Wiring shall be of a sufficient size to carry maximum currents found in the associated circuit(s) and still maintain equipment voltages at a continuous operational level throughout the system.
2. All wiring for door readers shall be of size 18 gauge.
3. All exposed wiring runs shall be enclosed in conduit or wire mold; armored sheath must cover wiring between conduit/walls and associated access control panels, contacts, and sensors to prevent tampering with wiring.
4. Wiring inside walls or ceilings will not be considered exposed wiring.
5. All wiring shall be clearly labeled at each termination point to show the origin and use of the wire (or pair of wires or cable); an identification scheme (numbers and/or letters for designation) may be used in conjunction with circuit diagrams referenced in Section 6 of this Specification.
6. Any exception to provisions of this section must be approved in writing by the UC Police Department Crime Prevention Unit.

3. Approved Signaling Systems
a. General Information: Access Control controller panels shall employ the following signaling system to communicate access information from the user premise to the University of California Police Department Computer Room.

b. Dedicated Communication Line:
1. Access control panels communicate with the Sproul Hall server via IP addressing on a restricted UCPD subnet. These network drops shall be ordered through campus IS&T. Only Crime Prevention Unit employees can request such drops.
2. Coordinate closely with the University project manager on provision of:
   1. Communications lines.
   2. Communications conduit.
3. This system is a partially supervised system. Loss of communication results in an internal computer alarm being received at the Police Department. This condition may or may not be noticed by the user department depending on the use of the auto unlock feature.

4. Standards and Guarantees
a. Technical Standards: Equipment to be supplied shall conform, unless otherwise indicated, to the current applicable standards of the following organizations or documents:
2. Electronics Industries Association (EIA).
6. Underwriter's Laboratories (UL).
vii. US Occupational Safety and Health Administration (OSHA).

b. Contractor's Provisions, Equipment and Hardware:
   i. The term Contractor, as used in the remainder of this section, refers to the Contractor or original equipment manufacturer if manufacturer's original equipment warranty and repair service is applicable.
   ii. The Contractor shall provide the following services that will repair or exchange, in the times indicated, all defective parts and assemblies returned by the University for repair:
      1. Emergency no-charge warranty service within five (5) calendar days, excluding shipping time, for defective items returned within the appropriate guarantee time specified herein.
      2. Non-emergency no-charge warranty service within twenty (20) calendar days, excluding shipping time, for defective items returned within an appropriate guarantee period specified herein.
      3. Emergency full-charge non-warranty service within five (5) calendar days, excluding shipping time, for defective items returned after expiration of the guarantee period specified herein.
   iii. For a period up to one (1) year after Substantial Completion, and upon order placement, the Contractor shall supply to the University exact replacement plug-in modules, printed circuit board assemblies, and specialized parts for use in the equipment delivered in accordance with this Specification. Coordinate with Division 1 contract guarantee requirements.

c. Minimum Guarantees, Equipment and Hardware:
   i. All parts and materials employed in delivered equipment which normally require installation shall be guaranteed by the Contractor against mechanical, electrical and workmanship defects for one (1) year from date of system acceptance.
   ii. All parts and materials employed in delivered equipment requiring no installation shall be guaranteed by the Contractor against mechanical, electrical and workmanship defects for a period of one (1) year from the date of delivery.
   iii. A manufacturer's shop drawing defect, for the purpose of this standard, shall be defined as identical failures occurring within one (1) year after delivery in at least five or five percent (5%) of total, whichever is larger, of identical assemblies, subassemblies, or parts, supplied on the same contract.
   iv. Delivered items shall be guaranteed by the Contractor against manufacturer's shop drawing defects for one (1) year from the date of system final acceptance. Upon written notification and confirmation by the Contractor of shop drawing defects evidenced within the one (1) year guarantee period, the Contractor shall take corrective action at the equipment site within five (5) calendar days at no cost to the University.
   v. Whenever it is necessary for the Contractor to take corrective action for shop drawing defects in a delivered item, the Contractor shall take the same corrective action in all identical equipment delivered on the same purchase order.
   vi. All parts and materials used in corrective action for shop drawing defects shall be guaranteed by the Contractor against mechanical, electrical, and workmanship defects for one year from date of such corrective action.
   vii. Guarantee, other than for shop drawing defects, shall include parts and materials during appropriate guarantee period specified herein and on-site labor guarantee period of one (1) year after Final Acceptance for equipment installation or after equipment delivery if installation is not applicable.
   viii. If the Contractor has not completed on-site guarantee repairs within five (5) calendar days after notification of malfunction, the University may complete such
repairs and bill the Contractor for material and labor costs at the current Government Technician hourly rate.

d. Minimum Guarantees, Material and Workmanship:
   i. Workmanship and materials provided by the Contractor in performance of any initial installation or modification work required in compliance with this Specification shall be guaranteed for a period of one year after date of system acceptance. Workmanship or materials found to be defective during this period shall be corrected by the Contractor within five (5) calendar days at his expense.
   ii. Workmanship and materials provided by the Contractor in performance of any maintenance work required in compliance with this Specification shall be guaranteed for a period of one (1) year after maintenance work is completed. Workmanship or materials found to be defective during this period shall be corrected by the Contractor within five (5) calendar days at his expense.

5. Detailed System Specifications
   a. This section is reserved for a detailed description of the proposed system. It should follow the same format as the remainder of this specification.
   b. The Police Department Crime Prevention Bureau's Security Survey of the facility which will use the automated access control system will usually provide sufficient detail for a designer to complete this specification.
   c. The Crime Prevention Bureau maintains Specifications from other projects which may be used as a guideline in preparing this Chapter.

6. System documentation
   a. The contractor shall supply complete installation and operation manuals for each system component or sub-assembly.
   b. The contractor shall supply applicable Federal Communications Commission (FCC) type acceptance number for new systems or modifications where changes are made to equipment interconnected to the public telephone network.
   c. The contractor shall supply as-built wiring diagrams which show location(s) of all equipment and wiring for the access control system. For installations where wiring is identical for several systems, the Contractor need only supply one set of diagrams referencing all applicable locations. Wiring diagrams include:
      i. Block diagram of system showing major components, junction blocks, panels, and their locations.
      ii. Detailed wiring diagrams, to include any Contractor identification numbers applied to wiring or cables.
      iii. Layout diagrams for Contractor supplied terminals, interconnect strips or junction panels in the systems.

7. Testing, Inspection and Acceptance
   a. Systems Testing:
      i. All components of new installations or modifications shall be tested by the Contractor to ensure each is operating properly following installation. This testing shall be conducted in conjunction with the UCPD Crime Prevention Unit.
      ii. The system shall be connected to the Police Access Control computer in coordination with the Crime Prevention Unit to ensure proper interface.
   b. Inspection:
      i. Following testing, the Contractor shall notify the University of California Police Crime Prevention Unit and Construction & Design (C&D) inspectors to arrange for inspection of the completed system. Inspection shall be requested as stated in the particular contract, but in no case less than twenty-four (24) hours in advance of the requested inspection. Inspection will require the Contractor to demonstrate that all...
requirements of the contract are met and that all parts of the access control system(s) are operational.

c. System Acceptance:
i. Acceptance of installed access control systems and modifications shall be made only after they are operational for a period of thirty (30) continuous days with less than one percent (1%) downtime attributable to failure of equipment, material, and/or workmanship.

ii. Should the system require adjustment or replacement of parts, another thirty (30) day acceptance period shall begin on the day the adjustment or replacement is made.

iii. A system will be accepted only after it operates for a full thirty (30) days in compliance with the requirements above, unless otherwise approved in writing by the Police and Purchasing Departments.

iv. Acceptance of installed access control systems and modifications shall be made only after successful completion of the inspection as outlined above.

26 16 00 Intrusion Detection

1. General Information
   a. Description: Provide general description of the project in this section
   b. Coordination with Management:
      i. All work on systems described herein shall be completed in coordination with the building management and University of California Police Department Crime Prevention Unit personnel to provide a consistent level of service. Coordinate closely with the University Project Manager to obtain latest system requirements to develop scope of work, and to obtain list of pre-approved vendors.
      ii. Only prequalified University vendors may install security alarm work.
      iii. ADA mounting heights shall be observed.
      iv. Coordinate final alarm devices with the architect's hardware consultant.
      v. Submit intrusion detection system for approval by the Project Manager and UCPD prior to bidding.

2. Alarm Equipment and Wiring
   a. Description: This chapter describes acceptable alarm hardware for use where such hardware is referenced hereafter in this Specification and describes wiring requirements.
   b. Equipment Approval:
      i. Fire alarm equipment shall not be installed under this security alarm contract. See 28 30 00: Electronic Detection and Alarm of this document for coverage of these systems.
      ii. Emergency, hold-up, and intrusion alarm equipment protecting high hazard or security facilities shall be Underwriter's Laboratory (UL) approved/listed for use in the type of application being proposed. Emergency, hold-up, and intrusion equipment includes:
         1. Dual technology motion detectors.
         2. Door and window switches/contacts:
            a. Magnetic reed contacts.
            b. Mechanical switches.
            c. Vibration contacts.
         3. Glass-breakage detectors (window foil shall not be used).
         4. Shunt and reset switches.
         5. Control instruments or panels.
         6. Power supplies, batteries, and wiring.
         7. Horns, bells and sirens are not allowed except with written permission of the Crime Prevention Unit.
iii. All alarm systems must be equipped with a battery operated stand-by power supply capable of continuously operating the alarm system (including any associated signal circuit to the UCPD) for a period of eight (8) continuous hours in case of the loss of commercial power. Switchover to or from battery power, must not activate associated alarm equipment, nor send any alarm to the Police Department. Digital communicator panels may send a low battery signal to the Police Department at the time that battery voltage reaches a preset low level.

   1. Standby battery, as referenced in this Specification, is a gelled electrolyte rechargeable battery with a minimum two (2) ampere-hour capacity, unless otherwise approved by the Crime Prevention Unit.

iv. It is desirable to have a battery system that is continuously float charged from commercial power to maintain batteries at full charge during periods of non-battery operation and to automatically recharge them when commercial power is restored following battery powered operation.

c. Wiring Requirements:

   i. All alarm wiring of size 18 gauge or smaller shall be stranded copper or tinned copper wire to minimize the risk of breakage from movement or impact by a foreign object. Wiring shall be of a sufficient size to carry maximum currents found in the associated circuit(s) and still maintain equipment voltages at a continuous operational level throughout the system.

      1. Use of any wire smaller than 24 gauge other than inside of an alarm panel is prohibited.

      2. Any cable containing wire of size 22 gauge or smaller which has more than six (6) conductors (3 pairs) shall have, at a minimum, two (2) additional wires (1 pair) for use in future expansion or breakage repair. An extra two (2) wires (1 pair) shall be allowed for each multiple of twelve wires (6 pairs) thereafter in the same cable.

   ii. All exposed wiring runs shall be enclosed in conduit or wire mold; armored sheath must cover wiring between conduit/walls and associated alarm panels, contacts, and sensors to prevent tampering with wiring.

      1. Wiring inside walls or ceilings shall not be considered exposed wiring.

3. Approved Signaling systems

   a. General Information

      i. Alarm panels shall communicate alarm information from the user premise to the University of California Police Department Communications Center.

         1. Alarm signaling methods and user account numbers shall supplied by the Alarm and Access Control Unit.

      ii. Coordinate with the Project Manager regarding which contracts will provide:

         1. Telephone lines (Centrex only).

         2. Conduit for telephone lines.

   b. Digital Communicator (Non-supervised)

      i. Bosch GV Series alarm panels shall be required. Comparable panels, capable of using Bosch PRS remote programming software for dialing into the UCPD alarm receiver may be acceptable.

      ii. Alarm receiver telephone number and zone information shall be provided by the UCPD Crime Prevention Unit for each system.

4. Standards and Guarantees

   a. Technical Standards: Equipment to be supplied shall conform, unless otherwise indicated, to the current applicable standards of the following organizations or documents:
i. American National Standards Institute (ANSI).
ii. Electronics Industries Association (EIA).
iii. Federal Communications Commission (FCC).
vi. Underwriter's Laboratories (UL).
vii. US Occupational Safety and Health Administration (OSHA).

b. Contractor's Provisions, Equipment and Hardware:
   i. The term Contractor, as used in the remainder of this Chapter, refers to the Contractor or original equipment manufacturer if manufacturer's original equipment warranty and repair service is available.
   ii. The Contractor shall provide the following services that will repair or exchange, in the times indicated, all defective parts and assemblies returned by the University for repair:
      1. Emergency no-charge warranty service within five (5) calendar days, excluding shipping time, for defective items returned within the appropriate guarantee time specified herein.
      2. Non-emergency no-charge warranty service within twenty (20) calendar days, excluding shipping time, for defective items returned within appropriate guarantee period specified herein.
      3. Emergency full-charge non-warranty service within five (5) calendar days, excluding shipping time, for defective items returned after expiration of the guarantee period specified herein.
   iii. Whenever it is necessary for the Contractor to take corrective action for design defects in a delivered item, the Contractor shall take the same corrective action in all identical equipment delivered on the same purchase order.
   iv. All parts and materials used in corrective action for design defects shall be guaranteed by the Contractor against mechanical, electrical, and workmanship defects for one year from date of such corrective action.
   v. Guarantee, other than for design defects, shall include parts and materials during appropriate guarantee period specified herein and on-site labor guarantee period of ninety (90) calendar days after equipment installation or after equipment delivery if installation is not applicable.
   vi. If the Contractor has not completed on-site guarantee repairs within five calendar days after notification of a malfunction, the University may make such repairs and bill the Contractor for material and labor costs at the current Government Technician hourly rate.

c. Minimum Guarantees, Material and Workmanship:
   i. Workmanship and materials provided by the Contractor in performance of any initial installation or modification work required in compliance with this Specification shall be guaranteed for a period of one (1) year after date of system acceptance. Workmanship or materials found to be defective during this period shall be corrected by the Contractor within five (5) calendar days at its expense.
   ii. Workmanship and materials provided by the Contractor in performance of any maintenance work required in compliance with this Specification shall be guaranteed for a period of one (1) year after maintenance work is completed. Workmanship or materials found to be defective during this period shall be corrected by the Contractor within five (5) calendar days at its expense.
   iii. Coordinate with Division 1 for contract guarantee requirements.

5. Documentation
a. The Contractor shall supply complete installation and operation manuals for each system component or subassembly in hard copy and PDF formats.
b. The Contractor shall supply applicable Federal Communications Commission (FCC) type acceptance numbers for new systems or modifications where changes are made to equipment interconnected to the public telephone network.
c. The Contractor shall supply as-built wiring diagrams which show location(s) of all equipment and wiring for alarm system. For installations where wiring is identical for several systems, the Contractor need only supply one (1) set of diagrams referencing all applicable locations. Wiring diagrams include:
   i. Block diagram of system showing major components, junction blocks, panels, and their locations.
   ii. Detailed wiring diagrams, to include any Contractor identification numbers applied to wiring or cables.
   iii. Layout diagrams for Contractor supplied terminals, interconnect strips or junction panels in the systems.
   iv. The fee for services for initial inspection and one re-inspection (if needed) will be paid by user. Any subsequent inspection charges for re-inspection(s) resulting from Contractor failure to meet requirements of the contract will be assessed against the contract.
   v. Wiring diagrams shall be submitted in hard copy and PDF formats.
d. Number, length and scheduling of demonstration and training sessions shall be determined by the Police Department in cooperation with the Contractor and user.

6. Systems Acceptance
   a. Acceptance of installed alarm systems and modifications shall be made only after they are operational for a period of thirty (30) continuous days with less than one percent (1%) downtime attributable to failure of equipment, material, and/or workmanship.
   b. Should the system require adjustment or replacement of parts, another thirty (30) day acceptance period shall begin on the day the adjustment or replacement is made.
   c. A system will be accepted only after it operates for a full thirty (30) days in compliance with requirements outlined in this section; unless otherwise approved in writing by the Police and Purchasing Departments.
   d. Acceptance of installed alarm and/or video surveillance systems and modifications will be made only after successful completion of inspection as outlined above.

28 20 00 Electronic Surveillance

28 23 00 Video Surveillance

1. Cameras and equipment for video monitoring shall be reviewed by UCPD Crime Prevention Unit prior to any proposed installations and must meet the approval of UCPD.
2. Standard video monitoring solutions shall include:
   a. Server: Supermicro SSG-6027R-E1R12T 2U rackmount server or equivalent (must be approved by UCPD)
      i. CPU: Intel Xeon E5-2620 Sandy Bridge EP 2.0 GHz 15MB L3 Cach LGA 2011 95W Server Processor or equivalent (must be approved by UCPD)
      ii. Operating System hard drives: 2 Samsung 256 Pro SATA III Internal solid state drives–RAID 1 or equivalent (must be approved by UCPD)
      iv. Memory: 2 x 8 GB 240 pin DDR3 Crucial Ballistix Sport (16 GB) SDRAM 1600 (PC3 12800) low profile memory
v. Storage Attached Units: Attached storage units will utilize serial attached SCSI interface
vi. Storage hard drives: Western Digital “Purple” or better (or equivalent), minimum 3TB each (drives must be approved by UCPD)

vii. Video Management Platform: Genetec

b. Network related installations and equipment must meet the specifications and approval of UC Berkeley IS&T: Switches, routers, network cable must be installed and approved by IS&T.
c. Network Connectivity shall be provided by IS&T for all video monitoring in university-owned buildings and environs.

Camera Cabling: Must conform to IST standards for testing and labeling.

28 30 00 Electronic Detection and Alarm
28 31 00 Fire Detection and Alarm

General

1. Codes and Standards
   b. This standard is a supplement to legal code requirements. The provisions of this document address how code required systems are configured and installed.

2. Structures
   a. When more than one structure is served by a single fire alarm control panel, an alarm initiated in one structure shall cause the audible devices to sound only in that structure. The silencing of the audible devices in one or more structures shall not prevent the sounding of subsequent alarms in another structure.

3. Wire Types And Sizes
   a. All circuit runs shall be continuous between devices, without splices, wherever feasible. Where a continuous run is not feasible, connections shall be made in a UL listed metal electrical box. Wire nuts shall be permitted only in nominal four-inch (4”) metal outlet or junction boxes in conformance with Section 370-16 and limited by Table 370-16(a). All other connections shall be via terminal blocks or wire nuts (no but-splice or crimp connections) in metal enclosures conforming to the requirements of Chapter 3 of NFPA 70, National Electrical Code. Conductors connected together shall have the same color insulation. All connections shall be accessible for inspection and servicing and shall be clearly identified on the contractor record drawings.
   b. Wire and cable shall be sized, twisted and shielded as recommended by the fire alarm system manufacturer, and shall meet the requirements of Article 760 of NFPA 70, National Electrical Code.
   c. When a signaling line circuit is within the same conduit raceway as a notification appliance circuit for speakers or a firefighter’s telephone system, the signaling line circuit or the notification appliance circuit/firefighter’s telephone circuit shall shield both.
   d. Stranded wire is not to be used on any part of the fire alarm system. The single exception shall be factory provided internal wiring harnesses with factory provided termination. Stranded wire when not tinned produce ground faults and shorts when installed in electronic terminal strips.
   e. Fire alarm shop drawings will provide specific wiring direction for fire alarm systems. Wire type and gauge is not interchangeable and subject to strict AHJ approval for rating and voltage drop calculations.

Adopted August 2015
f. Two solid conductors of dissimilar size shall not be placed under the same terminal. Sample: Electronic resisters must be “pig-tailed” to a #14 solid wire if they are connected with a #14 solid wire under a terminal screw. Mechanical connections between dissimilar wires may become lose and become a chronic maintenance issue. All terminations shall be installed so as to guarantee continuous connection.

g. All fire alarm cable shall be labeled at each termination. All electrical circuits shall be numerically identified at both ends with wire taped numbers.

h. Tie in to existing systems using the following wire types, sizes and colors unless countermanded by considerations of distance, amperage, voltage drop or manufacturer’s requirements.
   i. Siemens MXL based addressable alarm systems alarm signaling circuits (Siemens ALD circuits) shall use twisted shielded cable #16 red and black solid.
   ii. Conventional alarm systems initiating zones (manual pull stations, smoke detectors, heat detectors, and sprinkler flow switches) shall use #18 AWG Solid Cu. TFN, red positive, blue negative.
   iii. Audible signal circuits (horns and horns with strobes) shall use #14 AWG Solid THHN, orange positive, yellow negative (polarity referenced to supervisory condition).
   iv. Strobe only circuits (strobos, strobes in tandem with speakers); #14 AWG Solid THHN, gray positive, violet negative
   v. Tamper Switches zones (conventional alarm systems); #18 AWG Solid TFN both wires black.
   vi. Door holder circuits, 24 volt DC shall use #18-#16 AWG Solid TFN, white positive, black negative.
   vii. Wires connecting remote annunciator panels and remote trouble annunciators (conventional systems); #18 AWG Solid TFN, Switch legs: black, common yellow, with wire number labels on both ends.

4. Risers and Terminal Cans.
   a. All vertical risers shall have terminal cans mounted at each floor. Each floor’s fire alarm conductors shall branch from the floor riser terminal can. This facilitates isolation of branch circuits.
      i. All splices in the riser terminal cans shall be via terminal strips.
      ii. All terminals in the riser junction cans shall be labeled with permanent labels. The label shall identify wire circuit number and destination. Sample: ALD 6-2nd floor.
   b. Access to fire alarm system components shall not be impeded by system wiring that passes over or around the component so as to restrict service access. Fire alarm components shall not be mounted in wire troughs, or J-Boxes and J-Cans of insufficient size to provide safe access to energized circuits.
   c. Vertical riser wiring will be in conduit, sized to allow for twenty-five percent (25%) additional expansion.

5. Conduits and Raceways
   a. All fire alarm system wiring must be installed in raceways separate from those used by other electrical systems.
   b. Power-limited fire alarm (PLFA) cable, where used, not installed in UL listed metal conduit or raceway shall be mechanically protected by building construction features:
   c. Installation shall be in areas not subjected to mechanical injury.
   d. Fire alarm circuits shall be supported by the building structure. Cable shall be attached by straps to the building structure at intervals not greater than 10 feet. Wiring installed above drop ceilings shall not be laid on ceiling tiles. Wire shall not be fastened in such a manner that puts tension on the cable.
   e. Cable shall be types FPLP, FPLR or FPL, or permitted substitutions, selected for the installation application as required by Section 760-61.
   f. Minimum size of raceway for all fire alarm systems shall be 3/4" trade size raceway unless approved by Construction & Design (C&D).
g. All fire alarm system wiring shall be installed in raceways separate from those used by other
electrical systems. Sample 1: 120 VAC feed from distribution panel (circuit Breaker) to fire alarm
control panel shall be in a separate conduit. Sample 2: Control switch leg from a 120 VAC Fire
Smoke Damper to a programmable fire alarm relay (Siemens TRI-R) must be in a separate conduit
from the fire alarm signal (Siemens ALD) wiring to that relay (Siemens TRI-R). Sample 3: Elevator
control wire switch leg 24 VAC to a programmable fire alarm relay (Siemens TRI-R), used for
elevator recall, and shall be in a separate conduit from the fire alarm signal (Siemens ALD) wiring to
that relay (Siemens TRI-R). The inclusion of AC wiring in the same raceway or non- separated J-
box with fire alarm wiring may induce inductance voltages that corrupt data transmission.

h. Flexible metal or seal-tight conduit may be used to connect individual fire alarm devices to the
conduit system. Sample 1: Seal-Tight (trade name) may be used to connect a Water Flow switch to a
programmable monitoring point (Siemens TRI). Sample 2: Flexible metal conduit may be used to
connect a smoke detector mounted on a 4sq electrical box in a drop-ceiling tile to the 4sq junction
box in the fire alarm EMT conduit system.

i. Except as otherwise required by the California Electrical Code and/or these Specifications, the
installation of fire alarm circuits shall conform to the requirements of Article 760 and raceway
installation to the applicable sections

j. NFPA 70, National Electrical Code. Fire alarm circuit wiring shall include all circuits described in
Section 760-1 including Fine Print Note No. 1 (FPN No. 1).

k. Non power-limited fire alarm (NPLFA) circuits shall have over current protection and be installed in
conformance with Parts A and B of Article 760 and the applicable requirements of NFPA 70.

l. Power-limited fire alarm (PLFA) circuits shall be installed in conformance with parts A and C of
Article 760. The power sources for PLFA circuits shall meet the requirements of Section 760-41 and
the equipment supplying power shall be durably marked as required by Section 760-42.

m. Power-limited circuits which are reclassified as non-power-limited circuits shall meet the
requirements of Part B of Article 760, including over current protection, and shall have the marking
required by Section 760-42 eliminated. Reclassified circuits shall remain non-power-limited
throughout their entirety.

n. Fire alarm circuits installed in locations other than ordinary indoor, dry locations shall be in
conformance with Sections 760-3 and 760-7 with conductor or cable types suitable for the
installation conditions.

o. Separation of circuits shall be in conformance with Section 760-27 for NPLFA circuits and Section
760-54 for PLFA circuits.

p. Non power-limited circuit (NPLFA) conductor sizes, insulation types and installation methods shall
be as limited by Sections 760-27, 760-28 and 760-30.

q. Power-limited circuit (PLFA) wiring material and installation methods shall be by either of two (2)
methods:
   i. Cable listed and marked in accordance with Section 760-71, or substitutions in accordance
      with Section 760-61, using wiring methods in accordance with Section 760-52(b), or
   ii. Conductors in raceway in accordance with Sections 760-52(a) and 760-27 or cables in
      accordance with Section 760-30.

r. All electrical enclosures, raceways and conduits shall contain only those electrical circuits associated
with the fire alarm system and shall not contain any circuits that are unrelated to the system.

s. All cable which is not enclosed by conduit shall be supported and anchored with nylon straps or
clamps. The use of staples is prohibited.

t. Cables and conductors having scrapes, nicks, and gouges or crushed insulation shall not be used.

u. All electrical circuits shall be labeled.

v. All fire alarm conduit systems shall be installed so as to have a continuous ground bond reference.
Sample: EMT conduit with approved fitting providing a complete and common ground reference
through the system. Sample: EMT conduit system with ground reference wire bonding the complete
conduit system providing a complete and common ground reference through the system.
6. Supervision
   a. The following circuits shall be supervised to detect the presence of open circuits, short circuits, or ground on either wire:
      i. Initiating zones (manual pull station, heat detector, smoke detector, flow switch, other)
      ii. Audible/visual signal zones
      iii. Battery circuit
      iv. Alarm annunciator circuits
   b. All connections to initiating devices or audible devices shall be made directly to the device (i.e., no pig-tail connections), in such a way that the disconnecting of any one or more wires from the device will interrupt the continuity of the zone and cause a trouble condition on the fire alarm control panel.

7. Auxiliary Relays
   a. There shall be provided, as required, within the control panel Siemens Programmable Supplementary Relay Modules, type CRM-4 (MXL) and CRC-6 (XLS). Each contains programmable independently actuated relays, fitted with form “C” contacts, rated at 120 VAC, 2 amps inductive.
   b. There shall be provided, as required, Intelligent Initiating Devices Interface Modules with programmable relays, type Siemens TRI-60R or HTRI-R, with one (1) form “C” relay contact, rated at 120 VAC, 2 amps.
   c. There shall be provided, as required, Auxiliary Relays in the bases of the Addressable Smoke Detectors. These relays shall be set by software to be controlled by the logic of the Fire Alarm System (CSG) not activated by default with the associated smoke detector independent of software conditions. Smoke detectors with built-in relays shall be used only when programmable remote relays (Siemens TRI-r type or subsequent model) are not available. Smoke detectors with relay bases shall only be installed with a back-box of sufficient size and accessibility to allow maintenance and repair without the hazard of electrical shock or ground fault.
   d. There shall be provided auxiliary relays with the air sampling tube type duct smoke detector assemblies when required, these relays are integrated within duct detector housing and fully controlled by the system software logic (CSGM or Zeus).
   e. All remote relays shall be installed in a location and manner that they may be accessible for easy maintenance. Each addressable device shall have its address and usage prominently marked for maintenance purposes.
   f. All relays in an addressable fire alarm system shall be controlled by the custom software logic (Siemens CSGM or Zeus software). This will allow the full control of auxiliary relays from the menu driven fire alarm control panel. The use of default relays is not allowed.
   g. Auxiliary relays and monitoring TRI and HTRI devices shall be mounted in weather-proof cans when installed in locations where high moisture content is possible.

8. Zoning
   a. Each sprinkler flow switch shall have its own zone.
   b. Each air duct smoke detector shall have its own zone.
   c. Each fire extinguishing system (e.g., Halon, dry chemical, preaction sprinkler or carbon dioxide) shall have its own zone.
   d. Each smoke detector that is part of an elevator recall system shall annunciate its particular floor at both the fire alarm control panel and at all alarm annunciator panels. It is permissible to connect an elevator recall smoke detector on the same initiating zone as other devices on its particular floor; however, an alarm triggered by any of these other devices shall not cause the elevator to be recalled.
   e. Vertical zoning shall not be allowed (i.e., no zone shall include more than one floor).

9. Living/Sleeping Areas
a. Each living unit (dormitory room or apartment) shall be provided with at least one 120-volt smoke detector with integral horn. This smoke detector shall not activate the building fire alarm system. It shall automatically reset itself when the smoke clears.
b. Each living unit (dormitory room or apartment) shall also be provided with at least one thermal detector. This thermal detector shall activate the building fire alarm system. The thermal detector may be housed in the same case as the smoke detector, as part of a combination smoke/heat detector. The thermal detector shall be rated 118°F to 135°F fixed temperature; a rate-of-rise action may be included.
c. The requirement for a thermal detector in living units is waived if all rooms are served by an automatic sprinkler system.

10. Labeling
   a. All fire alarm systems shall have the fire alarm terminations and sub-modules completely labeled (as appropriate) with professional-type labels. This includes control panels, annunciator panels, and terminal panels. Hand lettering and dyno-type label are not acceptable. Label shall identify wire circuit number and destination. Sample: ALD 6- 2nd floor, NAC Module 004.
   b. All junction boxes shall be provided with red covers on which the letters “FA” appear in white one inch (1”) high lettering. Fire Alarm conduit shall be red. AHJ requirement, this facilitates trouble shooting, inspection, and provides a visual indicator of a vital infrastructure.
   c. All alarm systems devices shall be labeled with a professional (Brother P-Touch-type) label with black lettering. This includes all initiating, notification and control devices. The label shall be visible from the floor, giving the address of each device. The label shall aid fire department rapid response, required maintenance testing, accurate and cost effective trouble shooting, and reduce time and cost on construction impairments.
   d. Sample: “003-034”, located on the mounting base of smoke and heat detectors, on the cover of TRI, on the upper activation lever of MPS, and on the cover of flow and tamper switches. All monitoring devices (TRI type alarm and status devices) shall have a label describing usage. Example: A TRI-D for sprinkler water flow and valve tamper alarm shall stay “ 010-010 Water Flow 3rd floor, 010-011 Tamper 3rd Floor” NAC (horn/strobes) shall have each circuit and device address labeled. Example: A22-3/V57-14.

11. All devices, such as smoke detectors, air duct detectors, flow switches, and sprinkler valves, which are hidden above ceilings, below floors or in other locations not readily visible from the common access floor shall have one of the following:
   a. A nearby remote indicating lamp to indicate when that device is in alarm condition.
   b. Professional signage, adjacent to the alarm devices or remote indicating lamp (LED), so that the fire response personnel and maintenance personnel may easily locate them. Example: “smoke detector 002-032 above ceiling”.
   c. Each alarm device shall have its address marked on the back of the plug-in unit and base.

12. All terminals in the riser junction cans shall be labeled with permanent labels. The label shall identify wire circuit number and destination. Sample: ALD 6- 2nd floor.
   a. All junction boxes shall be provided with red covers on which the letters FA appear in white one-inch (1") lettering

13. Access Door in Air Ducts
   a. Whenever duct smoke detectors are used, access doors shall be provided in the duct work of sufficient size and location to allow viewing, cleaning and replacement of smoke detector sampling tubes.

14. Roll-Down Fire Doors/Shutters

Adopted August 2015
a. See Division 08 00 00: Openings.

15. Wet Locations
   a. Fire alarm devices or other equipment to be installed in wet or damp locations shall be listed for weather-proof application. Wet locations shall include but not be limited to outdoor installations, machine rooms subject to high humidity, damp shower rooms, laboratory wash down areas and locations subject to the presence of stream and steam condensate.
   b. FA wiring to outdoor locations (PIV monitoring) shall have a zone isolation module. Isolation modules protect the system from cascading ground fault in monitored wiring.

16. Project record Documents
   a. The installer shall provide as-built three (3) hard copy and one (1) electronic copy of documents as follows:
      i. Provide as-built plans showing the physical routing of wires to devices.
      ii. Provide as-built riser diagram showing the zoning of initiating devices and audible signal devices.
      iii. Provide as-built panel wiring diagram of the fire alarm control panel.
      iv. Provide, for addressable systems, an address list showing, for each device, the address, device type, location, and message.
      v. Provide, for software-driven systems, a copy (on disc) of the software used to program the system. This software should be fully functional so that qualified University personnel can make future modifications and repairs to the programming.
      vi. Provide, for software-driven systems, a hard copy printout showing the programmable options and how each option is implemented in this system.
      vii. As-built drawings shall show at minimum, but not be limited to, the following:
        1. Drain locations
        2. Sprinkler heads and accessories
        3. Pipes and fittings
        4. Check valves
        5. Gauges
        6. Alarm flow switches
        7. Hangers and supports
        8. Fire department connections
        9. Control valves including post indicator valves, gate valves, butterfly valves, and globe valves
        10. Valve supervisory switches
        11. Hose cabinets and sprinkler head cabinets
        12. Identification signs
        13. CSFM listing numbers (include any tamper alarm supervisory devices)
      viii. Shop drawings shall include, but not be limited to, the following information (clearly identify design parameter i.e., hydraulic or pipe schedule):
        1. Hydraulic calculations for hydraulically designed systems
        2. Complete piping plan
        3. Reflected ceiling plan with all areas clearly designated
        4. Location and size of all hangers and earthquake bracing
        5. Project location
        6. Point of compass
        7. Ceiling construction
        8. Full length cross section
        9. Location of fire walls
        10. Location of seismic joints
11. Locations of partitions
12. Occupancy hazard classification of each area or room
13. Location and size of blank spaces and closets
14. Any questionable small enclosure where no sprinklers are intended to be installed (shall be clearly identified)
15. Water supply information – calculate water available from point of connection with water main, upstream of any cross connection device
16. Other sources of water supply
17. Make, type, number, and nominal orifice size of sprinklers
18. Temperature rating and location of high temperature sprinklers
19. Total area protected by each system on each floor
20. Number of sprinklers on each riser per floor
21. Location of alarm bells
22. Total number of sprinklers on each dry-pipe system, pre-action systems, combined dry-pipe/pre-action system or deluge system
23. Nominal pipe size and cutting lengths or center-to-center dimensions of pipe
24. Location and size of riser nipples
25. Type of fittings, joints, sleeves, and location of all welds and bends
26. Location of all control valves, check valves, drain pipes, test pipes, and their terminals
27. Size and location of hand hose, hose outlets, and related equipment
28. Underground pipe size, length, location, weight, material, point of connection to City of Berkeley or Campus main (whichever is relevant), type of valves and meters, and the depth that the top of pipe is laid below grade
29. Provisions for flushing: Size of all drains and test valves to handle maximum water volume
30. Additions to an existing system shall include sufficient depiction of the existing system on the drawings as to make all conditions clear
31. Complete name-plate data
32. Name and address of Contractor
33. California State Contractor’s license stamp and the signature of the designer
34. Mounting height of fire department connections
35. Penetrations of rated assemblies shall be fire-stopped. Fire stopping shall be an approved material as described in State Fire Marshal Standard 12-43.1

ix. Shop drawings submitted for approval to the AHJ shall include the general notes:
1. The automatic sprinkler system shall conform to the requirements of NFPA 13 adopted by the State of California
2. Penetrations of rated assemblies shall be fire-stopped. Fire-stopping shall be an approved material as described in State Fire Marshal Standard 12-43.1
3. Installation of the sprinkler system shall not be started until completed plans and specifications (including water supply information and capacity of existing sprinkler system, if any) have been approved by the AHJ.
4. Approved plans and specifications shall be kept on the job site and made available upon request.
5. At various stages and upon completion, the system shall be tested in the presence of the University Fire Prevention Services and/or Campus Fire Marshal
6. Submittals having inaccurate hydraulic calculations, content, which are illegible, incomplete or unclear, shall be returned without review or approval

17. Prior To Acceptance Testing

Adopted August 2015
a. Prior to acceptance testing, the installer shall pre-test all equipment to ensure a successful demonstration.
b. At the time of acceptance testing provide two (2) copies of record drawings and files and software to Facilities Services for maintenance usage in addition to documentation required by UCB project management.
c. Prior to acceptance testing the installer is to, provide a hard copy printout showing the fire alarm system programming for review, show all system configuration, alarm logic, and custom programming. Prior to acceptance testing the installer shall to provide at the job site a stamped set of fire alarm shop drawings and a set of drawings showing approved changes in device location or addressing.
d. Installers shall provide documentation that all design and manufacturers requirements to wire size, color, type, and installation have been met.
e. Manufactures of fire alarm equipment shall certify that the equipment has been installed per documentation and in accordance with the manufacture’s written requirements.
f. The installer shall test for grounds, induction, and continuity. A high-potential test shall be performed and documented by the installer before electronic alarm components are connected to the wiring system.

18. Execution
   a. Contractor Qualifications
      i. Work performed on University of California Berkeley fire alarm systems, shall be performed only by qualified personnel.
   b. Pre-Work Orientation Training.
      i. Installers, contractors and others working on University fire alarm systems shall meet with representatives of the equipment manufacture and/or Facilities Services staff to prior to commencement of work for an orientation on the equipment and installation standards.
   c. Testing and Demonstration
      i. During acceptance, the Contractor shall perform a complete demonstration of the fire alarm system. The demonstration shall include the following:
         1. Activation of every initiating device.
         2. Testing of all appropriate circuits for open-circuit supervision, short-circuit supervision, and ground-fault supervision.
         3. Observation of the functioning of all other components of the fire alarm system.
      ii. The above demonstration shall be in the presence of the State Fire Marshal or designee. Prior to that demonstration, the Contractor shall pre-test all equipment to ensure a successful demonstration.
   d. Limitations On Contractor Access
      i. No outside contractor shall access an existing fire alarm control panel or any other part of an existing fire alarm system unless the system has first been appropriately shut down or secured by the University. When the Contractor is finished, the system shall be re-energized or reconnected by the University.
      ii. When a new fire alarm system is completed, the final connection to the campus-wide fire alarm signaling system shall be performed by the University. Final connection shall be interpreted to mean the physical connecting of wires or similar action, and not the installation of equipment or wires.
   e. Maintaining Alarm Services In A Building
      i. Installers are responsible for installation of equipment and/or wiring per UCB standard, NEC, NFPA, CSFC and manufactures instructions.
      ii. When construction occurs in an occupied or partially occupied campus building, the installer and Contractor is responsible for maintaining the fire and life safety fire alarm system within the building.
the occupied portion of the building. This shall apply to construction that is “phased” and
construction with a limited scope of impact with in a building.

iii. When a contractor or installer has an existing fire alarm system within an occupied campus
building turned over to them for work via a shut-down by Facilities Services that contractor
is responsible for the fire life safety of the occupants during the duration of the shut-down.

f. Acceptance Testing

i. The acceptance test shall be in the presence of the Authority Having Jurisdiction (Designated
Campus Fire Marshal [DCFM]) and in the presence of Facilities Services fire alarm personnel.

ii. During the acceptance, the installer shall perform a complete demonstration of the fire alarm
system. The acceptance test shall include but not be limited to the following:

1. Activation of every initiating device.
2. Activation of every sprinkler control and monitoring device, with test of time delay
   features as outlined in this Division.
3. Activation and check of every notification appliance, audible/visual device.
4. Activation of all fire alarm system controlled components, these shall include but not
   be limited to all door closures, and all automated fire door functions, all air
   pressurization features, and all auxiliary signaling features.
5. Activation of all fan and air handler controls, with air handlers and fans in full
   operation.
6. Activation of Campus signaling to the University of California Police Department.
7. Activation of all fire alarm control features (i.e., by-pass software functions in
   addressable alarm systems).
8. Testing of all appropriate circuits for open-circuit supervision, short-circuit
   supervision, and ground fault supervision.
9. Proof of completion of meger testing of wire insulation, air velocity and flow tests of
   duct detection.

iii. If the fire alarm installation or remodel is in “phased” stages, or if there are substantial
   corrections and additions to the scope of the Project, the installer shall assume responsibility
   for subsequent testing and retesting of the fire alarm installation.

iv. If an existing fire alarm signal, notification, control circuit, or the system software logic has
   to be disrupted than the installer is responsible for retesting the existing system to the extent
   deemed acceptable to the authority having jurisdiction (UCB, Designated Campus Fire
   Marshal [DCFM]).

v. At final testing, the Contractor or fire alarm supplier shall submit for review a copy of the
   final alarm programming (Siemens MXL systems, CSGM). The program shall include all
   system logic functions, custom messaging, and network configurations.

19. State Fire Marshal Approval

a. All fire alarm equipment and devices shall be California State Fire Marshal listed. All drawings and
   specifications for fire alarm installations shall be submitted to the California State Fire Marshal's
   office for review and approval. Drawings and specifications shall be approved by the University for
   construction only after receiving the California State Fire Marshal's stamp of approval, including
   signature and date.

20. Approval By Fire Protection Engineer

a. All drawings and specifications for fire alarm installations shall be approved by a fire protection
   engineer licensed in the State of California. Drawings and specifications shall be approved by the
   University for construction only after receiving the fire protection engineer's stamp of approval,
   including signature and date.
1. Fire Alarm Control Panels
   a. The campus standard, identified by thorough, earlier bid processes, for fire alarm equipment is Siemens brand.
   b. This is a proprietary item. No substitutions allowed.
   c. Match existing system for device additions only.
      i. In existing systems where a limited scope of work does not require a new /upgraded fire alarm, match existing listed alarm components.
      ii. When existing FA system cannot support code required elements, a total system upgrade shall be required.
   d. New fire alarm control systems shall be fully addressable using Siemens MXL, XLS and Desigo series fire alarm systems. To expand existing systems use a Siemens MXL, Siemens MXLV (voice alarm) to match existing panels. These systems shall be referred to as addressable systems.
   e. In small buildings an addressable Siemens Desigo series fire alarm system may be used. Approval for this application must be obtained in advance from the Authorities Having Jurisdiction (Designated Campus Fire Marshal [DCFM] and Facilities Services Fire Prevention Unit).
   f. If any type of fire alarm control panel other than the above Siemens models is specified, it shall be reviewed for approval in advance by Construction & Design (C&D).
   g. Addressable fire alarm control systems that are installed in pre-existing buildings or during building renovations shall replace all pre-existing fire alarm control panels and sub-panels. The functions of these panels will be included in the design of the new addressable alarm system. This may include but not be limited to fire suppression systems, smoke control systems, and power shutdown systems. Pre-existing panels shall not be used as subpanels of the new alarm system.
   h. One building per fire alarm system, one system per building
      i. Each building shall have one dedicated fire alarm system. The designated main panel and select remote control/annunciator stations (Sample: Siemens RCC) shall control all of the fire alarm functions within that building. No building shall have more than one (1) fire alarm control system. Self-contained engineered suppression systems will be configured as a monitored sub-system of the building fire alarm system. All alarm initiating devices shall be controlled via the main FACP.
      ii. New administrative and/or occupancy areas shall not constitute a new building.
      iii. Each building shall have a distinct dedicated signal to the campus alarm monitoring facility (UC Police Department).
      iv. When a building is defined as having more than one (1) structure (with approved fire separation) and is served by single fire alarm control panel, an alarm initiated in one structure shall cause the audible/visual devices to sound only in that structure. The silencing of the audible devices in one or more structure shall not prevent the sounding of subsequent alarms in other structures that constituted that building’s system.
   i. All addressable fire alarm control systems shall include in the main fire alarm control panel a LCD alphanumeric display and the required key-pad switches or interactive touch screen, for full control of the fire alarm system. These controls will constitute the sole means of access and control for the fire department. For Siemens XLS “Fire Finder” the integrated video screen and keys shall constitute the control and display functions.
   j. All fire alarm control panels shall be mounted in locations that are accessible to routine maintenance, and protected from environmental hazards. Remote panels and fire alarm control panels mounted in custodial spaces, storage closets, above ceiling and damp or dusty locations shall not be allowed. This shall include all remote subpanels, power supply panels, notification power adder panels, and engineered sub-systems. Sample: Siemens MXLR, MXLRV, XLSR, PS-35, PAD-3 series NAC panels, auxiliary power or amplifier panels, and engineered sub systems such as VESDA or suppression systems.
k. All fire alarm panels (including remote panels, power panels, and engineered sub-system panels) shall require adequate permanent lighting to safely illuminate the interior of the panel, and a 110v AC receptacle within 4 feet of the panel.

l. The master fire alarm control panel or control function remote annunciator shall be located indoors, immediately adjacent to the main firefighter’s point of entry. The fire alarm control panel shall be located at the Berkeley Fire Department’s point for primary response. This location is to be determined by the Authority Having Jurisdiction (AHJ) (i.e. the Designated Campus Fire Marshal [DCFM]). The master or main fire alarm control panel shall contain all the fireman controls necessary for full control of alarm annunciation, alarm acknowledge, audible silence, and alarm reset.

m. All addressable fire alarm control systems Siemens XLS, MXL, Siemens MXLV (voice alarm) and Siemens Desigo shall have a panel-mounted printer (Siemens TSP-40, thermal strip printer). This printer shall be on the main fire alarm control panel. When control panels require a remote printer, type and location of the remote printer shall have approval, obtained in advance, from the University of California, Berkeley AHJs (Designated Campus Fire Marshal [DCFM] and Facilities Services Fire Prevention Unit)

n. Fire Alarm Panel Configurations: The main Fire Alarm Control Panel (FACP) shall include:

   i. A “RESET” switch in the main fire alarm control panel or remote annunciation/control panel shall reset the fire alarm system, including alarm initiating devices (smoke detectors and duct smoke detectors), and alarm notification devices (audible/visual horn/strobes). The exception to this is specific engineered panels. No additional switch shall be needed to reset smoke detectors, or sub-panels.

   ii. A single switch, located in the main fire alarm control panel, shall silence all fire alarm system audible/visual alarm indicating appliances.

   iii. All addressable fire alarm systems shall be software configured for self-restoring trouble conditions.

   iv. Addressable fire alarm systems shall have keypad or touch screen activated, software controlled, by-pass functions. All by-pass functions shall be supervised and produce a monitored system "trouble" condition.

      1. All supervised bypass switches shall be programmed to “survive reset” and to toggle on/off.

      2. The by-pass switch software functions shall “by-pass” the inputs of alarm and supervisory devices, and the outputs of the notification and other control functions.

      3. These by-pass switches shall be assigned to perform logic functions, one switch per function, per the current UCB, Facilities Services alarm programming guide for Siemens alarm systems. AHJ and UCB, FA Engineer pre-approval of function assignments shall be required. The functions for by-pass shall include but not be limited to:

         a. U.C Police Department by-pass (monitoring).

         b. Audible/visual alarm by-pass.

         c. Auto sprinkler flow alarm and tamper switch by-pass.

         d. Elevator recall by-pass.

         e. Smoke control by-pass (fan and damper controls).

         f. Door closure by-pass.

         g. Alarm input by-pass (device grouping by pre-approval only).

         h. Suppression system activation by-pass.

   o. Within any building, all locked fire alarm equipment, such as control panels, sub-panels, power supply panels, battery cans, fan control panels, manual pull stations, terminal cans and key switches, shall have one common key.

   p. All alarm indication and notification devices shall be connected to the fire alarm system.
i. All alarm-initiating devices shall be wired so as to trigger the building central fire alarm system in the advent of an alarm. This includes (but is not limited to) elevator-recall smoke detectors, duct smoke detectors and devices which are part of engineered fire-extinguishing systems such as inter gas, range-hood, and dry-sprinkler systems. All notification appliances, evacuation alarms including voice speaker, horn, chime and visual strobe lights shall be connected to and controlled via the building fire alarm system.

q. Fire Alarm Sub-Panels

i. The use of any third party add-on or stand-alone controls or control panels other than engineered detection and suppression assemblies is not acceptable. All fire alarm panels, sub-panels and appliances shall be of the same manufacturer, and product line (MXL, XLS or Desigo) and listed for its application.
   1. Sample: XLS and XLSR panels, Siemens Pad-3 series NAC extender panel, Siemens PS-35 power supply.
   2. Sample exceptions: Engineered suppression and special detection systems. FM-200 chemical suppression system, Vesda high sensitivity smoke detection (HSSD) or Gas leak detection systems.

r. All doors and other front-covers on fire alarm control panels shall swing on factory-installed hinges. Front-covers which need to be lifted off and removed from the panel to gain access to the wiring terminals shall not be allowed.

s. Capacity For Expansion:

i. All new fire alarm systems shall have capacity for future expansion. The control panels, and component modules, shall have sufficient, node address, electrical capability and enclosure space to handle the following:
   1. In addressable fire alarm systems (Siemens MXL and XLS) each Signaling Line Circuit (SLC) shall have 25% spare capacity in the number of addresses assigned.
   2. A 25% increase in the number of visual alarm indicating appliances (NAC) or proportional increase in the candela rating of visual devices in each zone.
   3. A 25% increase in the number of audible alarm indicating appliances (NACs) or proportional increase in the wattage rating of voice speaker devices in each circuit.
   4. A 25% increase in the number of Initiating Device Circuits.
   5. Graphic displays including smoke control fan status and elevator status displays, if approved, must include at least 25% more lamps and directory space than required, with wires for the additional lamps installed to the fire alarm control panel.

t. Connection To The Campus-Wide Monitoring System.

i. All building fire alarm systems shall automatically transmit all required alarm signals to the University of California Police Department Communications Center. A digital alarm communicator transmitter (DACT) compatible with Cerberus alarms systems and the receiving equipment at the University of California Police Department Communications Center shall be provided. The digital dialer shall transmit the code required "alarm", "supervisory", "trouble" signals and other monitored signals required by the AHJ.

ii. The University of California specifies the use of a Digital Alarm Communicator Transmitter (DACT). It shall be a Silent Knight model 5128.
   1. A remote keypad, Model 5230 shall be mounted adjacent to the DACT enclosure.
   2. By-pass of the DACT activation shall be by impairment of the alarm panel monitoring contacts. This function shall be part of the required "fire department by-pass" feature of the fire alarm system and be supervised by the FACP.
   3. The alarm system on the DACT must be activated by supervised, switched contacts, normally open/ closes on activation.
   4. Alarm, Trouble, and Supervision conditions shall be transmitted to the DACT via programmable relay contacts. In XLS, XLSV, MXL and MXLV systems use a CRC-
6 or CRM (convention relay) module. Use of the non-programmable, default relay contacts shall have the pre-approval by the UCB FA Engineer.

5. The Silent Knight model 5128/29 zones shall be assigned and wired as follows:
   a. Zone 1 - Alarm
   b. Zone 2 - Trouble, connected to FACP trouble condition contacts
   c. Zone 3 - Supervision including Fire Sprinkler valves
   d. Zone 4 – User defined

6. All penetrations of the DACT enclosure must be made in a manner approved by the NEC.

7. Signals shall be sent via SK 4/2 format.

8. The DACT shall require two (2) voice analog POTs telephone lines, dedicated to the use of the fire alarm signaling system.

9. The DACT enclosure shall include a terminal strip connecting the alarm zone input harness and the FACP control relays. Wire nuts and but splicing is not acceptable.

   iii. When alarm and supervisory functions other than fire alarms are monitored by UCB via UCPD, each function shall have a dedicated and distinct Digital Dialer zone assignment. Multiple Dialers with dedicated account and zone assignment may be required for additional alarm monitoring zones with pre-approval of AHJ and UCB FA Engineering.

   iv. Campus wide Mass Notification is under design consideration. New Fire Alarm Systems and System up-grades will pre-plan for Mass Notification.

u. One Floor Per Signaling Line Circuit And Initiating Device Circuit:
   i. Design the SLC and IDC circuits so that each circuit shall provide alarm detection and communication for only one (1) floor (or wing off a large floor) per circuit. No SLC or IDC shall serve more than one (1) floor. The intent is to prevent more than one geographic area within the building from having a loss of alarm detection if an SLC or IDC circuit is impaired for any reason, and to facilitate shut-downs, expansion and maintenance operations.

   ii. When more than one initiating circuit is required per floor than the circuits shall not be overlapping on the floor plan. Each circuit shall cover a distinct geographic or functional area only. Exception: Cross-Zoned areas using overlapping SLC or IDC circuits.

   iii. When two (2) or more distinctly different occupancies or functions are on the same floor than a separate SLC or IDC shall be assigned to that geographic area and circuits shall not be overlapping. Sample: A building divided between a laboratory wing and a general classroom wing.

28 31 53.13 Fire Alarm Pull Stations

1. Manual Pull Stations
   a. For new addressable installations, manual pull stations shall be Pyrotronics MSI-10.
   b. Manual pull stations shall be addressable and intrinsic to the alarm system. The use of an intelligent interface device between a conventional (non-addressable) manual pull station and an addressable control panel shall not be allowed, except where ambient conditions preclude electronic components
   c. For new hard-wired installations, manual pull stations shall be Pyrotronics MS-57 or equivalent. The two (2) poles of the switch shall be wired in parallel for backup purposes.
   d. For additions to existing installations, manual pull stations shall be of the same brand and model as existing ones, if available.
   e. When manual pull stations are surface-mounted (as opposed to flush-mounted), proper back-boxes specifically manufactured for the device shall be used. Ordinary electrical junction boxes shall not be acceptable as back-boxes.
   f. All manual pull stations shall be mounted at a height of forty-eight inches (48") on center above the finished floor.
g. In areas where a security device is required to prevent nuisance alarms a Safety Technology International Inc. “Stopper II” type pull station cover shall be installed.

h. Manual pull stations shall not be mounted in outdoor applications. Example: MPS shall not be mounted to security fences or patio gates.

23 31 43/46  Fire/Smoke Detection Sensors

1. Automatic Fire Detectors
a. Automatic fire detectors shall be selected, located and spaced according to the guidelines contained in NFPA 72 and its appendices.

b. Smoke detectors for the initiation of addressable building-wide alarms shall be: Siemens FP-11, HFP-11(environment compensations type) or subsequent model. The location and software configuration of the individual smoke detectors shall be determined by the application, including but not limited to consideration of dust, gas, air velocity, fumes, temperature and ambient electromagnetic fields.

c. Smoke detectors with integrated heat sensing that cannot be software suppressed (Siemens FP-11) shall not be used in areas subject to high ambient temperature (sun light or steam release). Smoke detectors shall be photoelectric/ non heat sampling type in these applications.

d. Smoke Detectors for the initiation of conventional (non-addressable) building-wide alarms shall be listed for the fire alarm system. Sample: Siemens PE-11, or subsequent model. The type of smoke detector shall be determined by the individual application, including but not limited to consideration of dust, gas, and air velocity, fumes and ambient electromagnetic fields.

e. All smoke detectors shall be connected to the building fire alarm system, and shall initiate a fire alarm condition when in alarm.

f. Smoke alarm and smoke detectors for local-alarm initiation (i.e., detectors with integral horns, self-restoring, and not designated to trigger the building alarm system) shall be Gentex 9120-F series or subsequent model with internal 9 volt battery back-up. The internal battery shall be omitted if the detector power is backed up by an approved emergency power system. These detectors are 120vac with one (1) C-form auxiliary relay. This relay shall not be used for fire alarm system monitoring.

2. Placement
a. Smoke or heat detectors shall be placed in locations that are readily accessible for routine maintenance and testing. Detector placement that has obstructed access due to layered building systems (cable trays, HVAC duct work) is not acceptable. Detectors shall be accessible in construction areas, without undue obstruction.

   i. Spot-type smoke detectors shall be ceiling mounted.

   ii. Sidewall mounting of spot-type smoke detectors shall be accepted only with Facilities Services (FS) and Designated Campus Fire Marshal (DCFM) pre-approval. Sidewall mounting increases maintenance and induces false alarms due to dust accumulation.

   iii. Spot-type smoke detectors shall be placed no closer than three feet to air-supply or air-return registers.

   iv. For high-ceiling applications and for atriums, stair wells and large area applications photoelectric beam-type smoke detectors and air sampling detection shall be used in place of spot-type smoke detectors. The potential for smoke stratification and inaccessibility of spot type detectors shall be considered.

   v. For high-value applications and for high-air-flow applications, air-sampling-type smoke detectors are preferable to spot-type smoke detectors.

   vi. Heat detectors shall not be used in areas protected by a wet fire sprinkler system unless called for by the Authority Having Jurisdiction (Designated Campus Fire Marshal [DCFM]). Exceptions may include head detectors used to anticipate automatic sprinkler system activation (elevator shunt-trip configurations).
vii. Rate-of-rise-type thermal detectors, detectors which utilize air passing through an orifice for their operation, shall not be used in areas where high humidity is anticipated.

viii. Smoke detectors powered solely by batteries shall not be permitted except for battery-powered smoke detectors installed on a temporary basis to provide for coverage while the permanent smoke detectors or fire alarm system are under repair or otherwise not functioning.

ix. For high-value applications and for high-air-flow applications, air-sampling-type smoke detectors are preferable to spot-type smoke detectors. Brand and model shall be submitted to Construction & Design (C&D) for approval.

b. Air Duct Smoke Detectors

i. Air-duct smoke detection shall be accomplished by one of three methods, the use of in-duct mounted or plenum mounted spot-type detector, sampling tube type duct detectors or full-air detection in accordance to National and State Fire Codes.

ii. In low air flow or static air ducts use an in-duct mounted smoke detector.

iii. In-duct mounted smoke detectors shall be Siemens HFP-11, FP-11 or subsequent model, listed for the anticipated air velocity and temperature conditions.

iv. In-duct smoke detectors shall be mounted “pendant style” to inside top of the duct. Detector shall be mounted to a listed electrical conduit box.

v. Do not use relay bases on in-duct mounted smoke detectors. Use a programmable remote relay (Siemens TRI-R, HTRI-R type or subsequent model), mounted outside of the duct, for relay functions. Relay base and wiring are virtually inaccessible for maintenance after construction and constitute a shock hazard. This restriction applies to all similar installations.

vi. A remote alarm indicating light (LED) shall be required, located so that it is readily visible from the floor by emergency responders and service personnel. The LED shall be clearly labeled to indicate the detector that is in alarm, and located as close as possible to the in-duct detector.

1. Lamp shall be clearly visible from a common access floor space.
2. Lamp shall be clearly labeled for this purpose. Sample; “In-Duct Smoke Detector 002-027 in alarm. Detector in duct above”.

vii. An access hatch within the duct shall be provided to inspect and clean the smoke, and access hatches through any sub-ceilings or structural features shall be provided.

c. For high-ceiling applications and for atriums, stair wells and large area applications photoelectric beam-type smoke detectors and air sampling detection shall be used in place of spot-type smoke detectors. For high-ceiling applications the possibility of smoke stratification shall be considered in the design of the smoke detection system. Duct detectors mounted outside the duct and using air-sampling tubes shall include the following:

i. All smoke sampling tubes shall extend beyond the duct and penetrate the far wall of the duct. The tube end shall be sealed in an approved manner. Exception: Where the outer duct wall is against a structural wall the sampling tube may be sealed and secured to the inside duct wall, inspection hatches must be provided for routine inspection of the sampling tube seal.

ii. Duct detectors mounted 10’ above the floor or concealed, either within a ceiling or obscured by any building feature, shall have a remote alarm indicating light (LED). The remote light shall be located so that it may be readily visible from the floor by emergency responders and service personnel. The LED shall be clearly labeled to indicate the detector that is in alarm, and located as close as possible to the duct detector.

iii. An access hatch in the duct shall be provided to inspect and clean the outside of the sampling tubes within the duct and access hatches through any sub-ceilings or structural features shall be provided.

iv. All air-duct smoke detectors shall activate the building fire alarm system in addition to controlling the heating, ventilating, smoke damper and air conditioning equipment. These
duct detectors shall be either Siemens addressable or Siemens conventional system duct detectors equipped with relays for auxiliary control contacts.

v. Air-duct detectors that are by a different manufacture than the building fire alarm system or that are supplied, as part of an integrated air-handler system shall not be used.

vi. Air-duct smoke detectors shall not be used as a substitute for other types of automatic fire detection. Air-duct smoke detectors shall not serve as the sole method of automatic fire detection.

vii. Air-duct smoke detectors shall be used only when required by the Fire Marshal for the control of smoke within heating, ventilating, damper control and air conditionings equipment. If an alternative technique for controlling the heating, ventilating, damper control and air conditioning equipment is available (e.g., 100% coverage of the affected area by spot-type smoke detectors), the alternative technique of area detection is to be preferred.

viii. Plenum-type high air velocity smoke detectors shall be used in plenum spaces whenever possible, instead of duct smoke detectors using an extended air sampling tube. In duct smoke detection application subject to high heat or extreme ambient heat variations do not use smoke detectors with a fixed thermal element (Siemens FP-11). Samples of high heat environments: Duct detectors in weatherproof outdoor roof enclosures, subject to sun light heat. In-duct detection in ducts used to mix hot and cold air near the detector; and plenums near heat exchanger coils.

ix. All duct, in-duct and plenum detectors shall be tested when the air handling systems are fully operational and air-balancing is complete. The installing agency is required to prove that air flow through and around the detector is within the Manufacturer’s specified tolerances. The test is to be conducted via AHJ approved metering devices.

x. Duct Detectors on air handling systems utilizing a Variable Frequency Drive (VFD) or an Energy Management System that changes or cycles air flow rates shall have all duct detectors listed for static air flow.

xi. The requirements for periodic testing, cleaning, and calibration of fire detectors shall be kept in mind when locating detectors. Access for maintenance crews shall be as convenient as possible.

3. Air Sampling Engineered Systems
   a. All air sampling systems shall be engineered by a qualified firm, shop drawings, calculations and design pre submitted to UCB AHJs for pre-approval.
   b. All sampling pipe connections to control units shall be via a pipe union assembly. This is to allow cleaning, testing and replacement of the units as required.
   c. Each sampling pipe run shall require a test point (at end-cap) located no higher than five feet, six inches (5’-6”) from the floor grade for periodic testing.
   d. Connection to the building fire alarm system for alarm, trouble and supervisory monitoring shall be supervised for open wiring per NFPA 72, plug in terminal strips shall be configured to supervise placement integrity.
   e. The power supply, if not integrated into the sampling control unit, shall be supervised independently of the air sampling unit. A distinct trouble address shall be assigned to power supply and the air sampling systems.

4. Sprinkler Flow Switches and Control Valve Tamper Switches will be connected to and monitored by the fire alarm system.
   a. All sprinkler flow switches shall be capable of a routine water flow test using an inspector’s test valve. The Inspector’s test valves shall be provided wherever necessary to accomplish this, preferably as far downstream from the flow switch as possible.
   b. Each wet sprinkler system shall have a main flow switch.
   c. Sectional flow switches are encouraged.
d. A non-silenceable water flow alarm, if required, shall be a component of the fire alarm system and software configured.

e. All sprinkler inspector’s test valves and drain valves will be piped into a plumbing drain of sufficient capacity to accept the full volume of water in that sprinkler section without overflow or flooding. Inspector’s tests and drains that empty into a sink or require the installation of a test hose are not accepted.

f. Dry-Sprinkler and Pre-Action Sprinkler systems shall be monitored and controlled by the building fire alarm system.

g. All flooding (filling with water) of a dry-sprinkler or pre-action sprinkler systems shall initiate a full alarm condition in the building fire alarm system. Sprinkler flooding shall initiate an alarm both during an engineered alarm triggered flood (e.g., a cross-zoned smoke detector condition) and the flooding of the sprinkler via a manual lever.

h. All dry-sprinkler and pre-action sprinkler systems shall monitor the status of the piping integrity (low supervisory air pressure) at the building fire alarm control panel. Low air status shall report as a “supervisory” condition.

i. Each fire sprinkler shut off valve shall be provided with a tamper switch to supervise it electrically against undetected closure. Valve tamper switches including PIV switches shall induce a “Supervisory” condition.

j. On existing hard-wired conventional systems, each tamper switch shall be wired to a dedicated tamper-switch zone in the fire alarm control panel. There shall be one (1) such zone for each tamper switch. Tamper switches shall not be connected to flow switch initiating alarm zones.

k. On addressable alarm systems each tamper switch shall have a dedicated address. The grouping of more than one (1) valve tamper switch to activate an alarm-monitoring device is not acceptable.

28 31 63 Fire Alarm Integrated Audio Visual Evacuation Systems

1. Audible/Visual Signaling (Notification Appliances)
   a. One (1) Floor Per Notification Appliance Circuit (NAC)
   b. No notification circuit (fire alarm audible/visual devises) shall serve more than one (1) floor.
   c. When more than one (1) circuit is required per floor than the circuits shall not overlap on the floor plan.
   d. No alarm notification impairment on a single circuit/floor shall prevent any other floor performing alarm activation.
   e. When two (2) or more distinctly different occupancies or functions are on the same floor, separate NACs shall be assigned to each occupancy. Circuits shall not be overlapping. Sample: A building divided between a laboratory wing and a general classroom wing shall have one NAC for each wing.
   f. All fire alarm systems shall include audible/visual notification appliances. Systems using silent alarms shall not be permitted.

2. Audible/Visual Alarm Shall Be Seen And Heard In All Areas
   a. Sufficient audible/visual indicating appliances shall be provided so that fire alarms can be heard and seen in all areas of the building. The sound and visual alarm shall conform to the requirement of California Fire Code (NFPA 72).
   b. This level of notification shall be provided in all occupied areas, including those areas only occasionally occupied by service staff, such as mechanical equipment rooms. All final sound measurements shall be performed while the space is completely occupied by its assigned tenants and while normal activities are in progress. All audible levels are determined in field tests by the Designated Campus Fire Marshal (DCFM).
   c. All building remodeling projects in existing buildings shall provide for additional fire alarm notification appliances if the remodeling would otherwise result in areas where the fire signals are not sufficient.
3. Audible/Visual Alarm Characteristics
   a. Audible signaling devices shall be of the same manufacture within a building. All equipment shall be compatible with the building fire alarm.
   c. Wall mounted notification strobe lights and combination horn/strobes and speaker/strobes shall be at eighty inches (80”) above finished floor to bottom of lens, or six inches (6”) from ceiling to bottom of lens if ceiling is less than eighty-six inches (86”) from floor. Code required mounting locations (ADA hearing impaired) take precedence. Exceptions to mounting location require pre-approval by the University of California, Berkeley Authorities Having Jurisdiction.
   d. Listed ceiling mounted notification appliances are to be used in open area floor plans, and locations where sight lines to visual devices may be routinely obscured.
   e. Audible and Visual notification appliances shall be fully synchronized. Audible pulse rate and strobe flash shall be synchronized throughout the building alarm system. Exceptions allowing Synchronization by-floor requires pre-approval by the University of California, Berkeley Authorities Having Jurisdiction.
   f. At least one notification appliance shall be located so that its signal can be heard and seen at the fire alarm control panel, with any door(s) to the control panel room closed. No audible indicating appliance shall be located within twenty feet (20’-0”) of a fire alarm control panel or sub-panel, unless it is in a separate room with a door in between.
   g. All audible-signaling devices shall sound with uniform alarm code (3 beats, pause, and 3 beats). Voice messages shall incorporate this code.
   h. Audible/visual fire alarm devices shall be red in color. White devices with red lettering will require pre-approval by the University of California, Berkeley Authorities Having Jurisdiction. All non-fire evacuation notification devices shall be a different color and visual devices shall have a distinct lens color different than that used on the fire alarm. All NAC device colors shall be consistent within a building.
   i. Surface mounted notification appliances (horns, strobes, and speakers) shall have back boxes provided by the manufacture for that use only. Flush mounted notification appliances shall use “deep” mounting boxes.

4. Notification Device Controls
   a. Notification Appliance Circuits (NACs) shall be controlled by the main fire alarm control panel, and through integrated remote control panels.
   b. Notification Appliance Circuits (NACs) may be controlled by control modules mounted in the fire alarm control panel and remote panels. For non-voice systems use the Siemens CSM-4 (Conventional Signal Module) or subsequent model. In a Siemens MXLV system use Siemens Zone Control Modules (for example, ZC2-8B).
   c. Notification Appliance Circuits (NACs) may be controlled via remote control panels. Control panels (PAD-3) that use the alarm signaling circuit (Siemens MXL ALD loop) to supply control activation are not accepted. Sample; in the Siemens MXL, Intelligent Control Points (ICPs) or Siemens TRI-R monitoring modules for notification control are not accepted.
      i. NAC extender panels may be used in upgrading existing fire alarm systems that are incapable of having the existing notification circuits expanded or upgraded to match current code requirements.
      ii. NAC extender panels may be used when the building design precludes the practical use of a central NAC panel. Sample: When voltage loss in NAC conductors is excessive due to linear distance (buildings with extended wings) or extensive audible sound baffling (buildings with many small rooms and suites within suites).
d. Audible/visual indicating appliances shall be designed to continue signaling until manually silenced by the fire department. No automatic time-out circuitry shall be used to silence the indicating appliances.

e. A single alarm silence switch shall be provided inside the fire alarm control panel so that the alarm indicating appliances may be silenced without resetting the fire alarm system. If this switch is of the maintained-contact type, its position shall be supervised so that it cannot unknowingly be left in the silenced position. New alarm systems will be designed to accommodate subsequent alarms (alarms initiated after the alarm silence switch has been operated) by sounding and flashing the indicating appliances.

f. In laboratories where the level of sound provided by corridor notification appliances is not adequate and because of the need to avoid startling laboratory occupants who may be engaged in potentially hazardous activities the following may be installed with Fire Marshal pre-approval:
   i. Addressable voice systems allowing speaker volume and sound levels to be adjustable inside laboratory applications.
   ii. A strobe light only may be used with AHJ pre-approval.

g. In residential occupancies fire alarm system (general building alarm) notification appliances shall be located to provide required sound levels in all rooms (this applies to audible/visual devices located in corridors and inside living spaces). Each living space shall have a building fire alarm system notification appliance within apartment, suite or stand-alone dorm room. The device may be an audible base on a system smoke detector. This will insure the required evacuation alarm sound level.

5. Battery Backup
   a. Battery backup shall be provided to power the fire alarm system in the event of AC power failure.
   b. Battery capacity shall be determined in accordance with appropriate codes and industry practice.
   c. Batteries shall be of the lead acid gel or deep cycle type unless otherwise approved by the University.
   d. Manufacture date must be within one (1) month of system acceptance.
   e. An automatic battery charger, integral to the fire alarm control panel, shall be provided.
   f. Batteries shall be supervised to detect open circuits, short circuits, grounds, and low battery voltage.
   g. Meters shall be provided as part of the fire alarm control panel to indicate charging voltage and charging current.
   h. Provide 24-hour battery back-up test to check for adequate voltage and drop.

28 31 33.16 Fire Detection and Alarm Interfaces to Access Control Hardware

1. Door Releases
   a. Alarm-controlled door releases shall be of the simple electromagnetic type as opposed to the integrated hydraulic closer type of door release.
   b. Door releases shall have an operating voltage of 24 VDC.
   c. Each door release circuit shall be independently fused at the fire alarm control panel. The fuse shall be chosen to open the circuit at 125% of normal current.
   d. Electromagnetic door hold opens shall be wired so as to be de-powered during AC power failure; alternatively, electromagnetic door holders shall be included in the battery stand-by calculations.

2. Automatic Fire Doors
   a. Where possible a horizontal accordion fire door shall be used rather than a coiling roll-down door.
   b. All self-closing fire doors shall incorporate the following features:
      i. Provide battery back-up or emergency AC panel circuits for the power supply for the fire door system. When operating on battery power the door should operate, in every respect, as when on normal power.
ii. An uninterruptible power supply (UPS) is required with the use of generator emergency power. The power supply transfer time must be less than the time required to release the fire door fire release mechanism. This will prevent door closure during the transfer period from normal power to stand-by power.

iii. Standby power for the door controls shall not be provided by the fire alarm system.

iv. Provide an audible (voice) and visual local alarm on all fire closures (including motorized and gravity drop closures).

v. Provide adequate and safe access to control and mechanical elements of the door (access panels shall be of a size and placement so that service personnel may work safely with both hands, without inordinate leaning, stretching or reaching). An application requiring the removal of hoods, shrouds, and architectural elements such as soffits to reset door systems does not provide an acceptable access.

vi. Provide a motorized closure and a motorized reset of the door system during normal fire conditions.

vii. Provide, on roll-down, doors access for drum and curtain repair and replacement. If door curtains cannot be repaired the assembly must be removed from the wall.

viii. The door control smoke detector (s) shall send an alarm signal via the alarm system control software to the associated programmable relay that shall operate the fire doors or accordion partition. The door control fire alarm relay shall be located near the door system and accessible for maintenance and repair without having to raise the door to normal position. Door assemblies that require maintenance or emergency response personnel to enter via a temporary unsecured secured door present a safety hazard.

3. Annunciator Panels
   a. An annunciator panel is not required if:
      i. The fire alarm control panel is located immediately inside the fire department's entry door, or;
      ii. The fire alarm control panel is located within a room whose entrance is immediately inside the fire department's entry door.
         1. The fire department's entry door shall be selected by the Campus Fire Marshal, in consultation with the Berkeley Fire Department.
         2. The requirements for a remote annunciator and location of the annunciator shall be determined by the Authority Having Jurisdiction (Designated Campus Fire Marshal [DCFM]).
   b. Annunciators shall not be mounted in outdoor locations. The only exceptions shall be mounting within approved listed weatherproof enclosures located in non-weather or sun exposed locations (i.e. covered porches).
   c. For addressable alarm systems the annunciator shall be a Siemens RCC-1 or subsequent model. This uses an alphanumeric display that is a one-to-one match with the display at the main fire alarm control panel. The remote annunciator shall be software configured as a “read-only” display. Use of the remote annunciator for system control shall require pre-approval by the University of California, Berkeley Authorities Having Jurisdiction.

28 31 33.26 Fire Detection and Alarm Interfaces to Intrusion Detection

1. Connection To Security Alarm Systems
   a. Connection to building security systems shall be by programmable remote relays Siemens type TRI-R or subsequent model.
   b. The interface between a fire alarm system and building security system shall be determined by consultation between the Designated Campus Fire Marshal (DCFM), UC Police Department Crime Prevention Unit and Facilities Services.
c. Control relays connecting the fire alarm system and a building security system shall have a secure (key operated) by-pass switch. This shall be provided and configured so that an impairment of the fire alarm system shall not impair the building security operation. Power loss and or shifting to stand-by power on the fire alarm system shall be considered as impairment.

d. Panels using LED lights shall not be acceptable. Panel shall be LCD Digital Remote Enunciator RCC Series Display or equal.
   i. Graphic displays for smoke control fan status and elevator status displays may be approved by the Authority Having Jurisdiction and must include at least twenty-five (25%) more lamps and directory space than required, with wires for the additional lamps installed to the fire alarm control panel.

2. Single Reset Switch
   a. The main Reset in a fire alarm control panel shall reset all smoke detectors (including air duct smoke detectors) connected to that panel. No additional switching action shall be needed to reset any smoke detector. Exception: Engineer detection and suppression systems (Veda HSSD).

3. Single Alarm Silence Switch
   a. A single switch, located in the main fire alarm control panel, shall silence all audible alarm devices. The main fire alarm control panel is the panel which either trips the Gamewell Master Box or contains the leased-line driver, as described in this division.

4. Bypass Switches
   a. The fire alarm control panel shall include supervised bypass or disconnect switches for each of the following functions:
      i. municipal tie (central station signaling)
      ii. audible signaling devices (one [1] bypass switch for all devices)
      iii. door holders (one [1] bypass switch for all door holders)
      iv. sprinkler flow switches (one [1] bypass switch for each flow switch)
      v. extinguishing systems which initiate a fire alarm condition on the fire alarm control panel, e.g., range hood extinguishing system, (one [1] bypass switch for each extinguishing system.)
      vi. equipment shutdown or turn-on circuits, e.g., building fan shutdown circuits, fan turn-on circuits, door opener circuits, etc., (one [1] bypass switch for each circuit.)
      vii. elevator recall circuits (one [1] bypass switch for each elevator bank)
      viii. extinguishing devices that are controlled by the fire alarm control panel, e.g., Halon systems or pre-action sprinkler systems (one [1] bypass switch for each device.)

5. Single Circuit Breaker - Dedicated Circuit
   a. No other (non-fire-alarm) equipment shall be fed by this circuit breaker.

6. Single Key Connection To Security Alarm Systems
   a. All fire alarm systems shall be totally separate from security alarm systems. No common wiring, raceways, batteries, control panels or signal transmission systems shall be used.
   b. Connection to building security systems shall be by programmable remote relays Siemens type TRI-R , HTRI-R or subsequent model.
   c. The interface between a fire alarm system and building security system shall be determined by consultation between the Designated Campus Fire Marshal (DCFM), UC Police Department-Alarms and Access, and Facilities.
   d. Control relays connecting the fire alarm system and a building security system shall have a secure (key operated) by-pass switch. This shall be provided and configured so that an impairment of the fire alarm system shall not impair the building security operation. Power loss and/or shifting to stand-by power on the fire alarm system shall be considered as impairment.
1. Soil Management Requirements
   a. All soil must be evaluated by UC Berkeley standards for environmental contamination with laboratory analysis before export to any off-site location. UC Berkeley soil cannot be taken to K-12 schools, residential developments or other sensitive receptor sites.
   b. Soil, Landscaping and Fill Material cannot be removed, transported or reused without full environmental screening as approved by UC Berkeley’s Office of Environment, Health and Safety.
   c. Non-Hazardous Soil must have Bills of Lading (BOL) or other shipping documents for transportation to acceptance site signed by UC representatives.
   d. Hazardous materials disposal manifests may only be signed by EH&S Campus Staff with DOT training. All soil shipping documents (BOLs and manifests) must be sent to EH&S for final record retention.
32 00 00 Exterior Improvements

32 10 00 Bases, Ballasts, and Paving

32 12/13 00 Flexible/Rigid Paving

1. Materials
   a. Use asphalt or concrete with broom or salt finish of natural color.

2. Joints
   a. Determine expansion requirements before specifying.

3. Installation
   a. Specify standard installation methods: base depths, reinforcement (concrete) and weak surface depth depend on load requirements and thus vary.

4. Styles, Colors, Finishes
   a. Darker materials preferred, as they are usually easier to match in the future.

5. Contractor Additional Requirements
   a. Identify manufacturer's source for replacement for paving types of individual pieces, i.e., tiles, bricks, slate.
   b. Stamped concrete installations shall require turn-over of tamp template pattern to the University.

32 14 00 Unit Paving

32 14 13 Precast Concrete Unit Paving

Campus standard impervious concrete unit paving for shared pedestrian and vehicular walkways and plazas shall be a Mission Style 6” x 12” x either 60mm or 80mm Gray Charcoal blend, from Cal Stone, 426 East Grant Line Road, Tracy, CA 95376; (209) 833-7366 or approved equal.

32 14 13.19 Porous Precast Concrete Unit Paving

Campus standard pervious concrete unit paving for shared pedestrian and vehicular walkways and plazas shall be a 6” x 12” x either 60mm or 80mm Gray Charcoal blend, from Pacific Interlock Pavingstone (408) 257-3645 or approved equal.

32 14 40 Stone Paving

Avoid flagstone pavers as they tend to come loose from base material, crack and can be difficult to match at later dates.

32 15 00 Aggregate Surfacing

32 15 40 Crushed Stone Surfacing

Standard campus crushed stone surfacing stabilizer shall be Soilshield-LS polyvinyl acrylic copolymer, tan in color, from Soil-Loc, Inc. Scottsdale, Arizona; (888) 828-7300, or approved equal. Install per manufacturer’s instructions.

32 16 00 Curbs, Gutters, Sidewalks, and Driveways

All new concrete flatwork shall include a glare-reducing admixture. This shall be either be one (1) pound of lampblack per cubic yard or an equivalent liquid measurement.
32 17 00  Paving Specialties

32 17 13.19  Precast Concrete Parking Bumpers

Parking blocks shall be precast reinforced concrete, 10" wide x 6" high x 3' long, with minimum of two (2) anchor pin holes. Provide 1/2" diameter x 24" length hot dipped galvanized steel anchor pins for securing parking blocks.

32 17 26  Tactile Warning Surfacing

Curbs and ramps shall follow state access code requirements, UC Berkeley standard detectable warning shall be black reinforced “CASTinTACT 3” concrete tiles either mortar or wet set with black grout supplied by Masco Masons Supply (www.castintact.com). Overall dimensions per applicable state and federal access code. Each detectable warning field shall be bordered by a four inch (4”) wide reflectorized white thermal plastic “PreMark” tape by Ennis-Flint (336) 475-6600. Install per manufacturer’s instructions.

32 30 00  Site Improvements

32 31 00  Fences and Gates

See Landscape Heritage Plan section on Pedestrian Barriers and Traffic Controls for various approved campus fence designs. The campus standard two (2) rail wood fence shall be used near natural areas or steep drop offs. See Appendix A: Drawings for typical details.

33 33 13  Site Bicycle Racks

1. Discuss bicycle planning requirements with the campus transportation planner to determine the appropriate bike parking accommodations. New buildings and buildings undergoing major renovation should provide bicycle parking/storage per the campus’ Bicycle Master Plan.

2. It is recommended that the site provide a mixture of secure/indoor bicycle parking (long-term parking) and outdoor bicycle racks (short-term parking) for no less than 15% of the average peak daily occupancy of the building. In some cases, providing more bike parking may be advisable, particularly for residential buildings and for buildings that house a substantial number of faculty, staff or researchers (e.g., office buildings, laboratories, clinics, special event spaces such as the stadium or athletic fields). To determine this, discuss with the campus transportation planner.
   a. Short-term bike parking (bicycle racks) should be highly-visible, well lit and located at major building entrances. Outdoor bicycle racks should be securely surface mounted or cast in place.
   b. Bicycle racks shall use inverted u style racks of galvanized or stainless steel pipe. The rack shall be able to accommodate two bicycles parallel to the rack. The rack shall securely accommodate a bicycle six feet (6’-0”) long with its frame supported at two locates so that the bicycle cannot be pushed or fall in a manner that will damage wheels or components.
   c. Bicycle racks should be placed so that bicycles do not disrupt the path of travel or intrude into the street. On sidewalks less than fifteen feet (15’-0”), racks may be parallel to the curb with at least twenty-four (24”) from the curb.
   d. Each bicycle parking space shall be accessible without moving another bicycle. Racks perpendicular (side-by-side) to the curb shall be no less than thirty-six inches (36”) apart (forty-eight inches [48”] preferred). Racks parallel (end-to-end) to the curb should be no less than forty eight inches (48”) apart (seventy-two inches [72”] preferred).
   e. The area devoted to bicycle parking should be hard surfaced: concrete, asphalt, decomposed granite or equivalent at the discretion of the campus landscape architect.
f. Racks shall be at least five feet (5’-0”) from fire hydrants and four feet (4’-0”) from bus stops, loading zones, blue (ADA) zones, curb ramps, and crosswalks. Racks should not conflict with utility boxes or access.

32 33 14 Site Bicycle Lockers

Long-Term Bike Parking

1. Indoor bike storage areas may consist of indoor bike rooms, secure bicycle cages, bicycle lockers, or other structures accessible only by those issued keys for use. Indoor bike parking/storage locations should be indicated with signage directing people to these spaces. It is recommended that indoor bike rooms also include storage units for bicycle commuter personal effects.

2. Indoor secure bicycle parking may use hanging wall racks, inverted U racks, bike lockers, or two-tiered racks depending on which style maximizes use of the space. Each space must be accessible without moving another bicycle and must accommodate a path of travel to allow people to access the bicycle parking.

32 33 00 Site Furnishings

32 33 23 Site Trash and Litter Receptacles

The campus standard for thirty-two (32) gallon waste and recycling receptacles follows three waste streams: Cans & Bottles, Mixed Paper, and Landfill. Product is manufactured by Fabritesch at 717 S. 32nd St., Richmond, CA 94804, (510) 367-1858. Thirty-two (32) gallon plastic liners for the receptacles may be purchased from various campus vendors. Receptacles may be anchored to a concrete footing or base with a single, centered ⅝” diameter galvanized anchor bolt. Designation and distribution of the receptacles shall be determined by Facilities Services in coordination with Construction & Design Project Manager.

32 33 43.13 Site Seating

The campus standard outdoor or memorial bench in the public realm shall be an unfinished, teak wood bench either 6’ or 8’ long “Parkside” bench, available from Gardenside International Limited at 808 Anthony St, Berkeley, CA 94710, (415) 455-4500, or approved equal. All benches shall be blind anchored into concrete. See Appendix A: Drawings for typical Installation details. Wherever possible, benches shall have center armrest to discourage unlawful lodging. Plaques or engravings shall undergo campus approval process.

32 35 00 Screening Devices

32 35 13 Screens and Louvers

Trash and Recycling Enclosure

1. All projects that include Trash and Recycling Enclosures, whether new or modification to existing, require review and approval, including Designated Campus Fire Marshal (DCFM) approval.

2. Drainage
   a. Provide a three inch (3”) minimum drain line inside the enclosure routed to the sanitary sewer; with a trap-type catch basin or a cleanout to grade in combination with a p-trap.

3. Doors
   a. Install sturdy, wide, and positive closing doors (not to exceed 15lbf for opening).
   b. Doors shall have a mechanism with sufficient tolerance to remain closed with ½ inch of door misalignment.
c. Design door opening width to extend a minimum of two feet (2’-0”) past width of bins on both sides to allow ease of bin movement.

4. Paving
   a. Pave enclosure pad and front entry concrete apron with an impermeable material.
   b. Reinforced six inch (6”) thick concrete is recommended at a minimum.

5. Grading
   a. If the enclosure is open to rainfall, the inside of the enclosure shall be graded to drain to a dual sanitary sewer - storm drain. A valve shall be installed to enable switching from storm to sanitary drain for cleaning or spills.
   b. Grade the apron away from the enclosure pad to keep storm water out.
   c. Grades shall not exceed five percent (5%), nor be less than one percent (1%).
   d. Create positive surface run off around enclosure and swale in front of doors, if site grades require it.

6. Walls/Screening
   a. Include an interior curb, with strike plate or bumper guard to prevent damage to walls.
   b. Walls/screening shall screen the contents inside the enclosure.

7. Lighting
   a. Provide motion sensor controlled lighting in the enclosure.
   b. Lighting shall be designed to provide a minimum of 0.5 foot-candles inside and along the access route to the enclosure.
   c. Use long life lamps compatible with surrounding pedestrian lighting.

8. Water Supply
   a. Provide hose bib source inside the enclosure.

9. Access
   a. The top of the dumpsters cannot exceed thirty-six inches (36”) from the finished grade or use of mechanical assisted or automated system must be provided
   b. The dumpsters must be accessible to the street level for servicing
   c. The path from the service elevator to an indoor enclosure shall be within a building. No impediments shall exist in the path of travel to any enclosures. Impediments include: stairs, textured surfaces, bumps, drains, slopes/grades greater than two percent (2%).
   d. Distance from Enclosure to Truck Access
      i. Locate the enclosure no more than five feet (5’-0”) away from truck access. Pathway and parking grades shall not exceed two percent (2%).
      ii. If needed for protection, traffic control bollards shall be placed to allow pedestrian access to the enclosure and spaced eighty inches (80”) on center to allow bins to roll through them.

10. Materials and Size of Enclosure to accommodate dumpsters/carts
    a. Dumpster or cart space shall be provided for:
       i. mixed paper
       ii. cans and bottles
       iii. organic materials
       iv. trash
       v. reusable items
    b. Size of the enclosure and number of dumpsters will be determined by size of building, occupancy, and building use. Please contact Campus Recycling and Refuse Services for proper sizing of the enclosure. Two cubic yard bins are 54” tall x 80” wide x 52” deep.

Adopted August 2015
11. Pest Considerations
   a. Enclose refuse and recycling areas with concrete, metal, or similar materials to prevent vertebrates from gnawing or climbing the enclosures.
   b. Avoid having refuse dumpsters inside structures. If they are part of a building, be sure to rodent-proof the room by using metal kick plates on doors and sealing all gaps to less than 1/4 inch.
   c. Use refuse containers that are heavy-duty, rust resistant, rat and damage resistant and equipped with tight-fitting lids.

32 39 00 Manufactured Site Specialties

1. For bollards and barrier-poles, consult with the UCPD Crime Prevention Unit (510-642-3722) for device type and dimensions, as well as campus padlocks and anchoring mechanisms to the ground.

32 80 00 Irrigation

1. General
   a. Quality Assurance
      i. Underwriters Laboratories: Electrical wiring, controls, motors and devices must be U. L. listed, and so labeled.
      ii. Installer Qualifications for solvent joints: Employ personnel trained by the manufacturer's representative in techniques for making correct joints prior to performing work on the site.
   b. Delivery, Storage and Handling
      i. Storage: Store material in an orderly manner. Avoid interference with other construction activities.
      ii. Protection: Protect all materials to prevent intrusion of dirt and moisture. Protect the installed work and materials of other trades. Cover and protect from sunlight.
   c. Site Conditions
      i. Perform irrigation installations when weather and soil conditions are suitable as determined by the Owner's Representative.
      ii. Coordinate with the work of others, particularly with respect to utilities and underground systems.
      iii. If underground construction, obstructions, or unforeseen utilities are encountered, notify the Owner’s Representative.
      iv. Examine the drawings and the site and be aware of connections required and existing improvements to remain and those to be protected.

2. Submittals:
   a. Operating and Maintenance Tools:
      i. Deliver the following items to the Owner when work is completed prior to final acceptance.
         1. Two keys for each automatic controller cabinet.
         2. Four quick coupler and matching hose swivels with globe valves.
         3. Two keys for opening valve boxes.
         4. Two laminated color-keyed zone diagrams for the area covered by each controller.
   b. Product data: Prior to installation of any work, prepare a list of each material proposed for use and submit to the Owner's Representative for review.
   c. Record Drawings: Submit record reproducible drawings (Mylar) showing dimensioned locations and depths for each of the following:
      i. Point of connection: Sprinkler pressure line routing. Provide dimensions for each one hundred lineal feet (100'-0”), maximum along each routing, and for each change in direction.
Gate valves; sprinkler control valves (buried only); quick coupling valves; control wire routing; other related items as may be directed.

ii. Locate all dimensions from two permanent reference points such as buildings, monuments, sidewalks, curbs, or pavements.

iii. Record all changes that are made from the drawings, including changes in pressure and non-pressure lines.

iv. Final review will not commence without prior receipt of record drawings.

d. Controller Charts:
   i. Do not prepare charts until record drawing have been reviewed by the Owner's Representative.
   ii. Provide one controller chart for each automatic controller installed. Chart shall be a reproduction of the Record Drawing, fitting the controller door. Photo reduction prints are required, keeping reduction to maximum size possible to retain full legibility. The chart shall show the area covered by that controller.
   iii. Identify the area of coverage of each remote control valve.
   iv. Following acceptance of charts hermetically seal between two layers of thirty-millimeter (30 mil.) thick plastic sheet.

e. Operating and Maintenance Manuals: Provide descriptions of all installed materials and systems in sufficient detail to permit maintenance personnel to understand, operate and maintain the equipment.
   i. Include one laminated, color-keyed zone diagram for the area covered by each controller in the manuals.
   ii. Submit both hard and electronic (PDF) copies of all Operations and Maintenance Manuals.

3. Warranties/Guarantees
   a. In addition to the manufacturer's guarantees or warranties, warrant all work for one year from the date of final acceptance against defects. Cover repair of damage to any portion of the site or adjacent areas resulting from leaks or defects in materials and workmanship. Submit warranty in writing to the Owner's Representative.

32 81 00 Irrigation Components

1. General piping: Main line: Schedule 40 PVC with schedule 40 solvent weld fittings; 1-1/2” size throughout.
   Lateral Line: Schedule 40 PVC with schedule 40 solvent weld fittings; size as shown on drawings. Pressure test supply line from point of connection through backflow prevention unit. Pressure test supply lines downstream of backflow prevention units and non-pressure lines.
   b. Plastic Pipe and Fittings:
      i. Pipe shall be identified with the following markings:
         1. Manufacturer’s name
         2. Nominal pipe size
         3. Schedule of class
         4. Pressure rating psi
         5. NSF (National Sanitation Foundation) seal of approval
         6. Date of extrusion
      ii. No ring tight piping allowed – All connections to be solvent weld.
      iv. Threaded nipples: Standard weight, Schedule 80 with molded threads.
      v. Joint Cement and Joint Primer: Type as recommended by manufacturer of pipe and fittings.
2. Components:
   a. Tracer wire: 12 gauge unshielded copper wire.
   b. Gate valves: Nibco, Stockham or equal with brass handle. Non-rising stems. For 3” pipe or larger, use a square head valve.
   c. Chloramine Resistant Backflow Preventer: 975 XL Y Wilkins. Install in painted metal cage on a concrete pad. Color TBD by Owner’s Representative
      i. Pressure Regulator valve (PRC) or Watts N55BDU-MI Wilkins 500 series.
      ii. Turbine Meter Class 2 – Brass construction by Master Meter Neptune-Trident with dry contact leads.
   d. Remote Control Valves: Rainbird 6B series brass valves or equal; PEB series or equal for drip. Install ball valve before remote control valve and union on lateral side, label with Christy ID tags.
   e. Valve Boxes: Carson 910 ten inch (10”) series for isolation valves and/or Brooks splice boxes 1419 to 1200. Use Christie “B” series concrete in high traffic areas.
   f. Quick Couplers: Rainbird 33DNP yellow with locking covers or equal. Install in fourteen inch (14”) square concrete sprinkler blocks in high traffic areas. Schedule 80 fittings. No premade swing joint assemblies allowed.
   g. Sprinkler Heads – Lawns:
      i. Rotary Type: Hunter Stainless I-20, I-25, I-40, I-44 or equal.
      ii. Spray Type: Rainbird 1800 SAM PRS Series, with MP Rotator nozzles by Walla Walla (or equal) for low water use
      iii. Sprinkler Heads – Shrub Areas:
         1. Rotary type: Hunter I-10 Shrub rotor, Hunter G series 12” high pop rotor or equal.
         2. Spray heads: Rainbird 1800 SAM PRS series 6” – 12” or equal.
         3. Bubblers: Hydro Rain 610 Flood Bubbler or Rainbird Bubbler or equal.
   h. Drip Systems:
      i. Emitter Hose and Tubing: Netafim Techline Tubing or equal
      ii. Flexible vinyl chloride compound conforming to ASTM D2287
      iii. Polyethylene and vinyl tubing
      iv. Emitters: Rainbird – Xeri Bug – single emitter (or equal), if using Pressure Regulator.
      v. Filter: Pressure regulating Rainbird PRF-100 RB1” with 200 mesh screen, Amiad or equal
      vi. Pressure Regulators: If not using the preceding: Watts IR56G or Senninger Pre-Set
      vii. Tubing stakes 12 gauge galvanize cold drawn wire clad with PVC
   i. Controllers: Campus Vendor for Motorola systems is Central Control Systems Ltd. (530) 662-6841. Before specifying, consult with Facilities Services Grounds Manager Gary Imazumi (garyi@berkeley.edu) regarding the desired controller configuration at this site in coordination with the campus network.
      i. Cabinets: Use Strongbox stainless steel enclosure on a concrete pad for exterior installations or a wall-mount Type 1 electrical enclosure for interiors.
      ii. Controller:
         1. Motorola IRRInet XI ACE field controller with 14, 28, 42, 48, 64, or 80 station field controller with 8 amp Elisra power supply/charger, TC&D/IP Interface for LAN communications.
         2. UHF Second radio kit for MS communications
         3. Wall mount chassis if indoors.
         4. Large 100/24 VAC transformer for valve control.
         5. 450-470 MHz antenna system for communication to MS V2 controllers.
         6. Weatherproof GFI/power switch with 8 station two input with auto/on/off switchboards with surge protection (Northern Technologies TCS-HW is campus standard for surge protection)
      iii. MS V2 Field Controller:
1. 8, 16, 24, 32, 40 or 48 station Motorola MS field controller.
2. Cosel R50A 12 volt DC power supply.
3. 450-470 MHz antenna system for communication to IRRInet XL
4. ACE field controller
5. Weatherproof GFCl/power switch with 8 stations, two inputs with auto/on/off switchboards with surge protection.
7. Portable programming keyboard for MS field unit.

iv. Electrical Wiring and Service:
1. 120V High voltage: In conformance with drawings. Provide hookup to controller.
2. Low voltage: Connections between controller and remote control valves. Make direct burial AWG – UF, 600 volt wire. Make water proof splices, where permitted, use # MNO DBLY splice kit with copper crimp-type connectors, or equal. Size wire according to manufacturer’s recommendations, in no case less than NO 14. Ground wires: white in color.
3. A spare control wire of a different color shall be looped through every valve on the system.

ev. Flow Meters:
1. Specify ARAD, Ltd model by line size (1.5”, 2”, 3”, 6”, 8”) 2 BMU-CIR (for 2” line) Hydrometer, master valve /flow meter with potted 24v AC solenoid, manual on/off auto valve with copper tubing and drain plug., 10 gallons/pulse. Meter cable from controller to the meter to be installed with dry contacts.

3. Execution
a. Examine site conditions prior to commencement of work. Note the extent and type of work to be done and after verification of quantity, location and condition of all existing systems and/or components to remain and how they will integrate with new improvements. Should there be discrepancies between the contract documents and the actual site conditions, do not proceed with the installation without notifying the Owner’s Representative. Proceeding without notification, the Contractor assumes full responsibility for all revisions and related costs.
b. Preparation.
   1. Exercise care in excavation and working near existing utilities. Check existing utility locations.
   2. Do not proceed with work until unacceptable site conditions are corrected or existing utilities are located and/or marked out in field.
c. Design:
   1. Rain Sensors:
      i. Use of rain sensors to override the control program and conserve water is required for all new installations or substantive renovations of irrigation systems.
d. Protection:
   1. Provide barricades, coverings, warning signs, lights and other protection required by local code or OSHA to prevent damage to existing improvements to remain and protect the public.
   2. Protect improvements on adjoining areas as well as those on the project site.
   3. Restore any improvements damaged by this work to original condition, as acceptable to the Owner’s Representative.
   4. Protect existing trees and other vegetation to remain against damage. Do not stockpile construction or excavated materials within drip lines without protection.
e. Trenching.
   1. Trench Depths: Main line 24”, Control Wires 24”, Lateral Lines 14” - 18” (2”pipe), sleeves beneath pavement 24”.
   2. Line Clearances: Provide 3” – 4” (36” top of pipe) of clearance between each line and not less than 6” of clearance between lines of other trades.
f. Backfilling
   1. Initial backfill over lateral lines to be clean, fine granular material as reviewed and accepted by the Owner’s Representative.
   2. Initial backfill over all pressure lines to be clean sand.
   3. Compact native soil backfill to a dry density equal to adjacent undisturbed soil. Restore to adjacent grade, free from depressions, humps, or other irregularities.
      i. Backfill: Free of rocks over 2 inches, metal and trash.
      ii. Sand bedding for pressured pipe: Not less than 6 inches below and above pipe. Note: Avoid introduction of dissimilar materials which may result in a galvanic reaction.

   g. Installation
   1. Install plastic pipe and fittings in compliance with manufacturer’s instructions for same. Install RCV manifold with schedule 80 threaded nipples and “L” couplers. Each RCV shall have a line size ball valve and union.
   2. Install any back flow assembly in area shown at minimum height permitted by local code. Install pressure line from point of connection to backflow unit per local code. Chlorinate all extensions of domestic water lines to the backflow assembly. Install with unions at both upstream and downstream connections. Install in order: meter; PRV; backflow device. Use all brass or copper fittings under and above ground from supply line. A buried isolation valve at backflow and meter station shall be placed on the supply line to isolate the backflow station. The first fitting of copper or brass downstream leg of the backflow will be a female to male PVC SCH 80 fitting.
   3. The Owner’s Representative shall approve the location of all specified assemblies.
   4. Brass pipe and fittings: Assemble using Teflon tape applied to male threads only.
   5. Plastic pipe and threaded fittings: Assemble using Teflon tape applied to male threads only. Make threaded connections from main line to RCV.
   6. Tape all open ends of pipe during installation to prevent entry of any foreign matter into the system.
   7. Install copper tracer wire to all PVC pressured lines, taped every fifteen feet (15’-0”). Stub tracer wire up at backflow unit, isolation valves and/or irrigation controller.
   8. Quick Coupling Valves: Unless otherwise indicated, locate valves 12 inches maximum from hardscape. Install with steel rod clamped by two stainless steel clamps. Assemble with triple swing joint utilizing SCH 40 nipples and SCH 80 90 degree elbows.
   9. Sprinkler Heads: Adjust locations indicated on drawings to achieve full coverage and prevent overspray. Do not exceed the maximum or minimum spacing indicated by manufacturer – All heads to be equipped with nozzles of matching precipitation rates for any one RCV circuit.
   10. All sprinkler heads to be assembled with triple swing joints utilizing SCH 40 nipples and SCH 80 90 degree elbows – Prefabricated joint assemblies not allowed.
   11. Existing Pavement:
      i. Piping under existing pavement may be installed by jacking, boring or by hydraulic driving except as otherwise specified or directed. Use existing sleeves where applicable.
      ii. At location where cutting is required make all cuts clean using power saws.
      iii. Replace and restore all surfaces to original conditions, including grades and landscaping.
      iv. Match restoration work with original work in every respect, including type, strength, texture and finish.
   12. New Pavements:
      i. Coordinate installation of piping and wires under paved areas with the Contractor. Use sleeves under pavement.
      ii. If wires under paved areas cannot be continuous, enclose all splices in an acceptable splice box.
   13. Valves and Valve Boxes:
i. Provide at all locations indicated. Install only one (1) valve per box, minimum six inches (6”) clearance from bottom of valve to soil level. Valve must be fully enclosed within box allowing space for maximum opening of flow control.

ii. Fill area under box at each corner with supporting brick.

iii. All remote control valves to be installed with SCH 80 threaded fittings, with ball valve and union. To be threaded from main.

14. Identifications:
   i. Identify valves with Christie ID tags.
   ii. Burn valve number in box lids.
   iii. Burn MSTR in master valve lid.

15. Low Voltage Wiring:
   i. Place wiring in the same trench and routing as pressure supply lines.
   ii. Install wiring under main line, minimum six-inches (6”) sand cover between control wires and pipe and top of pipe.
   iii. When more than one wire is placed in a trench, tape wires together at a maximum of ten foot (10’-0”) intervals.
   iv. Provide a twenty-four inch (24”) expansion loop at each connection and directional change.
   v. Use a continuous wire between controller and remote control valves.
   vi. Except as otherwise approved, do not splice wire at any point.
   vii. At locations where splicing is allowed, make splices within an acceptable splice box.
   viii. Provide each controller with a separate ground wire.
   ix. A spare control wire of a different color shall be looped through every valve on the system.

16. Connections:
   i. Make connections to the existing water line at the location indicated on drawings. Make any minor changes in the location as may be necessary due to actual site conditions.
   ii. Make connections to electrical service for full operation. Make minor changes in location as may be necessary due to site conditions.

h. Field Quality Control
   1. System Flushing:
      i. After sprinkler pipe lines and risers are in place and connected, and prior to installation of sprinkler heads, thoroughly flush all lines with a full head of water.
      ii. Do not install sprinkler heads until lines have been flushed and reviewed by Inspector.

2. Pressure Tests:
   i. Provide all equipment necessary to test systems, including pump.
   ii. Perform all hydrostatic tests in the presence of the Project Inspector and the Owner’s Representative.
   iii. Test all pressure supply lines under hydrostatic pressure of 125 PSI for a period of two (2) hours unless another test is accepted to show lines free of leaks and defects.
   iv. If the only piping installed is less than twenty feet (20’-0”) long, pressure testing shall be required for that section at the time of installation.
   v. Upon the completion of the piping installation, the entire system shall be tested with the Owner’s Representative present.
   vi. Do not backfill over any line more than is necessary until it has been inspected and tested. Leave all joints uncovered.
   vii. Do not connect remote control valves, quick couplers or any other valve assembly until testing is satisfactorily complete.

3. Coverage Tests:
i. Perform coverage tests in the presence of the Owner’s Representative after sprinkler system is completed, but prior to any planting. Test the system to assure that all areas are irrigated completely and uniformly.

ii. Do not spray onto pavement or structures. Install adjustable arc nozzles as needed to provide full coverage without over spray.

iii. Adjusting and Cleaning:
   1. System adjustment
      b. Heads: Adjust for alignment and coverage.
      c. If it is determined that coverage can be improved by a nozzle change, make such changes or arrange with the manufacturer to have changes made as part of the Work.

iv. Make changes and adjust the system prior to any planting.

v. Perform final cleaning of all risers, heads, and equipment for proper operation. Demonstrate operation and uniform coverage in the presence of the Owner’s Representative prior to start of maintenance period and again before final acceptance.

4. Programming:
   i. Assign the master valve to the last valve control position in the controller.
   ii. Set the master valve to “auto-operate”
   iii. Coordinate controller program with the product vendor, Facilities Services Grounds Irrigation staff, and the Owner’s Representative.
   iv. Prepare laminated diagram of circuit system for installation in the controller cabinet.
   v. Submit a written schedule of circuits and programs to the Owner’s Representative for the maintenance period and recommendations for post establishment period.
   vi. At final inspection, demonstrate operation of the controller and coverage for all spray and drip systems. Turn over charts and specified materials to the Owner’s Representative.

5. Clean-up:
   i. Upon completion of the work, restore ground surfaces to required elevations and remove excess materials, debris and equipment from the site. Keep soil out of storm water lines. Thoroughly remove soils via vacuuming or dry sweeping.

32 91 13.16 Mulching

1. Where called for, the Contractor shall furnish and install three inch (3”) depth of clean, natural wood chip “Walk-On” top-dressing mulch in areas designated on plan. Suppliers include Redi-Gro Corporation 8909 Elder Creek Road, Sacramento, CA 95828 (916) 381-6063 or approved equal. Dyed mulches are prohibited.

2. Mulch can harbor ants, and as such should not be used in close proximity to buildings, refuse areas or outdoor eating areas.

32 90 00 Planting

32 92 00 Turf and Grasses

32 92 23 Sodding

1. Campus mowed turf lawns for general use are commercial improved tall dwarf fescue blends with 5-10% bluegrass. This may be installed as seed with ninety (90) day Contractor’s maintenance period until a uniform density is achieved with at least two mowings and a top dress fertilizer application. It may be installed as sod with a forty-five (45) day maintenance period with at least two mowings and a top dress fertilizer application. Sod shall feature tight joints, be rolled smooth and be fully rooted by the end of the maintenance period. See guidelines on protecting new lawn in 32 92 00: Turf and Grasses and 32 93 00: Plants Maintenance sections.
32 93 00 Plants

1. Maintenance
   a. New or renovated plant or turf installations shall be protected during the maintenance period by a perimeter post and rope barricade. Posts shall be two inch (2”) diameter or larger tree stakes, forty-eight inches (48”) above grade, six to eight feet (6’0”-8’-0”) on center. The rope shall be two strands of three-eighths inch (⅜”) diameter yellow polypropylene, at twelve inches (12”) and forty-two inches (42”) above finished grade; attach the rope to posts by drilling the posts or tying clove hitch knots at each post. Maintain assembly in a plumb, tight, condition throughout the maintenance period. At the conclusion of the maintenance period remove and deliver the assembly to Facilities Services Grounds Operations.

2. Selection of Plants and Pest Management
   a. The following plant species harbor roof rats in the bay area and shall be avoided:
      i. Algerian ivy (Hedera canariensis)
      ii. Arborvitae (Thuja orientalis)
      iii. Bamboo (Bambusa spp.)
      iv. Himalayan blackberries (Rubus procerus [discolor])
      v. Honeysuckle (Lonicera caprifolium)
      vi. Italian cypress (Cupressus sempervirens)
      vii. Lombardy poplar (Populus nigra "Italica")
      viii. Juniper tams (Juniperus Sabina "Tamariscifolia")
      ix. Palm trees (date) (Phoenix dactylifera)
      x. Pampas grass (Cortaderia selloana)
      xi. Star jasmine (Trachelospermum jasminoides)
      b. Acceptable Ground Cover Substitutes for Algerian Ivy Include:
         i. African Daisy (Arctotis acaulis)
         ii. African Daisy (Arctotheca calandulacea)
         iii. African Daisy (Osteospernum fruiticosum)
         iv. Trailing African Daisy (Gazania)
         v. Creeping Thyme (Thymus sepyllum)
         vi. Dichondra
         vii. Goldmoss stonecrop (Sedum acre)
         viii. Ground ivy (Nepeta hederacea)
         ix. Needle point ivy
         x. Hahns Ivy
         xi. Climbing Fig (Ficus repens)
         xii. Fescue (Festuca rubia iliahae)
         xiii. False Strawberry
         xiv. Sand Strawberry (Fragaria chiloeinsis)
         xv. Spring cinquefoil (Potentilla verca)
         xvi. Creeping Speedwell (Veronica repens)
         xvii. Mondo grass (Opthoprogon japonicas)
         xviii. Snow-in-summer (Cerastium tomentosum)
         xix. Wooley Yarrow (Achillea tomentosa)
         xx. Bronze Ajuga (Ajuga crispa)
xxi. Chamomile (*Anthemis nobilis*)
xxii. Germander (*Teucrium chamaedrys*)
xxiii. Japanese Spurge (*Pachysandra terminalis*)
xxiv. Wintercreeper (*Evonymus fortunci*)
1. Design Requirements:
   a. Use the following criteria in determining pipe sizes:
      i. Existing known or estimated demands or flows.
      ii. Future known or estimated demands or flows due to expansion of the area served, new
         buildings or building additions.
      iii. Steam distribution and condensate return piping and electric cable sizing shall be based
         on existing sizes and campus requirements. Discuss these with Construction & Design
         (C&D).
   b. Show or note the following on the plans:
      i. Existing and future surface grades where there is to be a change.
      ii. Invert elevation of sewer and drainage structures and pipe.
      iii. Rim elevation of manholes and drainage grates.
      iv. Percent of slope where drainage and velocities are a factor.
      v. Any intersecting or closely parallel utilities or obstructions, new or existing, that may
         cause interference.
      vi. Provide a profile to determine clearances and show the above required information.
      vii. Coordinates of manholes and catch basins from the University grid.

2. Pipe testing requirements vary. Discuss with Construction & Design (C&D).

3. Base all elevations on Berkeley campus datum. Do not use City of Berkeley or United States Geological
   Studies (USGS) datum unless outside of the campus property. Indicate datum used on the drawings.

4. Verify with the Project Manager availability of utilities needed during construction.

5. Clearly identify who pays for construction utilities. On major University-administered projects, the
   University of California shall pay for water but the Contractor shall pay for electrical power, meters,
   transformers and connections and is responsible for their installation.

6. Use the following criteria in determining pipe sizes:
   a. Obtain design loads from the Facilities Services Utilities Shop.
   b. Specify equipment such as lift stations.
   c. The Contractor shall maintain equipment (e.g., lift station, etc.) during construction.

7. Specify dewatering requirements during construction.

8. Building, Utility Service Locations
   a. Obtain information from Construction & Design (C&D) on the location, size and elevation of
      existing campus utilities and service points. Do not start the layout of any building utility system
      without this information.

9. Installation Schedule
   a. If possible, site work shall be performed without blocking campus walks or roads. Where utility
      work will block campus walkways or roads, discuss with the Project Manager scheduling the work
      for academic breaks, such as summer vacation and semester breaks. When work requires the closure
      or blocking of campus walkways or roads, temporary access routes—particularly for pedestrians and
      cyclists—shall be provided and indicated with signs or other means, regardless of whether work
occurs during the academic year or during breaks. Prepare a preliminary schedule showing bid dates, construction time and anticipated completion date and submit to Construction & Design (C&D) for approval.

10. Utilities Metering
   a. For new construction and major renovations, building main utility meters and data acquisition servers are required. These shall be installed following these standards.

b. Electric Meters:
   i. Manufacturers
      1. Eaton IQ 250/260
      2. ElectroIndustries/Gaugetech Shark 100/200
      3. Square D ION 6200
      4. Siemens 9200
   ii. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) business days prior to bid date.

c. Microprocessor-Based Metering Equipment
   i. General:
      1. Where indicated on the drawings, provide a microprocessor-based line of multifunction, power, and energy meters, designated device equal to meters identified in paragraph 1. The meter shall be UL Listed. All meters shall have the following ratings, features, and functions in the following paragraphs, unless a specific meter is designated.
      2. The meter shall be designated Multifunctional Electrical measurement on 3 phase, 4 wire power systems. The Meter shall support 3 Element Wye, 2.5 Element Wye, 2 Element Delta, and 4 wire Delta systems.
      3. Meter dielectric shall meet or exceed 3000 VAC RMS for one (1) minute.
      4. All inputs and outputs shall be galvanically isolated to 1500 Volts AC.
      5. The meter shall have an accuracy of +/-0.5% or better for volts, amps, power, and energy functions. The meter shall meet the accuracy requirement of IEC60687 class 0.5 and ANSI 12.20 class 0.5.
      6. The meter shall provide true RMS measurements of voltage - phase to neutral and phase to phase; current - per phase and neutral.
      7. The meter shall provide sampling at 64+ samples per cycle on all channels.
      8. The meter shall provide volts - phase to phase and phase to neutral, Amps - each phase, total kW, kVAR, PF, kVA, Frequency, kWh, kVAh, kVARh, and 1 KYZ pulse output. Measured quantities shall be available on display and via MODBUS registers.
      9. The meter shall provide total % THD (Total Harmonic Distortion) monitoring for voltage and current per phase.
     10. The meter shall include a three-line, bright red, 0.56” LED display or larger.
     11. The meter shall fit in both DIN 92mm and ANSI C39.1 round cut-outs.
     12. The meter shall be capable of operating on a power supply of 90 to 265 Volts AC.
     13. The meter shall provide update rate of 1 second.
     14. The meter shall be programmable from front faceplate.
      ii. Voltage Inputs
1. The meter shall be user programmable for voltage range to any standard PT ratio up to and including 1,000:1 (120 kV:120 V).
2. The meter shall accept a direct voltage input range of up to 400 Volts Line to Neutral and a range of up to 690 Volts Line to Line.

iii. Current Inputs
1. The meter current circuits shall have a burden not to exceed 0.05 VA at five (5) amps RMS.
2. The meter shall accept a current input of up to ten (10) amps continuous. Start-up current for a five (5) amp input shall be no greater than 0.005 amps.
3. Fault Current Withstand shall be 120 Amps for one (1) second, non-recurring.
4. The meter shall be programmable for current to standard CT ratio up to and including 5,000:5.
5. The meter shall accept current inputs of Class 10 (0 to 10A), five (5) amp nominal.

iv. Communications
1. The communications portion of the meter shall be capable of Modbus communication via RS485 port and be able to communicate to Obvius data acquisition server.
2. Baud rates shall be selectable between 9600 baud and 19,200 baud.

v. Outputs
1. The meter shall include 1 set of KYZ terminals on the back for connection to building Energy Management System (EMS) for kW load monitoring.

vi. Environment
1. The power meter shall be able to be stored and operate in the range of -20 to +70 degrees Celsius.

d. Water Meters:
i. Disc or turbine water meters shall be capable of providing a pulse output signal to connect to Obvius data acquisition server. Meter dry-contact pulse output can utilize 24VDC power available from the server.
ii. Maximum pulse rate is 10hz and the minimum pulse width is 50ms.
iii. Acceptable meter pulse output signals are:
   1. 1, 10 or 100 gallons per pulse
   2. 1 cubic feet per pulse
   3. Maximum of 600 pulses per unit volume (gallon or cubic feet) with maximum continuous operation not to exceed a rate of 100 gallons per minute for disc meters and 600 gallons per minute for turbine meters. Use the design or expected flow rate in the meter selection.
iv. Where meters with single pulse output shall be connected to both the building Energy Management System (EMS) and the Obvius data acquisition server, provide and install pulse-splitter solid-state isolation relay like the TransData IB6 or approved equal.
v. For meters that only provide analog output (e.g. 4 to 20mA signals), provide and install a precision integrator/relay output converter like the Flex-Core VFC-070 or approved equal, to convert analog output to pulse signal required for the Obvius data acquisition server.
vii. Installation standards such as parallel connections, bypass and isolation valves are covered in separate sections under Division 15 and corresponding Appendix.

vii. Suggested manufacturers, meter models and required electronic transmitters:
1. Neptune Technology Group - T8/T10 Disc, Trident Turbine (TT), High Performance Turbine (HPT) and Compound meter models with Tricon/E digital pulse output, 3-terminal, 24VDC electronic transmitter.
2. Badger Meter – RCDL Disc or Turbo Series models with RTR 2-terminal, dry-contact pulse output, electronic transmitter register.
3. Sensus Meter – Omni Compound C2 or Turbo T2 models with Omni electronic register that provides programmable pulse outputs.

e. Condensate Meters:
i. Building steam condensate return shall be measured with a condensate meter designed to work with a condensate receiver to measure varying flow for intermittent and multi-pump applications. The unit shall have a local flow and flow rate display and remote pulse output for flow rate.
   ii. Flow meter using electromagnetic induction designed to measure volumetric flow rate of fluid. Meter shall not be affected by electrostatic or electromagnetic interference.
   iii. Meter size shall be one inch (1”) with measurement range of 0 – 1.0 ft/s to 0 – 32.8 ft/s flow velocity shall be installed to the discharge side or condensate return pipe to the steam plant.
   iv. Provide individual meter calibration documentation indicating accuracy and current output.
   v. Provide dry-contact pulse output signal with flow rate (gallons per minute) to connect to the Obvius data acquisition server. Pulse multiplier shall be 1 gallon per pulse.
   vi. Where meters with single pulse output will be connected to both the building Energy Management System (EMS) and the Obvius data acquisition server, provide and install pulse-splitter solid-state isolation relay like the TransData IB6 or approved equal.
   vii. Accepted manufacturer and meter model. No substitution allowed:
      1. Central Station Steam Company Cadillac CMAG-RC electromagnetic flow detector with remote converter/flow computer.
   viii. Follow manufacturer’s installation requirements.

f. BTUH Meters:
i. For systems where the heating hot water system is shared across two (2) isolated buildings, a BTUH (British thermal unit hour) meter shall be installed to measure quantity of thermal energy of heating hot water of the receiving building.
   ii. Follow the manufacturer’s installation requirements.

g. Steam Meters:
i. Steam use shall be measured with a steam metering system consisting of a vortex shedding flow meter and except in condensate returns, with pressure and temperature sensors connected to a flow computer. Flow computer shall have a local display to read mass flow (pounds) and mass flow rate (pounds per hour).
   ii. The system shall be set up at the main service entrance to the building before the building steam pressure reducing station. The meter to be flanged-type designed for service at nominal steam pressure of 125 psi.
   iii. The flow computer shall provide a contact pulse output signal to communicate mass flow rate in pounds per hour to the Obvius data acquisition server.
   iv. Where meters with single pulse output will be connected to both the building Energy Management System (EMS) and the Obvius data acquisition server, provide and install pulse-splitter solid-state isolation relay like the TransData IB6, or approved equal.
   v. For meters that only provide analog output (e.g. 4 to 20mA signal), provide and install a precision integrator/relay output converter like the Flex-Core VFC-070, or approved...
equal that will convert analog output to pulse signal required for the Obvius data acquisition server.

vi. Installation standards such as parallel connections, bypass and isolation valves are covered in separate sections under Division 15 and corresponding Appendix.

vii. Suggested manufacturers and meter models:
1. Yokogawa – Vortex flow meter with flow converter model DigitalYewflo DY/DYA.
2. Endress and Hauser – Flow meter model Proline 72F vortex flow meter with RMS621 remote flow computer and Cerabar PMC 131 pressure transmitter.
3. Emerson Rosemount – Vortex Flow Meter 8800D series with remote display

viii. Follow the manufacturer’s installation requirements.

h. Data Acquisition Server
i. The data acquisition server shall be a server appliance, not a PC.
ii. The data acquisition server shall be able to receive and store data from metering devices in 15- minute intervals. The server shall be able to upload data from every data log using the comma separated value (CSV) format. Users shall be able to access data through a web-browser.
iii. The data acquisition server shall be capable of ModBus RTU communications supporting a minimum of 32 external devices and be expandable. A minimum of eight (8) flexible inputs, three (3) terminals (+24VDC, Input signal and Ground) with expansion capability are required. Servers shall have a minimum of thirty-two megabytes (32MB) of random access memory (RAM) and at least a sixteen megabyte (16MB) flash drive with RJ45 10/100 Ethernet network connection that will allow connection to the campus local area network.
iv. For remote meter locations that do not allow direct 2 or 3-wire communication hard-wiring to the data server, a wireless Modbus/pulse transceiver shall be installed to send meter signal to the server.
v. Provide expansion modules to increase the capacity of either ModBus or pulse input from external metering devices as needed.
vi. Accepted manufacturer and model numbers. No substitution allowed except for the latest model as approved by UCB.
   1. Data acquisition server shall be from Obvius. Use Obvius AcquiSuite model A8812-1. However, for smaller buildings where the electric metering involves only one (1) distribution panel with relatively low electrical demand and usage, the Obvius data acquisition server model Acquiseuite+ A8814 with integral Modbus electric meter may be used. Specify appropriate current transformer ratios (up to 6000 Amps) provided by Obvius, for the different load phases. When connecting additional pulse output meters to the Acquisuite+ server, provide Flex IO Module model A8332-8F2D from Obvius.
   2. Wireless Modbus/pulse transmitter shall be Obvius Modhopper model R9120
   3. Expansion modules shall either be Obvius Flex I/O Module model A8911 or the High Density Pulse Module model A8911-23
   4. See www.obvius.com for additional information.

vii. Install data acquisition server in twenty-four inch tall by twenty inch wide by six inch deep (24”h x 20” w x 6” d) enclosure panel. Provide two (2) 120-volt power outlets and one (1) Ethernet data connection port inside panel.

i. Gas Meters
i. The main campus gas service is most often used for research and laboratory applications like Bunsen burners, and is not normally metered in individual buildings but rather by the utility company. Heat is provided from the central steam distribution system.

ii. For off-campus buildings where gas service is used for both heat and research and laboratory applications, work with the utility company to install a compatible metering system that provides a dry-contact pulse output signal to the Obvius data acquisition server.

iii. Where meters with single pulse output shall be connected to both the building Energy Management System and the Obvius data acquisition server, provide and install pulse-splitter solid-state isolation relay like the TransData IB6, or approved equal.

iv. For meters that only provide analog output (e.g. 4 to 20mA signal), provide and install a precision integrator/relay output converter like the Flex-Core VFC-070, or approved equal that will convert analog output to pulse signal required for Obvius data acquisition server.

11. Earthwork for Utilities:
   a. Designs that deviate from the coverages required by this section require written approval from Construction & Design (C&D) and may require additional concrete cover where vehicular traffic occurs. Where existing, uncovered conditions conflict with the contract documents, notify Construction & Design (C&D) immediately for a written modification.
   b. Sewer and Storm Drainage: Three foot (3'-0") minimum cover.
   c. Water and Gas: Three foot (3'-0") minimum cover.
   d. Steam and Electric: Thirty inch (30") minimum, or more if recommended by prefabricated pipe manufacturer.
   e. When two (2) or more services are installed with the same alignment, stagger their placement one foot (1'-0") vertically and one foot horizontally (1'-0") to allow side connections without interference.
   f. Maintain sufficient clearance between parallel piping to permit repair or new taps.
   g. Where services are in municipal streets, comply with City requirements for installation, coverage, backfill, and compaction in lieu of University requirements.
   h. Irrigation mainlines and control wiring require twenty-four inch (24") cover; laterals (non-pressure lines) require fourteen inch (14") cover.
   i. The Contractor shall excavate all materials, regardless of character, to the depths indicated. The Contractor shall be aware of and plan for encountering ground water during any coring, drilling, or excavating.
   j. Applicable Publications: The publications listed below, but referred to thereafter by basic designation only, form a part of this specification.
      i. American Society for Testing and Materials (ASTM) Publications:

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<td>D 2419-14</td>
<td>Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregates</td>
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k. Submittals
   i. Shoring and Sheeting Plan: Before starting work submit a shoring and sheeting plan prepared by a licensed civil engineer.
   ii. Dewatering Plan: Before starting work, submit a dewatering plan describing the basic components of the dewatering system proposed and its planned method of operations. Submit the dewatering performance records weekly.

l. Delivery and Storage
   i. Deliver and store materials in a manner to prevent contamination or segregation.

m. Protection
   i. Per CBP CUL-4, if the project would affect a known cultural resource, mitigation shall be required by avoiding or reducing ground disturbance. See Division 01 35 04: Precautions.
   ii. Shoring and Sheeting:
       1. Shall meet the following requirements:
          a. Prevent undermining of pavements and slabs.
          b. Banks may be sloped where space permits and as directed.
   iii. Dewatering: Include in dewatering the collection and disposal of all forms of surface and subsurface water that may be encountered in the course of construction.
   iv. High Voltage Duct Banks: Restrict placement of soils from placement on top of duct bank vaults.
   v. Protect areas from traffic with marking tape.

n. Surface Preparation
   i. In general, soil materials shall be free of debris, roots, wood, scrap material, vegetable matter, refuse, soft unsound particles and frozen, deleterious, or objectionable materials.
   ii. Backfill for structures shall be approved on-site materials.

33 10 00 Water Utilities

33 11 00 Water Utility Distribution Piping

1. See Appendix A: Drawings for typical details. Fittings shall conform to type and pressure rating of piping in which they are used.

2. Path of Travel for debris removal: Include requirements in specifications for Path of Travel.

a. Water: 250 lbs minimum AWWA standard, Pratt butterfly valve or equal with ends to suit pipe used. When below grade, delete hand wheel and install operating nut and valve box.
b. Install traffic rated concrete valve boxes (e.g.: G-5 Christy) and extensions to grade. Cover shall have type of service (water, gas, etc.) cast in.
c. Provide one tee handle operating wrench for each size operating nut, with length to suit maximum valve depth. See Appendix, Typical Water Service and Piping Systems, for PVC details for extension stem.

4. Piping Materials and Sizes.
   a. Refer to the latest edition of the California Building Code. Materials and systems must be based on a comprehensive review of the project design requirements. Use of non-standard materials requires the express written consent of the Campus Building Official during the design phase of any project.

5. Water Piping Design
   a. After demands are determined, size water lines on the basis of friction loss. Do not exceed ten percent (10%) of the initial pressure at full demand or 7.5 feet per second velocity with a minimum pressure of 60 per square inch for building services.
   b. Show valves at all services from mains and at other points to minimize disruption of building operations. Valves should be located at the building exterior and where mains enter the building.
   c. Use separate cold water services for domestic and fire where it is from the University system.
   d. Use two pressure zones where the pressure at the lowest point of use will exceed 80 per square inch to maintain 35 per square inch at the highest point of use.
   e. Show a thrust block table on the drawings. See Appendix, Typical Water Service and Piping Systems.
   f. Fire protection service from single building service (campus).
      i. Fire Sprinklers
         1. Connect the fire sprinkler service for both single and two pressure zone buildings to the main building supply, ahead of building meters and regulators.
         2. Provide separate service from exterior mains for buildings served by the utility company (off campus).
         3. Where a building has fire sprinkler piping, hose racks shall be supplied from the sprinkler piping system.
         4. The University will arrange for and pay for domestic and fire protection water service to off-campus buildings served by the utility company. Furnish size and pressure requirements to Construction & Design (C&D).

33 12 00 Water Utility Distribution Equipment

33 12 13.13 Water Supply Backflow Preventer Assemblies

1. General
   a. The University of California at Berkeley adheres to State requirements (California Code of Regulations Title 17: Group 4) and adopts the standards and recommendations set forth by the University of Southern California: Foundation for Cross-Connection Control and Hydraulic Research - Manual of Cross-Connection Control (9th edition, August 1993 or subsequent revisions). The proper design, selection, installation and maintenance of cross-connection control devices is imperative, particularly in a university/mixed-use environment, for the protection of potable drinking water and distribution systems. Appropriate backflow prevention assemblies shall be selected from the most current USC-FCCCHR List of Approved Backflow Prevention Assemblies and shall be inspected and periodically tested as specified by the manufacturer by a certified tester.
b. Provide backflow protection at any building water system where there are connections, actual or potential, to a contaminating liquid. Examples include laboratory hose cocks and connections from domestic system to HHW makeup and cooling towers.

c. Backflow shall be prevented by installing a backflow prevention device at each individual point of possible contamination, where devices such as vacuum breakers or air gaps may be employed, or at a single point where an industrial water piping system takes off from the domestic water piping. Industrial water used in labs for experiments is assumed to be non-contaminated. The industrial system must be protected from heating hot water, cooling towers, etc., by additional pressure-reducing devices.

d. Select the type of backflow prevention system appropriate to each individual case. Generally, a separate industrial water system will be justified in buildings having numerous outlets that are susceptible to contamination. A chemistry or laboratory building is a good candidate for a separate industrial system.

e. Discuss the requirements for backflow prevention for any building located off-campus with Construction & Design (C&D) and the utility company.

2. Backflow Prevention Devices
   a. See Appendix A: Drawings for typical details.
   b. Select appropriate backflow prevention devices for the intended service. The following devices are listed in approximate decreasing order of effectiveness and reliability.
   c. Air-Gap Separations (a physical break between the supply pipe and a receiving vessel): The air gap shall be at least twice the diameter of the supply pipe, measured vertically above the overflow rim of the vessel with a minimum clearance of one inch (1”). This provides the maximum degree of protection and should be used wherever a non-pressurized supply is acceptable. It shall be used where sewage or toxic substances are involved.
   d. Reduced-Pressure Backflow Preventers: Use for protection of all direct or indirect connections where the device may be subject to back pressure and for isolating industrial water systems from the domestic water system. Locate in an accessible location. Where spillage is unacceptable, discharge with an air gap into a floor drain. Install backflow preventer at least 12” above floor or ground. Test cocks must be accessible.
   e. Where Backflow devices are used in a fire-protection system, the device shall have appropriate connection to perform a forward-flow test.
   f. Pressure-Type Vacuum Breaker: Use only as protection for direct or indirect water connections to all types of polluted or contaminated liquids where the vacuum breakers are not subject to back pressures. These units may be installed under continuous line pressure. Install in an accessible location. Where spilling into room is objectionable, it shall be specified as modified with drain connection and waste.
   g. Anti-Siphon Ballcocks: Use for tank-type water closets and urinals. The outlet of the backflow preventer shall be at least one inch (1”) above the opening of the overflow pipe.
   h. Vacuum Breakers for Flush Valves: Occurs at toilets or urinals. Specify installation at least four inches (4”) above the overflow rim.
   i. Double Check Valve Assemblies: Use to protect direct or indirect water connections where contaminants entering the system would not constitute a health hazard. Examples include steam, air, foods and beverages.

3 3 13 00 Disinfection of Water Distribution Systems

1. Standard Disinfection Procedure For Domestic Water System
   a. Supervision and Testing: Perform entire disinfection procedure under the supervision of Environment, Health and Safety (EH&S). Provide five (5) days’ notice to schedule procedure.
b. Contractor's Responsibility: Furnish a copy of the California Department of Pesticide Regulation (DPR) Qualified Applicator License, equipment, materials and transportation to disinfect domestic hot and cold water systems and fire lines directly connected thereto, in conformity with procedures and standards described herein.

c. Disinfecting Agent: An aqueous solution of sodium hypochlorite (minimum 5.25% available chlorine). The use of powdered hypochlorite and chlorine gas are prohibited unless specifically approved by Environment, Health and Safety (EH&S).

d. Preliminary Preparations:
   i. Service Cock: Provide within three feet (3'-0") of the entrance of the supply main to the building, a three-quarter inch (3/4") service cock, or valve, for the purpose of introducing the disinfecting agent
   ii. Flushing: After final pressure tests and before draining for disinfection, open each fixture or outlet until the water flow is clear.

e. Disinfection Procedure:
   i. Drain entire domestic water system including fire line.
   ii. Post suitable warning signs at each outlet: Warning - Do Not Use - Water System Being Chlorinated.
   iii. Inject disinfectant solution into the system through the service cock by means of a pump, or other pressure device, at a slow continuous rate, simultaneous with a reduced flow from the water main, until the Ortho-Tolidin test for residual chlorine at each outlet shows a concentration of at least 50 ppm, but note more than 100 ppm.
   iv. Close all outlets and valves, including the service valve at the main and the injection cock. Retain the chlorinated water in the system for 24 hours.
   v. After the 24 hour holding period, the residual chlorine concentration shall be not less than 50 ppm as shown by the Ortho-Tolidin test.
   vi. Drain and flush entire domestic water system until Ortho-Tolidin tests show background residual chlorine concentration at any and all outlets.
   vii. Environment, Health and Safety (EH&S) shall determine whether samples of water must be collected and analyzed for the determination of bacteriological quality.

f. Standards Necessary for Approval:
   i. The water system shall have been uniformly chlorinated under the supervision of Environment, Health and Safety (EH&S) as outlined above.
   ii. The results of water sample analysis shall be negative for the Coliform organisms.
   iii. If the test for the bacteriological quality of the water in the system does not meet the standards, repeat the disinfection procedure until the specified standards are met.
   iv. Final Approval: Environment, Health and Safety (EH&S) shall give written approval to the University for acceptance and use of the water system after the above procedures have been successfully completed and the standards met.

33 30 00 Sanitary Sewerage Utilities

1. After loads are estimated, size sewer lines on quantity of flow and slope of line to give minimum velocity of one and one-half feet (1'-6") per second when flowing at any percentage of full flow. Show manholes at all changes in direction or slope and not exceeding three hundred feet (300'-0") distances between manholes.
2. See Appendix for Pipe Standards.
3. Consider future connections at new manholes and provide stub out with plugged end hub.
4. Install manholes on reinforced concrete bases, with flow lines smoothly grouted in, steps installed and rim and cover grouted in place.

33 40 00 Storm Drainage Utilities
1. After loads are estimated, size storm drainage lines on the quantity of flow and slope of line to give minimum velocity of three feet (3’-0”) per second when flowing full. Show manholes at all changes in direction or slope and not exceeding three hundred feet (300’-0”) distance between manholes.

2. See Appendix for Pipe Standards.

3. All inlet structures, such as catch basins, curb inlets, headwalls, etc., may be reinforced concrete or suitable precast concrete with galvanized steel or cast iron grating.

4. Install storm sewer manholes similar to sanitary sewer manhole installation. Storm sewer manholes shall be precast or cast-in-place reinforced concrete with cast iron rim and open-grate cover and galvanized steps. Provide steps in any inlet structure with depth greater than three feet (3’-0”). Cover shall be round and have STORM cast in.

5. Install manholes on reinforced concrete bases, with flow lines smoothly grouted in, steps installed and rim and cover grouted in place.

33 46 00 Subdrainage

33 46 13 Foundation Drainage

1. Coordinate with the geotechnical consultant and the civil consultant. Keep surface drainage away from the building.

2. In addition to waterproofing requirements, floor levels which are below finish grade shall have a foundation drainage system where possible. Drainage pipes shall be smooth perforated drain pipe in a gravel drainage bed, protected with filter fabric. Filter fabrics and mats shall be specified and shown. Provide gravel backfill or drainage mats. Show and detail drainage and backfill system in wall section. Locate drainage pipe invert elevation below bottom of concrete floor slab elevation.

3. Additional drainage pipes will usually be required near the top of the below-grade wall at a point five to ten feet (5’-0” - 10’-0”) away from the wall. Direct roof water or subsurface water to drainage pipes using membranes and/or clay caps sloped away from the building to the drainage pipe. Water diversion membranes shall be detailed with fold (slack) for possible settlement.

4. Eliminate hydrostatic head wherever possible. Where a water table is present, install additional drainage pipes as may be required to draw down water table at wall, below floor, and through footing in coordination with the geotechnical, civil, and structural consultants.

5. Where drainage depends on mechanical pumping, provide emergency power as well as structural provisions for buoyancy and lateral pressure.

6. Slab-on-grade construction (where below-slab waterproofing is not required) shall include a four inch (4”) minimum gravel layer for capillary break, an 8 mil polyethylene moisture barrier (or equivalent) and a two inch (2”) minimum layer of sand over the polyethylene.

7. Show and specify drainage backfill, drainage pipe and damp-proofing (or waterproofing) at retaining walls.

33 50 00 Fuel Distribution Utilities

33 51 00 Natural Gas Distribution

1. Size gas piping for estimated maximum demand flow in CFH (using 1000 BTU per cubic foot) per code requirements.

2. Show valves at all services from main and at other points to allow isolation of portions of main without interference to other building services.

3. Metallic gas piping below grade or within six feet (6’-0”) of finish grade shall have a minimum wrap equal to Pabco D-13-20-246M or extruded polyethylene coating. Joints shall receive equivalent coating after tests.

4. Jeep test all pipe coatings and joints.
1. Steam Piping: Valves for high-pressure steam distribution (125 psi system) shall be 300 psi minimum steam rated flanged gate valves with rising stem (outside screw and yoke) and bypass/warm-up valve. Valves three inches (3”) and smaller shall have a screwed union bonnet.

2. Condensate Piping: Valves for steam condensate return shall be 150 psi minimum steam rated flanged gate valves with rising stem (outside screw and yoke). Valves three inches (3”) and smaller shall have a screwed union bonnet.

3. See also 22 35 00: Domestic Water Heat Exchangers

4. Size an individual building service on the estimated building demand, with velocities not exceeding 5,000 feet per minute. Discuss estimated building demand with Construction & Design (C&D).

5. Size pumped building condensate piping for velocities not exceeding five feet (5'-0") per second and gravity condensate piping for estimated quantity at available slope.

6. Install prefabricated steam and condensate piping complete with insulation suitable for direct burial. Discuss type of prefabricated steam and condensate piping with Construction & Design (C&D) before starting design.

7. Access Hatches:
   a. Refer to 05 00 00: Metals for requirements of metal fabrication, finishes and fasteners
   b. Access Hatches shall be in accordance with the latest adopted standards of the National Association of Architectural Metal Manufacturers (NAAMM), American Welding Society (AWS) and ASTM International.
   c. Products include:
      i. Single Leaf: Bilco Model J-AL or equal
      ii. Double Leaf: Bilco Model JD-AL or equal
   d. Door leaves shall be at least one quarter inch (¼”) thick aluminum with stiffeners as required to demand live load of three hundred pounds (300lbs) per square foot and AASHTO HS20 loading, including a slip resistant finish (Slipnot, or equal).
   e. Frame shall be at least one quarter inch (¼”) thick aluminum channel with anchor flange only along sides that are to be embedded in concrete. Provide channel to collect and drain water and provide a one and one-half inch (1½”) drainage coupling for connection to drainlines.
      i. Provide Isolation coating between aluminum frame in contact with steel and concrete as required by 05 00 00: Metals
      ii. All aluminum shall be mill finished with bituminous coating applied to the exterior portion of the frame that will be concealed after installation.
   f. Doors shall be equipped with heavy forged brass hinges, stainless steel pins, spring operators and automatic hold-open arms with a positive automatic latch that will secure the door in the open position until the release handle is activated. Submit details of latch for review. Provide snaplock with removable handle, aluminum recessed hasp to door and frame where required for padlock.
      Doors shall not deflect more than one quarter inch (¼”) under a three hundred pound (300lb) point load either up or down, especially at the perimeter.
   g. Channel support shelf for stiffeners shall be trimmed as shown in drawings.
   h. Stainless steel fasteners:
      i. For bolting hatch frame through flange of steel beam supports, see Appendix A: Drawings
      ii. See Section 05 00 00: Metals for stainless steel bolt, nut and washer requirements.
      iii. Provide isolation coating between dissimilar metals in contact with one another, in accordance with Section 05 00 00: Metals
   i. All hardware shall be stainless steel throughout.
   j. Provide stainless steel hold-open pin through holes in hold-open arms to ensure against accidental hatch closure. Attach pin to hatch with short stainless steel chain to prevent misplacement.
k. Provide stainless steel safety chain between double leaf doors at opposite end from latch.
l. Provide a ten inch by twelve inch (10” x 12”) minimum size sign permanently attached to the underside of the hatch doors reading: “Danger: make sure hold-open latch is positively engaged before using. Insert pin in holes in hold-open arms to hold.”
m. Coordinate dimensions and installation of access hatches with the dimensions and installation of alternating tread stairs and ladders. The alternating tread stairs and ladders shall not interfere with the operation of the hatch and personnel access through the hatch. The top of the alternating tread stairs and ladders shall not interfere with the stiffener beams beneath the hatch doors, thus allowing the hatch doors to close flush with the top of the hatch frame.

n. Coordinate connection of drainage coupling to plumbing drain line prior to concrete placement.
o. Set frame level and true to plane at all four corners and flush with the adjacent finished surfaces prior to concrete placement. Doors, when closed, shall be flush with frames and flush with each other.
p. Submittals: Submit product data, including full description of items proposed for use, and shop drawings, showing dimensions, attachments, inserts and relationships to adjoining construction.
q. Guarantee: Provide a written guarantee effective for a period of twenty five (25) years from date of final acceptance of the project that floor hatches will not leak and will be free of defects in materials and workmanship

33 70 00 Electrical Utilities

1. Electric Power Transmission
   a. Sizing of distribution ducts and cable is based on campus requirements. Obtain from Construction & Design (C&D).

33 80 00 Communications Utilities

2. See Divisions 26 and 27 for combined power and communication in duct banks.
3. Fire Alarm
   a. Number and size of conduits are based on campus requirements. Obtain from Construction & Design.
   b. See Division 28 31 00: Fire Detection and Alarm.
Division 34 — Transportation

Division 35 — Waterway and Marine

Divisions 36-39 — RESERVED FOR FUTURE EXPANSION

Division 40 — Process Integration

Division 41 — Material Processing and Handling Equipment

Division 42 — Process Heating, Cooling, and Drying Equipment

Division 43 — Process Gas and Liquid Handling, Purification and Storage Equipment

Division 44 — Pollution and Waste Control Equipment

Division 45 — Industry-Specific Manufacturing Equipment

Division 46 — Water and Wastewater Equipment

Division 47 — RESERVED FOR FUTURE EXPANSION

Division 48 — Electrical Power Generation

Division 49 — RESERVED FOR FUTURE EXPANSION
Appendix A: Drawings

The following are typical installation details for the specified application. Consult Construction & Design (C&D) for clarification or specific project requirements.

FS 01: Backflow Preventer Outdoor Horizontal Installation
FS 02: Pressure Reducing Backflow Preventer for lines 2” and below
FS 03: Pressure Reducing Valve Outdoor Horizontal Installation for lines above 2”
FS 04: Pressure Reducing Valve Outdoor Horizontal Installation for lines 2” and below
FS 05: Reduced Pressure Backflow Assembly with OS&Y Gate Valves for lines above 2”
FS 06: Flanged Valve or Tee with Adapters
FS 07: Mechanical Joint Tie-In Using 12” Long Sleeve
FS 08: Concrete Thrust Block Installation Detail
FS 08A: Thrust Block Table
FS 09: Fire Hydrant Installation Detail
FS 10: Trench Backfill and Resurfacing in Paved Areas
FS 11: Trench Backfill and Resurfacing in Landscaped Areas
FS 12: Concrete Encased 6-way Duct Bank
FS 13: Site Lighting Control Schematic Maintenance Bypass
FS 14: Steam Distribution Drip Trap
FS 15: Steam Distribution Vent & Drain for Pressure Testing
FS 16: Steam Warm-up Valve
FS 17: Steam Vault
FS 18: Manhole Structure
FS 19: Steam Access Hatch
FS 20: UCB “House” Vacuum System Design Layout & Schematic
FS 21: Post and Rail Fence
FS 22: Teak Bench Installation
WILKINS MODEL 350 AST
BACKFLOW PREVENTER
OUTDOOR HORIZONTAL INSTALLATION 10"

NO SCALE
MODEL 825Y REDUCED PRESSURE BACKFLOW PREVENTOR ASSEMBLY FOR LINE SIZES 2" AND LESS

NO SCALE
WILKINS MODEL 375 AST
REDUCED PRESSURE PRINCIPLE ASSEMBLY
OUTDOOR HORIZONTAL INSTALLATION 2½" AND 10"
(NOTE: MODEL 350 FOR FIRE SERVICE)
NO SCALE
WILKINS MODEL 975XL
REDUCED PRESSURE PRINCIPLE ASSEMBLY
OUTDOOR HORIZONTAL INSTALLATION
LINE SIZES 2" AND LESS

NO SCALE
MODEL 880 REDUCED PRESSURE BACKFLOW ASSEMBLY
WITH OS&Y GATE VALVES FOR LINE SIZES

2 1/4" AND ABOVE

NO SCALE
THIS IS THE APPROVED STANDARD. USE THIS DETAIL FOR NEW INSTALLATIONS OR WHEN CUTTING IN A VALVE OR TEE ON AN EXISTING LINE. VALVES SHALL CONFORM TO AWWA C504. DO NOT ENCASE TIE ROD BOLTS IN CONCRETE. PROVIDE A LAYER OF 10 MIL PLASTIC AROUND THE FITTINGS.

BRING TRACER WIRE UP INTO VALVE BOX W/3FT COLLED INSIDE BOX (TYP)

EXIST. GRADE

WARNING TAPE

FLANGED BUTTERFLY VALVE OR TEE

#4812 EW CTR

4" MIN CONCRETE PAD UNDER ALL VALVES AND TEES

#1 METHOD
FLANGED VALVE OR TEE WITH ADAPTERS

NO SCALE
THIS IS THE ALTERNATIVE METHOD TO D-1 WITH APPROVAL OF PP-CS.
USE THIS DETAIL FOR CUTTING-IN TEES AND VALVES.
ON EXISTING PIPE USE A SOLID D.I. SLEEVE WHERE APPROPRIATE.
VALVES SHALL CONFORM TO AWWA C904.
DO NOT ENCASE TIE ROD BOLTS IN CONCRETE.
PROVIDE A LAYER OF 10 MIL PLASTIC AROUND THE FITTINGS.

#2 METHOD
MECHANICAL JOINTS TIE-IN USING 12" LONG SLEEVE

NO SCALE
PROVIDE A LAYER OF 10 MIL PLASTIC AROUND THE FITTINGS AT THE THRUST BLOCK.

6" EMBEDMENT IN CONCRETE THRUST BLOCK, REBAR TO BE PLACED TIGHT AGAINST PIPE

PROJECTED THRUST AREA
SEE TABLE NO. 1

CONCRETE THRUST BLOCK
NO SCALE

NOTE:
CONCRETE SHALL BE 2500 PSI AT 28 DAYS

NOTE:
The sides (only) of all thrust blocks shall be accurately formed with wood and firmly braced. Thrust area and bottom of block shall be placed against undisturbed earth. Pipe, fitting, joints and bolting shall be kept free of concrete.
Areas in table have been derived using a water pressure of 225 psi (15.5 bars) and a soil resistance of 2000 pounds per square foot (1.0 bars). The values include a 1.5 safety factor. NFPA 24

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>90° Bend ft²</th>
<th>m²</th>
<th>45° Bend</th>
<th>ft²</th>
<th>m²</th>
<th>Tees, Plugs, Caps, &amp; Hydrants</th>
<th>ft²</th>
<th>m²</th>
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<tbody>
<tr>
<td>in.</td>
<td></td>
<td></td>
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<td></td>
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<td>0.19</td>
<td>2</td>
<td>0.19</td>
<td></td>
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<td>1.67</td>
<td>10</td>
<td>0.93</td>
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<td>1.21</td>
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<table>
<thead>
<tr>
<th>Size of Fitting</th>
<th>Cubic Yards</th>
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<tr>
<td>3”-8”</td>
<td>¾</td>
</tr>
<tr>
<td>10”-12”</td>
<td>1 ½</td>
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**THRUJT @ 225 PSI WATER PRESSURE FOR FITTINGS**

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<th>90° Bend</th>
<th>45° Bend</th>
<th>Dead End</th>
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<td>4</td>
<td>2,559</td>
<td>1,385</td>
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<td>6</td>
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<td>8</td>
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<td>4,923</td>
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<tr>
<td>10</td>
<td>13,685</td>
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<tr>
<td>12</td>
<td>19,353</td>
<td>10,474</td>
<td>13,685</td>
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</table>

Water Pressure > 100 psi MULTIPLY Table by Ratio of Pressure …150 psi/100 psi = 1.5 Factor 2007 NFPA 24

Minimum Thrust Block Size

\[ A_b = \frac{(h)(b)}{T} \cdot \frac{S_f}{S_b} \]

(h) = block height, (b) = block width, 
T = thrust force table, 
S_f = safety factor (1.5), 
S_b = soil bearing from table

<table>
<thead>
<tr>
<th>SOIL</th>
<th>BEARING lb/ft²</th>
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<tbody>
<tr>
<td>SOFT CLAY</td>
<td>1,000</td>
</tr>
<tr>
<td>SAND</td>
<td>4,000</td>
</tr>
<tr>
<td>SAND CLAY</td>
<td>6,000</td>
</tr>
<tr>
<td>HARD CLAY</td>
<td>9,000</td>
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</table>

**ROD NUMBER – DIAMETER COMBINATIONS**

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<tr>
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<th>3/4 in.</th>
<th>7/8 in.</th>
<th>1 in.</th>
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<tbody>
<tr>
<td>4</td>
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</tr>
<tr>
<td>12</td>
<td>6</td>
<td>4</td>
<td>3</td>
<td>2</td>
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</table>

Table derived using pressure of 225 psi (15.5 bars) and design stress of 25,000. 2007 NFPA 24 Table 10.8.3.1.2.2
NOTE: APPLY TACK OIL TO ALL SURFACES PRIOR TO PLACING A.C. CONFORM TO EXISTING GRADE

ASPHALT CONCRETE (3" MIN.)
AGGREGATE BASE
9" MIN IN ROADWAY
6" MIN IN PATHWAYS
PROPOSED AC

SAWCUT EDGE
(AC OR CONC)
6" FROM SIDE OF TRENCH

WARNING TAPE

EXISTING AC
PROPOSED ABM

FINAL ZONE

TRENCH ZONE

VARIES

12"

PIPE ZONE

6"

PIECE

TRACER WIRE

SAND

NOTE: WHERE AC IS AT EDGE OF PATHWAY INSTALL REDWOOD HEADER BOARD

TRENCH BACKFILL & RESURFACING
IN PAVED AREAS
NO SCALE

UC BERKELEY—FACILITIES SERVICES

Drawing Title: TRENCH BACKFILL & RESURFACING IN PAVED AREAS
Scale: NTS Check: HC Rev. By: JS Rev. Date: 1/23/15
TRENCH BACKFILL IN LANDSCAPED AREAS

NO SCALE
CONCRETE ENCASED 6-WAY DUCTBANK CROSS-SECTION

NOTES:
PVC IS SCHEDULE 40.
RED CONCRETE FOR 12KV ONLY.

UC BERKELEY—FACILITIES SERVICES

Drawing Title: CONCRETE ENCASED 6-WAY DUCTBANK
Scale: NTS  Check: HC  Rev. By: JRJ  Rev. Date: 1/23/15

FS12
SITE LIGHTING CONTROL SCHEMATIC
Maintenance Bypass
NO SCALE
NOTES:
1) Drip leg size to equal steam line size, for 6" and over can be 1/2 size but not less than 4". See material #1.

2) All supports for the steam trap piping shall be electrically isolated from the pipe and tubing by felt strips.

DISTRIBUTION DRIP TRAP
NO SCALE

<table>
<thead>
<tr>
<th>Item</th>
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<th>Description</th>
<th>Item</th>
<th>Size</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Note 1</td>
<td>Sch. 80, Carbon Steel</td>
<td>12</td>
<td>1/2&quot;</td>
<td>Brass Gate Valve, 300 Screwed</td>
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<tr>
<td>2</td>
<td>As Req’d</td>
<td>Sch. 80 Cap, Carbon Steel</td>
<td>13</td>
<td>1/2&quot;</td>
<td>Brass Check Valve, 150 Screwed</td>
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<tr>
<td>3</td>
<td>1&quot;</td>
<td>3000# Socket or El–O–LET</td>
<td>14</td>
<td>1/2&quot;NPT X 1/2&quot;T</td>
<td>Adapter, Compression Type Stainless Steel</td>
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<tr>
<td>4</td>
<td>1&quot;</td>
<td>8&quot; Min. Nipple, Sched 160, POE X TBE</td>
<td>15</td>
<td>3/4&quot;NPT X 1/2&quot;T</td>
<td>Adapter, Compression Type Stainless Steel</td>
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<tr>
<td>5</td>
<td>1&quot;</td>
<td>Gate Valve, 800# Screwed</td>
<td>16</td>
<td>1/2&quot;</td>
<td>0.049 Wall, 304 or 316 Stainless Steel Tubing</td>
</tr>
<tr>
<td>6</td>
<td>1&quot; X 1/2&quot;</td>
<td>Swage Nipple, Sched 80, TBE</td>
<td>17</td>
<td>3/4&quot;</td>
<td>Brass Gate Valve, Class 300 Screwed</td>
</tr>
<tr>
<td>7</td>
<td>1/2&quot;</td>
<td>&quot;STEAMGARD&quot; Trep w/Strainer</td>
<td>18</td>
<td>3/4&quot;</td>
<td>Red Brass Nipple, TBE</td>
</tr>
<tr>
<td>8</td>
<td>1/2&quot;</td>
<td>600# Brass Ball Valve, Male X Female Connection</td>
<td>19</td>
<td>3/4&quot;</td>
<td>Reducing Tee</td>
</tr>
<tr>
<td>9</td>
<td>1/2&quot; x 2&quot;</td>
<td>Red Brass Nipple, TBE</td>
<td>20</td>
<td>1/2&quot; X 6&quot;</td>
<td>Red Brass Nipple</td>
</tr>
<tr>
<td>10</td>
<td>1/2&quot;</td>
<td>Brass Threaded Tee</td>
<td></td>
<td></td>
<td>Uni–Strut Pipe Support, Stainless Steel Superstrut S–250</td>
</tr>
</tbody>
</table>

UC BERKELEY—FACILITIES SERVICES

Drawing Title: DISTRIBUTION DRIP TRAP

Scale: NTS  Check: HC  Rev. By: GE  Rev. Date: 1/23/15
VENT & DRAIN for PRESSURE TEST

MATERIAL LIST

<table>
<thead>
<tr>
<th>Item</th>
<th>Size</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>As Req’d</td>
<td>Sched. 80, some size up to 2”</td>
</tr>
<tr>
<td>2</td>
<td>As Req’d</td>
<td>Sched. 80 Pipe Cup</td>
</tr>
<tr>
<td>3</td>
<td>3/4”</td>
<td>3000# Socket or Elbolet</td>
</tr>
<tr>
<td>4</td>
<td>3/4”</td>
<td>Nipple, Sched 160, POE X TOE</td>
</tr>
<tr>
<td>5</td>
<td>3/4”</td>
<td>Gate Valve, 800# Screwed</td>
</tr>
<tr>
<td>6</td>
<td>3/4”</td>
<td>Plug Threaded Bar Stock</td>
</tr>
<tr>
<td>7</td>
<td>3/4”</td>
<td>Tee/Reducing for 1” or Larger Main</td>
</tr>
<tr>
<td>8</td>
<td>3/4”</td>
<td>Red Brass Nipple, TBE, Sched 80</td>
</tr>
<tr>
<td>9</td>
<td>3/4”</td>
<td>Brass Gate Valve, Class 150 or 200 Screwed</td>
</tr>
<tr>
<td>10</td>
<td>3/4”</td>
<td>Brass Plug, Bar Stock</td>
</tr>
</tbody>
</table>
WARM-UP VALVE

No Scale

<table>
<thead>
<tr>
<th>Steam Valve Size</th>
<th>Bypass Size</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>5&quot; x 6&quot;</td>
<td>1 1/4&quot;</td>
<td>Bypass Break-Out Flanges. Must provide adequate clearance for removal of Steam Valve.</td>
</tr>
<tr>
<td>8&quot; x 10&quot;</td>
<td>1 1/2&quot;</td>
<td>Bypass piping shall be self-draining. No low points.</td>
</tr>
</tbody>
</table>
STEAM MANHOLE COVER FRAMING PLAN

BILCO TYPE MANHOLE HATCH

NO SCALE

UC BERKELEY—FACILITIES SERVICES

Drawing Title: STEAM MANHOLE COVER FRAMING PLAN — MANHOLE HATCH

Scale: NTS  Check: HC  Rev. By: GE  Rev. Date: 1/23/15

Dwg. FS19
UCB “HOUSE” VACUUM SYSTEM DESIGN LAYOUT & SCHEMATIC
FOR A DRY (NO WATER) COMMERCIAL SYSTEM

Note: All system valves not shown, and cross piping to parallel pumps / vacuum systems not shown.

Intake
From Building, Laboratory Equipment and Research

Primary Vapor Aspirant Separator and associated piping
Manufacturer-provided Vacuum Snubber Tank
Manufacturer-provided Vapor Aspirant Separator and associated piping

Note: All system valves, separators, filters, drain ports, unions, skidded pump(s), accumulator(s), mufflers, etc. are located within a 4" high concrete berm. Any spilled / leaked materials / liquids must be contained within the berm for controlled clean-up. There are NO FLOOR DRAINS installed within the berm area.

Atmosphere

120" Minimum Clearance
Exhaust Rain Guard
Roof Deck

12" Min. Vertical Bypass

Exhaust manifold from Other pump

Intake manifold to Other pumps

Bypass Pipe – Locate bypass at least 12" above main-pipe. The vertical leg from main to bypass is critical to keep liquids in the main and out of bypass piping.

Vapor Aspirant / Waste Separator. Includes Clear-bowl or Site-glass for in-use visual inspection, Sampling Port and Drain with 24" clear of obstructions below drain valve.

Snubber Tank – Liquid Aspirant Site-glass, Sampling Port Drain

Typical 24" Below Drain Minimum Clearance

Vapor Aspirant / Particulate Filter Collector Waste Site-glass, Sampling Port Drain

Typical Vacuum Pump (Change Crankcase Oil)

Typ. Manufacturer-provided Vacuum Pump Pre-Filter (Must have a drain and sampling location, site glass and/or clear bowl.)

Bypass Pipe – 12" Vertical leg from main is critical to keep liquids in main and out of by-pass piping.

Exhaust Muffler and Separator

Exhaust Aspirant / Collector Site-glass, Sampling Port and Drain

Typical 12" Min. Vertical Bypass

Minimum 4" high by 4" wide concrete floor berm located completely under and surrounding all vacuum system piping valves and mechanical components. No floor drains inside berm.

Floor Drain to Sanitary Sewer located adjacent-to but outside of 4" high concrete berm.

Dotted Line indicates typical commercial skid-packaged multi-pump vacuum system.

Mechanical Room Floor

Questions – Please contact UCB EH&S Safety Engineering at 510-642-3073

File: UCB House Vacuum Component Schematic – Specification 01-07-15
POST AND RAIL FENCE
SECTION ELEVATION
NO SCALE

POST AND RAIL FENCE
CROSS SECTION
NO SCALE

NOTES:
1. PAINT ALL WOOD MEMBERS OLYMPIC OXFORD BROWN SOLID COLOR STAIN
2. SET POSTS 18" OFF EDGE OF PAVEMENT AND 6' ON CENTER.
3. SQUARE FACE OF POST TO EDGE OF PAVEMENT.

1/4" GAP

GALV. HANGER

GALV. STEEL STRAP ANCHOR WITH TWO GALV. 3/8" STEEL THROUGH BOLTS AND WASHERS.

12" x 30" CONCRETE FOOTING, SLOPE TOP TO FOLLOW GRADE.

COMPACTED OR UNDISTURBED SUBGRADE.

6" x 6" CON. HEART REDWOOD POST, SET PLUMB.

4" x 4" FIR OR EQ. RAILS, CHAMFER TOP EDGES. TOE NAIL INTO POST AND SET ON HANGER.

6" CHAMFER ALL EDGES.

1/2" 45°
ANCHOR LEGS DIAGRAM

TEAK BENCH INSTALLATION
BLIND ANCHORS
ANCHORING SECTION FOR VARIOUS CONDITIONS

UC BERKELEY—FACILITIES SERVICES

Drawing Title: TEAK BENCH INSTALLATION
Scale: NTS  Check: HC  Rev. By: JRH  Rev. Date: 1/23/15
Appendix B: Guarantee Form

See form next page.

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GUARANTEE

Project Name: ___________________________ Date: ___________________________

Project Location: ___________________________

Project Number: ___________________________

Guarantee For: ___________________________
  (Specification SECTION and Contract No.)

(Name of Contractor, Subcontractor, or Supplier as Applicable) hereby guarantees to Owner that the portion of the Work described as follows:

which it has provided for the above referenced Project, is of good quality; free from defects; free from any liens, claims, and security interests; and has been completed in accordance with Specification Section ___________________________ and the other requirements of the Contract.

The undersigned further agrees that, if at any time within _______ months after the date of the guarantee the undersigned receives notice from Owner that the aforesaid portion of the Work is unsatisfactory, faulty, deficient, incomplete, or not in conformance with the requirements of the Contract, the undersigned will, within ten (10) calendar days after receipt of such notice, correct, repair, or replace such portion of the Work, together with any other parts of the Work and any other property which is damaged or destroyed as a result of such defective portion of the Work or the correction, repair, or replacement thereof; and that it shall diligently and continuously prosecute such correction, repair, or replacement to completion.

In the event the undersigned fails to commence such correction, repair, or replacement within (10) calendar days after such notice, or to diligently and continuously prosecute the same to completion, the undersigned, collectively and separately, do hereby authorize Owner to undertake such correction, repair, or replacement at the expense of the undersigned; and Contractor will pay to Owner promptly upon demand all costs and expenses incurred by Owner in connection therewith.

SUBCONTRACTOR OR SUPPLIER (If Applicable)

Signed: ___________________________ Title: ___________________________
Typed Name: ___________________________
Name of Firm: ___________________________

Contractor License Classification and License Number: ___________________________

Address: ___________________________
Telephone Number: ___________________________

CONTRACTOR

Signed: ___________________________ Title: ___________________________
Typed Name: ___________________________
Name of Firm: ___________________________