Building 1000 Chiller Replacement

Bid No. B14-04

***Specifications***

Bid RFI Questions Due:
Monday, February 3rd, 2014 2:00PM
Gale Stevens, Buyer
gasteven@cabrillo.edu

Bid Documents: Gale Stevens, Buyer 831-477-5613
Mechanical Engineer: Young Engineering Services, James W. Young
Electrical Engineer: Prime Design Group, Inc., Mike Cabak, P.E.
SECTION 15050 - BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE: Basic Mechanical Requirements specifically applicable all to Division 15 and 17 specifications, in addition to General Conditions, Supplemental General Conditions and Special Conditions.

A. Labor, materials, services, equipment and appliances required for completion of tasks as indicated on drawing or in specification or as inherently necessary for installation and testing of all HVAC, control, and testing systems.

1.2 DRAWINGS AND SPECIFICATIONS

A. Drawings accompanying these Specifications show intent of Work to be completed. Drawing notes and these specifications identify quality and grade of installation. Where equipment and hardware is not particularly specified, Contractor shall provide submittals for all products and install them per manufacturers’ recommendations, and in a first class manner.

B. Examine Drawings and Specifications for elements in connection with this Work; determine existing and new general construction conditions and be familiar with all limitations caused by such conditions.

C. Plans are intended to show general arrangement and extent of Work contemplated. Exact location and arrangement of parts shall be determined after equipment has been approved by the College, as Work progresses, to conform in best possible manner with surroundings, and as directed by the College.

D. Do not scale from drawings. Dimensions on drawing shall be followed. Where dimensions are not provided Contractor shall coordinate with all trades to achieve the drawing intent.

1.3 WORK SEQUENCE: Install work in phases to accommodate College’s occupancy requirements. Prior to the construction period, coordinate the mechanical schedule and operations with the College.

1.4 UTILITIES: Location and sizes of mechanical service facilities are shown in accordance with data secured from existing record drawings and limited site observations. Data shown are offered as an estimating guide without guarantee of accuracy. Contractor shall check and verify all data given, and verify exact location of all utility services pertaining to Work prior to excavation or performing Work.

1.5 COLLEGE FURNISHED PRODUCTS: Unless noted otherwise, all items shall be furnished by the Contractor for a complete and operational installation.

1.6 APPLICABLE CODES AND REGULATIONS: Meet requirements of all applicable local, state and federal codes and standards having jurisdiction including but not limited to:

A. State of California Code of Regulations:

1. Title 8, Industrial Relations
2. Title 19, State Fire Marshal Regulations
3. California Building Code (CBC), Title 24, Part 2
4. California Electrical Code, Title 24, Part 3
5. California Mechanical Code, Title 24, Part 4
6. California Plumbing Code, Title 24, Part 5
7. California Fire Code, Title 24, Part 9
8. California Standards Code, Title 24, Part 12
9. Title 24, Energy Conservation Standards

B. NFPA - National Fire Protection Association Standards outlined in CBC 3801(d).

C. Codes and ordinances having jurisdiction over Work are minimum requirements; but, if Contract Documents indicate requirements which are in excess of those minimum requirements, then requirements of the Contract Documents shall be followed. Contractor shall identify any conflicts between Contract Documents and any codes or ordinances having jurisdiction and report these to the Engineer prior to proceeding with the work.
D. Obtain permits, and request inspections from authority having jurisdiction.

1.7 PROJECT/SITE CONDITIONS

A. The arrangement of and connection to equipment shown on the drawings is based upon information available to the Engineer at the time of design and is not intended to show exact dimensions peculiar to a specific manufacturer. The drawings are, in part, diagrammatic and some features of the illustrated equipment installations may require revision to meet actual equipment installation requirements.

B. Install Work in locations shown on approved Drawings, unless prevented by Project conditions.

C. Prepare revised drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Engineer before proceeding.

1.8 COOPERATION WITH WORK UNDER OTHER DIVISIONS

A. Cooperate with other trades to facilitate general progress of Work. Allow all other trades every reasonable opportunity for installation of their work.

B. Work under this Division shall follow general building construction closely.

C. Work with other trades in determining exact location of outlets, pipes, diffusers, and pieces of equipment to avoid interference with lines required to maintain proper installation of Work.

D. Make such progress in the Work to not delay work of other trades.

1.9 DISCREPANCIES

A. Refer to General Conditions.

B. The Contractor shall check all drawings furnished him immediately upon their receipt and shall promptly notify the Engineer of any discrepancies. Figures marked on Drawings shall in general be followed in preference to scale measurements. Process and instrumentation diagrams shall in general govern floor plans and sections. Large scale drawings shall in general govern small scale drawings. The Contractor shall compare all drawings and verify the figures before laying out the work and will be responsible for any errors which might have been avoided thereby.

1.10 CHANGES: The Contractor shall be responsible to make and obtain approval for all necessary adjustments in piping, ductwork and equipment layouts as required to accommodate the relocations of equipment and/or devices which are affected by any approved authorized changes or Product substitutions. All changes shall be clearly indicated on the "Record" drawings.

1.11 SUBMITTALS

A. Submit five (5) copies of each submittal to the University Representative, unless otherwise specified in the General Conditions or if the Contractor requires more than three (3) copies returned. Engineer will retain one (1) copy and one (1) copy will be forwarded to the College.

B. Submit shop drawings, manufacturer's data certificates for equipment, materials and finish, and pertinent details for each system as grouped and referenced by the specification technical section numbers, and obtain approval before procurement, fabrication, or delivery of the items to the job site. Refer to drawings for additional submittal data.

C. Partial submittals are not acceptable and will be returned without review.

D. Include the manufacturer's name, trade name, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and paragraph reference, applicable technical society publication references, and other information necessary to establish contract compliance of each item the Contractor proposes to furnish. Photographs of existing installations and data submitted in lieu of catalog data are not acceptable and will be returned without approval.
E. Contractor shall include with each submittal, applicable specification paragraphs listed with the differences noted for each paragraph or the words “No Exception” next to each paragraph.

F. Contractor shall be responsible for reviewing and certifying submittals as conforming to the Drawings and Specifications prior to submittal and shall verify conformance of equipment as delivered with final shop submittals, specifications and plans. Contractor shall report to Engineer any deviations prior to initiation of Work. Contractor is responsible for promptly reporting to Engineer any news of late equipment delivery which is likely or certain to delay installation.

G. Sequentially number the transmittal forms. Resubmittals shall have original number with an alphabetic suffix.

H. Identify Cabrillo Community College District Bldg. 800, Project Number, Project Name, Contractor, Subcontractor or supplier, Engineer; pertinent Drawing sheet and detail number(s), and specification Section number, as appropriate.

I. Apply Contractor’s stamp, signed or initialed certifying that review, verification of Products required, field dimensions, adjacent construction Work, and coordination of information, is in accordance with the requirements of the Work and Contract Documents.

J. Schedule submittals to expedite the Project and comply with time restraints of the General Conditions and Supplemental General Conditions, and deliver to the College. Coordinate submission of related items.

K. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work.

L. Provide space for Contractor and Engineer review stamps.

M. Revise and resubmit submittals as required, identify all changes made since previous submittal.

N. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.

O. Shop Drawings: Drawings shall be a minimum of 8.5 inches by 11 inches in size with a minimum scale of 1/4-inch per foot, except as specified otherwise. Site distribution piping shop drawings shall be a minimum scale of 1”=20’ or larger. Include installation details of equipment indicating proposed location, layout and arrangement, accessories, piping, duct work, and other items that must be shown to assure a coordinated installation. Indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. If equipment is disapproved, revise drawings to show acceptable equipment and resubmit.

P. Manufacturer's Data: For each manufactured item, provide current manufacturer's descriptive literature of cataloged products, certified equipment drawings, diagrams, performance and characteristic curves if applicable, and catalog cuts.

Q. Standard Compliance: When materials or equipment provided by the Contractor must conform to the standards of organizations such as American National Standards Institute (ANSI) or American Water Works Association (AWWA), submit proof of such conformance to the Engineer for approval. If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified. In lieu of the label or listing, submit a certificate from an independent testing organization, which is competent to perform acceptance testing and is approved by the College. The certificate shall state that the item has been tested in accordance with the specified organization’s test methods and that the item conforms to the specified organization’s standard.

R. Certified Test Reports: Before delivery of materials and equipment, certified copies of all test reports specified in individual sections shall be submitted for approval.

1.12 PRODUCT ALTERNATIVES OR SUBSTITUTIONS: Refer to General Conditions.
1.13 GUARANTEE

A. Except as may be specified under other sections in the Specifications, guarantee all equipment furnished under the Specifications for a period of one year from date of project acceptance against defective workmanship and material and improper installation. Upon notification of failure, correct deficiency immediately and without cost to the College.

B. Standard warranty of manufacturer shall apply for replacement of parts after expiration of the above period. Manufacturer shall furnish replacement parts to the College for their service agency as directed.

1.14 OPERATION AND MAINTENANCE MANUALS

A. Format

a. Prepare data in the form of an instructional manual.

b. Binders: Commercial quality, 8-1/2 x 11 inch three-ring binders with hardback, cleanable, plastic covers; one inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

c. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; list title of Project and separate building; identify subject matter of contents.

d. Arrange content by systems and process flow under section numbers and sequence of Table of Contents of this Project Manual.

e. Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

f. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.

g. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

B. Contents, Each Volume (Provide 4 copies)

a. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of the Engineer, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

b. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.

c. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

d. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

e. Type Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

C. Manual For Equipment and Systems

a. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

b. Panelboard Circuit Directories: Provide electrical service characteristics, controls and communications.

c. Include color coded wiring diagrams as installed.

d. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

e. Maintenance Requirements: Include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

f. Provide servicing and lubrication schedule, and list of lubricants required.

g. Include manufacturer's printed operation and maintenance instructions.

h. Include sequence of operation by controls manufacturer.

i. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
j. Provide control diagrams by controls manufacturer as installed.
k. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.
l. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
m. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

n. Additional Requirements: As specified in individual product specification sections.
o. Provide a listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

1.15 INSTRUCTION TO COLLEGE PERSONNEL:

A. Provide training as specified in individual sections.

B. Before final inspection, instruct the College's designated personnel in operation, adjustment, and maintenance of products, equipment, and systems, at agreed upon times. Furnish the services of competent instructors to give full instruction to College personnel in the adjustment, operation, and maintenance of systems and equipment, including pertinent safety requirements. Each instructor shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

C. The amount of time required for instruction on each item of equipment and system is that specified in individual sections.

D. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with the College's personnel in detail to explain all aspects of operation and maintenance.

E. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

F. Submit six copies of Manufacturer's Instruction Certificates as specified in individual specification Sections.

1.16 MANUFACTURER'S RECOMMENDATIONS: Where installation procedures or any part thereof are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendations shall be cause for rejection of the equipment or material.

1.17 DELIVERY AND STORAGE: Handle, store, and protect equipment and materials in accordance with the manufacturer's recommendations and with the requirements of NFPA 70B P, Appendix I, titled "Equipment Storage and Maintenance During Construction." Replace damaged or defective items with new items.

1.18 PROJECT RECORD DOCUMENTS

A. Maintain on site, one set of the following record documents; record actual revisions to the Work:

   b. Specifications.
   c. Addenda.
   d. Change Orders and other Modifications to the Contract.
   e. Reviewed shop drawings, product data, and samples.

B. Store Record Documents separate from documents used for construction. Record documents shall be available for review by the Construction Inspector and Engineer at all times.

C. Record information concurrent with construction progress.

D. Specifications: Legibly mark and record at each Product section description of actual Products installed, including the following:

   a. Manufacturer's name and product model and number.
b. Product substitutions or alternates utilized.

c. Changes made by Addenda and Modifications.

d. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:

1. Field changes of dimension and detail.
2. Details not on original Contract Drawings.

B. All changes and information recorded on the set of prints maintained during the Work shall be neatly drawn and printed on a new set of plans in an orderly and legible manner, using approved permanent materials and methods. Any additional sheets necessary to complete the record drawings shall be provided by the Contractor and shall be of the same size, borderline, titling identification, and media as the record drawings.

C. Submit completed documents (one set of original blueprints and one set of reproducibles) to the College prior to Completion.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 WORK RESPONSIBILITIES

A. The drawings indicate diagrammatically the desired locations or arrangement of ducts, piping, equipment, etc., and are to be followed as closely as possible. Proper judgment must be exercised in executing the work so as to secure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference with structural conditions. The Contractor is responsible for the correct placing of Work and the proper location and connection of Work in relation to the work of other trades. Advise appropriate trade as to locations of access panels.

B. In the event changes in the indicated locations or arrangements are necessary, due to developed conditions in the building construction or rearrangement of furnishings or equipment, such changes shall be made without extra cost, providing the change is ordered before the ductwork, piping, etc. and work directly connected to same is installed and no extra materials are required.

C. Where equipment is furnished by others, verify dimensions and the correct locations of this equipment before proceeding with the roughing-in of connections.

D. All scaled and figured dimensions are approximate of typical equipment of the class indicated. Before proceeding with any work, carefully check and verify all dimensions, sizes, etc. with the drawings to see that the equipment will fit into the spaces provided without violation of applicable codes.

E. Should any changes to the Work indicated on the Drawings or described in the Specifications be necessary in order to comply with the above requirements, notify the College immediately and cease work on all parts of the contract which are affected until approval for any required modifications to the construction has been obtained from the College.

F. Be responsible for any cooperative work which must be altered due to lack of proper supervision or failure to make proper provisions in time. Such changes shall be under direction of the Engineer and shall be made to his satisfaction.

G. Perform all Work with competent and skilled personnel.

H. All work, including aesthetic as well as mechanical aspects of the Work, shall be of the highest quality consistent with the best practices of the trade.
I. Replace or repair, without additional compensation, any work which, in the opinion of the Engineer, does not comply with these requirements.

END OF SECTION
SECTION 15400 - CHILLED WATER PIPING AND EQUIPMENT

SECTION 15400
CHILLED WATER PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL

A. The requirements specified in Division 1 General Requirements and Section 15050 Basic Mechanical Requirements are incorporated herein.

1.2 SYSTEM DESCRIPTION

A. Provide all piping, fittings, equipment, fixtures, labor, materials and testing as required for a complete and operational system as herein specified and as specified on the drawings.

B. RELATED WORK

1. Section 15050: Basic Mechanical Requirements

1.3 SUBMITTALS - Reference Section 15050 and construction drawings.

PART 2 - PRODUCTS

2.1 AIR COOLED CHILLER

A. Rotary screw air cooled chiller with variable speed compressors as scheduled on drawings and in accordance with the following:

B. Manufacturers:

1. Trane RTAE165FU (basis of design)
2. York YVAA0183

C. Features in addition to items scheduled on drawings:

1. Factory startup
2. UL listed
3. ASME Pressure Vessel
4. Refrigerant: 134a
5. AHRI certified
6. ASHRAE 90.1 - all versions compliant
7. Standard cooling (40 to 65F/4.4 to 18C)
8. 2 pass evaporator
9. Fluid type = water
10. Grooved pipe connections
11. Factory installed flow switch - water (45 cm/s)
12. Factory insulation - all cold parts 0.75" 
13. Standard ambient (32 to 105F)
14. Aluminum fins with slits
15. Variable speed compressors, quantity 2, 2 independent circuits
16. Single point power connection
17. Terminal block
18. Default amp short circuit rating 10,000 amps
19. No transformer
20. Line reactors (~30% TDD)
21. Tracer TD7 Display or equal
22. LonTalk LCI-C Interface to existing Trane Tracer Summit BMS
23. Invisisound Superior Noise control package (see drawings for maximum sound pressure and sound power).
24. Epoxy condenser coating, Trane Complete Coat or approved equal.
25. Compressor sequence shall automatically alternate starts for the two compressors to even out run time for the compressors

D. The following control and monitoring points shall be available and mapped to the existing BMS graphics screen. Modify graphics screen as required to accommodate these points and show them clearly:

1. Input Variables:
   a. Chiller enable/disable
   b. Chilled water setpoint adjust
2. Output Variables
   a. Evaporator water pump request
   b. Evaporator water flow status (flow switch makes)
   c. Evaporator leaving water temp
   d. Evaporator entering water temp
   e. Evaporator Refrigerant temperature (each circuit)
   f. Evaporator Refrigerant pressure (each circuit)
   g. Condenser Refrigerant temperature (each circuit)
   h. Condenser Refrigerant pressure (each circuit)
   i. Outdoor Air Temperature
   j. Condenser air flow
   k. Active Chilled water setpoint
   l. Compressor motor drive frequency
   m. State (Alarm, Run, Local)
   n. Actual Capacity (% RLA)
   o. Current per line
   p. Oil Temp per Compressor
   q. High side oil pressure per compressor
   r. Compressor Starts
   s. Compressor Run Time
3. Submit sample graphics screen for review by Engineer

2.2 PIPING

A. Chilled Water:

1. Outdoors (Above Grade):
   a. Pipe: Schedule 40 Black Steel pipe conforming to ASTM A53, ERW Grade B.
   b. Fittings: Victaulic Style 107 QuikVic Rigid fittings for carbon steel pipe, cut groove in accordance with manufacturer's instructions

2.3 VALVES

A. Chilled Water:

1. Butterfly Valves: Ductile iron body, stainless steel disc, 200 psi cold working pressure (CWP), lug Body, lever operated, EPDM removable seat (rated to 250°F), 416 SS shaft, PTFE bushings, Stockham Figure LD-712 or approved equal. Valve and seat shall be rated for use with solutions containing sodium nitrite corrosion inhibitor.

2.4 PIPE INSULATION

A. Owens Corning preformed fiberglass pipe insulation w/ all-service jacket conforming to ASTM C547,
thermal conductivity 0.23 Btu-in/hr-sqft-°F at 75°F. Thickness as follows:

1. Chilled Water Supply and Return: 1” thickness, provide continuous impervious vapor barrier over entire length of piping including all fittings, valves, joints, etc.

B. Provide external aluminum jacket for all piping exposed outdoors. All longitudinal seams shall be on side with upper flap overlapping lower flap to prevent rain intrusion. Seal all joints with silver color caulk.

2.5 PIPE SUPPORTS:

A. All component model numbers noted are Cooper B-line. Substitutions are allowed in accordance with provisions in specifications for acceptance of substitutions.

B. All piping shall be seismically braced in accordance with SMACNA Seismic Restraint Guidelines, latest edition. Braces shall be in the lateral and axial directions. Slack cable braces shall be used for hangers required to move as part of thermal expansion provisions and shall not interfere with that movement.

C. All pipe support components and hardware used outdoors including areaways shall be hot-dipped galvanized steel. Hot dipping shall occur after fabrication.

D. All insulated piping shall be supported with the use of calcium silicate insulated pipe supports to prevent collapse of insulation.

E. All supports shall be manufactured of steel components. Use of plumbers tape, metal strap, plastic hangers or other types is not allowed.

F. Clevis Hangers: Figure B-3100 or equal.

G. Pipe Clamps: Figure B-2400 Standard Pipe Clamp, Figure B-2000 Series clip-in pipe clamps


I. Structural steel tubes and shapes as specified on details, fully hot-dipped galvanized after cutting and welding. Required field welds and cuts shall be coated with cold galvanizing compound.

2.6 PIPE LABELING

A. Label all new and existing piping within mechanical room in accordance with ASME A13.1 pipe labeling standards and University Standards.

B. Labels: As manufactured by Seton or approved equal, vinyl plastic labels with pressure sensitive adhesive backing.

C. Submit labeling scheme for review by the Engineer prior to ordering labels.

D. Clean all piping and insulation jackets prior to application of labels.

E. Labels applied outdoors shall be rated for use in outdoor environments.

2.7 PRESSURE GUAGES

A. Ashcroft 1008AL, Weiss or equal.

B. 4” dial size, Glycerin Filled, Buordon Tube type, sealed case. Range as indicated on drawings and as required so that normal operating pressure is approximately mid-scale.
C. Provide with gauge cock, 1/4" NPT lower connection.

2.8 THERMOMETERS

A. Dial type, range as required for measurement of expected fluid temperature range.

B. Ashcroft series EI, Weiss or equal. 5” dial, Vari-Angle with recalibrator. Provide thermowell with heat conducting paste.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. General:

1. All piping shall be seismically braced and supported in accordance with CBC requirements and in accordance with SMACNA Seismic Restraint Manual, latest edition.

2. Contractor shall consider and accommodate thermal expansion of all piping systems and shall arrange support and bracing systems so as to not induce undue stress on any piping, equipment, appurtenances, hangers or building elements. This shall include the use of spring hangers where appropriate. Spring hanger supports shall be seismically braced against movement in all directions with the use of slack cables.

3. Where galvanically dissimilar pipe materials interconnect, appropriate manufactured adapters or flanged connections with suitable gaskets shall be provided.

4. Piping shall be protected from damage and contamination during transport and construction. Exposed ends of piping shall be kept sealed prior to and during erection and at the end of each working day.

B. Piping Supports:

1. Refer to drawings for pipe hanger requirements.

3.2 PIPE AND EQUIPMENT INSULATION

A. All pressure testing shall be completed prior to covering of any piping systems with insulation.

B. General: Piping shall be continuously insulated along its entire length including in-line devices such as valves, fittings, flanges, couplings, strainers, suction diffusers, triple-duty valves and other piping appurtenances. Insulation shall be butted firmly together and jacket laps and joint strips provided with lap adhesive. Jackets shall be provided with their seams located on the topside of pipe for pipes located at least five feet above finished floor. Pipes located below five feet above finished floor shall be provided with their seams located on the bottom side of pipe. Removable flexible blanket-type insulation need not be jacketed. Continue insulation through walls, sleeves, and other pipe penetrations.

3.3 FIELD QUALITY CONTROL

A. General

1. Any deviation from the cleaning, installation testing, and certification requirements herein shall be approved in writing by the Project Manager.

B. All materials and workmanship shall be subject to inspection and examination by the Project Manager.
and/or Project Manager's representative at any place where fabrication or erection is carried on.

C. The University Representative reserves the right to reject all or any part of the system that does not conform to the requirements herein. Rejected materials or equipment shall be returned at the Contractor's expense for re-cleaning and certification.

D. The University Representative reserves the right to remove random samples of the installed work sufficient to establish the quality of materials and workmanship. If such samples indicate materials and workmanship do not meet the contract specification, the Contractor shall be required to replace or re-clean the installed work at no expense to the University. The University shall reimburse the Contractor on a time and materials basis for such work if the system proves to be installed to specification.

E. All testing shall be done in the presence of the College representative.

F. Upon completion of this work, all systems shall be adjusted for use. Should any piece of apparatus or any material or work fail in any of these tests, it shall be immediately removed and replaced by new materials. The defective portion of the work shall be replaced by the Contractor in the presence of the University Representative at no expense to the University.

G. Any leaks found shall be repaired in the following manner:
   1. Welded joint - Grind out defect and re-weld
   2. Brazed joint - Cut out and re-braze
   3. Plastic joint - Remove/Re-weld
   4. Screw joint - Taken apart and re-done (do not use compound)

H. Pipe Testing:
   1. Contractor shall review pressure rating of all valves, strainers, equipment, steam traps and other appurtenances and provide temporary bypass as required to avoid subjecting them to test pressures above their rating. All such equipment and connections thereto shall be tested separately at the rated pressures of the equipment.
   2. All testing shall be completed prior to covering of any joints in piping or equipment.
   3. All piping shall be tested as noted below unless more stringent testing is specified in other applicable sections.
   4. Test pressures shall be maintained until all leaks have been identified.
   5. Defective piping shall be repaired or replaced until tests are accomplished successfully.
   6. Test gauges shall be installed at convenient process connections. After completion of testing, the gauges and source connection shall be removed and the specified process attachments replaced.

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>TEST PRESSURE</th>
<th>TEST MEDIUM</th>
<th>TEST TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chilled Water</td>
<td>100 PSIG</td>
<td>water</td>
<td>1 hr</td>
</tr>
</tbody>
</table>

I. Welding Tests: Visual inspection shall be made for undercutting, porosity, inclusions, and cracking in addition to pressure testing as noted above.
A. General Cleaning Requirements: All pipe, fittings, valves, and system-related materials shall be cleaned before use. Contractor shall indicate in writing when each system is sufficiently clean for consideration by the College representative for acceptance. Tie-in to central systems shall not occur prior to receipt of written acceptance from the University’s representative.

END OF SECTION
SECTION 16010 – ELECTRICAL GENERAL PROVISIONS

PART 1  GENERAL

1.01    DEFINITIONS (APPLICABLE TO DRAWINGS AND SPECIFICATIONS)

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Above Grade</td>
<td>Not buried in ground and not embedded in concrete slab on ground.</td>
</tr>
<tr>
<td>Below Grade</td>
<td>Buried in ground or embedded in concrete slab in ground.</td>
</tr>
<tr>
<td>Concealed</td>
<td>Inside building above grade and located within walls, furred spaces, crawl</td>
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<td></td>
<td>spaces, attic and above suspended ceilings, etc. In general, any item not</td>
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<tr>
<td></td>
<td>visible or directly accessible.</td>
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<tr>
<td>Connect</td>
<td>Complete hookup of item with required services, including conduit, wires</td>
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<td></td>
<td>and other accessories.</td>
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<tr>
<td>Exposed</td>
<td>Either visible or subject to mechanical or weather damage, indoors or</td>
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<td></td>
<td>outdoors, including areas such as mechanical and storage rooms. In general,</td>
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<td></td>
<td>any item that is directly accessible without removing panels, walls,</td>
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<td></td>
<td>ceiling or other parts of structure.</td>
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<tr>
<td>Furnish</td>
<td>Supply and deliver complete.</td>
</tr>
<tr>
<td>Install</td>
<td>Place, secure and connect as required to make fully operational.</td>
</tr>
<tr>
<td>Provide</td>
<td>Furnish and install as defined above; perform work.</td>
</tr>
<tr>
<td>Underground</td>
<td>Buried in ground, including under building slabs.</td>
</tr>
<tr>
<td>Use (verb)</td>
<td>Furnish and install as defined above.</td>
</tr>
<tr>
<td>Wiring</td>
<td>Electrical raceway, conductor and connection.</td>
</tr>
</tbody>
</table>

1.02    SCOPE OF WORK

A. Furnish and install all materials and equipment and provide all labor required and necessary to complete the work shown on the drawings and/or specified and all other work and miscellaneous items, not specifically mentioned, but reasonably inferred for a complete installation, including all accessories and appurtenances required for testing the system. It is the intent of the drawings and specifications that all systems be complete and ready for operation. Paint all exposed raceways to match adjacent surfaces.

1.03    CODE COMPLIANCE

A. All work and materials shall comply with the latest rules, codes and regulations, including, but not limited to the following:
   1. Occupational Safety and Health Act Standards (OSHA).
   5. All other applicable Federal, State and Local laws and regulations.
B. Code compliance is mandatory. Nothing in these 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 inspection and approval by proper authorities. If work is concealed without inspection and approval, the Contractor shall be responsible for all work required to open and restore the concealed areas in addition to all required modifications.
1.04 CONDITIONS AT SITE

A. Visit to site is required of all bidders prior to submission of bid. All will be held to have familiarized themselves with all discernible conditions and no extra payment will be allowed for work required because of these conditions, whether specifically mentioned or not.

B. Lines of other services that are damaged as a result of this work shall promptly be repaired at no expense to the Owner to complete satisfaction of the Owner’s Representative.

1.05 DRAWINGS AND SPECIFICATIONS

A. All Drawings and all Divisions of these specifications shall be considered as a whole and work of this Division shown anywhere therein shall be furnished under this Division.

B. The Contract Drawings are diagrammatic and indicate the general arrangement of equipment and wiring. Most direct routing of conduits and wiring is not assured. Exact requirements shall be governed by Owner’s representative, structural and mechanical conditions of the job. Consult all other Drawings in preparation of the bid. Extra lengths of wiring or addition of pull or junction boxes, etc., necessitated by such conditions shall be included in the bid. Check all information and report any apparent discrepancies before submitting bid.

C. Right is reserved to make change up to ten feet in location of any outlet or equipment prior to roughing-in without increasing contract cost.

D. Equipment and fixtures shall be connected to provide circuit continuity in accordance with applicable codes, whether or not each piece of conductor, conduit or protective device is shown between items of equipment or fixtures and the point of circuit origin.

1.06 SAFETY AND INDEMNITY

A. No act, service, drawing review or construction review by Owner, the Owner’s representative, the Engineers, or their Consultants, is intended to include review of the adequacy of the Contractor’s safety measures, in, on, or near the construction site.

1.07 RECORD DRAWINGS

A. Contractor shall obtain a complete record set of reproducible transparencies from the Owner’s representative. This shall be corrected daily to show all changes from original contract drawings and shall be kept on the job. This set of reproducibles, clearly and neatly marked, shall be delivered to the Owner’s representative upon completion of the job.

PART 2: PRODUCTS

2.01 MATERIAL APPROVAL

A. All materials must be new and bear Underwriters’ Laboratories label. Materials that are not covered by UL testing standards shall be tested and approved by an independent testing laboratory or a governmental agency.

B. Material not in accordance with these specifications may be rejected either before or after installation.

2.02 SUBSTITUTION

A. All substitutions shall be subject to Engineer’s and Owner’s approval.
2.03 SUBMITTALS

A. Submittals required as follows:

2. Manufacturer’s Data and Cut Sheets for all electrical equipment.

2.04 OPERATING AND MAINTENANCE MATERIAL

A. Submit Operating and Maintenance Manuals of all equipment. Verify exact quantity with Owner’s representative.

2.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver and handle materials in a manner to prevent damage.
B. Store and protect equipment from weather and dampness.

PART 3: EXECUTION

3.01 WORKMANSHIP AND CONTRACTOR’S QUALIFICATIONS

A. Only quality workmanship will be accepted. Haphazard or poor installation practice will be cause for rejection of work.
B. Provide foreman in charge of this work at all times.

3.02 COORDINATION

A. Coordinate work with other trades to avoid conflict and to provide correct rough-in and connection for equipment furnished under other 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.
B. Verify equipment dimensions and requirements with provisions specified under this Section. Check actual job conditions before fabricating work.

3.03 CUTTING AND PATCHING

A. See General Conditions

3.04 EXISTING UNDERGROUND UTILITIES AND SERVICES

A. Locations of existing utilities, where shown, were established from best possible information. Assume that this information is approximate. Contractor shall verify exact locations and depths before starting work. Should, during the course of the work, conditions arise that indicate conditions are other than indicated, notify Owner’s representative immediately. Use extreme caution so as not to damage or break lines that are in use. If breakage does occur, Contractor shall be responsible for all damage and repairs resulting therefrom. All unusual conditions with respect to existing facilities shall be brought to Owner’s representative’s attention immediately. See Division I, General Provisions.

3.05 CONNECTIONS TO EXISTING WORK
A. Install new work and connect to existing work with minimum interference to existing facilities. All existing service interruptions shall be held to a minimum. Interruptions must be scheduled in advance with Owner to suit his convenience. Duration of interruptions shall be as agreed with Owner's representative. Owner reserves the right to require that necessary interruptions be at times other than usual business hours. Contractor shall follow the approved work phasing sequence as directed by the Owner's representative. Maintain continuous operations of existing facilities as required with necessary temporary connections between new and existing work. Restore existing disturbed work to original condition, including maintenance of wiring continuity as required.

3.06 ACCEPTANCE DEMONSTRATION

A. Upon completion of work, at a time to be designated by the Owner's representative, the Contractor shall demonstrate for the Owner the operation of the electrical installation, including any and all special items installed by him or installed under his supervision.

3.07 FIELD TEST AND OPERATIONAL CHECK

A. Arrangements for a final test and inspection of completed systems by the Owner's representative shall include:
   1. Demonstration that all systems, circuits, lights and equipment operate satisfactorily and as called for, with fixtures and equipment/devices connected.
   2. Spot check verification of color coding, tagging, numbering and splice make up.

END OF SECTION
SECTION 16050 – BASIC MATERIALS AND METHODS

PART 1: GENERAL

1.01 CONDITIONS AND REQUIREMENTS

A. Refer to Section 26 01 10 - Electrical General Provisions.

1.02 DESCRIPTION

A. Work included in this Section is conduits, wires and other miscellaneous materials not specifically mentioned in other Sections of DivisionS 26 and 28, but necessary or required for equipment or system operation or function, and the labor to install them.

B. Related work: Other Sections of DivisionS 26 and 28.

PART 2: PRODUCTS

2.01 CONDUITS AND OTHER RACEWAYS

A. Rigid Steel: Hot-dipped galvanized or sherardized.

B. Intermediate Metal Conduit (IMC): Electro-galvanized or sherardized.

C. Electrical Metal Tubing (EMT): Electro-galvanized or sherardized.

D. Plastic: Schedule 40 PVC, approved for use as non-metallic raceway for 90 degree C. conductors. Carlon, CertainTeed or Kalroy., or equal.

E. Wireway (gutter): Code gauge steel, with knockouts and hinged cover. Corrosion resistant gray baked enamel finish.

F. Provide fittings and accessories approved for the purpose equal in all respects to the conduit or raceway. EMT connectors and couplings shall be steel compression type.

G. Surface Raceway: Wiremold non-metallic raceway system per plans. Verify finish with Owner.

2.02 WIRES AND CABLES

A. For power and lighting systems 600V or less:

1. Conductor: #12 and #10 AWG solid copper. #8 AWG and larger shall be stranded copper.

2. Insulation type: #12 to #1 AWG shall be THWN for wet or underground locations and THHN for dry locations. Grounding wire shall be type THWN.

3. Minimum Conductor Size:

   a. Minimum size: #12 AWG for 120/208V circuit runs less than 100 feet
   b. Runs over 100 feet for 120/208V system shall be #10 AWG or larger as directed by NEC Voltage Drop Restrictions.
   c. Underground circuits shall use #10 AWG minimum wires unless otherwise noted.

4. Aerial Conductor: Thermoplastic insulated Type THW-2 copper.

B. Acceptable Products: General Electric, Anaconda, Okonite, Paranite, Pirelli-General, Triangle, or equal products conforming to or exceeding applicable IPCEA standards.

2.03 OUTLET BOXES, JUNCTION BOXES AND PULL BOXES
SECTION 16050 - BASIC MATERIALS AND METHODS

A. Outlet boxes: Hot-dipped, galvanized or sherardized of required size, 4" square, minimum, for flush mounted devices and lighting fixtures. Cast type with gasketed covers for outdoors or wet locations.
B. Junction and pull boxes: Use outlet boxes with appropriate covers as junction boxes wherever possible. Larger junction and pull boxes shall be fabricated from sheet steel, sized according to code, with screw-on covers, finished gray baked enamel.

2.04 CONDUIT HANGERS

A. For individual conduit runs not directly fastened to the structure, use rod hangers manufactured by Caddy, Unistrut, Powerstrut or equal.
B. For multiple conduit runs, use Unistrut, Powerstrut, or equal trapeze type conduit support designed for maximum deflection not greater than 1/8".

2.05 WIRE CONNECTORS

A. For wires size #8 AWG and smaller: Insulated pressure type (with live spring) rated 105 degrees C., 600V for building wiring and 1000V in signs or fixtures. Scotchlok, Ideal, or equal.
B. For wires size #6 AWG and larger: T&B or equivalent compression type with 3M #33+ or Plymouth "Slipknot Grey" tape insulation or equal.

2.06 GROUNDING

A. Ground wire shall be medium hard drawn copper conductor, stranded, bare, minimum sizes per NEC unless larger conductors are shown on drawings.
B. Bond ground rod(s) to metal underground cold water pipe, building structural metal columns, and/or concrete-encased electrodes with #4/0 bare copper ground wire to form a ground electrode system.
C. Unless otherwise noted on drawings, provide green insulated copper ground wire in all feeders and circuits connected to motors, equipment, exterior lighting fixtures, GFI receptacles, in feeders/circuits using non-metallic conduits. Size ground wire per NEC unless otherwise shown.

PART 3: EXECUTION

3.01 GENERAL

A. Electric system layouts indicated on the drawings are generally diagrammatic, but shall be followed closely as actual construction and work of other trades will permit. Govern exact routing of cable and wiring and the locations of outlets by the structure and equipment served. Take all dimensions from Owner's representative drawings.
B. Consult all other drawings. Verify scales and report any dimensional discrepancies or other conflicts to Owner's representative before submitting bid.
C. All home runs to panelboards are indicated as starting from the outlet nearest the panel and continuing in the general direction of that panel. Continue such circuits to the panel as though the routes were completely indicated. Terminate home-runs of signal, alarm and communications systems in a similar manner.
D. Avoid cutting and boring holes through structure or structural members wherever possible. Obtain prior approval of Owner's representative and conform to all structural requirements when cutting or boring the structure is necessary and permitted.
E. Furnish and install all necessary hardware, hangers, blocking, brackets, bracing runners, etc., required for equipment specified under this Section.
F. Provide necessary backing required to insure rigid mounting of outlet boxes.
3.02 WIRING METHOD

A. Install all wiring in raceway, unless specifically shown otherwise.
B. Minimum conduit size shall be 1/2" when installed above ground and 3/4" when installed underground or under building slabs. Increase conduit size as required for wiring. Size for conduit, unless specifically shown otherwise, shall be determined from Table 3A for conductors #16 through #4/ AWG and Table 3C for conductors 250 MCM or larger, Chapter 9 of latest National Electrical Code.
C. Conduit shall be rigid steel, IMC, EMT or plastic as follows:
   1. Above ground: Use rigid steel, EMT or IMC only.
      a. Wet locations: Rigid steel or IMC only.
      b. Hazardous locations: Rigid steel conforming to NEC requirements.
      c. Locations subject to mechanical injury: Rigid steel or IMC only.
      d. In concrete walls or block walls: Rigid steel only or IMC only.
      e. Dry locations and not subject to mechanical injury: EMT, IMC or rigid steel conduit.
   2. Underground: Use rigid steel or plastic.
      a. Underground conduits shall be installed as specified on trench detail on plans. Multiple runs shall maintain 3" minimum separation between runs. Contractor shall maintain minimum burial depth.
   3. Make all risers to grade with rigid steel conduit and rigid steel elbow fittings only.
   4. Burial depth of conduits shall be as follows:
      a. Concrete encased: 24" minimum for 600V or lower systems to top of concrete encasement.
      b. Concrete capped: 24" minimum to top of conduit.
      c. Conduits without concrete encasement or cap: 24" minimum to top of conduit.
      d. When installed under buildings the above minimum depth shall be 18" below bottom of floor slab.
D. Use flexible conduits in the following applications:
   1. Recessed lighting fixtures.
   3. At expansion joints.
   4. At wet locations, flexible conduit shall be liquid tight type.
E. Provide all junction boxes/pull boxes as required to limit any power system conduit run to a maximum of four 90 degree bends (two 90 degree bends for telephone conduit run) or to avoid "U" bends.

3.03 INSTALLATION OF CONDUITS

A. General:
   1. Run all conduits concealed unless otherwise noted or shown.
   2. Run exposed conduit parallel to or at right angles to center lines of columns and beams.
   3. Run no conduit in concrete slabs or floors except at point of penetration. All penetrations shall be at right angles to slab surfaces.
   4. Install conduits above ceilings to avoid obstructing removal of ceiling tiles, lighting fixtures, air diffusers, etc.
   5. Conduits shall not cross any duct shaft or area designated as future duct shaft horizontally. Conduit rises when allowed in duct shaft must be coordinated with Mechanical work to avoid any conflict.
B. Conduit Supports:
   1. Support conduits with Underwriters' Laboratories listed steel conduit support intervals required by the National Electric Code. Wires or sheet metal strips are not acceptable for conduit support. Use conduit hangers for all conduits not directly fastened to structure and for all multiple conduit runs.
2. Individual conduits 1/2" and 3/4" size may be supported from ceiling support wires with Caddy clips only if acceptable to local code. Only one conduit is permitted to be attached to any ceiling support wire. Hang such conduit so as not to affect level of ceiling.

3. Avoid attaching conduit to fan plenums. When it is necessary to support conduit from fan plenum, provide a length of flexible conduit between portion attached to the fan plenum and portion attached to the building to minimize transmission of vibration to the building structure.

C. Conduit Penetrations Conduit penetrations of roof, walls, floors and ceilings shall be sealed to preserve the integrity of waterproofing, fire rating and soundproofing for which the roof, wall, floor or ceiling is designed. Materials and methods used shall conform to that specified under Owner's General Sections.

D. All underground conduits and ducts 2" and larger shall be proven clear by pulling through a mandrel 1/4" smaller than the inside diameter.

E. Where flush branch circuit panelboards or terminal cabinets are shown on walls, stub a minimum of four 1" empty conduits into overhead ceiling spaces and four 1" empty conduits into space below floors (if any) in addition to conduits required for circuit wiring.

F. All exposed raceways shall be prime painted and finished to match adjacent surfaces unless otherwise directed by owner.

3.04 INSTALLATION OF WIRES

A. Pull no wire into any portion of the conduit system until all construction work which may 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 8" of correctly color-code tails left in the box.

C. Splices in wires and cables shall be made utilizing materials and methods described hereinbefore.

D. All cables and wires passing through manholes and handholes shall be full looped inside the manhole and handhole and supported on galvanized steel racks.

E. Make all ground, neutral and line connections to receptacle and wiring device terminals as recommended by manufacturer. Provide ground jumper from outlet box to ground terminal of devices when the device is not approved for grounding through the mounting screws.

F. Provide Brady wire markers where number of conductors in a box exceeds four.

3.05 WIRE COLOR CODE

A. Color code all conductors. Wire sizes #8 AWG and smaller shall have integral color coded insulation. Wire sizes #6 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 6" of the conductor.

B. Color code wires as follows:

<table>
<thead>
<tr>
<th>Conductors</th>
<th>120/208V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase A</td>
<td>Black</td>
</tr>
<tr>
<td>Phase B</td>
<td>Red</td>
</tr>
<tr>
<td>Phase C</td>
<td>Blue</td>
</tr>
<tr>
<td>Neutral</td>
<td>White</td>
</tr>
<tr>
<td>Ground</td>
<td>Green</td>
</tr>
</tbody>
</table>

3.06 CONNECTIONS TO EQUIPMENT

A. General
1. Furnish and install required power supply conduit and wiring to all equipment. See below for other wiring required.

2. Furnish and install a disconnect switch immediately ahead of and adjacent to each magnetic motor starter or appliance unless the motor or appliance is located adjacent and within sight of the serving panelboard, circuit breaker or switch. Verify all equipment nameplate current ratings prior to installation.

3. Mount all motor starters and provide all power wiring to them, including those furnished under other Sections or specifications.

4. Install all rough-in work for equipment from approved shop drawings to suit the specific requirements of the equipment.

5. 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.

6. Furnish and install manual thermal protection for all motors not integrally equipped with thermal protection.

7. Furnish 120V power to each control panel and time clock requiring a source of power to operate.

B. Other Contract-Furnished and/or Owner-Furnished Equipment

1. All required power and control conduit, wiring and connections are included under this Section of the work. Control sensing and alarm devices will 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 will be mounted in a place by the Contractor furnished the devices. All others shall be mounted under this Section of the work.

3.07 IDENTIFICATION

A. Provide engraved, lamacoid screw fastened nameplates for panels, motor starters, disconnect switches and all similar devices.

B. Provide dymo labels on all lighting switches and convenience and special purpose receptacles to show panel and circuit number to which the device is connected.

C. Provide label on all motors: "Caution, Automatic Equipment. May start at any time."

3.08 UTILITY SHUTDOWN

A. Contractor shall inform the Owner of any system or power shutdown required at least five (5) days prior to shut down.

END OF SECTION