



**REQUEST FOR PROPOSALS:
Cooling Tower Replacement**

Issue Date: Thursday, January 16, 2020

Due Date: Wednesday, February 12, 2020

In order to be considered, proposals must be signed and returned via email to oleon@wested.org.

Hard copies may be mailed to the WestEd Procurement Department at 4665 Lampson Ave., Los Alamitos, CA 90720 by (Wednesday, February 12, 2020).

Proposal responses will be considered valid for a period of 120 calendar days after the proposal due date.



RFP – COOLING TOWER REPLACEMENT

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I. INTRODUCTION

WestEd invites qualified companies, hereinafter referred to as Contractors, to submit proposals for replacing the cooling tower located at WestEd's headquarters in San Francisco ("Project").

This request for proposal (RFP) contains background information on WestEd, specific information that must be included in the proposals submitted and technical specifications related to the Project. An electronic version of the proposal must be received no later than **February 12th, 2020**.

Electronic copies must be delivered via email to oleon@wested.org. If necessary, physical copies may be delivered directly to our office at the following address:

WestEd
4665 Lampson Ave.
Los Alamitos, CA 90720
Attn: Oscar Leon, Procurement Manager

II. BACKGROUND

WestEd is a not-for-profit research, development, and service agency that works with education and other communities to promote excellence, achieve equity, and improve learning for children, youth, and adults. WestEd has over 700 employees, located in 16 offices across the United States, and had revenue of \$172 million for Fiscal Year 2020.

WestEd is a Joint Powers Agency ("JPA") formed under the California Joint Exercise of Powers Act, California Government Code section 6500 et seq. and governed by public entities in Arizona, California, Nevada, and Utah. WestEd's Board of Directors is comprised of members representing agencies from these states, as well as other national education and business leaders. WestEd's income is tax exempt under Section 115 (1) of the Internal Revenue Code.

WestEd complies with the required federal regulations on procurement, as well as applicable State procurement law and procedures.

Efforts, including affirmative steps prescribed by federal regulation (if applicable), will be made by WestEd to utilize small and minority-owned businesses, women's business enterprises and labor surplus area firms when possible. The selected firm may be required to undertake affirmative steps to utilize such firms in subcontracts if this contract is federally funded. A firm qualifies as a small business firm if it meets the definition of "small business" as established by the Small Business Administration (13 CFR 121.201, Subsector 238220) by having average annual receipts for the last three fiscal years not exceeding \$16.5 million.

III. WESTED CONTACT

All communications, including any requests for clarification, concerning this RFP should be addressed in email to the following contact:

Oscar Leon
Procurement Manager
oleon@wested.org

IV. SOLICITATION KEY DATES AND TIMELINE

RFP Activity	Dates
RFP Released	January 16, 2020
730 Harrison HVAC Walkthrough	January 31, 2020
Questions Due by bidders	February 3, 2020
Response to questions released	February 7, 2020
Proposal Due Date	February 12, 2020
Target Award Notice	February 17, 2020

V. SOLICITATION FORM

FAILURE TO SIGN THIS PAGE WILL DISQUALIFY YOUR RESPONSE

If awarded, the undersigned offers and agrees to furnish the services listed in this RFP at the prices and terms stated, subject to mutually agreed upon terms and conditions. Additionally, the undersigned warrants and represents their authority to bind the firm into an agreement subject to the terms and conditions of this Request for Proposal.

Company Name:

Street Address:

City, State Zip:

Email:

Telephone:

By (Authorized Signature)	Date Signed:
Print name and title of Authorized Signatory	

ALL SPECIFICATIONS, TERMS, AND CONDITIONS OF THIS PROPOSAL WILL BE INCORPORATED INTO ANY RESULTING AGREEMENT.

VI. SCOPE OF WORK

WestEd invites qualified Contractors to submit proposals for replacing the original 800 GPM cooling tower located at 730 Harrison Street, San Francisco, CA.

This Project will require structural, electrical, and mechanical work as detailed in the master specifications in Appendix A and in the construction drawings provided in Appendix B.

VII. PROPOSAL OUTLINE

In order to simplify the review process and to obtain the maximum degree of comparability, the proposals should include the following items and be organized in the manner specified below.

1. Letter of Transmittal

A letter of transmittal briefly outlining the firm's understanding of the work and general information regarding the firm and individuals to be involved is limited to a maximum of two pages. The letter should clearly identify the local address of the office of the firm performing the work, the telephone number, and the name of the authorized representative. The letter shall include a clear statement from Proposer that this offer is binding and shall remain open for 120 days from the due date of this RFP and acknowledges that its proposal cannot be withdrawn within that time without the written consent of WestEd.

2. Table of Contents

Include a table of contents that identifies the material by section, page number, and a reference to the information to be contained in the proposal.

3. Solicitation Form

The Solicitation Form included in the RFP shall be included here.

4. Profile of Firm Proposing

- a. State whether the firm is a local, national, or international firm and include a brief description of the size of the firm. State whether the proposer is a qualified small or minority-owned business, women's business enterprise or labor surplus area firm.
- b. State whether the firm is in compliance with the registration and permit requirements to do business in California.
 1. Describe the local office from which the work is to be performed.
 2. Location of office.
 3. Current size of the office.
 4. The size of professional staff by level, such as partner, manager and supervisor, senior, and other professional staff.

5. The credentials and qualifications of professional staff.

5. Qualifications

Describe recent experience with similar engagements to which the proposal relates.

- a. Include resumes of all key professional members who will be assigned to the project. Résumés should be included for all professional members of the team. The résumés should include specific engagements or clients to whom similar services have been provided if possible.
- b. Describe the firm's policy on notification of changes in key personnel.
- c. Briefly describe the firm's system of quality control to ensure the work meets a high quality standard.
- d. Include three client references.

6. Scope of Services and Proposed Project Schedule

Briefly describe the firm's understanding of the scope of services to be provided.

7. Fees and Compensation

Provide a written and detailed proposal for all labor, materials and equipment for the Project.

8. Exceptions to RFP Requirements

Any exceptions to the requirements of this RFP shall be noted in the proposal. WestEd shall have no obligation to accept any exceptions and may reject any proposal noting exceptions to its RFP requirements.

VIII. PROPOSAL SUBMISSION AND SELECTION PROCESS

By use of numerical and narrative scoring techniques, proposals will be evaluated by WestEd against the factors specified below. The relative weights of the criteria—based on a 100-point scale—are shown below.

Criteria	Points
1. Qualifications, experience, references, and ability to carry out the described work	15 points
2. Proposed methodologies and processes to accomplish work	15 points

3. Fees / expenses	60 points
4. Other factors, including completeness of proposal, adherence to RFP instructions, other relevant factors not considered elsewhere	10 points

IX. REVIEW PROCESS

WestEd may, at its discretion, request interviews/presentations by or a meeting with any or all firms, to clarify or negotiate modifications to the firm’s proposal. However, WestEd reserves the right to make an award without further discussion of the proposals submitted. Therefore, proposals should be submitted initially on the most favorable terms, from both technical and price standpoints, that the firm can propose. WestEd contemplates award of the contract to the responsive, responsible firm whose proposal is the most advantageous to WestEd, based on the highest total points and its decision is final.

As a federal contractor, it is WestEd’s policy to utilize, whenever possible, small businesses, disadvantaged small businesses, veteran-owned small businesses, minority-owned firms, and/or woman-owned businesses. Therefore, firms that meet these criteria will be given preference, should they meet all other stated criteria in the RFP.

X. NOTICE TO FIRM(S)

All materials provided to WestEd become the property of WestEd and may be returned only at its sole discretion. WestEd is a public entity. All proposals and any materials submitted with a proposal may be deemed public records subject to disclosure pursuant to the California Public Records Act. No portion of any proposal or materials submitted therewith will be withheld from disclosure as proprietary, trade secret or confidential unless that portion is clearly marked by the firm as such, and the firm agrees to indemnify WestEd against any claim or action to compel disclosure of such portion of the proposal. WestEd is not obligated to accept any proposal or to negotiate with any entity. All transactions are subject to the final approval of WestEd, which reserves the right to reject any and all proposals without liability. All costs directly or indirectly related to a response to this RFP will be borne by the firm.

The contract, if any, shall be awarded to the responsible firm whose proposal is most advantageous to WestEd, based on the evaluation criteria set forth in this RFP. WestEd may at its sole discretion select the response that best fits its needs, may choose to cancel the RFP, or to not select any Firm. A selection committee will evaluate the responses based on established criteria, including compliance with the direction herein, experience and qualifications, cost, financial position of the company, and other factors as stated in this

RFP. If selected, the successful firm will enter into a written agreement with WestEd that will include service agreements and compensation agreements.

All information in this RFP should, for purposes of this RFP, be considered proprietary and confidential. Information contained in this RFP should not be shared or distributed without the expressed written consent of WestEd.

XI. REJECTION OF PROPOSAL(S)

WestEd reserves the right in its sole discretion to reject any or all proposals, in whole or in part, without incurring any cost or liability whatsoever. All proposals will be reviewed for completeness of the submission requirements. The proposal may be rejected if it fails to meet a material requirement of the RFP or if it is incomplete or contains irregularities. A deviation is material to the extent that a proposal is not in substantial accord with RFP requirements.

Immaterial deviations may cause a bid to be rejected. WestEd may or may not waive an immaterial deviation or defect in a proposal. WestEd's waiver of an immaterial deviation or defect will in no way modify the RFP or excuse a firm from full compliance with the RFP requirements.

Any proposal may be rejected where it is determined to be not competitive, or where the cost is not reasonable.

Proposals that contain false or misleading statements may be rejected if in WestEd's opinion the information was intended to mislead WestEd regarding a requirement of the RFP.

WestEd may reject a proposal from a firm it finds non-responsible. Any person or entity that has substantially assisted WestEd in preparing any part of this RFP is prohibited from submitting a proposal. Submission of a proposal to WestEd shall constitute the firm's certification that the proposal is not collusive.

XII. USE OF SEPARATE CONSULTANTS/CONTRACTORS & SUBCONSULTANTS FOR PORTIONS OF SERVICES

WestEd reserves the right to award all or only a portion of the work/scope of services that is the subject of this RFP to the successful proposer. This includes the right to award one or more portions of the services to a separate contractor if WestEd deems such award to be most advantageous to WestEd in its sole discretion. WestEd further reserves the right to review, approve, and/or reject any proposed subconsultants and/or subcontractors proposed by any proposer if deemed to be in the best interest of WestEd. Proposers acknowledge that if WestEd elects to award any such separate or independent contract the

successful proposer shall coordinate its work with such separate contractors as directed by WestEd.

XIII. COMPLIANCE WITH LAWS

Any Firm must affirmatively agree and certify that it will comply with all applicable federal, state, and local laws and regulations, including but not limited to the provisions of the Fair Employment and Housing Act (Govt. Code, § 12900 et seq.) and any applicable regulations promulgated there under (Cal. Code of Regs., tit. 2, § 72850.0 et seq.). Any Firm must affirmatively agree to include the non-discrimination and compliance provisions of this clause in any and all subcontracts to perform work under the agreement.

XIV. WRITTEN QUESTIONS AND ADDENDA

Written questions or comments regarding this RFP must be in writing and received no later than February 3rd, 2020. Questions should be emailed to the Procurement Manager at oleon@wested.org. All questions will be responded to via email. Firm(s) invited to submit proposal understand and agree that they have an affirmative duty to inquire and seek clarification regarding anything in this RFP that is unclear or open to more than one interpretation.

WestEd, at its sole discretion, may make questions submitted by Firms and responses to the submitted questions available to all Firms.

WestEd reserves the right in its sole discretion to revise or amend this RFP prior to the stated submittal deadline. Any such revisions will be made by written addenda to this RFP. Firms are responsible for verifying they have received, and all proposals shall acknowledge receipt of, all addenda issued by WestEd relating to this RFP. Failure to acknowledge receipt of all such addenda may render a proposal nonresponsive.

XV. SUBMISSION

Electronic copies of responses must be received by February 12th, 2020. Any response received after this date may be returned or not considered. Responses should be submitted electronically to the Procurement Manager at oleon@wested.org. If Firms wish to also submit a hard copy of the proposal, it needs to be postmarked no later than the due date and mailed to 4665 Lampson Ave., Los Alamitos, CA 90720; Attn: Oscar Leon. Submission of a proposal shall constitute the firm's representation that it:

- Has thoroughly examined and become familiar with the scope of work set forth in this RFP;
- Understands the requirements of the scope of work, the nature of the work and all other matters that may affect the work;

- Will honor its proposal for no less than 90 days after the submission date stated in this RFP (or until execution of a final contract with the selected firm, if sooner), and acknowledges that its proposal cannot be withdrawn within that time without the written consent of WestEd;
- Will comply with all requirements set forth in this RFP, and in the ensuing contract, if any.

XVI. PROTESTS

Following the selection of the apparent successful firm, WestEd shall notify all firms of its intent to award a contract to such firm. Any protest to the award of the contract to the apparent successful firm shall be submitted to WestEd in writing within no less than five (5) calendar days from the date of such notice. Any protest shall state with specificity the ground on which the protestor alleges the contract may not be awarded to the apparent successful firm. WestEd shall consider any properly submitted protest and may accept or reject such protest as it determines appropriate in its sole discretion.

XVII. GENERAL PROVISIONS

- A. Amendments to RFP. WestEd reserves the right to amend the RFP or issue to all Respondents a Notice of Amendment to answer questions for clarification.
- B. No Commitment to Award. Issuance of this RFP and receipt of proposals does not commit WestEd to award a contract. WestEd expressly reserves the right to postpone the RFP process for its own convenience, to accept or reject any or all proposals received in response to this RFP, to negotiate with more than one Respondent concurrently, or to cancel all or part of this RFP.
- C. Amendments to Proposals. No amendment, addendum or modification will be accepted after the deadline stated herein for receiving Proposals. Respondent may modify or amend its Proposal only if WestEd receives the amendment prior to the deadline stated herein for receiving Proposals.
- D. Non-Responsive Proposals. A Proposal may be considered non-responsive if conditional, incomplete, or if it contains alterations of form, additions not called for, or other irregularities that may constitute a material change to the Proposal.
- E. Late Proposals. WestEd will not be responsible for Proposals that are delinquent, lost, incorrectly marked, sent to an address other than that given herein, or sent by mail or courier service and not signed for or acknowledged by WestEd.
- F. Costs for Preparing. WestEd will not compensate any Respondent for the cost of preparing any Proposal, and all materials submitted with a Proposal shall become the

property of WestEd. WestEd will retain all Proposals submitted and may use any idea in a Proposal regardless of whether that Proposal is selected.

- G. Alternative Proposals. Only one final proposal is to be submitted by each Firm. Multiple proposals will result in rejection of all proposals submitted by the Respondent.
- H. Public Documents. All Proposals and all evaluation and/or scoring sheets shall be available for public inspection at the conclusion of the selection process.

Appendix A – Master Specifications: Division 23 (Mechanical) and Division 26 (Electrical)

This appendix contains the Master Specifications for the design and construction of the new cooling tower for WestEd's facility.

The general purpose of this appendix is to provide minimum criteria for materials and to address design criteria. Use of these Specifications will help Contractor meet WestEd's primary goal of providing a safe, reliable and successful installation of the replacement cooling tower.

SECTION 23 00 10

BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Materials, installation and testing of pipe, tubing and fittings, and valves.
 - 2. Refer to Specification Sections for each system medium (i.e., plumbing, hydronics, and the like) for pipe application.
 - 3. Mechanical identification materials.
 - 4. Seismic/vibration isolation.

1.2 QUALITY ASSURANCE

- A. Manufacturer's Inspection: Inspect flanges, fittings and field applied welds in accordance with manufacturer's standard written quality control procedure in accordance with the following techniques: Visual Method: Comply with MSS SP-55 except as otherwise indicated.
- B. Welding Qualification: Qualify welding procedures, welders and operators in accordance with ANSI B31.9 for shop and project site welding of piping work.

1.3 SUBMITTALS

- A. Piping Materials List: Provide typewritten list which schedules the piping materials to be used for each system as a function of applicable nominal pipe size ranges. Arrange schedule in outline form for each specific piping system, e.g., "Chilled Water System," "Soil, Waste, and Vent Piping System," and the like. Include ASTM, ANSI or other numbers and other data as necessary to demonstrate compliance with requirements.
- B. Test Procedure: Submit a typewritten checklist type of testing procedure indicating testing medium (i.e., water, air, nitrogen, and the like), pipe service, pipe and fitting type and classification, test pressure, pass/fail criteria and any other pertinent data.
- C. Maintenance Data: Submit maintenance data and parts list for each type valve. Include this data, product data, and certifications in maintenance manual.
- D. Welders Certification: Submit certificates verifying welders are qualified in welding procedures required for this project.

PART 2 - PRODUCTS

2.1 PRODUCT STANDARDS

- A. References to product Specifications for materials are listed according to accepted base standards. Materials to meet latest approved versions of these standards.

- B. See Section 23 00 00, Basic Mechanical Requirements where piping materials are approved for use.
- 2.2 PIPING (SEE SECTION 23 21 00)
- A. Steel Pipe: ASTM A53, Black Welded or Seamless, Grade B: Schedule as specified.
 - B. Copper Tube: Temper: Annealed (hard drawn).
- 2.3 FITTINGS FOR STEEL PIPE (SEE SECTION 23 21 00)
- A. General: Flanges, fittings, unions and other products, mark in accordance with MSS SP-25.
 - B. Welding Fittings: Wrought carbon steel fittings, ASTM A234, ANSI B16.9, B16.28. Butt-welding type unless otherwise indicated to be socket welding type.
 - C. Branch Connections: From mains or headers 2-1/2 inches or larger, welded tees or forged welding outlets.
 - D. Welding Outlets: "Weldolets" or "Threadolets" equivalent to Bonney Forge. Use forged welding outlets wherever branch line is at least 1 nominal pipe size smaller than local main or header.
 - E. Threaded Fittings: Case Iron screwed fittings, 250 PSR rating.
 - F. Flanges: Carbon steel conforming to ASTM A105, ANSI B16.5, and factory forged in the USA. Flanges which have been machined, remade, painted, or are nondomestic origin are not acceptable. Provide raised or full face ends wherever indicated or required. Pressure rating shall be 250 psi.
 - G. Unions: ANSI B16.39, ASTM A47, and be fabricated from malleable iron with bronze-to-iron ground joints rated at 150 percent design operating pressure. Threads: ANSI B2.1.
 - H. Fasteners: Semi-finished carbon steel bolts and hex nuts conforming to ASTM A307. Threads and Dimensions: ANSI B1.1 and B18.2.
 - I. Threaded Pipe Plugs: ANSI B16.14.
 - J. Thread Lubricant: RectorSeal No. 5 or Slic-tite Teflon Paste.
- 2.4 FITTINGS FOR COPPER TUBE
- A. Wrought copper/bronze solder joint fittings complying with ANSI B16.22.
- 2.5 VALVES
- A. General:
 - 1. Sizes: Unless otherwise indicated, provide valves of same size as upstream pipe size.
 - 2. Operators: Provide hand wheels, fastened to valve stem, for valves other than quarter-turn. Provide lever handle for quarter-turn valves 6 inches and smaller, and 4 inches and smaller for plug valves. Provide gear operators for quarter-turn valves

8 inches and larger. Provide chain-operated sheaves and chains for overhead valves.

3. End Connections: Mate with pipe, tube and equipment connections. Where more than one type is indicated, selection is installer's option.

B. Service:

1. Drain Service; All Pipe Sizes: [Drain valves.
2. Check Valves: Swing check valve.

C. Manufacturers: Crane, Fairbanks, Anvil, Jenkins, Kennedy, Walworth, Red/White (commercial grade), Mueller, Legend, Conbraco, Nibco, DeZurik, Hays, Powell, Stockham, Hammond, Watts, Milwaukee or approved. Note:

D. GATE VALVES

1. 2 Inches and Smaller: Class 125, bronze, screw-in bonnet, solid wedge. Rising Stem: Nibco 111. Nonrising Stem: Nibco 113.
2. 2-1/2 Inches and Larger: Flanged ends, Class 125, iron body, bolted bonnet, solid wedge, bronze mounted. OS&Y: Nibco 617-0. Nonrising Stem: Nibco F-619.
3. Valves to be Class 250 for installation in the high pressure side of pressure regulating stations.

E. DRAIN VALVES

1. Class 125, bronze body, screw-in bonnet, rising stem, composition disc, 3/4-inch hose outlet. Threaded: Nibco 73. Solder: Nibco 72.
 - a. 2 Inches and Smaller: Nibco 134 (rising stem) or Nibco 136 (non-rising stem).
 - b. Over 2 Inches: Nibco F-667 (OS&Y) or Nibco F-669 (non-rising stem).

F. BALANCING VALVES

1. Bronze with a machined orifice flow restriction, multi-turn globe type valve, internal O-rings, rated working pressure of at least 240 PSIG (175 PSI iron construction, 2-1/2 inches and larger), flow setting indicating pointer and calibrated nameplate, memory stops, and pressure readout port with integral check valve on each side of the orifice. Armstrong, Nibco, Wheatley, Tour & Anderson, or Illinois.
2. Combination check valve/balancing valve not allowed, 1/4 turn plug type allowed on 8 inches and larger pipe only.

G. BALL VALVES

1. 2-1/2 Inches and Smaller: 150 PSI, bronze body, full port, bronze trim, two-piece construction, TFE seats and seals. Threaded: Nibco T-595-Y. Soldered: Nibco S-595-Y.

2. 3 Inches and Larger: 150 PSI, cast-iron body, full port, two-piece body, TFE seats with stainless steel ball. FDA rated for potable water. Flanged Connection: Watts G4000.

H. BUTTERFLY VALVES

1. Select lug type valves, rated for 300°F.
2. 6 Inches and Smaller: 200 PSI, ductile iron body, extended neck, aluminum bronze disc, reinforced resilient EDPM seat, manual lever and lock. Nibco LD2000 for mechanical coupling fittings.
3. 8 Inches and Larger: 200 PSI, ductile iron body, extended neck, aluminum bronze disc, reinforced resilient EDPM seat, gear operator. Nibco DL2000-5 for mechanical coupling fittings.
4. Do not use for steam.

I. SWING CHECK VALVES

1. 2 Inches and Smaller: Class 125, bronze body, horizontal swing, regrinding type, Y-pattern, renewable disc. Nibco 413.
2. 2-1/2 Inches and Larger: Class 125, iron body, bolted bonnet, horizontal swing, renewable seat and disc, flanged ends. Nibco F918.

2.6 PIPING HANGERS AND SUPPORTS

A. General:

1. Horizontal Piping Hangers and Supports-Horizontal and Vertical Piping, and Hanger Rod Attachments: Factory fabricated horizontal piping hangers and supports complying with MSS SP-58, to suit piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for uninsulated copper piping systems
2. Building Attachments: Factory fabricated attachments complying with MSS SP-58, selected to suit building substructure conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods.
3. Saddles and Shields: Factory fabricated saddles or shields under piping hangers and supports for insulated piping. Size saddles and shields for exact fit to mate with pipe insulation. 1/2 round, 18 gauge, minimum 12 inches in length (4-inch pipe and larger to be three times longer than pipe diameter).
4. Roller Hangers: Adjustable roller hanger. Black steel yoke, cast iron roller.
5. Concrete Inserts: Malleable iron body, black finish. Lateral adjustment.
6. Continuous Concrete Insert: Steel construction, minimum 12 gauge. Electrogalvanized finish. Pipe clamps and insert nuts to match.

- B. Hangers For Pipes 2 Inches and Smaller: Adjustable swivel ring hanger, UL listed. Michigan 100 or 101.
- C. Hangers For Pipes 2-1/2 Inches and Larger: Adjustable clevis type, UL listed. Michigan 400.
- D. Riser Clamps: Steel, UL listed. Michigan 510 or 511. Copper coated; Michigan 368.
- E. Plumbers Tape: Not permitted as pipe hangers or pipe straps.
- F. Michigan numbers are indicated for type and quality. Comparable products manufactured by Globe, Elcen, B-Line, Kindorf, Kinline, Unistrut, Anvil, Super Strut, Tolco, PHD, Power-Strut, or approved.

2.7 WALL AND FLOOR SLEEVES

- A. Minimum 20 gauge galvanized steel in concrete, 18 gauge in other construction. 1/2-inch clearance around pipe or insulation. Provide UL approved fire-rated assemblies/caulking as required. 3M or approved.

2.8 ANCHORS

- A. General: Anchor supports to existing masonry, block and tile walls per anchoring system manufacturer's recommendations or as modified by project structural engineer.
- B. Manufacturers: Anchor-It, Hilti Hit System, Epcon System, or Power Fast System.

2.9 ELECTRIC MOTORS

- A. Motors: Energy efficient, suitable for non-overloading operation, and capable of continuous operation at full nameplate rating. Motors 1 HP and larger must meet Energy Policy act of 1992. Motors to be high efficient type similar to Century/Gould E-plus.
- B. Take NEMA standards as minimum requirements for motor design and performance. Motors suitable for load, duty, voltage, frequency, hazard and for service and location intended. Motors, unless specified otherwise, to be general purpose open drip-proof type, ball bearing equipped, 40C temperature rise; and rated for continuous duty under full load. Motors to have name plate giving manufacturer's name, shop number, HP, RPM and current characteristics.
- C. Motors smaller than 1/2 horsepower, 1 phase; and motors 1/2 horsepower and larger, 3 phase and voltage as indicated on Drawings. Maximum motor speed of 1750 RPM, unless otherwise noted. One phase motors to have internal thermal overload protection with automatic reset.

2.10 STARTERS

- A. Three phase motors up to and including 15 HP:
 1. Provide enclosed type magnetic across-the-line starter with thermal overload and under voltage protection.
 2. Operator: "Start-Stop" pushbutton, except where automatic control is indicated on Drawings or specified. Then provide "Hand-Off-Auto" selector switch.

3. Starters for 3 phase motors to have overload protection in each of the three legs, with external manual reset.
4. Unless indicated on Drawings or in Specifications, furnish motor starters with a neon pilot light. Neon lights are required for exhaust fan switches.
5. Equip starters with integral transformer and coil for control circuit. Coordinate coil voltage with control voltage.

2.11 DISCONNECTS

- A. Provided by Division 26 unless otherwise specified.

2.12 MECHANICAL IDENTIFICATION MATERIALS

- A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 23 sections. Where more than a single type is specified for application, provide single selection for each product category.
- B. Manufacturers: Allen Systems, Inc., W. H. Brady Co., Signmark Division, Industrial Safety Supply Co., Inc., Seton Name Plate Corporation, or approved.

C. PLASTIC PIPE MARKERS

1. Provide one of the following:
 - a. Snap-on Type: Manufacturer's standard preprinted, semi-rigid snap-on, color-coded pipe markers.
 - b. Pressure-Sensitive Type: Manufacturer's standard preprinted, permanent adhesive, color-coded, pressure sensitive, vinyl pipe markers.
2. Small Pipes: For external diameters less than 6 inches (including insulation, if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
 - a. Snap-on application of pretensioned semi-rigid plastic pipe marker.
 - b. Adhesive lap joint in pipe marker overlap.
 - c. Laminated or bonded application of pipe marker to pipe (or insulation).
 - d. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4 inch wide; full circle at both ends of pipe marker, tape lapped 1-1/2 inches.
3. Large Pipes: For external diameters of 6 inches and larger (including insulation, if any), provide either full-band or strip-type pipe markers, but not narrower than three times letter height (and of required length), fastened by one of the following methods:
 - a. Laminated or bonded application of pipe marker to pipe (or insulation).

- b. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2 inches wide; full circle at both ends of pipe marker, tape lapped 3 inches.
 - c. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.
 - 4. Lettering: Comply with piping system nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application length.
 - 5. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.
- D. VALVE TAGS
 - 1. Brass Valve Tags: Polished brass valve tags with stamp-engraved piping system abbreviation in 1/4-inch high letters and sequenced valve numbers 1/2 inch high, and with hole for fastener. 1-1/2-inch diameter tags, except as otherwise indicated. Valve designations to be coordinated with *existing* valve identifications to ensure no repetitive designations are utilized.
 - 2. Valve Tag Fasteners: Solid brass chain (wire link or beaded type), or solid brass S-hooks.
 - 3. Access Panel Markers: Manufacturer's standard 1/16-inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include center hole to allow attachment.
- E. VALVE SCHEDULE FRAMES
 - 1. General: For each page of a valve schedule, provide glazed display frame with removable mounting as appropriate for wall construction upon which frame is to be mounted. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.
- F. ENGRAVED PLASTIC-LAMINATE SIGNS
 - 1. General: Engraving stock melamine plastic laminate, Federal Specification L-P-387, in the size and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color), punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
 - 2. Thickness: 1/16 inch for units up to 20 sq.in. or 8 inches in length; 1/8 inch for larger units.
 - 3. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
- G. PLASTIC EQUIPMENT MARKERS
 - 1. General: Manufacturer's standard laminated plastic, color-coded equipment markers. Conform to the following color code:

- a. Green: Cooling equipment and components.
 - b. Yellow: Heating equipment and components.
2. Nomenclature: Match terminology used on drawing schedules as closely as possible.
 3. Size: Provide approximate 2-1/2- by 4-inch markers for control devices, dampers, and valves; and 4-1/2- by 6-inch markers for equipment.

H. LETTERING AND GRAPHICS

1. General: Coordinate names, abbreviations and other designations used in mechanical identification work with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.
2. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples: Chiller No. 3, Air Handling Unit No. 42, Standpipe F12, and the like).

2.13 SEISMIC RESTRAINTS FOR PIPING

- A. Use the document "Seismic Restraints Manual Guidelines for Mechanical Systems." Secure piping, ductwork, and the like to withstand a force in any direction.
- B. Sway bracing is not required for pipes that are installed on very short hangers (12 inches or less).
- C. Secure HVAC and plumbing piping bracing at every fourth hanger transversely and every eighth hanger longitudinally.
- D. Design restraints to meet CBC standards. Provide structural engineering calculations sealed by a professional engineer registered in state of California.

2.14 EQUIPMENT

- A. General:
 1. Provide a means to prohibit excessive motion of mechanical equipment during an earthquake.
 2. Provide mechanical equipment, both hanging and base mounted, with mounting connection points of sufficient strength to resist lateral seismic forces equal to 0.5 of equipment operating weight.
 3. Design restraints to meet CBC standards. Provide structural engineering calculations sealed by a professional engineer registered in state of California.
- B. NEOPRENE PAD
 1. One layer of 5/16-inch thick ribbed or waffled neoprene, 40 to 50 durometer. Size pads for loading between 40 and 50 PSI.

2. NP Isolators: Amber/Booth type NR.
3. Manufacturers: Supply vibration isolation mounts by a single manufacturer. Acceptable suppliers are as follows: Amber/Booth Co. - A.B., Korfund Dynamics - K.D., Mason Industries, Inc. - M.I., Peabody Noise Control Inc. - P.N.C., Vibration Mountings & Controls, Inc. - V.M.&C., IAC, Koppers, Vibrex.

2.15 FLEXIBLE PIPE CONNECTIONS

- A. Braided stainless steel over corrugated hose.
- B. Select and fit to suit the system temperature, pressure and fluid type.
- C. Pipe Sizes 2 Inches or Smaller: Threaded male on each end. Larger sizes: Steel flange couplings.
- D. FPC: Metroflex.
- E. Connections to match piping system.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General Electrical Equipment Clearances: Do not route piping through electrical rooms, transformer vaults, elevator equipment rooms, and other electrical or electronic equipment spaces and enclosures. Within equipment rooms, provide minimum 3-foot lateral clearance from sides of electric switchgear panels. Do not route piping above any electric power or lighting panel, switchgear, or similar electric device. Coordinate with electrical and coordinate exact pipe routing to provide proper clearance with such items.
- B. Pressure Piping Routing:
 1. Route piping, except as otherwise indicated, vertically and horizontally (sloped to drain). Avoid diagonal runs wherever possible. Orient horizontal routes parallel with walls and beam lines.
 2. Install piping as shown or described by diagrams, details and notations on Drawings or, if not indicated, install piping to provide the shortest route which does not obstruct usable space or block access for servicing the building and its equipment.
 3. Support piping adjacent to walls, overhead construction, columns and other structural and permanent enclosure elements of the building. Limit clearance to 1/2 inch wherever furring is indicated for concealment of piping. Allow for insulation thickness, if any. Locate insulated piping to provide minimum 1-inch clearance outside insulation.
 4. Wherever possible in finished and occupied spaces, conceal piping from view by locating within column or beam enclosures, hollow wall construction, or above suspended ceilings. Do not encase horizontal routes in solid partitions, except where approved.
- C. Preparation:

1. Unions:
 - a. Insulating Unions: Schedule 40 red brass nipples minimum length six times pipe diameter, minimum 6" long, 2" and smaller threaded, 2½" and larger flanged.
 - b. Standard Unions: Install where indicated on Drawings and on each side of pieces of equipment to permit easy removal of equipment.
2. Copper Tubing:
 - a. Remove burrs from and clean outer surface of tube ends and inner surface of fittings.
 - b. Copper-Soldered: Make soldered joints for copper tubing and fittings with code approved solder alloys meeting ASTM and ANSI standards and listings. Solder-paste-flux combination fillers are not approved. Installations to conform to accepted published procedures; i.e., UPC IS 375, IS 21-80 standards and CDA Publications. Use of steel wool for cleaning tube and fittings is prohibited. Apply flux as recommended by manufacturer. Solder domestic hot and cold water and condensate pipe within building above grade with 95 percent tin and 5 percent antimony, Allstate Silver Bearing Solder 430 or other approved solder alloys which do not contain lead or cadmium.
 - c. Copper-Brazed: Make brazed joints for copper tubing and fittings with code approved brazing filler alloys meeting ASTM and AWS standards and listings. Filler alloys of BCuP2 classification (e.g., "Phos-0" or "Fos-Copper") may not be used to make joints between copper tubing and cast brass or bronze fittings. Filler alloys containing cadmium are not approved for use in potable water piping. Installations to conform to accepted published procedures, i.e., UPC IS 3-75 standards and CDA Publications. Use of steel wool for cleaning tube and fittings is prohibited. Braze other copper pressure piping underground including water service. Remove bonnets and nonmetallic seats on valves and cool body with damp cloth while soldering or brazing. Remove excess flux from completed joints in accordance with manufacturer's instructions and code standards.
 - d. Pressurized Service:
 - 1) Unless otherwise indicated, wrought copper/bronze solder joint fittings complying with ANSI B16.22-1995.
 - 2) Copper Tube Unions: Standard products as recommended by manufacturer for use in the service. Rated at 150 percent design operating pressure.

3.2 PIPE AND PIPE FITTINGS

A. Pipe Sleeves:

1. Lay out work in advance of pouring concrete and furnish and set sleeves necessary to complete work.

2. Floor Sleeves (Except DWV Piping at Slab on Grade): Provide sleeves on pipes passing through concrete or masonry construction. Extend sleeve 1 inch above finished floor. Caulk pipes passing through floor with nonshrinking grout or approved caulking compound. Provide "Link-Seal" sleeve sealing system for slab on grade. Caulk/seal piping and ductwork passing through fire rated building assembly with UL rated assemblies. Provide fire-rated assemblies per local AHJ requirements.
 3. Wall Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Provide sleeve flush with finished face of wall. Caulk pipes passing through walls with nonshrinking caulking compound. Caulk/seal piping and ducts passing through fire-rated building assemblies with UL approved fire-rated assemblies. Provide fire-rated assemblies per local AHJ requirements.
 4. Beam Sleeves: Coordinate with trades for locations of pipe sleeves in reinforced concrete and steel beams. Penetrations must be indicated on structural shop drawings. See Drawings and Specifications for specific sleeve location limitations. Plumbing Drawings are diagrammatic. Offset piping as required to meet these limitations. Pipe sleeve locations must be indicated on reinforced concrete and steel beam shop drawings. Field cutting of beams not allowed without written approval of structural engineer. No extra costs allowed for failure to coordinate beam penetrations prior to reinforced concrete and steel beam shop drawing submittal.
- B. Conform with applicable codes and industry standards.
- C. Install uninsulated piping so that unrestrained direct contact with the structure or other system installations is avoided. Where contact with or passage through building or structural features cannot be avoided; firmly anchor piping to, or isolated from, the structure to prevent noise transmission and occurrence of physical damage. Install piping to be insulated with adequate clearance around piping to allow for placement of full thickness insulating material.
- D. Corrosion Control: Install hot water heating vessels with a stainless steel fitting at tank and a dielectric nipple on both supply and discharge sides of hot water tanks.
- E. Installation/Coordination:
1. Expansion and Flexibility: Install work with due regard for expansion, contraction, and building settlement to prevent damage to the piping, ductwork, equipment and the building and its contents. Provide piping offsets, loops, expansion joints, anchors or other means to control pipe movement, to minimize pipe forces and effects of building settlement.
 2. Install piping to prevent stresses and strains to piping and hangers and supports due to expansion or contraction and building settlement. Provide proper loops, guides, offsets, anchor points, or expansion joints. Verify with anticipated settlement or shrinkage of building. Verify construction phasing of project, type of building construction products and type for coordinating installation of piping systems. Include provisions for servicing and removal of equipment without dismantling piping.

3.3 ESCUTCHEONS

- A. Install on exposed pipes passing through walls or floors, and on fixture stops and waste connections to wall, except not required in stockrooms.

3.4 PIPING AND EQUIPMENT REMOVAL

- A. Piping and equipment removed as salvage by Owner to remain property of the Owner.
- B. Remove as shown on drawings. Piping and ductwork to be reused where shown. Dispose and remove excess piping, ductwork and equipment (and not identified by Owner as salvage).

3.5 ACCESSIBILITY

- A. Installation of valves, gauges and equipment conveniently and accessibly located with reference to finished building for repairs, removal and service.

3.6 PAINTING

- A. Ferrous Metal: After completion of mechanical work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces in mechanical rooms, i.e., hangers, hanger rods, equipment stands, and the like, with one coat of black asphalt varnish or black enamel suitable for hot surfaces.
- B. Machinery:
 - 1. In a mechanical room, on the roof or other exposed areas, machinery and equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
 - 2. See individual equipment specifications for other painting.
- C. Structural Steel: Repair damage to structural steel finishes or the finishes of other materials damaged by cutting, welding or patching to match original.
- D. Piping: Clean, primer coat, and paint exposed piping on the roof or at other exterior locations with two coats of paint suitable for metallic surfaces and exterior exposures. Color selected by Architect.

3.7 ACCESS PANELS

- A. Install ceiling or wall access panels to provide access to concealed valves, fans, motors, shock arrestors, fire dampers, terminal units, coils and other mechanical items needing service. Provide access panels at locations required or as specified herein. Coordinate locations/sizes of access panels with Architect prior to work.
- B. Where access panels are for service of fire, fire/smoke, or smoke dampers, stencil the words "Fire Damper," "Fire/Smoke Damper," or "Smoke Damper" in 1/2-inch high capital letters on the outside of the panels.

3.8 FIRESTOPPING PENETRATIONS IN FIRE-RATED WALL/FLOOR ASSEMBLIES

- A. Provide proper sizing when providing sleeves or core-drilled holes to accommodate the penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet the requirements of ASTM E814.
- B. Manufacturers: Hilti, Proset, or approved.
- C. UL Listed penetrations must be submitted and approved by campus Fire Marshal prior to installation.

3.9 FIELD QUALITY CONTROL

- A. Upon completion of installation of equipment and plumbing fixtures and after units are water pressurized, test fixtures to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.
- B. Inspect each installed unit for damage to finish. If feasible, restore and match finish to original at site; otherwise, remove fixture and replace with new unit. Feasibility and match to be judged by Architect. Remove cracked or dented units and replace with new units.

3.10 VALVE INSTALLATION

- A. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary.
- B. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward from horizontal plane. Install valve drains with hose-end adapter for each valve that must be installed with stem below horizontal plane.
- C. Insulation: Where insulation is indicated, install extended-stem valves, arranged in proper manner to receive insulation.
- D. Mechanical Actuators: Install with chain operators where indicated. Extend chains to 5 feet above floor and hook to clips to clear aisle passage.
- E. Stem Selection: Outside screw and yoke stems, except provide inside screw, nonrising stem where space prevents full opening of OS&Y valves.
- F. Seats: Renewable seats, except where otherwise indicated.

3.11 VALVE ADJUSTING AND CLEANING

- A. Inspect valves for leaks. Adjust or replace packing to stop leaks. Replace valve if leak persists.

3.12 VALVE IDENTIFICATION

- A. General: Provide valve tag on every valve, cock and control device in each piping system. Exclude check valves, valves within factory fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibbs, shutoff valves at plumbing fixtures, and similar rough-in connections of end-use fixtures. List each tagged valve in valve schedule for each piping system.

- B. Install mounted valve schedule in each mechanical room.

3.13 MECHANICAL EQUIPMENT IDENTIFICATION

- A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices: terminal units, coils, fans, water heaters, blowers, unitary HVAC equipment, similar equipment.

3.14 PIPING SYSTEM IDENTIFICATION

- A. Install pipe markers on each system and include arrows to show normal direction of flow.
- B. Locate pipe markers and color bands wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels and plenums), and exterior nonconcealed locations, in locations as follows:
 1. Near each valve and control device.
 2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
 3. Near locations where pipes pass through walls or floors/ceilings, or enter nonaccessible enclosures.
 4. At access doors, manholes and similar access points which permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced intermediately at maximum spacing of 50 feet along each piping run, except reduce spacing to 25 feet in congested areas of piping and equipment, i.e., mechanical rooms.

3.15 ADJUSTING AND CLEANING

- A. Adjusting: Relocate any mechanical identification device which has become visually blocked.
- B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

3.16 CONNECTIONS TO EXISTING

- A. Prior to connection of piping and ductwork to existing as illustrated on Mechanical Drawings, field verify existing conditions and exact sizes and locations of existing piping and ductwork. Provide additional offsets, transitions, joints, cut-ins, and replace portions of existing as required to facilitate connections of new as shown on Documents.

3.17 CAULKING

- A. Provide Geocel Corporation, (800) 348-7615, Construction 2000 Caulking Sealant. Standard color to match as close as possible to surrounding surface. Application standards, ASTM C920, Type S, Grade NS, Class 25, ICBO approved, Report No. 3680. Apply per manufacturer's re

B. commendations.

3.18 STARTERS

A. Install in sight of equipment controlled, easily accessible, protected from possible piping leaks and no more than 6 feet above the floor.

END OF SECTION

SECTION 23 00 10

BASIC MATERIALS AND METHODS

PART 4 - GENERAL

4.1 SUMMARY

- A. Work Included:
 - 1. Materials, installation and testing of pipe, tubing and fittings, and valves.
 - 2. Refer to Specification Sections for each system medium (i.e., plumbing, hydronics, and the like) for pipe application.
 - 3. Mechanical identification materials.
 - 4. Seismic/vibration isolation.

4.2 QUALITY ASSURANCE

- A. Manufacturer's Inspection: Inspect flanges, fittings and field applied welds in accordance with manufacturer's standard written quality control procedure in accordance with the following techniques: Visual Method: Comply with MSS SP-55 except as otherwise indicated.
- B. Welding Qualification: Qualify welding procedures, welders and operators in accordance with ANSI B31.9 for shop and project site welding of piping work.

4.3 SUBMITTALS

- A. Piping Materials List: Provide typewritten list which schedules the piping materials to be used for each system as a function of applicable nominal pipe size ranges. Arrange schedule in outline form for each specific piping system, e.g., "Chilled Water System," "Soil, Waste, and Vent Piping System," and the like. Include ASTM, ANSI or other numbers and other data as necessary to demonstrate compliance with requirements.
- B. Test Procedure: Submit a typewritten checklist type of testing procedure indicating testing medium (i.e., water, air, nitrogen, and the like), pipe service, pipe and fitting type and classification, test pressure, pass/fail criteria and any other pertinent data.
- C. Maintenance Data: Submit maintenance data and parts list for each type valve. Include this data, product data, and certifications in maintenance manual.
- D. Welders Certification: Submit certificates verifying welders are qualified in welding procedures required for this project.

PART 5 - PRODUCTS

5.1 PRODUCT STANDARDS

- A. References to product Specifications for materials are listed according to accepted base standards. Materials to meet latest approved versions of these standards.

- B. See Section 23 00 00, Basic Mechanical Requirements where piping materials are approved for use.
- 5.2 PIPING (SEE SECTION 23 21 00)
- A. Steel Pipe: ASTM A53, Black Welded or Seamless, Grade B: Schedule as specified.
 - B. Copper Tube: Temper: Annealed (hard drawn).
- 5.3 FITTINGS FOR STEEL PIPE (SEE SECTION 23 21 00)
- A. General: Flanges, fittings, unions and other products, mark in accordance with MSS SP-25.
 - B. Welding Fittings: Wrought carbon steel fittings, ASTM A234, ANSI B16.9, B16.28. Butt-welding type unless otherwise indicated to be socket welding type.
 - C. Branch Connections: From mains or headers 2-1/2 inches or larger, welded tees or forged welding outlets.
 - D. Welding Outlets: "Weldolets" or "Threadolets" equivalent to Bonney Forge. Use forged welding outlets wherever branch line is at least 1 nominal pipe size smaller than local main or header.
 - E. Threaded Fittings: Case Iron screwed fittings, 250 PSR rating.
 - F. Flanges: Carbon steel conforming to ASTM A105, ANSI B16.5, and factory forged in the USA. Flanges which have been machined, remade, painted, or are nondomestic origin are not acceptable. Provide raised or full face ends wherever indicated or required. Pressure rating shall be 250 psi.
 - G. Unions: ANSI B16.39, ASTM A47, and be fabricated from malleable iron with bronze-to-iron ground joints rated at 150 percent design operating pressure. Threads: ANSI B2.1.
 - H. Fasteners: Semi-finished carbon steel bolts and hex nuts conforming to ASTM A307. Threads and Dimensions: ANSI B1.1 and B18.2.
 - I. Threaded Pipe Plugs: ANSI B16.14.
 - J. Thread Lubricant: RectorSeal No. 5 or Slic-tite Teflon Paste.
- 5.4 FITTINGS FOR COPPER TUBE
- A. Wrought copper/bronze solder joint fittings complying with ANSI B16.22.
- 5.5 VALVES
- A. General:
 1. Sizes: Unless otherwise indicated, provide valves of same size as upstream pipe size.
 2. Operators: Provide hand wheels, fastened to valve stem, for valves other than quarter-turn. Provide lever handle for quarter-turn valves 6 inches and smaller, and 4 inches and smaller for plug valves. Provide gear operators for quarter-turn valves

8 inches and larger. Provide chain-operated sheaves and chains for overhead valves.

3. End Connections: Mate with pipe, tube and equipment connections. Where more than one type is indicated, selection is installer's option.

B. Service:

1. Drain Service; All Pipe Sizes: [Drain valves.
2. Check Valves: Swing check valve.

C. Manufacturers: Crane, Fairbanks, Anvil, Jenkins, Kennedy, Walworth, Red/White (commercial grade), Mueller, Legend, Conbraco, Nibco, DeZurik, Hays, Powell, Stockham, Hammond, Watts, Milwaukee or approved. Note:

D. GATE VALVES

1. 2 Inches and Smaller: Class 125, bronze, screw-in bonnet, solid wedge. Rising Stem: Nibco 111. Nonrising Stem: Nibco 113.
2. 2-1/2 Inches and Larger: Flanged ends, Class 125, iron body, bolted bonnet, solid wedge, bronze mounted. OS&Y: Nibco 617-0. Nonrising Stem: Nibco F-619.
3. Valves to be Class 250 for installation in the high pressure side of pressure regulating stations.

E. DRAIN VALVES

1. Class 125, bronze body, screw-in bonnet, rising stem, composition disc, 3/4-inch hose outlet. Threaded: Nibco 73. Solder: Nibco 72.
 - a. 2 Inches and Smaller: Nibco 134 (rising stem) or Nibco 136 (non-rising stem).
 - b. Over 2 Inches: Nibco F-667 (OS&Y) or Nibco F-669 (non-rising stem).

F. BALANCING VALVES

1. Bronze with a machined orifice flow restriction, multi-turn globe type valve, internal O-rings, rated working pressure of at least 240 PSIG (175 PSI iron construction, 2-1/2 inches and larger), flow setting indicating pointer and calibrated nameplate, memory stops, and pressure readout port with integral check valve on each side of the orifice. Armstrong, Nibco, Wheatley, Tour & Anderson, or Illinois.
2. Combination check valve/balancing valve not allowed, 1/4 turn plug type allowed on 8 inches and larger pipe only.

G. BALL VALVES

1. 2-1/2 Inches and Smaller: 150 PSI, bronze body, full port, bronze trim, two-piece construction, TFE seats and seals. Threaded: Nibco T-595-Y. Soldered: Nibco S-595-Y.

2. 3 Inches and Larger: 150 PSI, cast-iron body, full port, two-piece body, TFE seats with stainless steel ball. FDA rated for potable water. Flanged Connection: Watts G4000.

H. BUTTERFLY VALVES

1. Select lug type valves, rated for 300°F.
2. 6 Inches and Smaller: 200 PSI, ductile iron body, extended neck, aluminum bronze disc, reinforced resilient EDPM seat, manual lever and lock. Nibco LD2000 for mechanical coupling fittings.
3. 8 Inches and Larger: 200 PSI, ductile iron body, extended neck, aluminum bronze disc, reinforced resilient EDPM seat, gear operator. Nibco DL2000-5 for mechanical coupling fittings.
4. Do not use for steam.

I. SWING CHECK VALVES

1. 2 Inches and Smaller: Class 125, bronze body, horizontal swing, regrinding type, Y-pattern, renewable disc. Nibco 413.
2. 2-1/2 Inches and Larger: Class 125, iron body, bolted bonnet, horizontal swing, renewable seat and disc, flanged ends. Nibco F918.

5.6 PIPING HANGERS AND SUPPORTS

A. General:

1. Horizontal Piping Hangers and Supports-Horizontal and Vertical Piping, and Hanger Rod Attachments: Factory fabricated horizontal piping hangers and supports complying with MSS SP-58, to suit piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for uninsulated copper piping systems
2. Building Attachments: Factory fabricated attachments complying with MSS SP-58, selected to suit building substructure conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods.
3. Saddles and Shields: Factory fabricated saddles or shields under piping hangers and supports for insulated piping. Size saddles and shields for exact fit to mate with pipe insulation. 1/2 round, 18 gauge, minimum 12 inches in length (4-inch pipe and larger to be three times longer than pipe diameter).
4. Roller Hangers: Adjustable roller hanger. Black steel yoke, cast iron roller.
5. Concrete Inserts: Malleable iron body, black finish. Lateral adjustment.
6. Continuous Concrete Insert: Steel construction, minimum 12 gauge. Electrogalvanized finish. Pipe clamps and insert nuts to match.

- B. Hangers For Pipes 2 Inches and Smaller: Adjustable swivel ring hanger, UL listed. Michigan 100 or 101.
- C. Hangers For Pipes 2-1/2 Inches and Larger: Adjustable clevis type, UL listed. Michigan 400.
- D. Riser Clamps: Steel, UL listed. Michigan 510 or 511. Copper coated; Michigan 368.
- E. Plumbers Tape: Not permitted as pipe hangers or pipe straps.
- F. Michigan numbers are indicated for type and quality. Comparable products manufactured by Globe, Elcen, B-Line, Kindorf, Kinline, Unistrut, Anvil, Super Strut, Tolco, PHD, Power-Strut, or approved.

5.7 WALL AND FLOOR SLEEVES

- A. Minimum 20 gauge galvanized steel in concrete, 18 gauge in other construction. 1/2-inch clearance around pipe or insulation. Provide UL approved fire-rated assemblies/caulking as required. 3M or approved.

5.8 ANCHORS

- A. General: Anchor supports to existing masonry, block and tile walls per anchoring system manufacturer's recommendations or as modified by project structural engineer.
- B. Manufacturers: Anchor-It, Hilti Hit System, Epcor System, or Power Fast System.

5.9 ELECTRIC MOTORS

- A. Motors: Energy efficient, suitable for non-overloading operation, and capable of continuous operation at full nameplate rating. Motors 1 HP and larger must meet Energy Policy act of 1992. Motors to be high efficient type similar to Century/Gould E-plus.
- B. Take NEMA standards as minimum requirements for motor design and performance. Motors suitable for load, duty, voltage, frequency, hazard and for service and location intended. Motors, unless specified otherwise, to be general purpose open drip-proof type, ball bearing equipped, 40C temperature rise; and rated for continuous duty under full load. Motors to have name plate giving manufacturer's name, shop number, HP, RPM and current characteristics.
- C. Motors smaller than 1/2 horsepower, 1 phase; and motors 1/2 horsepower and larger, 3 phase and voltage as indicated on Drawings. Maximum motor speed of 1750 RPM, unless otherwise noted. One phase motors to have internal thermal overload protection with automatic reset.

5.10 STARTERS

- A. Three phase motors up to and including 15 HP:
 1. Provide enclosed type magnetic across-the-line starter with thermal overload and under voltage protection.
 2. Operator: "Start-Stop" pushbutton, except where automatic control is indicated on Drawings or specified. Then provide "Hand-Off-Auto" selector switch.

3. Starters for 3 phase motors to have overload protection in each of the three legs, with external manual reset.
4. Unless indicated on Drawings or in Specifications, furnish motor starters with a neon pilot light. Neon lights are required for exhaust fan switches.
5. Equip starters with integral transformer and coil for control circuit. Coordinate coil voltage with control voltage.

5.11 DISCONNECTS

- A. Provided by Division 26 unless otherwise specified.

5.12 MECHANICAL IDENTIFICATION MATERIALS

- A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 23 sections. Where more than a single type is specified for application, provide single selection for each product category.
- B. Manufacturers: Allen Systems, Inc., W. H. Brady Co., Signmark Division, Industrial Safety Supply Co., Inc., Seton Name Plate Corporation, or approved.

C. PLASTIC PIPE MARKERS

1. Provide one of the following:
 - a. Snap-on Type: Manufacturer's standard preprinted, semi-rigid snap-on, color-coded pipe markers.
 - b. Pressure-Sensitive Type: Manufacturer's standard preprinted, permanent adhesive, color-coded, pressure sensitive, vinyl pipe markers.
2. Small Pipes: For external diameters less than 6 inches (including insulation, if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
 - a. Snap-on application of pretensioned semi-rigid plastic pipe marker.
 - b. Adhesive lap joint in pipe marker overlap.
 - c. Laminated or bonded application of pipe marker to pipe (or insulation).
 - d. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4 inch wide; full circle at both ends of pipe marker, tape lapped 1-1/2 inches.
3. Large Pipes: For external diameters of 6 inches and larger (including insulation, if any), provide either full-band or strip-type pipe markers, but not narrower than three times letter height (and of required length), fastened by one of the following methods:
 - a. Laminated or bonded application of pipe marker to pipe (or insulation).

- b. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2 inches wide; full circle at both ends of pipe marker, tape lapped 3 inches.
 - c. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.
 - 4. Lettering: Comply with piping system nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application length.
 - 5. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.
- D. VALVE TAGS
 - 1. Brass Valve Tags: Polished brass valve tags with stamp-engraved piping system abbreviation in 1/4-inch high letters and sequenced valve numbers 1/2 inch high, and with hole for fastener. 1-1/2-inch diameter tags, except as otherwise indicated. Valve designations to be coordinated with *existing* valve identifications to ensure no repetitive designations are utilized.
 - 2. Valve Tag Fasteners: Solid brass chain (wire link or beaded type), or solid brass S-hooks.
 - 3. Access Panel Markers: Manufacturer's standard 1/16-inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include center hole to allow attachment.
- E. VALVE SCHEDULE FRAMES
 - 1. General: For each page of a valve schedule, provide glazed display frame with removable mounting as appropriate for wall construction upon which frame is to be mounted. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.
- F. ENGRAVED PLASTIC-LAMINATE SIGNS
 - 1. General: Engraving stock melamine plastic laminate, Federal Specification L-P-387, in the size and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color), punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
 - 2. Thickness: 1/16 inch for units up to 20 sq.in. or 8 inches in length; 1/8 inch for larger units.
 - 3. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
- G. PLASTIC EQUIPMENT MARKERS
 - 1. General: Manufacturer's standard laminated plastic, color-coded equipment markers. Conform to the following color code:

- a. Green: Cooling equipment and components.
 - b. Yellow: Heating equipment and components.
2. Nomenclature: Match terminology used on drawing schedules as closely as possible.
 3. Size: Provide approximate 2-1/2- by 4-inch markers for control devices, dampers, and valves; and 4-1/2- by 6-inch markers for equipment.

H. LETTERING AND GRAPHICS

1. General: Coordinate names, abbreviations and other designations used in mechanical identification work with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.
2. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples: Chiller No. 3, Air Handling Unit No. 42, Standpipe F12, and the like).

5.13 SEISMIC RESTRAINTS FOR PIPING

- A. Use the document "Seismic Restraints Manual Guidelines for Mechanical Systems." Secure piping, ductwork, and the like to withstand a force in any direction.
- B. Sway bracing is not required for pipes that are installed on very short hangers (12 inches or less).
- C. Secure HVAC and plumbing piping bracing at every fourth hanger transversely and every eighth hanger longitudinally.
- D. Design restraints to meet CBC standards. Provide structural engineering calculations sealed by a professional engineer registered in state of California.

5.14 EQUIPMENT

- A. General:
 1. Provide a means to prohibit excessive motion of mechanical equipment during an earthquake.
 2. Provide mechanical equipment, both hanging and base mounted, with mounting connection points of sufficient strength to resist lateral seismic forces equal to 0.5 of equipment operating weight.
 3. Design restraints to meet CBC standards. Provide structural engineering calculations sealed by a professional engineer registered in state of California.
- B. NEOPRENE PAD
 1. One layer of 5/16-inch thick ribbed or waffled neoprene, 40 to 50 durometer. Size pads for loading between 40 and 50 PSI.

2. NP Isolators: Amber/Booth type NR.
3. Manufacturers: Supply vibration isolation mounts by a single manufacturer. Acceptable suppliers are as follows: Amber/Booth Co. - A.B., Korfund Dynamics - K.D., Mason Industries, Inc. - M.I., Peabody Noise Control Inc. - P.N.C., Vibration Mountings & Controls, Inc. - V.M.&C., IAC, Koppers, Vibrex.

5.15 FLEXIBLE PIPE CONNECTIONS

- A. Braided stainless steel over corrugated hose.
- B. Select and fit to suit the system temperature, pressure and fluid type.
- C. Pipe Sizes 2 Inches or Smaller: Threaded male on each end. Larger sizes: Steel flange couplings.
- D. FPC: Metroflex.
- E. Connections to match piping system.

PART 6 - EXECUTION

6.1 INSTALLATION

- A. General Electrical Equipment Clearances: Do not route piping through electrical rooms, transformer vaults, elevator equipment rooms, and other electrical or electronic equipment spaces and enclosures. Within equipment rooms, provide minimum 3-foot lateral clearance from sides of electric switchgear panels. Do not route piping above any electric power or lighting panel, switchgear, or similar electric device. Coordinate with electrical and coordinate exact pipe routing to provide proper clearance with such items.
- B. Pressure Piping Routing:
 1. Route piping, except as otherwise indicated, vertically and horizontally (sloped to drain). Avoid diagonal runs wherever possible. Orient horizontal routes parallel with walls and beam lines.
 2. Install piping as shown or described by diagrams, details and notations on Drawings or, if not indicated, install piping to provide the shortest route which does not obstruct usable space or block access for servicing the building and its equipment.
 3. Support piping adjacent to walls, overhead construction, columns and other structural and permanent enclosure elements of the building. Limit clearance to 1/2 inch wherever furring is indicated for concealment of piping. Allow for insulation thickness, if any. Locate insulated piping to provide minimum 1-inch clearance outside insulation.
 4. Wherever possible in finished and occupied spaces, conceal piping from view by locating within column or beam enclosures, hollow wall construction, or above suspended ceilings. Do not encase horizontal routes in solid partitions, except where approved.
- C. Preparation:

1. Unions:
 - a. Insulating Unions: Schedule 40 red brass nipples minimum length six times pipe diameter, minimum 6" long, 2" and smaller threaded, 2½" and larger flanged.
 - b. Standard Unions: Install where indicated on Drawings and on each side of pieces of equipment to permit easy removal of equipment.
2. Copper Tubing:
 - a. Remove burrs from and clean outer surface of tube ends and inner surface of fittings.
 - b. Copper-Soldered: Make soldered joints for copper tubing and fittings with code approved solder alloys meeting ASTM and ANSI standards and listings. Solder-paste-flux combination fillers are not approved. Installations to conform to accepted published procedures; i.e., UPC IS 375, IS 21-80 standards and CDA Publications. Use of steel wool for cleaning tube and fittings is prohibited. Apply flux as recommended by manufacturer. Solder domestic hot and cold water and condensate pipe within building above grade with 95 percent tin and 5 percent antimony, Allstate Silver Bearing Solder 430 or other approved solder alloys which do not contain lead or cadmium.
 - c. Copper-Brazed: Make brazed joints for copper tubing and fittings with code approved brazing filler alloys meeting ASTM and AWS standards and listings. Filler alloys of BCuP2 classification (e.g., "Phos-0" or "Fos-Copper") may not be used to make joints between copper tubing and cast brass or bronze fittings. Filler alloys containing cadmium are not approved for use in potable water piping. Installations to conform to accepted published procedures, i.e., UPC IS 3-75 standards and CDA Publications. Use of steel wool for cleaning tube and fittings is prohibited. Braze other copper pressure piping underground including water service. Remove bonnets and nonmetallic seats on valves and cool body with damp cloth while soldering or brazing. Remove excess flux from completed joints in accordance with manufacturer's instructions and code standards.
 - d. Pressurized Service:
 - 1) Unless otherwise indicated, wrought copper/bronze solder joint fittings complying with ANSI B16.22-1995.
 - 2) Copper Tube Unions: Standard products as recommended by manufacturer for use in the service. Rated at 150 percent design operating pressure.

6.2 PIPE AND PIPE FITTINGS

A. Pipe Sleeves:

1. Lay out work in advance of pouring concrete and furnish and set sleeves necessary to complete work.

2. Floor Sleeves (Except DWV Piping at Slab on Grade): Provide sleeves on pipes passing through concrete or masonry construction. Extend sleeve 1 inch above finished floor. Caulk pipes passing through floor with nonshrinking grout or approved caulking compound. Provide "Link-Seal" sleeve sealing system for slab on grade. Caulk/seal piping and ductwork passing through fire rated building assembly with UL rated assemblies. Provide fire-rated assemblies per local AHJ requirements.
 3. Wall Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Provide sleeve flush with finished face of wall. Caulk pipes passing through walls with nonshrinking caulking compound. Caulk/seal piping and ducts passing through fire-rated building assemblies with UL approved fire-rated assemblies. Provide fire-rated assemblies per local AHJ requirements.
 4. Beam Sleeves: Coordinate with trades for locations of pipe sleeves in reinforced concrete and steel beams. Penetrations must be indicated on structural shop drawings. See Drawings and Specifications for specific sleeve location limitations. Plumbing Drawings are diagrammatic. Offset piping as required to meet these limitations. Pipe sleeve locations must be indicated on reinforced concrete and steel beam shop drawings. Field cutting of beams not allowed without written approval of structural engineer. No extra costs allowed for failure to coordinate beam penetrations prior to reinforced concrete and steel beam shop drawing submittal.
- B. Conform with applicable codes and industry standards.
- C. Install uninsulated piping so that unrestrained direct contact with the structure or other system installations is avoided. Where contact with or passage through building or structural features cannot be avoided; firmly anchor piping to, or isolated from, the structure to prevent noise transmission and occurrence of physical damage. Install piping to be insulated with adequate clearance around piping to allow for placement of full thickness insulating material.
- D. Corrosion Control: Install hot water heating vessels with a stainless steel fitting at tank and a dielectric nipple on both supply and discharge sides of hot water tanks.
- E. Installation/Coordination:
1. Expansion and Flexibility: Install work with due regard for expansion, contraction, and building settlement to prevent damage to the piping, ductwork, equipment and the building and its contents. Provide piping offsets, loops, expansion joints, anchors or other means to control pipe movement, to minimize pipe forces and effects of building settlement.
 2. Install piping to prevent stresses and strains to piping and hangers and supports due to expansion or contraction and building settlement. Provide proper loops, guides, offsets, anchor points, or expansion joints. Verify with anticipated settlement or shrinkage of building. Verify construction phasing of project, type of building construction products and type for coordinating installation of piping systems. Include provisions for servicing and removal of equipment without dismantling piping.

6.3 ESCUTCHEONS

- A. Install on exposed pipes passing through walls or floors, and on fixture stops and waste connections to wall, except not required in stockrooms.

6.4 PIPING AND EQUIPMENT REMOVAL

- A. Piping and equipment removed as salvage by Owner to remain property of the Owner.
- B. Remove as shown on drawings. Piping and ductwork to be reused where shown. Dispose and remove excess piping, ductwork and equipment (and not identified by Owner as salvage).

6.5 ACCESSIBILITY

- A. Installation of valves, gauges and equipment conveniently and accessibly located with reference to finished building for repairs, removal and service.

6.6 PAINTING

- A. Ferrous Metal: After completion of mechanical work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces in mechanical rooms, i.e., hangers, hanger rods, equipment stands, and the like, with one coat of black asphalt varnish or black enamel suitable for hot surfaces.
- B. Machinery:
 - 1. In a mechanical room, on the roof or other exposed areas, machinery and equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
 - 2. See individual equipment specifications for other painting.
- C. Structural Steel: Repair damage to structural steel finishes or the finishes of other materials damaged by cutting, welding or patching to match original.
- D. Piping: Clean, primer coat, and paint exposed piping on the roof or at other exterior locations with two coats of paint suitable for metallic surfaces and exterior exposures. Color selected by Architect.

6.7 ACCESS PANELS

- A. Install ceiling or wall access panels to provide access to concealed valves, fans, motors, shock arrestors, fire dampers, terminal units, coils and other mechanical items needing service. Provide access panels at locations required or as specified herein. Coordinate locations/sizes of access panels with Architect prior to work.
- B. Where access panels are for service of fire, fire/smoke, or smoke dampers, stencil the words "Fire Damper," "Fire/Smoke Damper," or "Smoke Damper" in 1/2-inch high capital letters on the outside of the panels.

6.8 FIRESTOPPING PENETRATIONS IN FIRE-RATED WALL/FLOOR ASSEMBLIES

- A. Provide proper sizing when providing sleeves or core-drilled holes to accommodate the penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet the requirements of ASTM E814.
- B. Manufacturers: Hilti, Proset, or approved.
- C. UL Listed penetrations must be submitted and approved by campus Fire Marshal prior to installation.

6.9 FIELD QUALITY CONTROL

- A. Upon completion of installation of equipment and plumbing fixtures and after units are water pressurized, test fixtures to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.
- B. Inspect each installed unit for damage to finish. If feasible, restore and match finish to original at site; otherwise, remove fixture and replace with new unit. Feasibility and match to be judged by Architect. Remove cracked or dented units and replace with new units.

6.10 VALVE INSTALLATION

- A. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary.
- B. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward from horizontal plane. Install valve drains with hose-end adapter for each valve that must be installed with stem below horizontal plane.
- C. Insulation: Where insulation is indicated, install extended-stem valves, arranged in proper manner to receive insulation.
- D. Mechanical Actuators: Install with chain operators where indicated. Extend chains to 5 feet above floor and hook to clips to clear aisle passage.
- E. Stem Selection: Outside screw and yoke stems, except provide inside screw, nonrising stem where space prevents full opening of OS&Y valves.
- F. Seats: Renewable seats, except where otherwise indicated.

6.11 VALVE ADJUSTING AND CLEANING

- A. Inspect valves for leaks. Adjust or replace packing to stop leaks. Replace valve if leak persists.

6.12 VALVE IDENTIFICATION

- A. General: Provide valve tag on every valve, cock and control device in each piping system. Exclude check valves, valves within factory fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibbs, shutoff valves at plumbing fixtures, and similar rough-in connections of end-use fixtures. List each tagged valve in valve schedule for each piping system.

- B. Install mounted valve schedule in each mechanical room.

6.13 MECHANICAL EQUIPMENT IDENTIFICATION

- A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices: terminal units, coils, fans, water heaters, blowers, unitary HVAC equipment, similar equipment.

6.14 PIPING SYSTEM IDENTIFICATION

- A. Install pipe markers on each system and include arrows to show normal direction of flow.
- B. Locate pipe markers and color bands wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels and plenums), and exterior nonconcealed locations, in locations as follows:
 1. Near each valve and control device.
 2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
 3. Near locations where pipes pass through walls or floors/ceilings, or enter nonaccessible enclosures.
 4. At access doors, manholes and similar access points which permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced intermediately at maximum spacing of 50 feet along each piping run, except reduce spacing to 25 feet in congested areas of piping and equipment, i.e., mechanical rooms.

6.15 ADJUSTING AND CLEANING

- A. Adjusting: Relocate any mechanical identification device which has become visually blocked.
- B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

6.16 CONNECTIONS TO EXISTING

- A. Prior to connection of piping and ductwork to existing as illustrated on Mechanical Drawings, field verify existing conditions and exact sizes and locations of existing piping and ductwork. Provide additional offsets, transitions, joints, cut-ins, and replace portions of existing as required to facilitate connections of new as shown on Documents.

6.17 CAULKING

- A. Provide Geocel Corporation, (800) 348-7615, Construction 2000 Caulking Sealant. Standard color to match as close as possible to surrounding surface. Application standards, ASTM C920, Type S, Grade NS, Class 25, ICBO approved, Report No. 3680. Apply per manufacturer's recommendations.

6.18 STARTERS

- A. Install in sight of equipment controlled, easily accessible, protected from possible piping leaks and no more than 6 feet above the floor.

END OF SECTION

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included: Materials, installation and testing of motors and starters.
- B. Refer to Specification sections for each system medium (i.e., hydronics, gas, and the like), for motor/starter application.

1.2 QUALITY ASSURANCE

- A. Motor Manufacturers:
 - 1. General Electric, Westinghouse, U.S. Motors, Wagner, Century/Gould, Louis-Allis, Reliance, Marathon, or approved.
 - 2. Standards: ANSI/IEEE 112 and NEMA MG-1.
- B. Starter Manufacturers:
 - 1. Allen Bradley, Square D, General Electric, Siemens, Furnas, Eaton Electrical, Cerus, or approved.
 - 2. Manufacturer is certified ISO 9002 facility 3, UL listed.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data, motor efficiency, installation instructions, and dimensioned drawings for each type of motor or starter.
- B. Maintenance Data: Submit maintenance data and parts list for each type. Include this data, product data, and certifications in maintenance manual.

PART 2 - PRODUCTS

2.1 ELECTRIC MOTORS

- A. Motors: Energy efficient, suitable for nonoverloading operation, and capable of continuous operation at full nameplate rating. Motors 1 HP and larger must meet Energy Policy act of 1992. Motors to be high efficient type similar to Century/Gould E-plus.
- B. Take NEMA standards as minimum requirements for motor design and performance. Motors suitable for load, duty, voltage, frequency, hazard and for service and location intended. Motors, unless specified otherwise, to be general-purpose open dripproof type, ball bearing equipped, 40C temperature rise; and rated for continuous duty under full load. Motors to have nameplate giving manufacturer's name, shop number, HP, RPM and current characteristics.
 - 1. Wet Application:
 - a. Motors located in exterior locations or wet air streams are to be of totally enclosed type.
 - b. Motors located wet/wash-down locations: Totally enclosed weatherproof epoxy-sealed type.
- C. Motors smaller than 1/2 horsepower, 1 phase; and motors 1/2 horsepower and larger, 3 phase and voltage as indicated on Drawings. Maximum motor speed of 1750 RPM, unless otherwise noted. One phase motors to have internal thermal overload protection with automatic reset.

- D. Motors for belt drive to have adjustable bases with setscrew to maintain belt tension. Motor horsepowers indicated on the Equipment Schedule on Drawings are the minimum size acceptable.
- E. Provide two-speed motors where indicated on schedule or in sequence.
- F. Provide inverter rated motors per NEMA MG1-31 where variable frequency drives are applied or soft start starters.

2.2 STARTERS

- A. Single Phase Motors:
 - 1. Manual across-the-line starting switch having toggle-operated switch pilot running light and built-in thermal overload device with heating element rated not more than 115 percent motor full load current indicated on name plate of motor to be protected. Surface mount starters. Provide NEMA-1 enclosure.
 - 2. Overload relays to be melting alloy type with a replaceable control circuit module. Thermal units to be interchangeable. Starter to be nonoperative if thermal unit is removed.
 - 3. Single phase motors with automatic controls. Provide motor rated relay with coils rated for control voltage.
- B. Starters up to size 8 to be suitable for the addition of a minimum of three external auxiliary contacts (normally open or normally closed). Contactor, coils, and relays to perform the control functions of the associated equipment and control sequence.
- C. Three phase motors up to and including 15 HP:
 - 1. Provide enclosed type magnetic across-the-line starter with thermal overload and under voltage protection.
 - 2. Operator: "Start-Stop" pushbutton, except where automatic control is indicated on Drawings or specified. Then provide "Hand-Off-Auto" selector switch.
 - 3. Starters for 3 phase motors to have overload protection in each of the three legs, with external manual reset.
 - 4. Unless indicated on Drawings or in Specifications, furnish motor starters with a neon pilot light. Neon lights are required for exhaust fan switches.
 - 5. Equip starters with integral transformer and coil for control circuit. Coordinate coil voltage with control voltage.
- D. Motor starters for equipment not installed in Division 26, Section 26 24 19 "Motor Control" to be furnished and installed by Division 23.
- E. Shaft Grounding:
 - 1. Provide shaft grounding assembly on motors controlled by variable frequency drive. Shaft grounding device to be in the form of brush that resides on the motor shaft. Brush assembly capable of tolerating misalignment and maintaining rotating contact throughout the motor's life.
 - 2. Material: Material used in the grounding assembly stable material commonly used within industry that is not believed to constitute a hazardous material under Office of Safety and Health Act (OSHA regulations).
 - 3. Brushes: Specifically developed carbon compounds of sustained performance with sear life expectancy of 3 years minimum.

4. Seals: Sealed type to keep contaminants from entering the shaft grounding system in wet or severe environment applications.
5. Shaft Grounding Assembly: For clean room air handling systems, use the type that contains the wear products within a special enclosure within the shaft grounding system.
6. Shaft grounding assembly installation not to affect the motor manufacturer warranty. Where the severe environment conditions require application of the shaft grounding types that are screwed into the motor shaft, the installation of the shaft grounding system performed either by the motor manufacturer or by the motor manufacturer authorized facility.
7. Manufacturer: Shaft Grounding Inc. Aegis, or approved.
8. Bond the brush to the closest ground point using code sized green insulated stranded copper conductor per manufacturer instructions.
9. Test and verify the performance of the assembly to ensure that under no conditions the shaft exceeds 3 volts.

2.3 DISCONNECTS

- A. Provided by Division 26 unless otherwise specified.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install a soft start per the manufacturer's specifications with a minimum clearance of 4 inches on each side of the enclosure.
- B. Include a standard wiring diagram for making the appropriate electrical connections.

3.2 START UP

- A. For soft starters provide the services of a qualified technician to program, test, and start up soft starts furnished under this Specification.

3.3 ELECTRICAL INTERLOCKS

- A. Where equipment motors are to be electrically interlocked with other equipment for simultaneous operation, utilize mechanical equipment wiring diagrams to coordinate with the electrical systems so that proper wiring of the equipment involved is affected.

END OF SECTION

SECTION 23 05 25

SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included: Material and installation of supports, anchors and sleeves including: horizontal piping hangers and supports; vertical piping clamps; hanger rod attachments; building attachments; saddles and shields; miscellaneous materials; anchors; equipment supports; wall and floor sleeves; and escutcheon plates.

1.2 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in the manufacture of supports and anchors, of types and sizes required.
- B. Regulatory Requirements:
 - 1. Provide pipe hangers and supports whose materials, design and manufacture comply with MSS SP-58, "Pipe Hangers and Supports - Materials, Design and Manufacture," latest edition.
 - 2. Select and apply pipe hangers and supports complying with MSS SP-69, Pipe Hangers and Supports - Selection and Application, latest edition.
 - 3. A copy of the above-referenced standards at the construction site.
- C. Seismic: Provide per 23 05 48, Vibration and Seismic Control.
- D. Manufacturers: B-Line, Superstrut, Unistrut, Power-Strut, or approved equal.

1.3 SUBMITTALS

- A. Submit the following:
 - 1. Manufacturer's technical product data, including installation instructions, for each type of support, anchor and sleeve. Include UL approval drawing from manufacturer for each different pre-engineered firestop assembly.
 - 2. Assembly type shop drawings for each type of sleeve, indicating dimensions, weights, required clearances, and methods of assembly of components.

PART 2 - PRODUCTS

2.1 PIPING HANGERS AND SUPPORTS

- A. General:
 - 1. Horizontal Piping Hangers and Supports-Horizontal and Vertical Piping, and Hanger Rod Attachments: Factory fabricated horizontal piping hangers and supports complying with MSS SP-58, to suit piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to

exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for uninsulated copper piping systems.

2. Building Attachments: Factory fabricated attachments complying with MSS SP-58, selected to suit building substructure conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods.
 3. Saddles and Shields: Factory fabricated saddles or shields under piping hangers and supports for insulated piping. Size saddles and shields for exact fit to mate with pipe insulation. 1/2 round, 18 gauge, minimum 12 inches in length (4-inch pipe and larger to be three times longer than pipe diameter).
 4. Roller Hangers: Adjustable roller hanger. Black steel yoke, cast iron roller.
 5. Concrete Inserts: Malleable iron body, black finish. Lateral adjustment.
- B. Pipe Hangers Size 2 Inches and Smaller: Adjustable swivel ring hanger, UL listed. Michigan 100 or 101.
- C. Pipe Hangers Size 2-1/2 Inches and Larger: Adjustable clevis type, UL listed. Michigan 400.
- D. Plumbers Tape: Not permitted as pipe hangers or pipe straps.
- E. Michigan numbers are indicated for type and quality. Comparable products manufactured by Anvil, Tolco, Elcen, B-Line, Kindorf, Kinline, Unistrut, Super Strut, Power-Strut, or approved equal.

2.2 WALL AND FLOOR SLEEVES

- A. General:
1. Pre-Engineered Firestop Pipe Penetration Systems: UL listed assemblies for maintaining fire rating of piping penetrations through fire-rated assemblies. Comply with ASTM E814.
 2. Insulating Caulking: Eagle, Pitcher Super 66 high temperature cement, or approved.
 3. Fabricated Accessories:
 - a. Steel Pipe Sleeves: Fabricate from Schedule 40 black or galvanized steel pipe. Remove end burrs by grinding.
 - b. Sheet Metal Pipe Sleeves: Fabricate from G-90 galvanized sheets closed with lock-seam joints. Provide the following minimum gauges for the sizes indicated:
 - 1) Sleeve Size 4 Inches in Diameter and Smaller: 18 gauge.
 - 2) Sleeve Sizes 5 to 6 Inches: 16 gauge.
 - 3) Sleeve Sizes 7 Inches and Larger: 14 gauge.

- c. Fire-Rated Safing Material: Rockwool Insulation: Complying with FS-HH-I-558, Form A, Class IV, 6 lbs./cu.ft. density with melting point of 1985F and K value of 0.24 at 75F.

2.3 ANCHORS

- A. General: Anchor supports to existing masonry, block and tile walls per anchoring system manufacturer's recommendations or as modified by project structural engineer.
- B. Manufacturers: Anchor-It, Hilti Hit System, Epcon System, or Power Fast System.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine the Drawings and coordinate for verification of exact locations of fire and smoke rated walls, partitions, floors and other assemblies. Indicate, by shading and labeling on Record Drawings such locations and label as "1-Hour Wall," "2-Hour Fire/Smoke Barrier," and the like. Determine proper locations for piping penetrations. Set sleeves in place in new floors, walls or roofs prior to concrete pour or grouting.
- B. Install hangers, supports, anchors and sleeves after required building structural work has been completed in areas where the work is to be installed. Coordinate proper placement of inserts, anchors and other building structural attachments. INSTALLATION
- C. Building Attachments: Install within concrete or on structural steel or wood. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert secure to forms. Where concrete with compressive strength less than 2500 PSI is indicated, install reinforcing bars through openings at top in inserts.
- D. Hangers and Supports:
 - 1. Group parallel runs of horizontal piping to be supported together on trapeze-type hangers. Maximum spacings: MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not support piping from other piping.
 - 2. Support fire protection piping independently of other piping.
 - 3. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated.
 - 4. Allow controlled movement of piping systems to permit freedom of movement between pipe anchors and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.
 - 5. Piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
 - 6. Insulated Piping: Provide protection saddles where insulation without vapor barrier is indicated. Provide protection shields on insulated piping where insulation with a vapor barrier is indicated.

7. Hanger Spacing:
 - a. Steel Pipe 1 Inch and Smaller: 6 feet.
 - b. Steel Pipe 1-1/4 Inches and Larger: 10 feet.
 - c. Copper Tubing 1-1/2 Inches and Smaller: 6 feet.
 - d. Copper Tubing 2 Inches and Larger: 10 feet.
 - e. 90 Degree Offsets: Within 2 feet, both sides of offset.

- E. Anchors: Install at ends of principal pipe runs where indicated on Drawings. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

- F. Escutcheon Plates: Install around horizontal and vertical piping at visible penetrations through walls, partitions, floors, or ceilings, including penetrations through closets, through below ceiling corridor walls, and through equipment room walls and floors.

- G. Fabricated Pipe Sleeves:
 1. Provide either steel or sheet metal pipe sleeves accurately centered around pipe routes. Size such that piping and insulation, if any, will have free movement within the sleeve, including allowance for thermal expansion. Sleeves not to be more than 1 pipe size larger than piping or piping plus insulation size.
 2. Length: Equal to thickness of construction penetrated, except extend floor sleeves 1/4 inch above floor finish and, where floor surface drains to a floor drain, extend floor sleeve 3/4 inch above floor finish.
 3. Provide temporary support of sleeves during placement in concrete and other work around sleeves. Provide temporary end closures to prevent concrete and other materials from entering pipe sleeves.
 4. Seal each end airtight with a resilient non-hardening sealer.

- H. Installation of metallic or plastic piping penetrations through non fire-rated walls and partitions and through smoke-rated walls and partitions:
 1. Install fabricated pipe sleeve.
 2. After installation of sleeve and piping, tightly pack entire annular void between piping or piping insulation and sleeve I.D. with specified material.

- I. Piping penetrations through fire-rated (1 to 3 hour) assemblies: Select and install pre-engineered pipe penetration system in accordance with the UL listing and manufacturer's recommendation.

3.2 ADJUSTING AND PAINTING

- A. Adjust hangers so as to distribute loads equally on attachments. Provide grout under supports to bring piping and equipment to proper level and elevations.

- B. Prime paint ferrous nongalvanized hangers, accessories, and supplementary steel which are not factory painted.

3.3 FIRESTOPPING PENETRATIONS IN FIRE-RATED WALL/FLOOR ASSEMBLIES

- A. Provide proper sizing when providing sleeves or core-drilled holes to accommodate the penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet the requirements of ASTM E84.
- B. Manufacturers: Hilti, Proset.

END OF SECTION

SECTION 23 05 48

VIBRATION AND SEISMIC CONTROLS

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included: Materials and installation of seismic restraint devices and related items. Provide complete vibration isolation systems in proper working order.

1.2 CERTIFICATION DATA

- A. Bidders on the chiller unit must supply the appropriate sound power level data, measure in accordance with the applicable ASHRAE or ANSI Specifications at a certified laboratory.

1.3 SEISMIC CONTROL AND RESTRAINT

A. Mechanical Equipment:

1. Brace or anchor mechanical equipment to resist a horizontal force acting in any direction using local building codes, latest edition.
2. Vibration Isolated Equipment: Provide factory fabricated seismic restrained vibration isolating components. Earthquake resistant designs for equipment, i.e., air handling units, blowers, motors, ductwork, and mechanical piping, to conform to the regulations of the local building codes, latest edition. Where standard factory fabricated components are not available, provide properly designed custom components which meet the requirements herein.
3. Provide any restraints noted on Drawings for Division 23 work.

B. Anchorage:

1. Where anchorage details are not shown on Drawings, the field installation subject to approval of the project structural engineer.
2. In other cases, retain a professional structural engineer licensed in the state in which the work will be done to provide shop drawings of seismic bracing for ductwork/equipment/water heaters. Professional engineer to design and provide wet stamped (sealed) shop drawings for equipment, ductwork, water heaters, and piping seismic bracing. Submit shop drawings and calculations along with equipment submittals.
3. The restraints which are used to prevent disruption of the function of the piece of equipment because of the application of the horizontal force to be such that the forces are carried to the frame of the structure in such a way that the frame will not be deflected when the apparatus is attached to a mounting base and equipment pad, or to the structure in the normal way, utilizing the attachments provided. Secure equipment to withstand a force in any direction.

- C. Specify the seismic bracing and anchorage piping in Section 23 05 25, Supports and Anchors.

1.4 ELECTRICAL CONNECTIONS

- A. Make electrical connections to mechanical equipment motors through a flexible conduit designed to reduce motor vibration transfer into the rigid conduit which is directly attached to the building structure.
- B. Flexible Conduit: Sufficiently long to provide a 360 degree loop in the flex between the motor and the rigid conduit. Route conduit through side of equipment roof curb and attaching flexible conduit. Caulk around curb penetration water tight.

- C. Provide a soft neoprene bushing at the connection point between the flex and the rigid conduit to break the metal-to-metal contact.
- D. Ground wires from vibrating equipment to be flexible with sufficient slack to prevent vibration transfer. Ground wires must not directly contact structural membranes (floors, walls or ceilings) of the building.

1.5 QUALITY ASSURANCE

- A. Coordinate the size, location, and special requirements of vibration isolation equipment and systems with building systems. Coordinate plan dimensions of final selections and mechanical equipment with size of housekeeping pads.
- B. Supply and install any incidental materials needed to meet the requirements stated herein.

1.6 SUBMITTALS

- A. Provide a complete description of products to be supplied including product data, dimensions and specifications. Provide installation instructions for each product.
- B. Provide a complete tabulation showing for each piece of vibration isolator supporting equipment the following:
 - 1. The equipment identification mark.
 - 2. The isolator type with rated load.
 - 3. The actual load per isolator.
- C. Provide fabrication/shop drawings of steel rails, inertia bases, steel base frames, reinforcing, vibration isolator mounting attachment method, unitary straps and location of equipment attachment bolts.
- D. Provide structural calculations for isolator seismic restraint for chiller equipment.

PART 2 PRODUCTS

2.1 SEISMIC RESTRAINTS FOR PIPING

- A. Use the document "Seismic Restraints Manual Guidelines for Mechanical Systems." Secure piping, ductwork, and the like to withstand a force in any direction.
- B. Sway bracing is not required for pipes that are installed on very short hangers (12 inches or less).
- C. Secure piping bracing at every fourth hanger transversely and every eighth hanger longitudinally.
- D. As approved by code authority, use a bracing system manufactured by Superstrut, Mason, or Pipe Shields Inc., or approved.
- E. Design restraints to meet local building codes. Provide structural engineering calculations sealed by a professional engineer registered in state of California.

2.2 EQUIPMENT

- A. Provide a means to prohibit excessive motion of mechanical equipment during an earthquake.
- B. Provide equipment, both hanging and base mounted, with mounting connection points of sufficient strength to resist lateral seismic forces equal to 0.5 of equipment operating weight.

- C. Design restraints to meet local building codes. Provide structural engineering calculations sealed by a professional engineer registered in state of California.

2.3 HANGER SPRING AND NEOPRENE OR GLASS FIBER (HSN)

- A. Freestanding, laterally stable steel spring and a neoprene or a glass fiber element in series, contained within a steel housing. Provide a neoprene neck bushing (or other means) where the hanger rod passes through the hanger housing to prevent the rod from contacting the hanger housing. Provide spring diameters and hanger housing lower hole sizes large enough to permit the hanger rod to swing through a 30 degree arc before contacting the housing. Neoprene Element: 0.3 inch minimum static deflection.
- B. HSN Isolators: Amber/Booth type BSRA.
- C. Manufacturers: Supply vibration isolation mounts by a single manufacturer. Acceptable suppliers are as follows: Amber/Booth Co. - A.B., Korfund Dynamics - K.D., Mason Industries, Inc. - M.I., Peabody Noise Control Inc. - P.N.C., Vibration Mountings & Controls, Inc. - V.M.&C., IAC, Koppers, Vibrex.

2.4 NEOPRENE PAD

- A. One layer of 5/16-inch thick ribbed or waffled neoprene, 40 to 50 durometer. Size pads for loading between 40 and 50 PSI.
- B. NP Isolators: Amber/Booth type NR.
- C. Manufacturers: Supply vibration isolation mounts by a single manufacturer. Acceptable suppliers are as follows: Amber/Booth Co. - A.B., Korfund Dynamics - K.D., Mason Industries, Inc. - M.I., Peabody Noise Control Inc. - P.N.C., Vibration Mountings & Controls, Inc. - V.M.&C., IAC, Koppers, Vibrex.

2.5 FLEXIBLE PIPE CONNECTIONS (FPC)

- A. Straight, double sphere shape fabricated of multiple plies of nylon cord, fabric and neoprene, vulcanized so as to become inseparable and homogenous. Able to accept compressive, elongative, transverse and angular movements.
- B. Select and fit to suit the system temperature, pressure and fluid type. Do not use rods or cables to control extension of the connector.
- C. Pipe Sizes 2 Inches or Smaller: Threaded female union couplings on each end. Larger sizes: Metallic flange couplings.
- D. FPC: Mason MFTNC.
- E. Manufacturers: Supply vibration isolation mounts by a single manufacturer. Acceptable suppliers are as follows: Amber/Booth Co. - A.B., Korfund Dynamics - K.D., Mason Industries, Inc. - M.I., Peabody Noise Control Inc. - P.N.C., Vibration Mountings & Controls, Inc. - V.M.&C., Metraflex, Vibrex.
- F. Connections to match piping system.
- G. Three Flexible Grooved Couplings Option: Where grooved systems are used, three Victaulic Style 77 couplings may be used in lieu of double sphere or metallic type flexible pipe connectors. See Victaulic publication "Vibration Attenuation Characteristics of Victaulic Couplings 26.04" for additional details.

PART 3 EXECUTION

3.1 APPLICATION

A. General:

1. Set floor-mounted equipment with steel base rails on 6-inch-high housekeeping type concrete pads, or as detailed. Extend pad 6 inches beyond footprint of equipment in each direction.
2. Install flexible pipe connections (FPC) at pipe connections to vibration isolated equipment. Included, but not be limited to, air handling units, pumps, chillers, and cooling towers.
3. Pipe Hangers in Equipment Rooms: Support water connected to rotating equipment within the equipment rooms on spring and neoprene hangers. The first three hangers from a piece of vibrating equipment to have a minimum of 1/2 the static deflection of that of the equipment isolators. Other isolators should have a minimum of 1/4 the static deflection of that of the equipment.

3.2 VIBRATION ISOLATION EQUIPMENT INSTALLATION

A. General: Install vibration isolation equipment in accordance with the manufacturer's written instructions.

B. Isolation Mounts:

1. Squarely align vibration isolators above or below mounting points of the supported equipment.
2. If a housekeeping pad is provided, install isolators such that they bear on the housekeeping pad and the isolator base plate rests entirely on the pad.
3. Connect hanger rods for vibration isolated support to structure. Provide intermediate members as necessary.
4. Adjust leveling bolts and hanger rod bolts so the isolated equipment is level and in proper alignment with connecting ducts or pipes.

C. Flexible Pipe Connections: Install flexible pipe connections to minimize initial misalignment.

D. Foam Rubber: Provide foam rubber sheets between fan bases and roof mounted equipment curbs and between rooftop mounted HVAC equipment and their curbs.

E. Anchorage: Adequately anchor or brace mechanical equipment and piping to resist displacement due to seismic action, include snubbers on equipment mounted on spring isolators, chiller, pump, cooling tower, and the like.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING AND BALANCING

PART 4 - GENERAL

4.1 SUMMARY

- A. Work Included: Materials, equipment and labor required for testing, adjusting, and balancing work required by this Section, including cooling tower, pumps, specific pipe volumetric flow on hydronic systems, and associated equipment and apparatus. The work consists of setting speed and volume (flow) adjustments, recording data, conducting tests, preparing and submitting reports, and recommending modifications to work as required.

4.2 SCOPE OF WORK

- A. Testing, adjusting, and Balancing (TAB) of the air conditioning systems and related ancillary equipment will be performed by a certified third party independent of the Contractor who specializes in testing, adjusting, and balancing of heating, ventilating, air-moving equipment and hydronic systems and has a minimum of 5 years experience in this specialty.
- B. Make changes or replacements to the sheaves, belts, dampers, valves, etc. required for the correct balance as advised the TAB Firm, at no additional cost to the Owner.
- C. The Drawings and Specifications indicate valves, dampers, and miscellaneous adjustment devices for the purpose of adjustment to obtain optimum operating conditions, and it will be the responsibility of the Contractor to install these devices in a manner that will leave them accessible and readily adjustable. Should the device not be readily accessible, provide access as requested by the TAB Firm. Correct equipment malfunction encountered during the balancing process.
- D. Complete TAB services prior to Owner occupancy.

4.3 QUALIFICATIONS

- A. Perform work of this Section by a firm certified by Associated Air Balance Council (AABC).
- B. Do work of this Section under the direct supervision of a person who has passed written and practical AABC examinations for testing, adjusting, and balancing of air and hydronic systems.

4.4 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. AABC compliance: Comply with AABC's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" as applicable to mechanical air and hydronic distribution systems, and associated equipment and apparatus.
 - 2. Industry Standards: Comply with ASHRAE recommendations pertaining to measurements, instruments, and testing, adjusting and balancing, except as otherwise indicated.
- B. Personnel: TAB personnel used on the project will be employees of the Test and Balance Agency. Perform TAB work under the direct supervision of the AABC Certified Test and Balance Supervisor.
- C. Instrumentation:
 - 1. List in balance report instrument description, serial number, and date of calibration.
 - 2. Use instruments calibrated no longer than 1 year prior to report submission.

4.5 SUBMITTALS

- A. Procedures: Submit certified test reports, signed by TAB supervisor who performed TAB work.
- B. Qualification Statements: Submit company's certification documents including Contractor Certification and Supervisor certification.
- C. Report Forms:
 - 1. Submit copies of report forms to Architect within 30 days of award of the Contract by Owner prior to commencement of testing and balancing work at the site.
 - 2. Provide 8-1/2- by 11-inch paper for loose-leaf binding, with blanks for listing the required test ratings and for certification of report.
 - 3. Submit reports on forms similar in content to standard AABC test forms.
 - 4. Submit final test and balance report. Include Record Drawings with terminal codes for cross-reference with the Submittal, such that terminals referenced in the Submittal are easily located on the Drawings.
 - 5. Include identification and types of instruments used, and their most recent calibration date.
 - 6. Submit resume data on person who is to directly supervise testing, adjusting and balancing work.
- D. Maintenance Data: Include copies of balancing report and identification of instruments in maintenance manuals.
- E. AABC Certificate: At time of submittal of forms, submit AABC certification form for review.

4.6 WARRANTY

- A. TAB Agency provides warranty for a period of 90 days following submission of completed report, during which time, Owner may request a recheck of up to 10 percent of total number of terminals, or resetting of outlet, coil, or device listed in the final TAB report.
- B. Warranty meets the requirements of the following programs:
 - 1. AABC – National Project Performance Guarantee

PART 5 - PRODUCTS

5.1 INSTRUMENTS

- A. Utilize test instruments and equipment as recommended in the following:
 - 1. AABC's Manual MN-1, "AABC National Standards."

PART 6 - EXECUTION

6.1 VERIFICATION OF CONDITIONS

- A. Perform TAB work with doors, closed windows, and ceilings installed, etc., to obtain simulated or project operating conditions. Do not proceed until systems scheduled for testing, adjusting and balancing are clean and free from debris, dirt and discarded building materials.
- B. Verify the following:
 - 1. Equipment is operable and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Hydronic Systems have been flushed, filled, and vented.

4. Correct pump rotation.
 5. Proper strainer baskets are clean and in place.
 6. Service and balance valves are open.
- C. Report defects or deficiencies noted during performance of services to the University Project Manager. Promptly report abnormal conditions in Mechanical Systems or conditions which prevent system balance.
- D. Automatic Temperature Control Systems:
1. Set and adjust automatically operated devices to achieve required sequence of operations. Coordinate with the automatic temperature control supplier. Do not proceed without his representation.
 2. Verify controls for proper calibration and correct as necessary.

6.2 ELECTRIC MOTORS TESTING

- A. Manufacturer.
- B. HP/BHP.
- C. Phase, voltage, amperage; nameplate, actual, no load. Record voltage and amperage on phases of 3 phase motors.
- D. RPM.
- E. Service factor.
- F. Starter size, rating, heater elements.

6.3 WATER SYSTEM PROCEDURES

- A. Adjust water systems to provide required or design quantities. Use calibrated orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on pressure drop across various heat transfer elements in the system.
- B. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- C. Effect system balance with automatic control valves fully open to heat transfer elements.
- D. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shutoff valves for balancing unless indexed for balance point.
- E. Adjust differential pressure on variable flow systems to minimum value that produces design flows to equipment.

6.4 PUMP DATA TESTING

- A. Identification/number.
- B. Manufacturer.
- C. Size/model.
- D. Impeller.
- E. Service.
- F. Design flow rate, pressure drop, BHP.
- G. Actual flow rate, pressure drop, BHP.
- H. Shutoff, discharge, and suction pressures.
- I. Differential pressure setpoint for each hydronic system.
- J. Parallel and single pump operation.

6.5 ADJUSTING

- A. Recorded data represents actually measured or observed conditions. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops. Adjust air systems to deliver specified volumes with lowest possible fan speed.

END OF SECTION

SECTION 23 09 13

VARIABLE FREQUENCY DRIVES

PART 7 - GENERAL

7.1 SUMMARY

- A. Materials and installation for a complete adjustable frequency motor drive consisting of a pulse width modulated (PWM) inverter for use on a standard NEMA Design B induction motor. Design drive specifically for variable torque applications.
- B. Variable Frequency Drive (VFD): Provided by Section "Controls."

7.2 QUALITY ASSURANCE

- A. It is required that the drive manufacturer have an existing:
 - 1. Sales representative exclusively for HVAC products, with expertise in HVAC systems and controls.
 - 2. An independent service organization.
 - 3. A parts stocking depot local to the installation site.
- B. Manufacturers: A firm engaged in the production of this type of equipment for a minimum of 10 years.
- C. Referenced Standards:
 - 1. IEEE Standard 519, Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
 - 2. UL 508, Industrial Control Equipment.
 - 3. NEMA: ICS 6, Industrial Controls and Systems Enclosures.
 - 4. IEC 801-2, 801-4, 255-4.
- D. Testing: Test printed circuit boards and bummed in before being assembling into the completed VFD. Subject VFD to a preliminary functional test, minimum 8-hour burn-in, and computerized final test at 104F (40C), at full rated load.
- E. Qualifications:
 - 1. UL listed.
 - 2. C-UL listed or CSA approved.

7.3 SUBMITTALS

- A. Include the following information:
 - 1. Outline dimensions.
 - 2. Weight.
 - 3. Typical efficiency versus speed graph for variable torque load.
 - 4. Compliance to IEEE 519, harmonic analysis for job site including total voltage harmonic distortion and total current distortion.
 - a. Provide calculations, specific to this installation, showing total harmonic voltage distortion is less than 5 percent size. Input line filters provided as required by VFD manufacturer to ensure compliance with IEEE Standard 519.

- b. Prior to installation, provide the estimated total harmonic distortion (THD) caused by the VFDs. Based results on a computer aided circuit simulation of the total actual system, with information obtained from the power provider and the user.
- c. If the voltage THD exceeds 5 percent, the VFD manufacturer is to recommend the additional equipment required to reduce the voltage THD to an acceptable level.

7.4 WARRANTY

- A. Warranty 12 months from the date of certified start-up. Include parts, labor, travel time, and expenses.

PART 8 - PRODUCTS

8.1 VARIABLE FREQUENCY DRIVES

- A. Design: Solid state, with a Pulse Width Modulated (PWM) output waveform enclosed in a NEMA 1 enclosure, completely assembled and tested by manufacturer. Employ a full wave rectifier (to prevent input line notching), DC Line Reactor, capacitors, and Insulated Gate Bipolar Transistors (IGBTs) as the output switching device drive efficiency: 97 percent or better at full speed and full load. Fundamental power factor: 0.98 at all speeds and loads. Unit designed to feed two motors simultaneously.
- B. Specifications:
 - 1. Input 440/450/480/500VAC plus or minus 10 percent (capable of operation to 550VAC), 3 phase, 48 to 63Hz or Input 208/220/230/240VAC plus or minus 10 percent, 3 phase, 48 to 63Hz.
 - 2. Output 0 - Input Voltage, 3 phase, 0 to 500Hz for drives up to 75 HP; 0 to 120Hz for drives over 75 HP.
 - 3. Environmental Operating Conditions: 0 to 40C at 3kHz switching frequency, 0 to 3300 feet above sea level, less than 95 percent humidity, noncondensing.
 - 4. Enclosure rated Type 1.
- C. Standard Features:
 - 1. Provide VFDs with the same customer interface, including digital display, keypad and customer connections; regardless of horsepower rating. The keypad is to be used for local control (start/stop, forward/reverse, and speed adjust), for setting parameters, and for stepping through the displays and menus.
 - 2. Fault Mode on Loss of Input:
 - a. Displaying a fault
 - b. Running at a programmable preset speed as selected by user.
 - 3. Utilize English digital display (code numbers are not acceptable). Digital Display: A 40 character (2 line by 20 characters/line) LCD display, backlit to provide easy viewing in light condition, adjustable contrast to optimize viewing at angles display. Set-up parameters, indications, faults, warnings and other information in words to allow the user to understand what is being displayed without the use of a manual or cross reference table.
 - 4. Utilize preprogrammed application macro's specifically designed to facilitate start-up. Provide one command to reprogram parameters and customer interfaces for a particular application to reduce programming time.

5. Automatic restart after an overcurrent, overvoltage, undervoltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts to be programmable. If the time between reset attempts is greater than zero, the time remaining until reset occurs to count down on the display to warn an operator that a restart will occur.
6. Capable of starting into a rotating load (forward or reverse) and accelerate or decelerate to setpoint without safety tripping or component damage (flying start).
7. Automatic extended power loss ride-through circuit.
8. Customer terminal strip isolated from the line and ground.
 - a. Prewired three-position Hand-Off-Auto switch and speed potentiometer. When in "Off" the VFD will be stopped. When in "Auto" the VFD will start via an external contact closure, and its speed will be controlled via an external speed reference.
9. Current Limit Circuits to Provide Trip Free Operation:
 - a. Slow current regulation limit circuit adjustable to 125 percent (minimum) of the VFDs variable torque current rating. Adjustment made via the keypad, and displayed in amps.
 - b. Rapid current regulation limit adjustable to 170 percent (minimum) of the VFDs variable torque current rating.
 - c. Current switch off limit fixed at 255 percent (minimum, instantaneous) of the VFDs variable torque current rating.
10. Overload Rating: 110 percent of its variable torque current rating for 1 minute every 10 minutes, and 140 percent of its H torque current rating for 2 seconds every 15 seconds.
11. DC Line Reactor to reduce the harmonics to the power line.
12. Optimized for a 3 kHz carrier frequency to reduce motor noise.
13. Manual speed potentiometer or keypad as a means of controlling speed manually.

D. Adjustments:

1. Five programmable critical frequency lockout ranges.
2. PI Setpoint controller.
3. Two programmable analog inputs for reference for PI controller. Analog Inputs: include a filters; programmable from 0.01 to 10 seconds to remove oscillation in the input signal.
4. Six programmable digital inputs for maximum flexibility in interfacing with external devices.
5. Two programmable analog outputs proportional to Frequency, Motor Speed, Output Voltage, Output Current.
6. Two independently adjustable accel and decel ramps. Ramp times adjustable from 1 to 1800 seconds.
7. The VFD to ramp or coast to a stop, as selected by user.

E. Display: The following operating information displays to be standard on the VFD digital display.

1. Output frequency
2. Motor speed (RPM, percent or engineering units)
3. Motor current
4. Calculated motor torque
5. Calculated motor power

6. Output voltage
 7. Analog input values
 8. Keypad reference values
 9. Elapsed time meter
 10. kWh meter
- F. Protection Circuits: In the case of a protective trip, stop the drive and announce the fault condition.
1. Overcurrent trip 315 percent instantaneous (225 percent RMS) of the VFDs variable torque current rating.
 2. Overvoltage trip 130 percent of the VFD's rated voltage.
 3. Undervoltage trip 65 percent of the VFD's rated voltage.
 4. Overtemperature plus 70C (ACH 501); plus 85C (ACH 502).
 5. Ground Fault either running or at start.
 6. Adaptable Electronic Motor Overload (I2t).
- G. Speed Command Input Via:
1. Keypad.
 2. Two analog inputs, each capable of accepting a 0 to 20mA, 4 to 20mA, 0 to 10V, 2 to 10V signal. Analog inputs programmable filter to remove an oscillation of the reference signal. Minimum and maximum values (gain and offset) adjustable within the range of 0 to 20mA and 0 to 10V.
- H. Accessories:
1. Door interlocked thermal magnetic circuit breaker disconnect handle, through-the-door type, and padlockable in the "Off" position.
 2. Fire alarm system control interlocks for "seize control" and "on/off."
 3. Two motor winding thermistor inputs to shut drive down if either motor registers overload.
 4. Refer to Division 28 fire alarm drawing for connection details.
 5. Fused disconnects for each motor.
 6. Trouble output contact.
 7. Include a set of contacts that signal the building automation system to open VAV boxes to 100 percent during bypass mode.
 8. Output filter to provide for wave shaping.
 9. Provide 5 percent impedance 3 phase line reactor on the input side of the VFD.
- I. Manufacturers: Siemens, General Electric, Danfoss, Yaskawa, Mitsubishi, ABB, Cerus, Toshiba, Allen Bradley, Square D, or approved.

PART 9 - EXECUTION

9.1 INSTALLATION

- A. Coordinate with installers of power and control wiring.

9.2 START UP

- A. Provide certified factory start-up for each drive by a factory-authorized service center. Provide a certified start-up form for each drive.
- B. Test unit operation in modes of operation.

END OF SECTION
2020 Cooling Tower Replacement RFP

SECTION 23 21 00

HYDRONIC PIPING SYSTEMS

PART 4 - GENERAL

4.1 SUMMARY

- A. Work Included: Materials, installation, and testing of:
 - 1. Pipes and pipe fittings for chilled water, heating water, and drain.
 - 2. Valves.
 - 3. Hydronics specialties, including the following:
 - a. Manual air vent valves.
 - b. Automatic air vent valves.
 - c. Liquid flow switches.
 - d. Water pressure relief valves.
 - e. Gauges.
 - f. Instrument probe fittings.

4.2 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of components of types and sizes required.

4.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data, installation instructions, and dimensioned drawings for each type of pipe, pipe fitting, valve, hydronic specialty, chemical, and component.
- B. Submit Piping Schedule showing manufacturer, pipe or tube weight, fitting type, and joint type for each piping system.
- C. Maintenance Data: Submit maintenance data and parts list for components. Include this data, product data, and certifications in maintenance manual.
- D. Certificates of Compliance: Submit letters of certification stating that the piping as submitted per the Piping Schedule is in compliance with the standards of compliance as specified.

4.4 PRODUCT HANDLING

- A. Provide factory applied end caps on each length of pipe and tube. Maintain end caps through shipping, storage, and handling as required to prevent pipe end damage and eliminate dirt and moisture from inside of pipe and tube.
- B. Store components inside and protected from weather.

- C. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate above grade and enclose with durable, weatherproof wrapping.
- D. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packing with durable, waterproof wrapping.

PART 5 - PRODUCTS

5.1 PIPE AND FITTINGS

- A. General: Provide pipe, tube and fittings of the type, fitting requirements, grade, class, size and weight indicated or required for each service. Where type, grade, or class is not indicated, provide proper selection as determined by installer for installation requirements, and comply with governing regulations and industry standards. Piping in a given size range of same type.
- B. Service:
 - 1. Drain Pipe:
 - a. Steel, black, Schedule 40, threaded fittings.
 - b. Copper tubing, M, soldered fittings (95/5 solder).
 - 2. Condenser Water (Above Grade):
 - a. Pipe Sizes 2-1/2 Inches and Larger:
 - 1) Steel, galvanized, Schedule 40 with welded, flanged, or grooved Victaulic.
 - 2) Copper tubing, Type K or L, with brazed fittings, or grooved Victaulic.
 - b. Pipe Sizes 2 Inches and Smaller:
 - 1) Steel, galvanized, Schedule 40 with welded or threaded fittings.
 - 2) Copper tubing, Type L, with soldered fittings (95/5 solder).
- C. Steel Drain Pipe: ASTM A53, Schedule 40, Galvanized or black.

5.2 VALVES

- A. General: Provide end connections which properly mate with pipe, tube and equipment connections. Where more than one type is indicated, selection is installer's option.
- B. Sizes: Unless otherwise indicated, provide valves of same size as upstream pipe size.

5.3 MANUAL AIR VENT VALVES

- A. Operated manually with screwdriver or thumbscrew, 1/8-inch NPS or 1/4-inch NPS connection as required.
- B. Manufacturers: Armstrong, Bell & Gossett, Hoffman, Spirax Sarco, or approved.

5.4 AUTOMATIC AIR VENT VALVES

- A. Float type with pressure rating equal to or greater than the system in which it is installed.
- B. Manufacturers: Taco Hy-Vent, Bell & Gossett, Hoffman, or approved for branch lines. Hoffman 78 or approved at air separators, mains, in mechanical rooms.

5.5 STRAINERS

- A. General: Full line size strainers with ends matching connecting piping materials, machined screen seats, gasketed cap, blow off outlet, minimum 2-1/2 to 1 open area ratio, and Type 304 stainless steel screens with 1/16-inch diameter holes.
- B. Y-Strainers: Steel Pipe Installations: Mueller 11.
- C. Manufacturers: Mueller, Armstrong, Keckley, Hoffman, Hayward, Wheatley, or approved.

5.6 LIQUID FLOW SWITCHES

- A. Brass for wetted parts, with packless construction, paddle with removable segments for pipe size and flow velocity, vapor-proof electrical compartment for switches mounted on cold hydronic piping systems, switches for 115V, 60 Hz, 1-phase with 7.4A rating.
- B. Manufacturers: McDonnell & Miller, Dwyer, or approved.

5.7 THERMOMETERS

- A. 5-inch diameter bimetal dial thermometer, stainless steel case, white dial, black numbers, adjustable angle, 4-inch stainless steel stem, brass separable socket. Back or bottom connections as required.

Service	Range
Chilled water	0°F to 120°F

- B. Manufacturers: Ashcroft, Terice, Weiss, Palmer, Marshaltown, Weksler, or approved.

5.8 THERMOMETER WELLS

- A. Brass or stainless steel, pressure rated to match piping system design pressure. Provide extensions for insulated piping of length required to extend above insulation used at each location. Provide cap nut with chain fastened permanently to thermometer well.
- B. Manufacturers: Same as thermometers.

5.9 PRESSURE GAUGES

- A. Type: General use, 1 percent accuracy, ANSI B40.1, Grade A, phosphor bronze bourdon type, bottom connection.
- B. Case: Drawn steel or brass, glass lens, 4-1/2-inch diameter.
- C. Connector: Brass with 1/4-inch male NPT.

- D. Scale: White coated aluminum, with permanently etched markings.
- E. Range:
 - 1. Pump Suctions: 30-inch Hg - 60 PSI.
 - 2. Water: 0 - 100 PSI.
- F. Manufacturers: Amtek/U.S. Gauge, Ashcroft, Palmer, Marshaltown Instruments, Terrice, Weiss, Weksler, or approved.

5.10 INSTRUMENT PROBE FITTINGS

- A. Brass or stainless steel body and cap, high pressure rated, valve material neoprene, Nordal or Viton to suit temperature range, 1/4 inch or 1/2-inch NPT tailpiece.
- B. Manufacturers: Pete's Plug, or approved.

5.11 PIPE GUIDES

- A. Manufacturers: Flexonics "Flexon," Mason Industries, Amber-Bush, Metraflex, or approved.

5.12 PIPE ANCHORS

- A. Manufacturers: Flexonics, Mason Industries, Amber-Bush, Metraflex, or approved.

PART 6 - EXECUTION

6.1 HYDRONICS SPECIALTIES INSTALLATION

- A. Manual Vent Valves: Install on each hydronic terminal at highest point, and on each hydronic piping drop in direction of flow for mains, branches, and runouts, and elsewhere as indicated. Provide manual vents of 1/8 inch in size in pipes through 2 inches in diameter, and vents of 1/4 inch size in pipes 2-1/2 inches and larger.
- B. Installation of Temperature Gauges:
 - 1. Install in vertical upright position, tilted so as to be easily read at floor.
 - 2. Glass Thermometers: Install at the following locations, and elsewhere as indicated:
 - a. At inlet and outlet of each chiller.
 - 3. Thermometer Wells: Install in piping in vertical upright position. Fill well with oil or graphite, secure cap.
- C. Installation of Pressure Gauges:
 - 1. General: Install pressure gauges in piping tee with pressure gauge cock, located on pipe at most readable position.
 - 2. Locations: Install in the following locations, and elsewhere as indicated:
 - a. At each pump inlet and outlet.

- b. At inlet and discharge of each pressure reducing valve.
- c. At make-up water service outlets.
- d. At inlet and outlet of condenser water and chilled water at chillers.

6.2 AIR VENTS

- A. Automatic: Furnish and install automatic air vents at high points of the water systems and as otherwise required. Vents: 3/4 inch with 1/2-inch IPS drain piping to the nearest floor drain or other approved location. Provide a gate valve and union ahead of automatic air vents.
- B. Manual Vents (Where no Floor Drain or other Acceptable Location Exists): Provide 10-inch length of 1/4-inch copper tube with 180 degree bend down to discharge into hand-held bucket.

6.3 GAUGE ADJUSTING AND CLEANING

- A. Adjust faces of meters and gauges to proper angle for best visibility.
- B. Clean windows of meters and gauges and factory finished surfaces. Replace cracked or broken windows, repair any scratched or marred surfaces with manufacturer's touch-up paint.

6.4 PIPE TEST

- A. General:
 - 1. Make tests in presence of Architect or authorized representative.
 - 2. Make test before pipes are concealed.
 - 3. Fill system and remove air from system at least 24 hours before test begins.
 - 4. Correct leaks in screwed fittings by remaking the joint. Cut out and reweld leaks in welded joints; caulking is not permitted.
- B. Water Piping: Apply test pressure 125 PSI and maintain for 1 hour with no visible leaks and no appreciable drops after the test pump has been disconnected.

6.5 PIPE GUIDES

- A. Install on continuous runs where pipe alignment must be maintained. Minimum two on each side of expansion joints, spaced per manufacturer's recommendations for pipe size. Fasten guides to pipe structure.
- B. Install approximately 4 pipe diameters (first guide) and 14 diameters (second guide) away from each end of expansion joints. Do not use as supports. Provide in addition to other required pipe hangers and supports.

6.6 PIPE ANCHORS

- A. Furnish and install pipe anchors where shown or required to prevent pipe movement. If fabricated, construct anchors of steel plate, 3/4-inch minimum thickness, securely welded to pipe with two steel plates, stiffeners and bolted to structure.

END OF SECTION

SECTION 23 65 00
COOLING TOWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Open-circuit, induced-draft, crossflow cooling towers.

1.3 DEFINITIONS

- A. BMS: Building management system.
- B. FRP: Fiber-reinforced polyester.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design cooling tower support structure [and seismic restraints] [and wind restraints], including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Cooling tower support structure shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to SEI/ASCE 7.
- C. Seismic Performance: Cooling towers shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified[and the unit will be fully operational after the seismic event]."

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, pressure drop, performance curves with selected points indicated, furnished specialties, noise criteria, and accessories.
- B. Shop Drawings: Complete set of manufacturer's prints of cooling tower assemblies, control panels, sections and elevations, and unit isolation. Include the following:
 - 1. Assembled unit dimensions.
 - 2. Weight and load distribution.
 - 3. Required clearances for maintenance and operation.

4. Sizes and locations of piping and wiring connections.
 5. Wiring Diagrams: For power, signal, and control wiring.
- C. Paragraph below is defined in Section 013300 "Submittal Procedures" as a "Delegated-Design Submittal." Retain if Work of this Section is required to withstand specific design loads and design responsibilities have been delegated to Contractor or if structural data are required as another way to verify compliance with performance requirements. Professional engineer qualifications are specified in Section 014000 "Quality Requirements."
- D. Delegated-Design Submittal: For cooling tower support structure indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail fabrication and assembly of support structure.
 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 3. Design Calculations: Calculate requirements for selecting vibration isolators[and seismic restraints] [and wind restraints] and for designing vibration isolation bases.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
1. Structural supports.
 2. Piping roughing-in requirements.
 3. Wiring roughing-in requirements, including spaces reserved for electrical equipment.
 4. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.
- B. Certificates: For certification required in "Quality Assurance" Article.
- C. Seismic Qualification Certificates: For cooling towers, accessories, and components, from manufacturers.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Startup service reports.
- G. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each cooling tower to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: [Certified by CTI] [An NRTL].
- B. Verification of Performance:
 - 1. The thermal performance shall be certified by the Cooling Technology Institute in accordance with CTI Certification Standard STD-201. Lacking such certification, a field acceptance test shall be conducted within the warranty period in accordance with CTI Acceptance Test Code ATC-105, by a Certified CTI Thermal Testing Agency. The Evaporative Heat Rejection Equipment shall comply with the energy efficiency requirements of ASHRAE Standard 90.1.
 - 2. Unit Sound Performance ratings shall be tested according to CTI ATC-128 standard, Test Code for Measurement of Sound from Water-Cooling Towers, by an Independent CTI-licensed sound test agency. Sound ratings shall not exceed specified ratings.
 - 3. Unit shall meet or exceed energy efficiency per ASHRAE 90.1
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- E. ASME Compliance: Fabricate and label heat-exchanger coils to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- F. CTI Certification: Cooling tower thermal performance according to CTI STD 201, "Certification Standard for Commercial Water-Cooling Towers Thermal Performance."
- G. FMG approval and listing in the latest edition of FMG's "Approval Guide."
- H. The cooling tower manufacturer shall have a Management System certified by an accredited registrar as complying with the requirements of ISO9001:2008 to ensure consistent quality of products and services. Manufacturers that are not ISO9001 Certified shall not be acceptable.

1.9 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate sizes, locations, and anchoring attachments of structural-steel support structures.
- C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.10 WARRANTY

- A. Special Warranty: Submit a written warranty executed by the manufacturer, agreeing to repair or replace components of the unit that fail in materials and workmanship within the specified warranty period.
 - 1. The Entire Unit shall have a comprehensive one (1) year warranty against defects in materials and workmanship from startup, not to exceed eighteen (18) month from shipment of the unit.
 - 2. Fan Motor/Drive System: Warranty Period shall be Five (5) years from date of unit shipment from Factory (fan motor(s), fan(s), fan shaft(s), bearings, mechanical support, sheaves, bushings and belt(s)).

PART 2 - PRODUCTS

2.1 INDUCED-DRAFT, COUNTERFLOW COOLING TOWERS

- A. Manufacturer
 - 1. Evapco.
 - 2. Marley Cooling Technologies; an SPX Corporation.
 - 3. Baltimore Aircoil Company.
 - 4. Or approved equal.
- B. Thermal Capacity: the thermal performance shall be certified by the Cooling Technology Institute in accordance with CTI Certification Standard STD-201. Manufacturers' performance guarantees or performance bonds without CTI Certification or independent field thermal performance test shall not be accepted. The cooling tower(s) shall comply with the energy efficiency requirements of ASHRAE Standard 90.1.
- C. Construction: Description below is standard construction, see schedule for optional stainless steel construction specifically required for the project.
 - 1. Except where otherwise specified, all components of the cooling tower shall be fabricated of series 316 stainless steel.
 - 2. All cold water basin components including vertical supports, air inlet louver frames and panels up to rigging seam shall be constructed of 316 stainless steel.
 - 3. Upper Casing, channels and angle supports shall be constructed of heavy gauge mill hot-dip galvanized steel. Fan cowl and guard shall be constructed of 316 stainless steel.
 - 4. Hot Water Distribution System: Spray nozzles shall be precision molded ABS, large orifice nozzles utilizing fluidic technology for superior water distribution over the fill media. Nozzles shall be designed to minimize water distribution system maintenance. Spray header and branches shall be Schedule 40 Polyvinyl Chloride (PVC) for corrosion resistance with a steel connection to attach external piping.
- D. Fans:
 - 1. Fan(s) shall be high efficiency axial propeller type with aluminum wide chord blade construction. Each fan shall be dynamically balanced and installed in a closely fitted cowl with venturi air inlet for maximum fan efficiency.
 - 2. Warranty: The motor shall be warranted against defects in materials and workmanship for a period of seven (7) years from date of shipment. The fan(s), fan shaft(s), drive,

sheaves, bearings, and mechanical equipment support shall be warranted against defects in materials and workmanship for a period of five (5) years from date of shipment.

E. Fill and Drift Eliminator:

1. Drift eliminators shall be constructed entirely of Polyvinyl Chloride (PVC) in easily handled sections. Design shall incorporate three changes in air direction and limit the water carryover to a maximum of 0.001% of the recirculating water rate.
2. Fill media shall be constructed of Polyvinyl Chloride (PVC) of cross-fluted design and suitable for inlet water temperatures up to 130° F. The bonded block fill shall be bottom supported and suitable as an internal working platform. Fill shall be self-extinguishing, have a flame spread of 5 under A.S.T.M. designation E-84-81a, and shall be resistant to rot, decay and biological attack.

F. Air-Intake Louvers:

1. Air inlet louvers screens shall be constructed from UV inhibited polyvinyl chloride (PVC) and incorporate a framed interlocking design that allows for easy removal of louver screens for access to the entire basin area for maintenance. The louver screens shall have a minimum of two changes in air direction and shall be of a non-planar design to prevent splash-out and block direct sunlight & debris from entering the basin.

G. Removable Air-Intake Screens: The air inlet faces of the tower shall be covered by 1" mesh hot-dipped galvanized welded wire screens. Screens shall be secured to removable galvanized U-edge frames. Screens shall be designed to permit full access to the cold-water basin by removal of one panel on each air inlet.

H. Electronic water level control package shall have five (5) stainless steel water level sensors (one (1) high level, one (1) high level alarm, one (1) low level, one (1) low level alarm and one (1) ground) with a NEMA 4x enclosure mounted in a cleanable Schedule 40 PVC external standpipe with slow closing solenoid valve(s) and "y" strainer(s). Wiring is not included and components must be field mounted. Valves shall be sized for 25 psi minimum to 125 psi maximum pressure. Standpipe may require heat tracing by others in cold weather applications.

I. Pan Strainer

1. Pan Strainer(s) shall be all Type 304 Stainless Steel construction with large area removable perforated screens.

J. Fan Motor and Drive

1. Fan motor(s) shall be totally enclosed, ball bearing type electric motor(s) suitable for moist air service. Motor(s) are Premium Efficient, Class F insulated, 1.15 service factor design. Inverter rated per NEMA MG1 Part 31.4.4.2 and suitable for variable torque applications and constant torque speed range with properly sized and adjusted variable frequency drives.
2. Fan motor(s) shall include strip-type space heaters with separate leads brought to the motor conduit box.
3. Fan shaft shall be solid, ground and polished steel. Exposed surface shall be coated with rust preventative.
4. Fan Shaft Bearings shall be heavy-duty, self-aligning ball type bearings with extended lubrication lines to grease fittings located on access door frame. Bearings shall be designed for a minimum L-10 life of 100,000 hours.

5. Vibration Switch: Unit shall be provided with a Vibration Cutout Switch, operating on 120 VAC feed, to protect the fan and drive assembly from damage in the event of excess vibration. Vibration switch shall be DPDT.

K. Maintenance

1. Fan Section

- a. Access door shall be hinged and located in the fan section for fan drive and water distribution system access. Swing away motor cover shall be hinged for motor access.

2. Basin Section

- a. Framed removable louver panels shall be on all four (4) sides of the unit for pan and sump access.

3. Internal Working Platform

- a. Internal working platform shall provide easy access to the fans, belts, motors, sheaves, bearings, all mechanical equipment and complete water distribution system. The fill shall be an acceptable means of accessing these components.

4. External Service Platform with Ladder

- a. An external service platform compliant with OSHA shall be provided at the motor access door of the unit extending the full length of the access door. Each platform shall have at least a 36 in wide walking surface. The platforms shall have galvanized steel grating, supported by galvanized steel framework attached to the unit and surrounded by a handrail, knee rail and toe plate system that is compliant with OSHA. Mounting channels shall be the same material as the casing section (galvanized or stainless steel). A vertical ladder shall be provided from the base of the unit to the platform.
- b. Safety cage(s) shall be provided on all vertical ladder(s) and ship mounted. Safety cage(s) shall begin between 7 feet (minimum) and 8 feet (maximum) above grade.

2.2 SOURCE QUALITY CONTROL

- A. Verification of Performance: Test and certify cooling tower performance according to CTI STD 201, "Certification Standard for Commercial Water-Cooling Towers Thermal Performance."
- B. Factory pressure test heat exchangers after fabrication and prove to be free of leaks.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before cooling tower installation, examine roughing-in for tower support, anchor-bolt sizes and locations, piping, and electrical connections to verify actual locations, sizes, and other conditions affecting tower performance, maintenance, and operation.
 1. Cooling tower locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install cooling towers on support structure indicated.
- B. Equipment Mounting: Install cooling tower on concrete bases using restrained spring isolators. Comply with requirements for vibration isolation devices specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."
 - 1. Minimum Deflection: 2 inches.
 - 2. Provide stainless-steel plate to equally distribute weight over elastomeric pad.
 - 3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 4. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 5. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- C. Equipment Mounting: Install cooling tower on concrete bases.
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- D. Install anchor bolts to elevations required for proper attachment to supported equipment.
- E. Maintain manufacturer's recommended clearances for service and maintenance.
- F. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

3.3 CONNECTIONS

- A. Coordinate piping installation and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be omitted.
- B. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Install piping adjacent to cooling towers to allow service and maintenance.
- D. Install flexible pipe connectors at pipe connections of cooling towers mounted on vibration isolators.
- E. Provide drain piping with valve at cooling tower drain connections and at low points in piping.

- F. Connect cooling tower overflows and drains, and piping drains to sanitary sewage system.
- G. Domestic Water Piping: Comply with applicable requirements in Section 221116 "Domestic Water Piping." Connect to water-level control with shutoff valve and union, flange, or mechanical coupling at each connection.
- H. Supply and Return Piping: Comply with applicable requirements in Section 232113 "Hydronic Piping." Connect to entering cooling tower connections with shutoff valve, balancing valve, thermometer, plugged tee with pressure gage,[flow meter,] and drain connection with valve. Connect to leaving cooling tower connection with shutoff valve. Make connections to cooling tower with a [union] [flange] [mechanical coupling] [union, flange, or mechanical coupling].

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to perform field tests and inspections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections: Comply with CTI ATC 105, "Acceptance Test Code for Water Cooling Towers."
- D. Cooling towers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.
- C. Obtain performance data from manufacturer.
 - 1. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
 - a. Clean entire unit including basins.
 - b. Verify that accessories are properly installed.
 - c. Verify clearances for airflow and for cooling tower servicing.
 - d. Check for vibration isolation and structural support.
 - e. Lubricate bearings.
 - f. Verify fan rotation for correct direction and for vibration or binding and correct problems.
 - g. Operate variable-speed fans through entire operating range and check for harmonic vibration imbalance. Set motor controller to skip speeds resulting in abnormal vibration.
 - h. Verify water level in tower basin. Fill to proper startup level. Check makeup water-level control and valve.

- i. Verify that cooling tower air discharge is not recirculating air into tower or HVAC air intakes. Recommend corrective action.
 - j. Replace defective and malfunctioning units.
- D. Start cooling tower and associated water pumps. Follow manufacturer's written starting procedures.
- E. Prepare a written startup report that records the results of tests and inspections.

3.6 ADJUSTING

- A. Set and balance water flow to each tower inlet.
- B. Adjust water-level control for proper operating level.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cooling towers.

END OF SECTION

SECTION 26 05 11

REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section applies to all sections of Division 26.
- B. Furnish and install electrical wiring, systems, equipment and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, cable, switchboards, switchgear, panelboards, motor control centers, and other items and arrangements for the specified items are shown on drawings.
- C. Wiring ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways accordingly sized. Aluminum conductors are prohibited.

1.2 MINIMUM REQUIREMENTS

- A. References to the International Building Code (IBC), National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL) and National Fire Protection Association (NFPA) are minimum installation requirement standards.
- B. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

1.3 TEST STANDARDS

- A. All materials and equipment shall be listed, labeled or certified by a nationally recognized testing laboratory to meet Underwriters Laboratories, Inc., standards where test standards have been established. Equipment and materials which are not covered by UL Standards will be accepted provided equipment and material is listed, labeled, certified or otherwise determined to meet safety requirements of a nationally recognized testing laboratory. Equipment of a class which no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as NEMA, or ANSI. Evidence of compliance shall include certified test reports and definitive shop drawings.
- B. Definitions:
 - 1. Listed; Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production or listed equipment or materials or periodic evaluation of services, and whose listing states that the equipment, material, or services either meets appropriate designated standards or has been tested and found suitable for a specified purpose.
 - 2. Labeled; Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose

labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3. Certified; equipment or product which:
 - a. Has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards or to be safe for use in a specified manner.
 - b. Production of equipment or product is periodically inspected by a nationally recognized testing laboratory.
 - c. Bears a label, tag, or other record of certification.
4. Nationally recognized testing laboratory; laboratory which is approved, in accordance with OSHA regulations, by the Secretary of Labor.

1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)

- A. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.
- B. Product Qualification:
 1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
 2. The Resident Engineer or Project Manager reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.
- C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 APPLICABLE PUBLICATIONS

Applicable publications listed in all Sections of Division are the latest issue, unless otherwise noted.

1.6 MANUFACTURED PRODUCTS

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.
- B. When more than one unit of the same class or type of equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
 1. Components of an assembled unit need not be products of the same manufacturer.
 2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.

3. Components shall be compatible with each other and with the total assembly for the intended service.
 4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.
- E. When Factory Testing Is Specified:
1. The Resident Engineer or Project Manager shall have the option of witnessing factory tests. The contractor shall notify the owner/UCB through the Resident Engineer a minimum of 15 working days prior to the manufacturers making the factory tests.
 2. Four copies of certified test reports containing all test data shall be furnished to the Resident Engineer prior to final inspection and not more than 90 days after completion of the tests.
 3. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including expenses of the owner/(UCB).

1.7 EQUIPMENT REQUIREMENTS

Where variations from the contract requirements are requested in accordance with the GENERAL CONDITIONS, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, the

connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

1.8 EQUIPMENT PROTECTION

- A. Equipment and materials shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.
1. Store equipment indoors in clean dry space with uniform temperature to prevent condensation. Equipment shall include but not be limited to main disconnect switch, branch breakers, panelboards, variable frequency drive, motor controllers, uninterruptible power systems, enclosures, controllers, circuit protective devices, cables, wire, light fixtures, electronic equipment, and accessories.
 2. During installation, equipment shall be protected against entry of foreign matter; and be vacuum-cleaned both inside and outside before testing and operating. Compressed air shall not be used to clean equipment. Remove loose packing and flammable materials from inside equipment.
 3. Damaged equipment shall be, as determined by the Resident Engineer, placed in first class operating condition or be returned to the source of supply for repair

or replacement.

4. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
5. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.9 WORK PERFORMANCE

- A. All electrical work must comply with the requirements of NFPA 70 (NEC), NFPA 70B, NFPA 70E, OSHA Part 1910 subpart J, OSHA Part 1910 subpart S and OSHA Part 1910 subpart K in addition to other references required by contract.
- B. Job site safety and worker safety is the responsibility of the contractor.
- C. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished in this manner for the required work, the following requirements are mandatory:
 1. Electricians must use full protective equipment (i.e., certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools, etc.) while working on energized systems in accordance with NFPA 70E.
 2. Electricians must wear personal protective equipment while working on energized systems in accordance with NFPA 70E.
 3. Before initiating any work, a job specific work plan must be developed by the contractor with a peer review conducted and documented by the Resident Engineer and his staff. The work plan must include procedures to be used on and near the live electrical equipment, barriers to be installed, safety equipment to be used and exit pathways.
 4. Work on energized circuits or equipment cannot begin until prior written approval is obtained from the Resident Engineer.
- D. For work on existing stations, arrange, phase and perform work to assure electrical service for other buildings at all times.
- E. New work shall be installed and connected to existing work neatly, safely and professionally. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required.

- F. Coordinate location of equipment and conduit with other trades to minimize interferences.

1.10 EQUIPMENT INSTALLATION AND REQUIREMENTS

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Working spaces shall not be less than specified in the NEC for all voltages specified.
- C. Inaccessible Equipment:
 - 1. Where the Resident Engineer or Project Manager determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the University (UCB).
 - 2. "Conveniently accessible" is defined as being capable of being reached quickly for operation, maintenance, or inspections without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

1.11 EQUIPMENT IDENTIFICATION

- A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as panelboards, cabinets, motor controllers (starters), safety switches, separately enclosed circuit breakers, individual breakers and controllers integral with unit equipment and motor control assemblies, control devices and other significant equipment.
- B. Nameplates for Normal Power System equipment shall be laminated black phenolic resin with a white core with engraved lettering. Nameplates for Essential Electrical System (EES) equipment, as defined in the NEC, shall be laminated red phenolic resin with a white core with engraved lettering. Lettering shall be a minimum of 1/2 inch [12mm] high. Nameplates shall indicate equipment designation, rated bus amperage, voltage, number of phases, number of wires, and type of EES power branch as applicable. Secure nameplates with screws.

1.12 SUBMITTALS

- A. Submit SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. The Resident engineer's or Project Manager's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job

site.

- C. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the UCB to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.

- D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
 - 1. Mark the submittals, "SUBMITTED UNDER SECTION _____".
 - 2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
 - 3. Submit each section separately.

- E. The submittals shall include the following:
 - 1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
 - 2. Elementary and interconnection wiring diagrams for communication and signal systems, control systems and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
 - 3. Parts list which shall include those replacement parts recommended by the equipment manufacturer.

- F. Manuals: Submit as required.
 - 1. Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections. Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.
 - 2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the

names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.

3. Provide a "Table of Contents" and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
4. The manuals shall include:
 - a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
 - b. A control sequence describing start-up, operation, and shutdown.
 - c. Description of the function of each principal item of equipment.
 - d. Installation instructions.
 - e. Safety precautions for operation and maintenance.
 - f. Diagrams and illustrations.
 - g. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers and replacement frequencies.
 - h. Performance data.
 - i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
 - j. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.

G. Approvals will be based on complete submission of manuals together with shop drawings.

H. After approval and prior to installation, furnish the Resident Engineer with one sample of each of the following:

1. A 300 mm (12 inch) length of each type and size of wire and cable along with the

tag from the coils of reels from which the samples were taken.

2. Each type of conduit coupling, bushing and termination fitting.
3. Conduit hangers, clamps and supports.
4. Duct sealing compound.
5. Each type of outlet box, device wall plate, engraved nameplate, wire and cable splicing and terminating material, and branch circuit single pole molded case circuit breaker.

1.13 SINGULAR NUMBER

Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

1.14 Acceptance Checks and Tests

The contractor shall furnish the instruments, materials and labor for field tests.

1.15 TRAINING

- A. Training shall be provided in accordance with this specification as well as required by Division (15) 25, Mechanical Specifications.
- B. Training shall be provided for the particular equipment or system as required in each associated specification.
- C. A training schedule shall be developed and submitted by the contractor and approved by the Resident Engineer at least 30 days prior to the planned training.

END OF SECTION

SECTION 26 05 21
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW)

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation, and connection of the low voltage power wiring.

1.2 RELATED WORK

- A. Sealing around penetrations to maintain the integrity of time rated construction: FIRESTOPPING.
- B. General electrical requirements that are common to more than one section in Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- C. Conduits for cables and wiring: Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
- D. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

1.3 SUBMITTALS

- A. In accordance with SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
 - 1. Manufacturer's Literature and Data: Showing each cable type and rating.
 - 2. Certificates: Two weeks prior to final inspection, deliver to the Project Manager four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by the basic designation only.
- B. American Society of Testing Material (ASTM):
 - D2301-04 Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape
- C. Federal Specifications (Fed. Spec.):
 - A-A-59544-00 Cable and Wire, Electrical (Power, Fixed Installation)
- C. National Fire Protection Association (NFPA):

70-05 National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):

44-02 Thermoset-Insulated Wires and Cables

83-03 Thermoplastic-Insulated Wires and Cables 467-01 Electrical Grounding and Bonding Equipment

486A-01 Wire Connectors and Soldering Lugs for Use with Copper Conductors

486C-02 Splicing Wire Connectors

486D-02 Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations

486E-00 Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors

493-01 Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable

514B-02 Fittings for Cable and Conduit

1479-03 Fire Tests of Through-Penetration Fire Stops PART 2 – PRODUCTS

2.1 CABLE AND WIRE (POWER)

- A. Cable and Wire shall be in accordance with Fed. Spec. A-A-59544, except as hereinafter specified.
- B. Single Conductor:
 - 1. Shall be annealed copper.
 - 2. Shall be stranded for sizes No. 8 AWG and larger, solid for sizes No. 10 AWG and smaller.
 - 3. Shall be minimum size No. 12 AWG, except where smaller sizes are allowed herein.
- C. Insulation:
 - 1. XHHW, or dual rated THHN-THWN shall be in accordance with UL 44, and 83.
 - 2. Isolated power system wiring: Type XHHW with a dielectric constant of 3.5 or less.
- D. Color Code:

1. Secondary service, feeder and branch circuit conductors shall be color coded as follows:

208/120 volt	Phase	480/277 volt
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray *
* or white with colored (other than green) tracer.		

2. Use solid color compound or solid color coating for No. 12 AWG and No. 10 AWG branch circuit conductors and neutral sizes.
3. Phase conductors No. 8 AWG and larger shall be color-coded using one of the following methods:
 - a. Solid color compound or solid color coating.
 - b. Stripes, bands, or hash marks of color specified above.
 - c. Color as specified using 19 mm (3/4 inch) wide tape. Apply tape in half overlapping turns for a minimum of 75 mm (three inches) for terminal points, and in junction boxes, pull boxes, troughs, manholes, and handholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable stating size and insulation type.
4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
5. Color code for isolated power system wiring shall be in accordance with the NEC.

2.2 SPLICES AND JOINTS

- A. In accordance with UL 486A, C, D, E and NEC.
- B. Branch circuits (No. 10 AWG and smaller):
 1. Connectors: Solderless, screw-on, reusable pressure cable type, 600 volt, 105 degree C with integral insulation, approved for copper and aluminum conductors.
 2. The integral insulator shall have a skirt to completely cover the stripped wires.

3. The number, size, and combination of conductors, as listed on the manufacturers packaging shall be strictly complied with.
- C. Feeder Circuits:
1. Connectors shall be indent, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material.
 2. Field installed compression connectors for cable sizes 250 kcmil and larger shall have not less than two clamping elements or compression indents per wire.
 3. Insulate splices and joints with materials approved for the particular use, location, voltage, and temperature. Insulate with not less than that of the conductor level that is being joined.
 4. Plastic electrical insulating tape: ASTM D2304 shall apply, flame retardant, cold and weather resistant.

2.3 CONTROL WIRING

- A. Unless otherwise specified in other sections of these specifications, control wiring shall be as specified for power, except the minimum size shall be not less than No. 14 AWG or per manufacturer's system installation.
- B. Control wiring shall be large enough so that the voltage drop under inrush conditions does not adversely affect operation of the controls.

2.4 WIRE LUBRICATING COMPOUND

- A. Suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.
- B. Shall not be used on wire for isolated type electrical power systems.

2.5 FIREPROOFING TAPE

- A. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.
- B. The tape shall be self-extinguishing and shall not support combustion. It shall be arc-proof and fireproof.
- C. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus and be resistant to sunlight and ultraviolet light.
- D. The finished application shall withstand a 200-ampere arc for not less than 30 seconds.
- E. Securing tape: Glass cloth electrical tape not less than 0.18 mm (7 mils) thick, and 19 mm (3/4 inch) wide.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install in accordance with the NEC, and as specified.

- B. Install all wiring in raceway systems, except where direct burial or HCF Type AC cables are used.
- C. Splice cables and wires only in outlet boxes, junction boxes, pull boxes.
- D. Wires of different systems (i.e. 120V, 277V) shall not be installed in the same conduit or junction box system.
- E. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.
- F. For panelboards, cabinets, wireways, switches, and equipment assemblies, neatly form, train, and tie the cables in individual circuits.
- G. Wire Pulling:
 - 1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
 - 2. Use ropes made of nonmetallic material for pulling feeders.
 - 3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the Resident Engineer.
 - 4. Pull in multiple cables together in a single conduit.

3.3 SPLICE INSTALLATION

- A. Splices and terminations shall be mechanically and electrically secure.
- B. Where the Resident Engineer or Project Manager determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices at no additional cost to the owner.

3.5 CONTROL AND SIGNAL WIRING INSTALLATION

- A. Unless otherwise specified in other sections, install wiring and connect to equipment/devices to perform the required functions as shown and specified.
- B. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system will not affect other systems.
- C. Where separate power supply circuits are not shown, connect the systems to the nearest panelboards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.
- D. Install a red warning indicator on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems.
- E. System voltages shall be 120 volts or lower where shown on the drawings or as required by the NEC.

3.6 CONTROL AND SIGNAL SYSTEM IDENTIFICATION

- A. Install a permanent wire marker on each wire at each termination.

- B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- C. Wire markers shall retain their markings after cleaning.

3.7 FEEDER IDENTIFICATION

- A. In each interior pulbox, wire trough and junction box, install metal tags on each circuit cables and wires to clearly designate their circuit identification and voltage.

3.8 EXISTING WIRING

Unless specifically indicated on the plans, existing wiring shall not be reused for the new installation. Only wiring that conforms to the specifications and applicable codes may be reused. If existing wiring does not meet these requirements, existing wiring may not be reused and new wires shall be installed.

3.9 FIELD TESTING

- A. Feeders and branch circuits shall have their insulation tested after installation and before connection to utilization devices such as motors, or appliances.
- B. Tests shall be performed by megger and conductors shall test free from short-circuits and grounds.
- C. Test conductor phase-to-phase and phase-to-ground.
- D. The Contractor shall furnish the instruments, materials, and labor for these tests.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies general grounding and bonding requirements of electrical equipment operations and to provide a low impedance path for possible ground fault currents.
- B. "Grounding electrode system" refers to all electrodes required by NEC, as well as including made, supplementary, lightning protection system grounding electrodes.

The terms "connect" and "bond" are used interchangeably in this specification and have the same meaning.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low Voltage power and lighting wiring.

1.3 SUBMITTALS

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:
 - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - 2. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.
- C. Test Reports: Provide certified test reports of ground resistance.
- D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the Resident Engineer:
 - 1. Certification that the materials and installation is in accordance with the drawings and specifications.
 - 2. Certification, by the Contractor, that the complete installation has been properly installed and tested.

1.4 APPLICABLE PUBLICATIONS

Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

- A. American Society for Testing and Materials (ASTM):
 - B1-2001 Standard Specification for Hard-Drawn Copper Wire
 - B8-2004 Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 81-1983 IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
- C. National Fire Protection Association (NFPA):
 - 70-2005 National Electrical Code (NEC) 99-2005 Health Care Facilities
- D. Underwriters Laboratories, Inc. (UL):
 - 44-2005 Thermoset-Insulated Wires and Cables
 - 83-2003 Thermoplastic-Insulated Wires and Cables 467-2004 Grounding and Bonding Equipment
 - 486A-486B-2003 Wire Connectors PART 2 – PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

- A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 25 mm² (4 AWG) and larger shall be permitted to be identified per NEC.
- B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.
- C. Isolated Power System: Type XHHW-2 insulation with a dielectric constant of 3.5 or less.
- D. Electrical System Grounding: Conductor sizes shall not be less than what is shown on the drawings and not less than required by the NEC, whichever is greater.
- E. Quantity of rods shall be as required to obtain the specified ground resistance.

2.2 SPLICES AND TERMINATION COMPONENTS

Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

2.3 GROUND CONNECTIONS

- A. Above Grade:
 - 1. Bonding Jumpers: compression type connectors, using zinc-plated fasteners and external tooth lockwashers.
 - 2. Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.
 - 3. Rack and Cabinet Ground Bars: one-hole compression-type lugs using zinc-

plated or copper alloy fasteners.

2.4 GROUND TERMINAL BLOCKS

At any equipment mounting location (e.g. backboards and hinged cover enclosures) where rack- type ground bars cannot be mounted, provide screw lug-type terminal blocks.

PART 3 - EXECUTION

3.1 GENERAL

- A. Ground in accordance with the NEC and as hereinafter specified.
- B. Equipment Grounding: Metallic structures (including ductwork and building steel), enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.
- C. Conduit Systems:
 - 1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
 - 2. Non-metallic conduit systems shall contain an equipment grounding conductor, except that non-metallic feeder conduits which carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment need not contain an equipment grounding conductor.
 - 3. Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.
- D. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power branch circuits.
- E. Boxes, Cabinets, Enclosures, and Panelboards:
 - 1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
 - 2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
 - 3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.
- F. Motors and Starters: Provide lugs in motor terminal box and starter housing or motor control center compartment to terminate equipment grounding conductors.

3.2 CORROSION INHIBITORS

When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.3 CONDUCTIVE PIPING

- A. Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

END OF SECTION

SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise.
- B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

1.2 RELATED WORK

- A. Sealing around penetrations to maintain the integrity of fire rated construction: Section 07 84 00, FIRESTOPPING.
- B. Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building: JOINT SEALANTS.
- C. General electrical requirements and items that is common to more than one section of Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- D. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

1.3 SUBMITTALS

In accordance with SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:

- A. Shop Drawings:
 - 1. Size and location of main feeders;
 - 2. Size and location pull boxes
 - 3. Layout of required conduit penetrations through structural elements.
 - 4. The specific item proposed and its area of application shall be identified on the catalog cuts.
- B. Certification: Prior to final inspection, deliver to the Resident Engineer or Project Manager four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. National Fire Protection Association (NFPA): 70-05 National Electrical Code (NEC)
- C. Underwriters Laboratories, Inc. (UL):
 - 1-03 Flexible Metal Conduit
 - 6-03 Rigid Metal Conduit
 - 50-03 Enclosures for Electrical Equipment
 - 360-03 Liquid-Tight Flexible Steel Conduit
 - 467-01 Grounding and Bonding Equipment
 - 514A-01 Metallic Outlet Boxes
 - 514B-02 Fittings for Cable and Conduit
 - 797-03 Electrical Metallic Tubing
 - 1242-00 Intermediate Metal Conduit
- D. National Electrical Manufacturers Association (NEMA):
 - FB1-03 Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Conduit Size: In accordance with the NEC, but not less than 13 mm (1/2 inch) unless otherwise shown. Where permitted by the NEC, 13 mm (1/2 inch) flexible conduit may be used for tap connections to recessed lighting fixtures.
- B. Conduit:
 1. Rigid galvanized steel: Shall Conform to UL 6, ANSI C80.1.
 2. Rigid aluminum: Shall Conform to UL 6A, ANSI C80.5.
 3. Rigid intermediate steel conduit (IMC): Shall Conform to UL 1242, ANSI C80.6.
 4. Electrical metallic tubing (EMT): Shall Conform to UL 797, ANSI C80.3. Maximum size not to exceed 105 mm (4 inch) and shall be permitted only with cable rated 600 volts or less.
 5. Flexible galvanized steel conduit: Shall Conform to UL 1.
 6. Liquid-tight flexible metal conduit: Shall Conform to UL 360.
 7. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).
 8. Surface metal raceway: Shall Conform to UL 5.
- C. Conduit Fittings:
 1. Rigid steel and IMC conduit fittings:
 - a. Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable

type IMC couplings are also acceptable. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.

- b. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
 - c. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
 - d. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
 - e. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.
2. Rigid aluminum conduit fittings:
- a. Standard threaded couplings, locknuts, bushings, and elbows: Malleable iron, steel or aluminum alloy materials; Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.
 - b. Locknuts and bushings: As specified for rigid steel and IMC conduit.
 - c. Set screw fittings: Not permitted for use with aluminum conduit.
3. Electrical metallic tubing fittings:
- a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
 - b. Only steel or malleable iron materials are acceptable.
 - c. Couplings and connectors: Concrete tight and rain tight, with connectors having insulated throats. Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller. Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches). Use set screws of case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
 - d. Indent type connectors or couplings are prohibited.
 - e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
4. Flexible steel conduit fittings:
- a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.

- b. Clamp type, with insulated throat.
 - 5. Liquid-tight flexible metal conduit fittings:
 - a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
 - b. Only steel or malleable iron materials are acceptable.
 - c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
 - 6. Expansion and deflection couplings:
 - a. Conform to UL 467 and UL 514B.
 - b. Accommodate, 19 mm (0.75 inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
 - c. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, and the NEC code tables for ground conductors.
 - d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.
- D. Conduit Supports:
 - 1. Parts and hardware: Zinc-coat or provide equivalent corrosion protection.
 - 2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
 - 3. Multiple conduit (trapeze) hangers: Not less than 38 mm by 38 mm (1-1/2 by 1-1/2 inch), 12 gage steel, cold formed, lipped channels; with not less than 9 mm (3/8 inch) diameter steel hanger rods.
 - 4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.
- E. Outlet, Junction, and Pull Boxes:
 - 1. UL-50 and UL-514A.
 - 2. Cast metal where required by the NEC or shown, and equipped with rustproof boxes.
 - 3. Sheet metal boxes: Galvanized steel, except where otherwise shown.
 - 4. Flush mounted wall or ceiling boxes shall be installed with raised covers so that front face of raised cover is flush with the wall. Surface mounted wall or ceiling boxes shall be installed with surface style flat or raised covers.
 - 5. Wireways: Equip with hinged covers.
- F. Warning Tape: Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape detectable type,

red with black letters, and imprinted with "CAUTION BURIED ELECTRIC LINE BELOW".

PART 3 - EXECUTION

3.1 PENETRATIONS

- A. Cutting or Holes:
 - 1. Locate holes in advance where they are proposed in the structural sections such as ribs or beams. Obtain the approval of the COTR prior to drilling through structural sections.
 - 2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed, except where permitted by the COTR as required by limited working space.
- B. Fire Stop: Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING, with rock wool fiber or silicone foam sealant only. Completely fill and seal clearances between raceways and openings with the fire stop material.
- C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight as specified in Section 07 92 00, JOINT SEALANTS.

3.2 INSTALLATION, GENERAL

- A. In accordance with UL, NEC, as shown, and as hereinafter specified.
- B. Essential (Emergency) raceway systems shall be entirely independent of other raceway systems, except where specifically "accepted" by NEC Article 517.
- C. Install conduit as follows:
 - 1. In complete runs before pulling in cables or wires.
 - 2. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
 - 3. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
 - 4. Cut square with a hacksaw, ream, remove burrs, and draw up tight.
 - 5. Mechanically and electrically continuous.
 - 6. Independently support conduit at 8'0" on center. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts).
 - 7. Support within 300 mm (1 foot) of changes of direction, and within 300 mm (1 foot) of each enclosure to which connected.

8. Close ends of empty conduit with plugs or caps at the rough-in stage to prevent entry of debris, until wires are pulled in.
 9. Secure conduits to cabinets, junction boxes, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
 10. Do not use aluminum conduits in wet locations.
- D. Conduit Bends:
1. Make bends with standard conduit bending machines.
 2. Conduit hickey may be used for slight offsets, and for straightening stubbed out conduits.
 3. Bending of conduits with a pipe tee or vise is prohibited.
- E. Layout and Homeruns:
1. Install conduit with wiring, including homeruns, as shown.
 2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the Resident Engineer or Project Manager.

3.3 EXPOSED WORK INSTALLATION

- A. Unless otherwise indicated on the drawings, exposed conduit is only permitted in mechanical and electrical rooms.
- B. Conduit for Conductors 600 volts and below:
 1. Rigid steel, IMC, rigid aluminum, or EMT. Different type of conduits mixed indiscriminately in the system is prohibited.
- C. Align and run conduit parallel or perpendicular to the building lines.
- D. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
- E. Support horizontal or vertical runs at not over 2400 mm (eight foot) intervals.

3.4 WET OR DAMP LOCATIONS

- A. Unless otherwise shown, use conduits of rigid steel or IMC.
- B. Provide sealing fittings, to prevent passage of water vapor, where conduits pass from warm to cold locations, i.e., (refrigerated spaces, constant temperature rooms, air conditioned spaces building exterior walls, roofs) or similar spaces.

3.5 MOTORS AND VIBRATING EQUIPMENT

- A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.

- B. Provide liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, inside (air stream) of HVAC units, and locations subject to seepage or dripping of oil, grease or water. Provide a green ground wire with flexible metal conduit.

3.6 EXPANSION JOINTS

- A. Conduits 75 mm (3 inches) and larger, that are secured to the building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
- B. Provide conduits smaller than 75 mm (3 inches) with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes with sufficient slack of flexible conduit to produce 125 mm (5 inch) vertical drop midway between the ends. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 375 mm (15 inches) and larger conduits are acceptable.
- C. Install expansion and deflection couplings where required.
- D. Seismic Areas: In seismic areas, provide conduits rigidly secured to the building structure on opposite sides of a building expansion joint with junction boxes on both sides of the joint. Connect conduits to junction boxes with 375 mm (15 inches) of slack flexible conduit. Flexible conduit shall have a copper green ground bonding jumper installed.

3.7 CONDUIT SUPPORTS, INSTALLATION

- A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.
- B. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.
- C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U-bolts or other approved fasteners.
- D. Support conduit independently of junction boxes, pull boxes, angle supports, and similar items.
- E. Fasteners and Supports in Solid Masonry and Concrete:
 - 1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
 - 2. Existing Construction:
 - a. Steel expansion anchors not less than 6 mm (1/4 inch) bolt size and not less than 28 mm (1-1/8 inch) embedment.
 - b. Power set fasteners not less than 6 mm (1/4 inch) diameter with depth of penetration not less than 75 mm (3 inches).
 - c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.

- F. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
- G. Spring steel type supports or fasteners are prohibited for all uses except: Horizontal and vertical supports/fasteners within walls.

3.8 BOX INSTALLATION

- A. Boxes for Concealed Conduits:
 - 1. Provide raised covers for boxes to suit the wall or ceiling, construction and finish.
- B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling in operations.
- C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
- D. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "PWR-CH1 JB No. 1".
- E. On all Branch Circuit junction box covers, identify the circuits with black marker.

END OF SECTION

SECTION 26 29 11
MOTOR STARTERS

PART 1 - GENERAL

1.1 DESCRIPTION

All motor starters and variable speed motor controllers, including installation and connection (whether furnished with the equipment specified in other Divisions or otherwise), shall meet these specifications.

1.2 RELATED WORK

- A. Other sections which specify motor driven equipment, except elevator motor controllers.
- B. Section: SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirement for Seismic Restraint for Nonstructural Components.
- C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one Section of Division 26.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS:

- A. Shop Drawings:
 - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - 2. Include electrical ratings, dimensions, weights, mounting details, materials, running over current protection, size of enclosure, over current protection, wiring diagrams, starting characteristics, interlocking and accessories per unit equipment manufacturer.
- B. Manuals:
 - 1. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets, wiring diagrams and information for ordering replacement parts.

- a. Wiring diagrams shall have their terminals identified to facilitate installation, maintenance and operation.
 - b. Wiring diagrams shall indicate internal wiring for each item of equipment and interconnections between the items of equipment.
 - c. Elementary schematic diagrams shall be provided for clarity of operation.
 - 2. Two weeks prior to the project final inspection, submit four copies of the final updated maintenance and operating manual to the Resident Engineer.
- C. Certification: Two weeks prior to final inspection, unless otherwise noted, submit four copies of the following certifications to the Resident Engineer:
 - 1. Certification that the equipment has been properly installed, adjusted, and tested.
 - 2. Certification by the manufacturer that medium voltage motor controller(s) conforms to the requirements of the drawings and specifications. This certification must be furnished to the Resident Engineer prior to shipping the controller(s) to the job site.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
- B. Institute of Electrical and Electronic Engineers (IEEE):
 - 519 Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
- C. National Electrical Manufacturers Association (NEMA):
 - ICS 1 Industrial Control and Systems General Requirements
 - ICS 1.1 Safety Guidelines for the Application, Installation and Maintenance of Solid State Control
 - ICS 2 Industrial Control and Systems, Controllers, Contactors and Overload Relays Rated 600 Volts DC
 - ICS 6 Industrial Control and Systems Enclosures
- D. National Fire Protection Association (NFPA):
 - 70 National Electrical Code (NEC)
- E. Underwriters Laboratories Inc. (UL):
 - 508 Industrial Control Equipment
 - 2020 Cooling Tower Replacement RFP

PART 2 - PRODUCTS

2.1 MOTOR STARTERS, GENERAL

- A. Shall be in accordance with the requirements of the IEEE, NEC, NEMA (ICS 1, ICS 1.1, ICS 2, ICS 6 and UL.
- B. Shall have the following features:
 - 1. Separately enclosed unless part of another assembly.
 - 2. Circuit breakers and safety switches within the motor controller enclosures shall have external operating handles with lock-open padlocking provisions and shall indicate the ON and OFF positions.
 - 3. Motor control circuits:
 - a. Shall operate at not more than 120 volts.
 - b. Shall be grounded except as follows:
 - 1) Where isolated control circuits are shown.
 - 2) Where manufacturers of equipment assemblies recommend that the control circuits be isolated.
 - c. Incorporate a separate, heavy duty, control transformer within each motor controller enclosure to provide the control voltage for each motor operating over 120 volts.
 - d. Incorporate over current protection for both primary and secondary windings of the control power transformers in accordance with the NEC.
 - 4. Overload current protective devices:
 - a. Overload relay (thermal or induction type).
 - b. One for each pole.
 - c. Manual reset on the door of each motor controller enclosure.
 - d. Correctly sized for the associated motor's rated full load current.
 - e. Check every motor controller after installation and verify that correct sizes of protective devices have been installed.
 - f. Deliver four copies of a summarized list to the Resident Engineer, which indicates and adequately identifies every motor controller installed. Include the catalog numbers for the correct sizes of protective devices for the motor controllers.
 - 5. H-O-A switch is not required for manual motor starters.
 - 6. Enclosures:
 - a. Shall be the NEMA types for the motor controllers and shall be the

NEMA types which are the most suitable for the environmental conditions where the motor controllers are being installed.

- b. Doors mechanically interlocked to prevent opening unless the breaker or switch within the enclosure is open. Provision for padlock must be provided.
 - c. Enclosures shall be primed and finish coated at the factory with the manufacturer's prime coat and standard finish.
- C. Motor controllers incorporated with equipment assemblies shall also be designed for the specific requirements of the assemblies.
- D. Additional requirements for specific motor controllers, as indicated in other sections, shall also apply.
- E. Provide a disconnecting means or safety switch near and within sight of each motor. Provide all wiring and conduit required to facilitate a complete installation.

2.2 MANUAL MOTOR STARTERS

- A. Shall be in accordance with applicable requirements of 2.1 above.
- B. Manual motor starters.
- 1. Starters shall be general-purpose Class A, manually operated type with full voltage controller for induction motors, rated in horsepower.
 - 2. Units shall include overload protection, red pilot light, auxiliary contact and toggle operator.
- C. Fractional horsepower manual motor starters.
- 1. Starters shall be general-purpose Class A, manually operated with full voltage controller for fractional horsepower induction motors.
 - 2. Units shall include thermal overload protection, red pilot light and toggle operator.
- D. Motor starting switches.
- 1. Switches shall be general-purpose Class A, manually operated type with full voltage controller for fractional horsepower induction motors.
 - 2. Units shall include thermal overload protection, red pilot light low voltage protection, auxiliary contact and toggle operator.

2.3 MAGNETIC MOTOR STARTERS

- A. Shall be in accordance with applicable requirements of 2.1 above.
- B. Starters shall be general-purpose, Class A magnetic controllers for induction motors rated in horsepower. Minimum size 0.
- C. Where combination motor starters are used, combine starter with protective or disconnect device in a common enclosure.

- D. Provide phase loss protection for each starter, with contacts to de-energize the starter upon loss of any phase.
- E. Unless otherwise indicated, provide full voltage non-reversing across-the-line mechanisms for motors less than 75 HP, closed by coil action and opened by gravity.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install motor control equipment in accordance with manufacturer's recommendations, the NEC and NEMA.
- B. Furnish and install heater elements in motor starters and to match the installed motor characteristics. Submit a list of all motors listing motor nameplate rating and heater element installed.
- C. Motor Data: Provide neatly-typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, voltage/phase rating and heater element installed.

3.2 Acceptance Checks and Tests

- A. Perform in accordance with the manufacturer's recommendations. Include the following visual and mechanical inspections and electrical tests:
 - 1. Visual and Mechanical Inspection
 - a. Compare equipment nameplate data with specifications and approved shop drawings.
 - b. Inspect physical, electrical, and mechanical condition.
 - c. Inspect contactors.
 - d. Verify overload element ratings are correct for their applications.
 - e. If motor-running protection is provided by fuses, verify correct fuse rating.
 - f. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.

3.3 FOLLOW-UP VERIFICATION

Upon completion of acceptance checks, settings, and tests, the Contractor shall show by demonstration in service that the motor starters are in good operating condition and properly performing the intended functions.

3.4 SPARE PARTS

Two weeks prior to the final inspection, provide one complete set of spare fuses (including heater elements) for each starter/controller installed on this project.

END OF SECTION

Appendix B – Construction Drawings

This appendix contains the construction drawings for the replacement of the cooling tower.

The Project and its drawings have been approved by the City and County of San Francisco. Contractor will be responsible for procuring all permits related to the Project.

CONT. GENERAL NOTES

- 7. Devices and equipment
 - a. All general type receptacles shall be rated 20 ampere, 125-volt DECORA type outlets as minimum unless noted in the drawings.
 - b. Noted or not in construction drawings to meet code. Provide weatherproof GFI type duplex receptacle within 25 ft. of the vicinity of mechanical equipment in the roof, and standard duplex receptacle within the building space.
 - c. All outdoor duplex receptacles shall be GFI type in a cast iron weatherproof enclosure
 - d. Label all outlets and junction boxes of the branch circuit used with Dymo type labeler.
 - e. All device shall be stainless type.
- 8. Electrical test
 - a. Submit all test results to the Engineer for review and approval. Submit test procedure prior to testing for review. Testing shall be performed by independent testing agency certified by NETA.
 - b. Megger all the new feeder cables in accordance with NETA latest standard procedure.
 - c. New cables should be checked for insulation resistance (megger testing).

LEGEND

-  NON-FUSED DISCONNECT, FUSED DISCONNECT (HP RATED) MIN. AS-AMP SWITCH, AF-AMP FUSE
-  JUNCTION BOX-CEILING, WALL MOUNTED
-  COMBINATION MAGNETIC MOTOR STARTER
-  MOTOR CONNECTION
-  MANUAL STARTER WITH THERMAL OVERHEAD (FRACTIONAL HP)
-  ELECTRICAL EQUIPMENT TAG
-  SHEET NOTE TAG
- (E), (N) EXISTING, NEW
- U.O.N UNLESS OTHERWISE NOTED
-  MOTOR OUTLET AND CONNECTIONS
- — — (E) CONDUIT RUN
-  VARIABLE FREQUENCY DRIVE UNDER DIV.25

SHEET INDEX

- EO.1 - LEGEND, GENERAL NOTES, AND ABBREVIATION
- E1.0 - PARTIAL ROOF ELECTRICAL DEMOLITION AND NEW PLANS

CONT. GENERAL NOTES

- c. Install a separate conduit for each home run indicated in the drawings.
- d. Do not run conduit closer than 6 inches to any hot water pipe, steam pipe, heater flue or vent.
- e. Install "EYS" conduit seals in all conduits entering or leaving hazardous areas, refrigerated rooms and clean rooms.
- f. Holes for conduits through existing concrete floors or walls shall be made by "core-drill" method. Prior to core drilling, determine conditions of the existing floor structure by X-ray, pacometer or other methods approved by the engineer of record. Coring shall be approved by UCB prior to any coring work.
- g. Exposed conduit installed within 8 feet above finished floor: Rigid steel conduit with compression fittings.
- h. Conductor color-coding shall match existing color-coding.
- i. Provide raceways penetrating fire rated walls, floors and ceilings with UL listed fire seals approved by Authority Having Jurisdiction. For additional information, refer to detail sheets and architectural drawings for identifying rated walls.
- j. Raceways passing thru structural expansion joints shall have expansion/deflection fittings (OZ Gedney AX/DX) or convert to flexible conduit with external ground bonding jumper strip. Flexible conduit shall have a minimum of 12 inches slack and allow seismic movement required by the structural engineer.
- k. Major raceways requiring elbow installation in the tight condition shall be provided with "Erickson coupling."
- l. Paint all exposed metal surface raceways, conduits, pullboxes, junction boxes, supports etc with paint type and color approved by the Owner/Architect. Paint color to match wall paint color.
- m. Provide all carpentry, cutting and patching for proper installation of electrical equipment, devices and raceways. Do not cut or drill structural elements without consent of Architect. All cutting and repairing shall conform to title 24 of California Code of regulations.
- n. The location of all accessories, conduit routing, trenching, saw cutting and coring on these drawings are shown diagrammatically. Coordinate exact locations with Owner/Architect prior to rough-in. Inaccuracies resulting from failure to comply with these requirements shall be corrected without additional cost to the owner.
- o. Exposed exterior conduit installation shall be coordinated with Architect and Engineer. Contractor shall submit drawings showing the proposed location of conduit and boxes to Architect for review and approval prior to rough-in.
- p. Conductors for circuiting shall be color-coded solid copper with minimum size no. 12 AWG, THWN insulation.
- q. Provide insulated green equipment grounding conductor in feeders and all branch circuits, including lighting circuits. Isolated ground conductor shall be green with yellow stripes.
- r. Provide 12 inches separation between power and signal raceways.
- s. Supports for all conduits shall be in accordance with NEC and the latest SMACNA "Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Systems."
- 6. Branch circuit wiring
 - a. Upsize wire size to next higher size for 120-volt system circuit homeruns exceeding 100 feet run from the first device to the respective panel.
 - b. Provide grounding wire in all feeders and branch circuits. Grounding wire size per NEC. Code size grounding wire shall be from panel and carried through to last device or equipment.
 - c. Provide a maximum of three (3) circuit conductors (from different phases) in a homerun with common neutral unless otherwise noted. Homeruns shall be conduit from the first junction box to the panel. Multi conductor cable is not allowed. This is considered as multi-wire branch circuits requiring simultaneous disconnection. Provide individual single pole breakers with common handle tie. Refer to 2016 NEC 210.4(A)(B).
 - d. Group all wires of multi-wire branch circuits with cable tie or similar means in the panelboard.
 - e. Identify branch circuit in all wires and junction boxes with black permanent markers. Use red color for emergency circuit, black for normal, and blue for isolated circuit.
 - f. Branch circuit wiring guide: Install individual neutral wire of same size as the phase wires for every three (3)-branch circuits in common raceway from panel to the last device. For data power outlet, install individual #10 neutral wire per #12 phase wire circuit or size to the next higher rating from the phase wires.
 - g. All home runs designated to the panelboard shall be assumed as starting from the nearest outlet and continuing in the general direction of the panel. Continue such circuits to the panel as though the routes are completely indicated. Home runs requiring upsizing circuit conductors for voltage drop (ie: #10 wire on 20-Ampere circuit breaker) shall have the conductor size carried throughout the run up to the last device.
 - h. All wiring for branch circuits shall be #12 AWG protected by 20-ampere circuit breaker unless otherwise indicated. If distance from panel to the first outlet is 100 feet or greater, provide #10 AWG. For derating factor for wire ampacity regarding wire quantity in a raceway refer to NEC Table B-310-11 and provide the correct wire size of the same insulation.

GENERAL NOTES

- 1. General Coordination Requirements
 - a. Contractor shall comply with the most stringent requirements indicated either by drawings or by the general notes.
 - b. Contractor shall visit the job site, verify field conditions, review construction documents and shall include all cost to construct the project in accordance with these construction documents and applicable codes.
 - c. All electrical work indicated on the construction documents, as a minimum, shall comply with all the applicable provisions of the latest edition of the NEC, local applicable codes, and authority having jurisdiction. These applicable code requirements whether indicated or not on the construction documents, constitute as part of the contract and shall be furnished without cost to the contact and owner.
 - d. Contractor shall bring to the attention of the architect any discrepancies or conflicts in the construction documents or the site conditions. The architect must approve all construction document revisions due to such discrepancies and conflicts in writing prior to commencing work.
 - e. Contractor shall obtain and pay all permits and fees required for the work.
 - f. All materials and equipment furnished and installed shall be new, free from defects and guaranteed for a period of one year from the date of the final acceptance by the owner. Should any problem arises within the guaranteed period due to faulty workmanship and material, the contractor shall furnish all necessary materials and labor to rectify the problem without additional cost to the owner.
 - g. Notify the owner representative at least three (3) weeks prior to commencing work in a particular area. Before any cutting or demolition work, contractor shall carefully survey the existing condition and review the construction documents to determine the scope of work. Contractor shall take all the necessary precautions not to damage any existing work to remain, or reuse as property of the owner. Repair or replace any damage to such at no additional cost to the owner. Provide required structural supports to elements that have been cut removed or demolished under any part of this contract.
 - h. Coordinate and schedule all work with all necessary consideration for the owner and the public. Avoid interference with the use of, and passage to and from adjacent areas and facilities designated to remain in use during demolition. Maintain all existing circuits to items required to remain in use. Provide abandoned outlet boxes with blank cover plates painted to match wall finished.
 - i. These plans refer to existing electrical facilities and are based upon the best information available at this time. Contractor shall field verify the information contained herein and report any inaccuracies, code violations, omissions and other unforeseen conditions affecting the indicated work to the Architect. Report to the Architect in writing all conditions found which will prevent proper provisions of this work. Commencing work without reporting such, conditions constitute acceptance of condition by the contractor. Therefore, required removal, repair and replacement due to such conditions shall be the sole responsibility of the contractor with no additional cost to the owner.
 - j. (For existing facility only): Prior to submitting proposal, bidder shall examine the complete construction documents thoroughly and visit the site for familiarity of the existing conditions under which he will have to operate and any which way can affect the work on this contract. Failure to adhere to this note shall constitute as a mis-coordination. Resulted to additional work shall not cost the owner.
 - k. Contractor shall be responsible for verifying the electrical characteristics and additional requirements of all equipment. Provide all necessary accessories for a complete, code-compliant and manufacturer-approved electrical wiring.
- 2. Drawing Description
 - a. Drawings are generally diagrammatic. Intention is to show size, capacity, approximate location, direction, and general relationship of one work phase to another. Drawings do not reflect exact detail or arrangement.
 - b. Scaled and figured dimensions are approximate and are for estimating purposes only. Indicated dimensions are limiting dimensions.
 - c. Before proceeding with the work, check and field verify all dimensions.
 - d. Contractor shall assume complete responsibility for fitting all materials and equipment to other parts of equipment and architectural and structural elements. Make adjustments that may be necessary or requested in order to resolve space problems, preserve headroom, and avoid architectural openings, structural members and work of other trades at no cost to the owner.
 - e. For exact locations of building elements, refer to dimensional architectural/structural drawings. Location shown on architectural ceiling drawings or on wall elevations shall take precedence over electrical drawing locations.
 - f. If documents interpretation is requested, contractor shall propose solution in accordance with all affected sub-contractors. Clearly identify areas requiring engineer's review by circling the area on coordinated shop drawings/contract documents and write questions that requires resolution.
- 4. Mechanical Equipment and Motor wiring
 - a. Provide fused disconnect to each mechanical equipment. Disconnect shall be a fused type and Horsepower rated with NEMA enclosure designation based on application. Fuse rating shall be coordinated with the manufacturer. This requirement shall take precedent over drawings.
 - b. Provide Horsepower and NEMA rated enclosed combination fused/starter to every motor not covered under Division 15. Starter shall have—at minimum—auxiliary contacts, run/off pilot lights and HOA switch for control interface. Size starter per motor HP rating.
 - c. Panel breaker feeding the equipment or motor shall be HACR type with rating compatible with equipment—required protection as directed by the manufacturer.
 - d. Final wiring shall be an adequate length of seal-tite (liquid-tight) flexible conduit 15 inches minimum, and 36 inches maximum.
 - e. Locate disconnect in accessible area, and within motor or equipment sight with 36 inches minimum code clearance in the front for maintenance and operation.
- 5. Wiring
 - a. General wiring shall be in EMT conduit. 3/4" minimum, with compression fittings. If conflict with specifications arises, this requirement shall take precedence.
 - b. Route all surface raceways shown along the walls, unless Architect or existing condition does not permit. (Across the ceiling as approved) Installation shall be as tight to corners as possible and perpendicular to building elements. Paint to match wall finished. Refer to architectural specifications.



ISSUE	INFORMATION	DATE
1.	ISSUE FOR PERMIT	07.18.17
2.	ISSUE FOR PERMIT	10.24.19
3.	ISSUE FOR BID	12.19.19

ARCHITECT

CONSULTANT



WestEd
730 HARRISON STREET
SAN FRANCISCO, CA 94107

LEGEND, GENERAL NOTES, AND ABBREVIATIONS

JOB NUMBER
CCE 19149

DRAWN BY
KV

SCALE

EO.1



ISSUE	INFORMATION	DATE
1.	ISSUE FOR PERMIT	07.18.17
2.	ISSUE FOR PERMIT	10.24.19
3.	ISSUE FOR BID	12.19.19

ARCHITECT

CONSULTANT



Cengineers
CANYON CONSULTING ENGINEERS
3150 Hilltop Mall Rd., Ste 18
Richmond, CA 94806

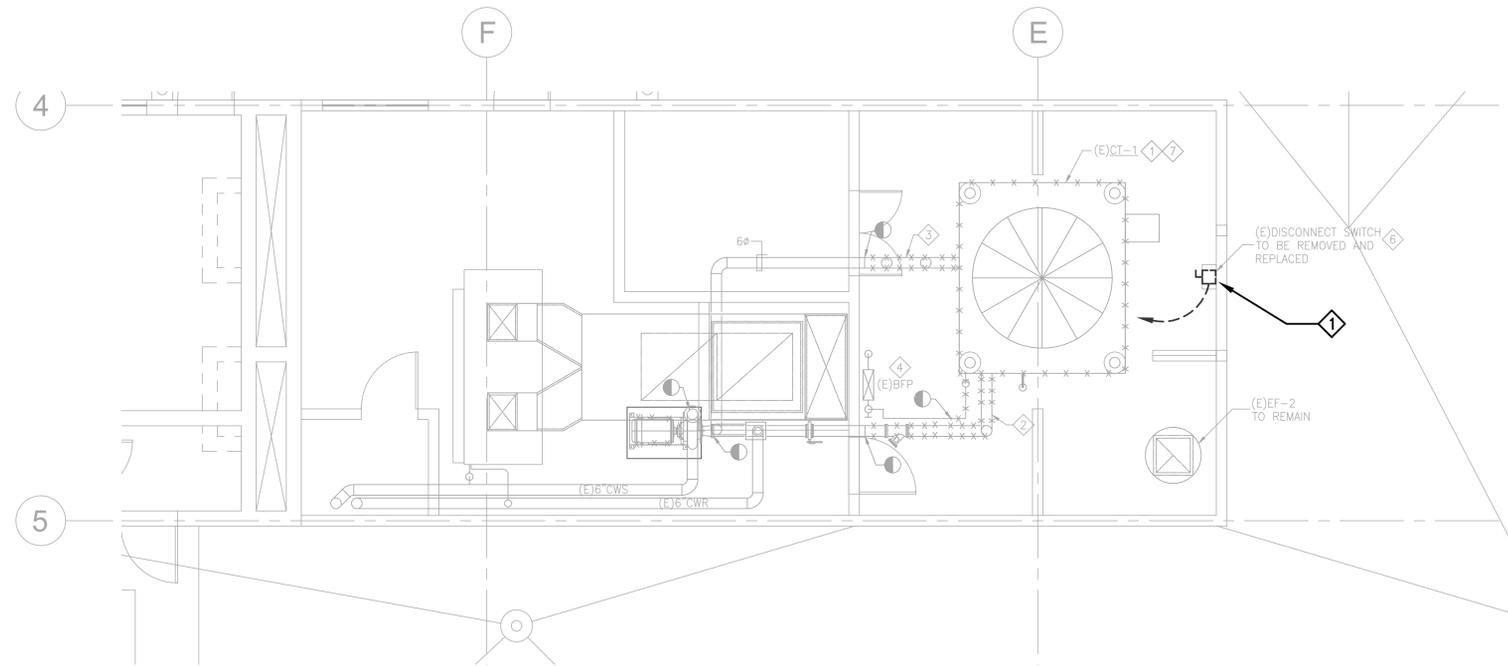
WestEd
730 HARRISON STREET
SAN FRANCISCO, CA 94107

PARTIAL ROOF ELECTRICAL
DEMOLITION AND NEW PLAN

JOB NUMBER
CCE 19149

DRAWN BY
KV

SCALE
E1.0

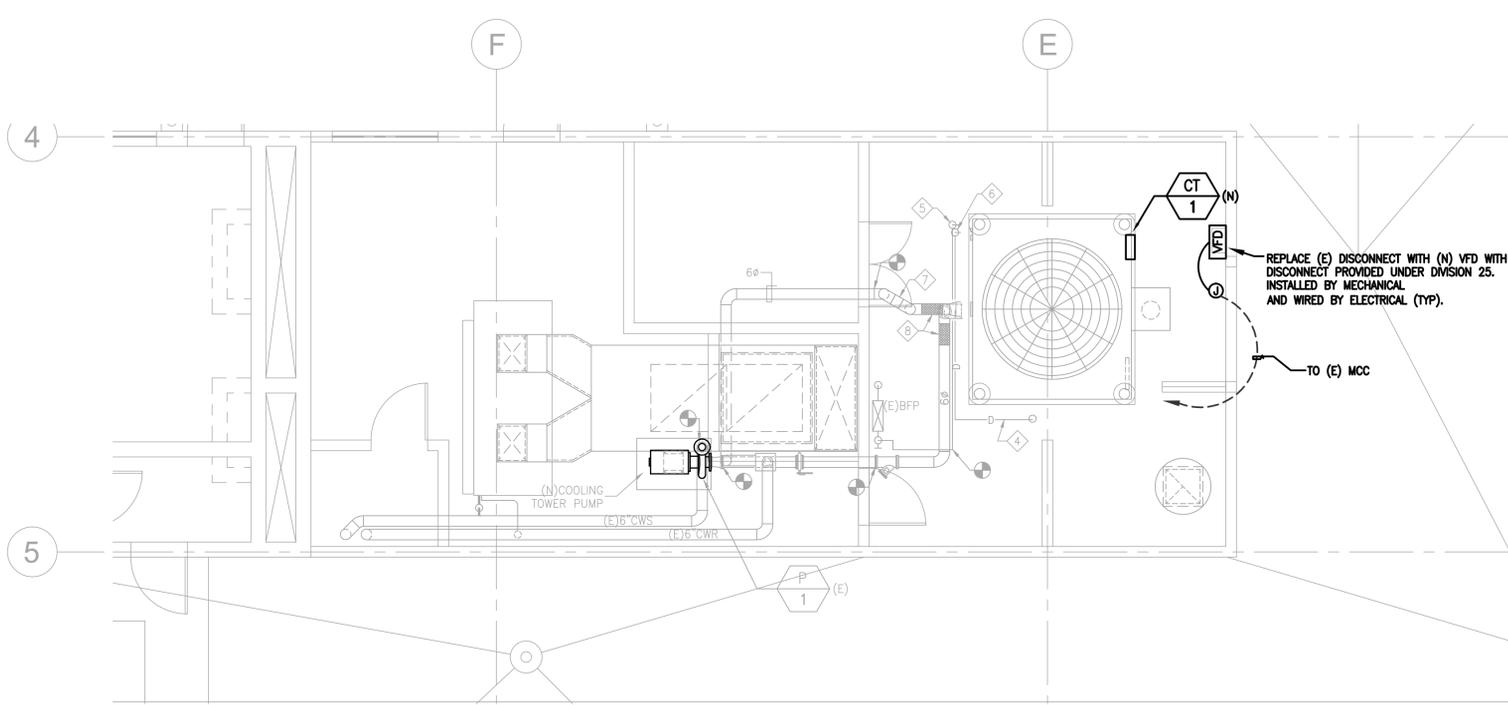


SHEET NOTES:
1 DISCONNECT (E) MOTOR AND ASSOCIATED NON-FUSED DISCONNECT TO ALLOW REMOVAL OF MOTOR. (E) BRANCH WIRING TO REMAIN AND TAG FOR FUTURE USE.



DISCONNECT AND REMOVE (E) 7.5 HP AND REPLACED WITH (N) 10 HP CT-FAN MOTOR.

REFERENCE PHOTO #1



REPLACE (E) DISCONNECT WITH (N) VFD WITH DISCONNECT PROVIDED UNDER DIVISION 25. INSTALLED BY MECHANICAL AND WIRED BY ELECTRICAL (TYP).
TO (E) MCC



(E) STARTER FOR COOLING TOWER FAN TO REMAIN.

REFERENCE PHOTO #2

PARTIAL ROOF ELECTRICAL DEMOLITION PLAN
SCALE: 1/4" = 1' - 0"
1
E1.0

PARTIAL ROOF ELECTRICAL NEW PLAN
SCALE: 1/4" = 1' - 0"
2
E1.0



MECHANICAL SYMBOL LIST

NOTE: This is a standard symbol list and not all items listed may be used.

Abbreviations		Piping Fittings, Appurtenances and Equipment	
A/C	AIR CONDITION(ED)	MA	MIXED AIR
AD	ACCESS DOOR	MAX	MAXIMUM
AFB	ABOVE FINISHED FLOOR	MBH	THOUSAND BTU'S PER HOUR
BDD	BACKDRAFT DAMPER	MIN	MINIMUM
BFF	BELOW FINISHED FLOOR	N/A	NOT APPLICABLE
BFP	BACKFLOW PREVENTER	NIC	NOT IN CONTRACT
BHP	BRAKE HORSEPOWER	NO.	NUMBER
CD	CONDENSATE DRAIN	NTS	NOT TO SCALE
CONT.	CONTINUATION	OA	OUTSIDE AIR
COP	COEFFICIENT OF PERFORMANCE	OC	ON CENTER
CH	CHILLER	OD	OUTSIDE DIAMETER
CW	COLD WATER	P	PUMP
D	DROP	PD	PRESSURE DROP
DIA	DIAMETER	PH	PHASE
EER	ENERGY EFFICIENCY RATING	PRV	PRESSURE REDUCING VALVE
EF	EXHAUST FAN	PSI	POUNDS PER SQUARE INCH
EFF	EFFICIENT	R	RISE
ELECT	ELECTRICAL	RPM	REVOLUTIONS PER MINUTE
EWT	ENTERING WATER TEMPERATURE	SEER	SEASONAL ENERGY EFFICIENCY RATING
EXH	EXHAUST	SF	SQUARE FEET
F	FAHRENHEIT	SH	SENSIBLE HEAT
FLA	FULL LOAD AMPS	SOV	SHUT OFF VALVE
FT	FEET	SP	STATIC PRESSURE
GPM	GALLONS PER MINUTE	T, TEMP	TEMPERATURE
HD	HEAD	TD	TEMPERATURE DIFFERENCE
HP	HORSEPOWER	TH	TOTAL HEAT
ID	INSIDE DIAMETER	TP	TOTAL PRESSURE
IN	INCHES	TWR	COOLING TOWER WATER RETURN
KW	KILOWATT	TWS	COOLING TOWER WATER SUPPLY
LWT	LEAVING WATER TEMPERATURE	V	VOLT
LBS.	POUNDS	VIP	VERIFY IN FIELD
LH	LATENT HEAT	W/	WITH
		W	WATT

Piping Fittings, Appurtenances and Equipment		Piping Valves	
	AIR SEPARATOR		PIPE TO DRAIN
	AUTOMATIC AIR VENT		PRESSURE GAUGE WITH COCK
	BACKFLOW PREVENTER		PRESSURE RELIEF VALVE
	CAP		PRESSURE SENSOR
	CONTINUATION		SHOCK ABSORBER
	EXPANSION TANK		TEE DOWN ON PIPE
	FLOW SWITCH		TEE UP ON PIPE
	HEAT EXCHANGER		TEMPERATURE SENSOR
	HOSE BIBB		TEST PORT (PETE'S PLUG OR EQUAL)
	MANUAL AIR VENT		THERMOMETER
	PIPE DROP		VENT TO ATMOSPHERE
	PIPE RISE		FLOOR SINK
			FLOOR DRAIN
			STRAINER

Piping Symbols Extended	
	HEATING HOT WATER SUPPLY
	HEATING HOT WATER RETURN
	CHILLED WATER SUPPLY
	CHILLED WATER RETURN
	MAKE-UP WATER
	INDUSTRIAL WATER
	COOLING TOWER RETURN
	COOLING TOWER WATER SUPPLY

GENERAL NOTES

- ALL WORK SHALL BE IN ACCORDANCE WITH THE LATEST APPLICABLE LOCAL AND STATE CODES AND REGULATIONS.
- CONTRACTOR SHALL OBTAIN AND PAY FOR ALL REQUIRED FEES, PERMITS AND INSPECTIONS.
- BEFORE SUBMISSION OF AN BID, THE CONTRACTOR SHALL PERFORM A FIELD SURVEY OF THE SITE CONDITIONS AND FEATURES. ANY SITE CONDITIONS, WHICH MAY CAUSE SIGNIFICANT DEVIATION FROM THE DESIGN DRAWINGS, SHALL BE BROUGHT TO THE ATTENTION OF ARCHITECT/ENGINEER OF RECORD FOR CLARIFICATION PRIOR TO SUBMISSION OF THE CONTRACTOR'S BID. IF APPLICABLE, VERIFY DIMENSIONS OF ALL OWNER-FURNISHED EQUIPMENT TO ENSURE PROPER COORDINATION WITH CONSTRUCTION OF THIS PROJECT. THE CONTRACTOR SHALL SUBMIT BID THAT INCLUDES ALL LABOR AND MATERIALS REQUIRED TO PROVIDE FOR COMPLETE AND SATISFACTORILY OPERATING SYSTEMS IN THE BID.
- IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO COORDINATE THE EXACT REQUIREMENTS GOVERNED BY ACTUAL JOB CONDITIONS. EXISTING INFORMATION SHOWN ON PLANS IS FROM ORIGINAL RECORD DRAWINGS AND CURSORY NONDESTRUCTIVE FIELD SURVEY. THE CONTRACTOR SHALL VERIFY AND ACCOUNT FOR ALL EXISTING CONDITIONS IN THE FIELD AFFECTING THE WORK.
- MECHANICAL CONTRACTOR SHALL BE COGNIZANT WITH BUILDING STRUCTURE AND CEILING SPACE. ALLOW FOR INSTALLATION OF EQUIPMENT PRIOR TO BID AND FROM PRICING AND ADDITIONAL OFFSETS OF DUCTS AND PIPING THAT ARE NOT SHOWN ON DRAWING. CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATING AND PROVIDING ALL CEILING ACCESS, PATCHING AND REPAIR REQUIRED IN THE IMMEDIATE AREA OF THE WORK AND ANY ACCESS OUTSIDE THE IMMEDIATE AREA OF THE WORK REQUIRED TO PROVIDE COMPLETE AND PROPERLY FUNCTIONING SYSTEMS.
- ABSOLUTE ACCURACY OF DRAWINGS IS NOT GUARANTEED. REPORT DISCREPANCIES OR INCONSISTENCIES BETWEEN THE SPECIFIED DESIGN AND EXISTING CONDITIONS IN THE FIELD TO THE ARCHITECT/ENGINEER FOR CLARIFICATION AND DIRECTION PRIOR TO BID AND COMMENCEMENT OF THE WORK.
- ALL DUCT DIMENSIONS ARE SHOWN IN INCHES. ALL DIMENSIONS ARE CLEAR INSIDE SIZES. FIRST FIGURE OF DUCT SIZE INDICATES DIMENSION OF FACE SHOWN OR INDICATED.
- ALL DUCTWORK AND PIPING SHOWN ON PLANS ARE DIAGRAMMATIC AND SHALL NOT BE SCALED TO DETERMINE EXACT LOCATION.
- ADVISE OWNER'S REPRESENTATIVE IN WRITING IN EVENT OF DISCREPANCIES BETWEEN CONTRACT DOCUMENTS PRIOR TO BID.
- CONTRACTOR SHALL ASSUME SOLE RESPONSIBILITY FOR SAFETY OF ALL PERSONS ON OR ABOUT THE CONSTRUCTION SITE, IN ACCORDANCE WITH APPLICABLE LAWS AND CODES. GUARD ALL HAZARDS IN ACCORDANCE WITH THE SAFETY PROVISIONS OF THE LATEST MANUAL OF ACCIDENT PREVENTION PUBLISHED BY THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA AND OSHA.
- MECHANICAL DRAWING IS DIAGRAMMATIC. CONTRACTOR SHALL DETERMINE FINAL PIPING AND DUCT ROUTING PER ACTUAL OR EXISTING FIELD/CEILING CONDITION.
- COORDINATE WORK WITH ALL OTHER TRADES.
- PROTECT THE PUBLIC FROM INJURY DURING PROGRESS OF WORK BY POSTING WARNING SIGNS, GUARD LIGHTS AND BARRICADES. ALL DIMENSIONS ARE IN INCHES UNLESS NOTED OTHERWISE.
- FURNISH AND INSTALL ALL MATERIALS EQUIPMENT AND LABOR AS SHOWN AND AS NECESSARY FOR COMPLETE WORKABLE SYSTEMS.
- ALL NEW PIPING SHALL BE PRESSURE TESTED AS REQUIRED TO 1.5 TIMES THE OPERATING PRESSURE OR PER CURRENT CODE REQUIREMENT WHICHEVER IS MORE STRINGENT.
- PERFORM TEST AND AIR BALANCING OF HVAC SYSTEM. SUBMIT A CERTIFIED TEST AND AIR BALANCE REPORT TO ENGINEER FOR REVIEW AND APPROVAL.
- DO NOT CUT ANY STRUCTURAL MEMBERS WITHOUT THE REVIEW AND APPROVAL OF THE ARCHITECT.
- WHERE EXISTING PIPES, CONDUITS AND/OR DUCTS WHICH ARE TO REMAIN PREVENT INSTALLATION OF NEW WORK, RELOCATE, OR ARRANGE FOR RELOCATION OF THESE ITEMS TO FACILITATE NEW WORK.
- ALL MATERIALS AND WORKMANSHIP ARE SUBJECT TO REVIEW AND APPROVAL BY THE ARCHITECT/ENGINEER. ANY PORTION OF THE WORK FOUND TO BE DEFECTIVE SHALL BE REPLACED BY THE CONTRACTOR AS PART OF THIS CONTRACT AT NO ADDITIONAL COST TO THE OWNER.
- ANY PIPING OFFSETS REQUIRED AS RESULT OF EXISTING JOB CONDITIONS, OR COORDINATION WITH OTHER TRADES, SHALL BE PROVIDED BY THE CONTRACTOR AT NO ADDITIONAL COST TO OWNER AND IS SUBJECT TO REVIEW BY THE ARCHITECT/ENGINEER.
- FOR PIPES PENETRATING WALLS, PROVIDE ESCUTCHEONS FOR FINISH COVER OF EXPOSED PENETRATIONS.

COOLING TOWER SCHEDULE

MARK	MANUFACTURER	MODEL	NO. OF CELLS	HEAT REJECTION MBH	TONS	AIR CFM	WATER					FAN MOTOR				OPERATING WEIGHT LBS	REMARKS
							WB °F	EWT °F	LWT °F	GPM	WTR ΔP PSI	QTY	RPM	HP	VOLTS-ϕ		
CT-1	EVAPCO	AT 19-318	1	4,000	266.67	40,800	63	92	82	800	6	1	1,780	10	460-3ϕ	6,270	① THROUGH ⑥

NOTE: ORIGINAL COOLING TOWER OPERATING WEIGHT = 6,020 LBS

NOTES:

- ① USS ULTRA 316 STAINLESS STEEL: STAINLESS STEEL SUMP, VERTICAL SUPPORT COLUMNS, AIR INLET LOUVERS, PLENUM, CASING AND STRUCTURE (FRAME AND PANELS), INCLUDING FAN COWL AND GUARD.
- ② WITH 5-PROBE ELECTRONIC WATER LEVEL CONTROLLER PACKAGE, VIBRATION SWITCH, EXTERNAL SERVICE PLATFORM WITH LADDER WITH EXTENSION, SAFETY CAGE WITH EXTENSION, SHAFT GROUNDING RING
- ③ BELT-DRIVEN, TEFC FAN MOTOR TO HAVE VFD WITH BYPASS AND INTEGRAL DISCONNECT.
- ④ PROVIDE UNIT CONTROL PANEL IN NEMA-3R ENCLOSURE.
- ⑤ HIGH-EFFICIENCY DRIFT ELIMINATOR
- ⑥ PROVIDE OPTIONS: HIGH-EFFICIENCY DRIFT ELIMINATOR, FLANGE CONNECTIONS, PULSE-PURE NON CHEMICAL WATER TREATMENT.

SCOPE OF WORK

THE PROJECT IS REPLACEMENT OF THE EXISTING COOLING TOWER UNIT ON THE ROOF INCLUDING ONE OF ITS SUPPORTING LEG. THE EXISTING COOLING TOWER IS FAILING.



ISSUE	INFORMATION	DATE
1.	ISSUE FOR PERMIT	10.24.19
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COOLING TOWER
REPLACEMENT

MECHANICAL
LEGENDS, GENERAL
NOTES, ABBREVIATIONS
AND SCHEDULES

JOB NUMBER

CCE 19149

DRAWN BY

KV

SCALE

M0.1



STATE OF CALIFORNIA
MECHANICAL SYSTEMS
CEC-NRCC-MCH-01-E (Revised 01/16) CALIFORNIA ENERGY COMMISSION NRCC-MCH-01-E
CERTIFICATE OF COMPLIANCE Page 1 of 3
Mechanical Systems
Project Name: WEST ED COOLING TOWER REPLACEMENT Date Prepared: 11-04-19

A. MECHANICAL COMPLIANCE DOCUMENTS & WORKSHEETS (check box if worksheet is included)
For detailed instructions on the use of this and all Energy Efficiency Standards compliance forms, refer to the 2016 Nonresidential Manual
Note: The Enforcement Agency may require all forms to be incorporated onto the building plans.

YES	NO	Comp. Doc./Worksheet #	Title
<input checked="" type="radio"/>	<input type="radio"/>	NRCC-MCH-01-E (Part 1 of 3)	Certificate of Compliance, Declaration. Required on plans for all submittals.
<input checked="" type="radio"/>	<input type="radio"/>	NRCC-MCH-01-E (Part 2 of 3)	Certificate of Compliance, Required Acceptance Tests (MCH-02-A to 11-A). Required on plans for all submittals.
<input checked="" type="radio"/>	<input type="radio"/>	NRCC-MCH-01-E (Part 3 of 3)	Certificate of Compliance, Required Acceptance Tests (MCH-12-A to 18-A). Required on plans where applicable.
<input type="radio"/>	<input checked="" type="radio"/>	NRCC-MCH-02-E (Part 1 of 2)	Mechanical Dry Equipment Summary is required for all submittals with Central Air Systems. It is optional on plans.
<input type="radio"/>	<input checked="" type="radio"/>	NRCC-MCH-02-E (Part 2 of 2)	Mechanical Wet Equipment Summary is required for all submittals with chilled water, hot water or condenser water systems. It is optional on plans.
<input type="radio"/>	<input checked="" type="radio"/>	NRCC-MCH-03-E	Mechanical Ventilation and Reheat is required for all submittals with multiple zone heating and cooling systems. It is optional on plans.
<input type="radio"/>	<input checked="" type="radio"/>	NRCC-MCH-07-E (Part 1 of 2)	Power Consumption of Fans. Required on plans where applicable
<input type="radio"/>	<input checked="" type="radio"/>	NRCC-MCH-07-E (Part 2 of 2)	Power Consumption of Fans, Declaration. Required on plans where applicable

B. MECHANICAL HVAC ACCEPTANCE FORMS (check box for required compliance documents)
Test Performed By:
Designer:
This compliance document is to be used by the designer and attached to the plans. Listed below are all the acceptance tests for HVAC systems. The designer is required to check the applicable boxes for all acceptance tests that apply and list all equipment that requires an acceptance test. All equipment of the same type that requires a test, list the equipment description and the number of systems.
Installing Contractor:
The contractor who installed the equipment is responsible to either conduct the acceptance test themselves or have a qualified entry run the test for them. If more than one person has responsibility for the acceptance testing, each person shall sign and submit the Certificate of Acceptance applicable to the portion of the construction or installation for which they are responsible.
Enforcement Agency:
Plancheck - The NRCC-MCH-01-E compliance document is not considered a completed document and is not to be accepted by the building department unless the correct boxes are checked.
Inspector - Before occupancy permit is granted all newly installed process systems must be tested to ensure proper operations.

Test Description	MCH-02-A	MCH-03-A	MCH-04-A	MCH-05-A	MCH-06-A	MCH-07-A	MCH-08-A	MCH-09-A	MCH-10-A	MCH-11-A
Equipment Requiring Testing or Verification										
# of Units										
Outdoor Air	<input type="checkbox"/>									
Single Zone Unitary	<input type="checkbox"/>									
Air Distribution Ducts	<input type="checkbox"/>									
Economizer Controls	<input type="checkbox"/>									
Demand Controlled Ventilation (DCV)	<input type="checkbox"/>									
Supply Fan VAV	<input type="checkbox"/>									
Valve Leakage Test	<input type="checkbox"/>									
Supply Water Temp. Reset	<input type="checkbox"/>									
Hydronic System Variable Flow Control	<input type="checkbox"/>									
Automatic Demand Shed Control	<input type="checkbox"/>									

CA Building Energy Efficiency Standards - 2016 Nonresidential Compliance January 2016

STATE OF CALIFORNIA
MECHANICAL SYSTEMS
CEC-NRCC-MCH-01-E (Revised 01/16) CALIFORNIA ENERGY COMMISSION NRCC-MCH-01-E
CERTIFICATE OF COMPLIANCE Page 3 of 3
Mechanical Systems
Project Name: WEST ED COOLING TOWER REPLACEMENT Date Prepared: 11-04-19

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT
1. I certify that this Certificate of Compliance documentation is accurate and complete.

Documentation Author Name: GEORGE ARELLANO
Signature Date: 11-04-19
Company: CANYON CONSULTING ENGINEERS
Address: 3150 HILLTOP MALL RD., STE 18
City/State/Zip: RICHMOND, CA, 94806
Phone: 510-243-5987

RESPONSIBLE PERSON'S DECLARATION STATEMENT
I certify the following under penalty of perjury, under the laws of the State of California:
1. The information provided on this Certificate of Compliance is true and correct.
2. I am eligible under Division 3 of the Business and Professions Code to accept responsibility for the building design or system design identified on this Certificate of Compliance (responsible designer).
3. The energy features and performance specifications, materials, components, and manufactured devices for the building design or system design identified on this Certificate of Compliance conform to the requirements of Title 24, Part 1 and Part 6 of the California Code of Regulations.
4. The building design features or system design features identified on this Certificate of Compliance are consistent with the information provided on other applicable compliance documents, worksheets, calculations, plans and specifications submitted to the enforcement agency for approval with this building permit application.
5. I will ensure that a completed signed copy of this Certificate of Compliance shall be made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a completed signed copy of this Certificate of Compliance is required to be included with the documentation the builder provides to the building owner at occupancy.

Responsible Designer Name: GEORGE ARELLANO
Signature Date: 11-04-19
Company: CANYON CONSULTING ENGINEERS
Address: 3150 HILLTOP MALL RD., STE 18
City/State/Zip: RICHMOND, CA, 94806
Phone: 510-243-5987

CA Building Energy Efficiency Standards - 2016 Nonresidential Compliance January 2016

STATE OF CALIFORNIA
HVAC DRY & WET SYSTEM REQUIREMENTS
CEC-NRCC-MCH-02-E (Revised 01/16) CALIFORNIA ENERGY COMMISSION NRCC-MCH-02-E
CERTIFICATE OF COMPLIANCE Page 2 of 3
HVAC Dry & Wet System Requirements
Project Name: WEST ED COOLING TOWER REPLACEMENT Date Prepared: 11-04-19

B. Equipment Tags and System Description¹ - Wet Systems

MANDATORY MEASURES	T-24 Sections	Reference to the Requirements in the Contract Documents ²	CT-1
Heating Hot Water Equipment Efficiency ³	110.1	N/A	
Cooling Chilled and Condenser Water Equipment Efficiency ³	110.1, 140.4(j)	N/A	
Open and Closed Circuit Cooling Towers conductivity or flow-based controls	110.2(e) 1	YES (EXISTING)	
Open and Closed Circuit Cooling Towers Maximum Achievable Cycles of Concentration (L/S) ⁴	110.2(e) 2	YES	
Open and Closed Circuit Cooling Towers Flow Meter with analog output	110.2(e) 3	YES	
Open and Closed Circuit Cooling Towers Overflow Alarm	110.2(e) 4	YES	
Open and Closed Circuit Cooling Towers Efficient Drift Eliminators	110.2(e) 5	YES	
Pipe Insulation	120.3	N/A	

PRESCRIPTIVE MEASURES

140.4(h)2, 140.4(h)5	<input checked="" type="radio"/> Yes <input type="radio"/> No	<input type="radio"/> Yes <input type="radio"/> No	<input type="radio"/> Yes <input type="radio"/> No
Cooling Tower Fan Controls	<input checked="" type="radio"/> YES		
Cooling Tower Flow Controls	<input checked="" type="radio"/> YES		
Centrifugal Fan Cooling Towers ⁴	<input type="radio"/> PROPELLER		
Air-Cooled Chiller Limitation ⁵	<input type="radio"/> N/A		
Variable Flow System Design	<input type="radio"/> N/A		
Chiller and Boiler Isolation	<input type="radio"/> N/A		
CHW and HHW Reset Controls	<input type="radio"/> YES		
WLHP Isolation Valves	<input type="radio"/> EXISTING		
VSD on CHW, CW & WLHP Pumps >5HP	<input type="radio"/> N/A		
DP Sensor Location	<input type="radio"/> N/A		

Notes:
1. Provide equipment tags (e.g. CH 1 to 3) or system description (e.g. CHW loop) as appropriate. Multiple units with common requirements can be grouped together.
2. Provide references to plans (i.e. Drawing Sheet Numbers) and/or specifications (including Section name/number and relevant paragraphs) where each requirement is specified. Enter "N/A" if the requirement is not applicable to this system.
3. The referenced plans and specifications must include all of the following information: equipment tag, equipment nominal capacity, Title 24 minimum efficiency requirements, and actual rated equipment efficiencies. Where multiple efficiency requirements are applicable (e.g. full- and part-load) include all. For chillers operating at non-standard efficiencies provide the Kadj values. For chillers also note whether the efficiencies are Path A or Path B.
4. Identify if cooling towers have propeller fans. If towers use centrifugal fans document which exception is used.
5. If air-cooled chillers are used, document which exceptions have been used to comply with 140.4(j) and the total installed design capacity of the air-cooled chillers in the chilled water plant.
6. Identify the existence of a completed MCH-06-E when open or closed circuit cooling towers are specified to be installed, otherwise enter "N/A".

CA Building Energy Efficiency Standards - 2016 Nonresidential Compliance January 2016

STATE OF CALIFORNIA
HVAC SYSTEM REQUIREMENTS
CEC-NRCC-MCH-02-E (Revised 01/16) CALIFORNIA ENERGY COMMISSION NRCC-MCH-02-E
CERTIFICATE OF COMPLIANCE Page 3 of 3
HVAC Wet System Requirements
Project Name: WEST ED COOLING TOWER REPLACEMENT Date Prepared: 11-04-19

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT
1. I certify that this Certificate of Compliance documentation is accurate and complete.

Documentation Author Name: GEORGE ARELLANO
Signature Date: 11-04-19
Company: CANYON CONSULTING ENGINEERS
Address: 3150 HILLTOP MALL RD., STE 18
City/State/Zip: RICHMOND, CA, 94806
Phone: 510-243-5987

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2. I am eligible under Division 3 of the Business and Professions Code to accept responsibility for the building design or system design identified on this Certificate of Compliance (responsible designer).
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4. The building design features or system design features identified on this Certificate of Compliance are consistent with the information provided on other applicable compliance documents, worksheets, calculations, plans and specifications submitted to the enforcement agency for approval with this building permit application.
5. I will ensure that a completed signed copy of this Certificate of Compliance shall be made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a completed signed copy of this Certificate of Compliance is required to be included with the documentation the builder provides to the building owner at occupancy.

Responsible Designer Name: GEORGE ARELLANO
Signature Date: 11-04-19
Company: CANYON CONSULTING ENGINEERS
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CA Building Energy Efficiency Standards - 2016 Nonresidential Compliance January 2016



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ARCHITECT

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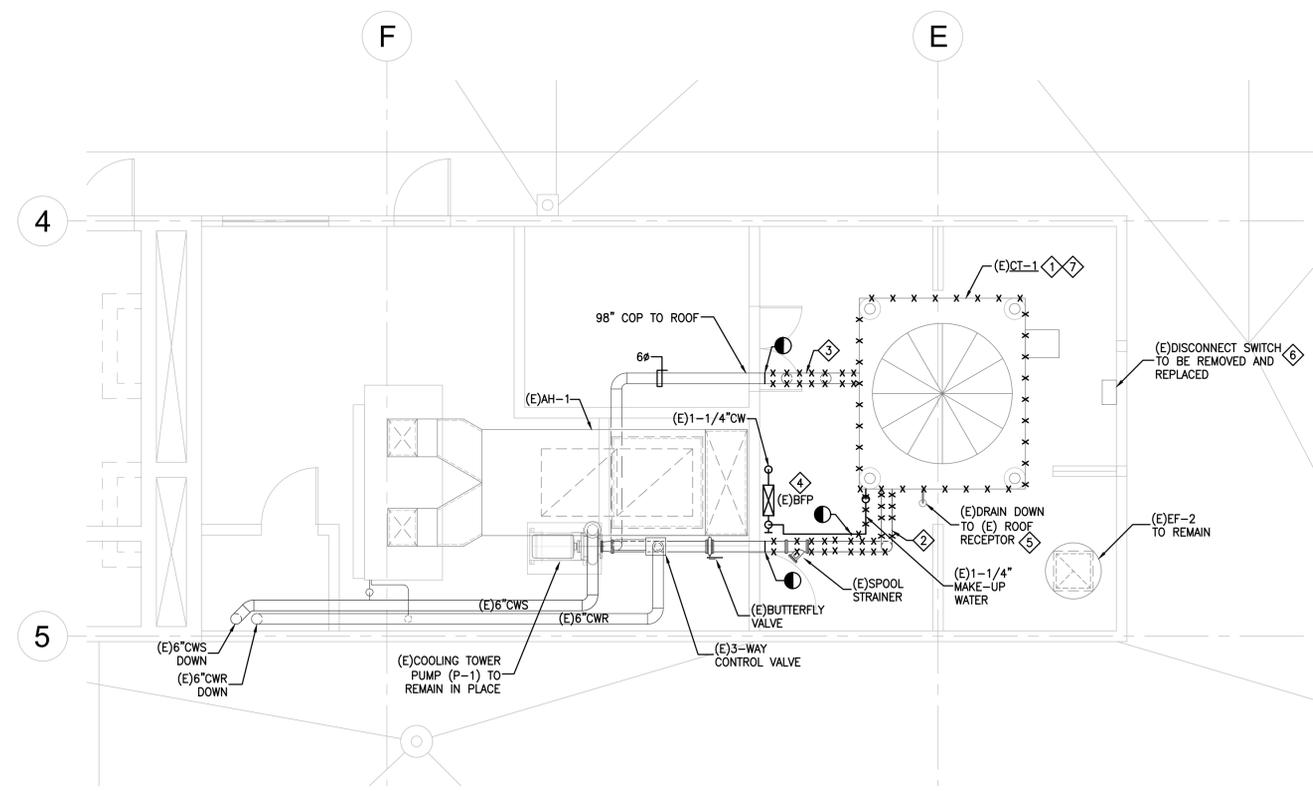
WestEd
730 HARRISON STREET
SAN FRANCISCO, CA 94107

COOLING TOWER
REPLACEMENT

**MECHANICAL
T-24 FORMS**

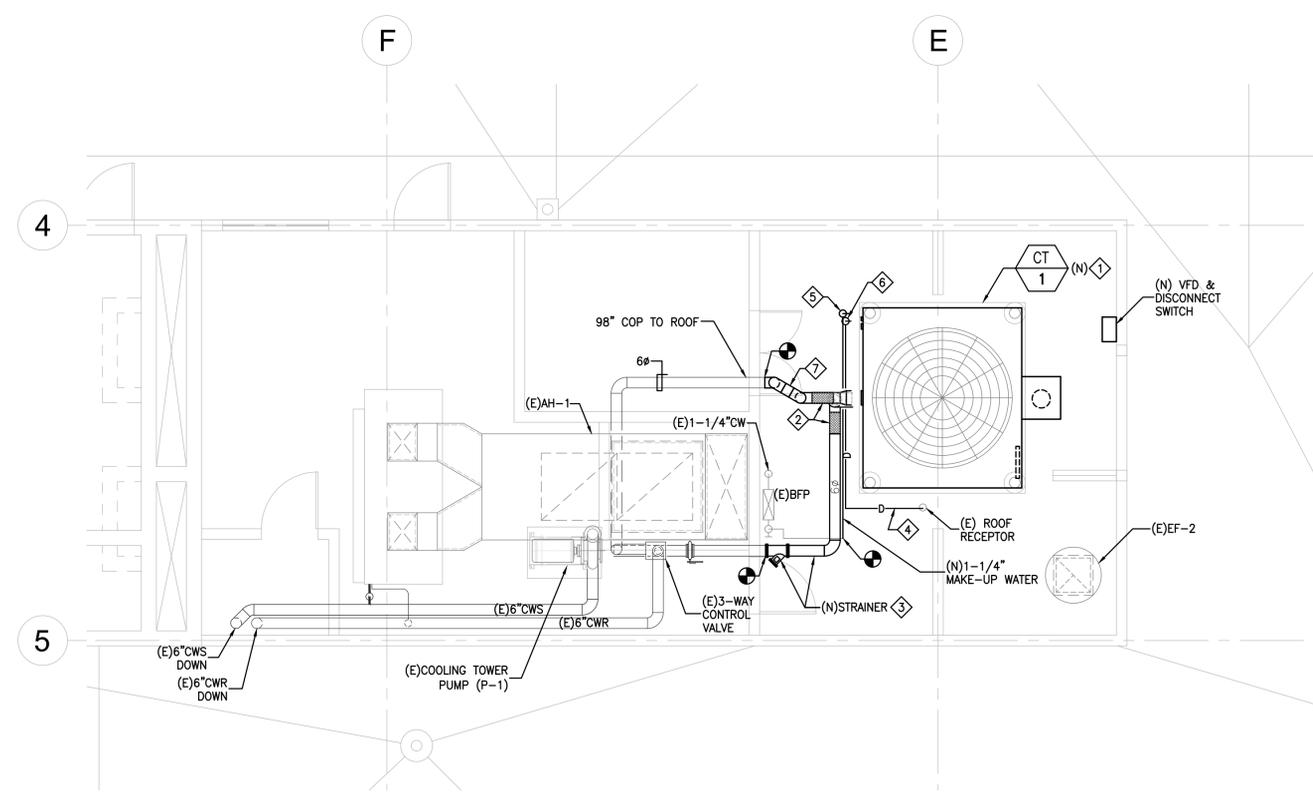
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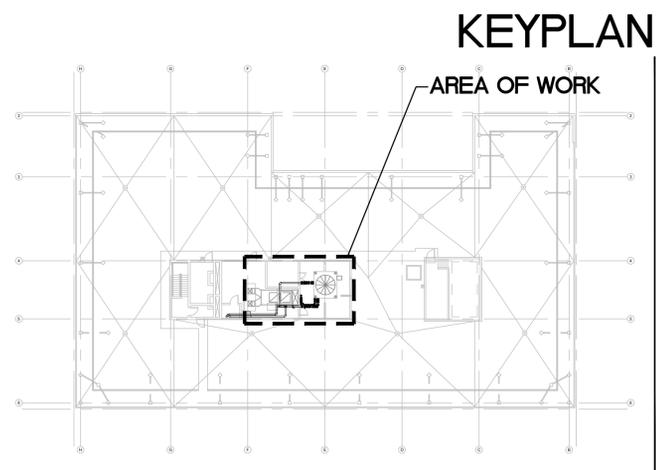
1 PARTIAL ROOF MECHANICAL DEMOLITION PLAN

- DEMOLITION SHEET NOTES:**
- 1 (E) CT-1 TO BE REMOVED AND REPLACED WITH NEW.
 - 2 (E) 6" CWS (TOWER WATER SUPPLY) TO BE REMOVED UP TO IMMEDIATELY DOWNSTREAM OF THE STRAINER.
 - 3 (E) 6" CWR PIPING TO BE REMOVED INCLUDING THE WATER LEVEL LOOP.
 - 4 (E) 1-1/2" MAKE-UP WATER BACKFLOW PREVENTOR (BFP) TO BE REMAIN IN PLACE.
 - 5 (E) DRAIN ROOF RECEPTOR TO REMAIN IN PLACE.
 - 6 (E) CT-1 DISCONNECT SWITCH TO BE REMOVED AND REPLACED WITH VFD WITH INTEGRAL DISCONNECT WITH BYPASS.
 - 7 FOR WORK ON COOLING TOWER STRUCTURAL SUPPORT, SEE STRUCTURAL.



1 PARTIAL ROOF MECHANICAL NEW PLAN

- NEW SHEET NOTES:**
- 1 (N) CT-1 TO BE INSTALLED OVER EXISTING STRUCTURAL SUPPORT. SEE STRUCTURAL DRAWINGS FOR MOUNTING AND INSTALLATION DETAILS.
 - 2 INSTALL NEW 15" LONG (MIN.) BRADED FLEXIBLE CONNECTION AT (N) 6" CWS/CWR PIPING TO/FROM (N) CT-1.
 - 3 INSTALL NEW STRAINER.
 - 4 TERMINATE (N) 3" DRAIN/OVERFLOW TO (E) ROOF RECEPTOR.
 - 5 (N) 2" MAKE-UP WATER TO BE CONNECTED TO (N)CT-1. PROVIDE WITH 12-INCH LONG FLEXIBLE CONNECTOR AT VERTICAL PIPING RISE UPSTREAM OF UNIT CONNECTION.
 - 6 (N)3" DRAIN AND OVERFLOW DRAIN PIPING TO BE ROUTED TO (E) ROOF RECEPTOR.
 - 7 (N) 6" CWR - INSTALL A VERTICAL LOOP RISER WITH TOP OF LOOP APPROX. 6" HIGHER THAN COOLING TOWER TO PREVENT WATER BACKFLOW.



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SAN FRANCISCO, CA 94107
**COOLING TOWER
REPLACEMENT**

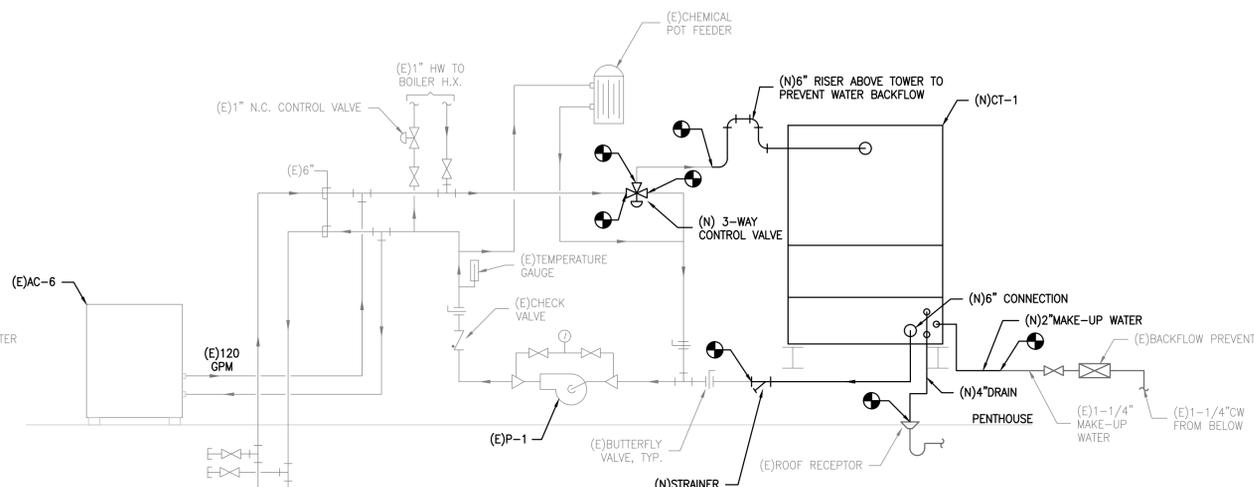
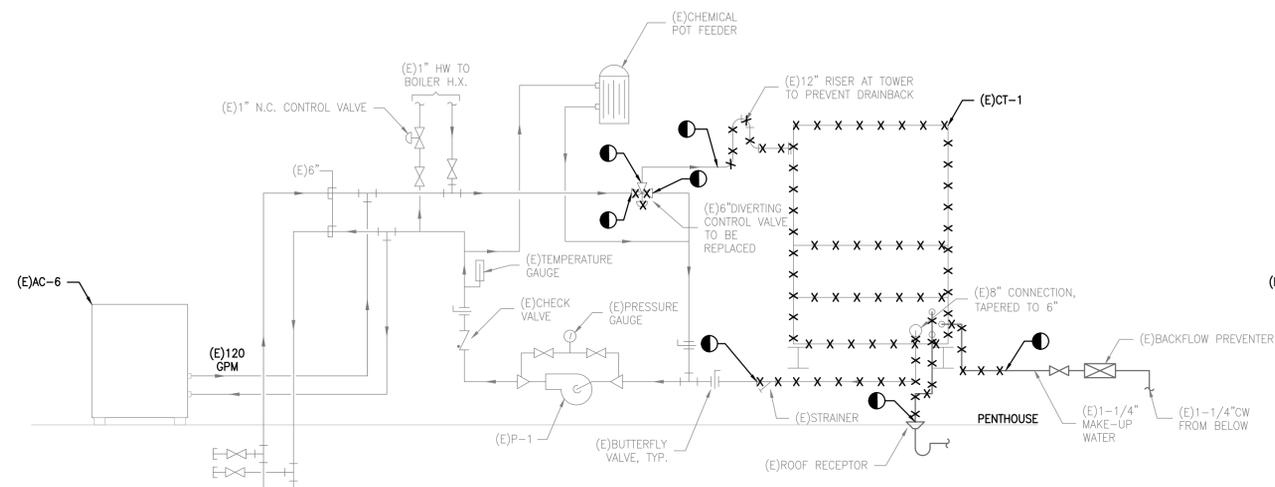
**PARTIAL
ROOF MECHANICAL
DEMOLITION AND NEW
PLANS**

JOB NUMBER
CCE 19149

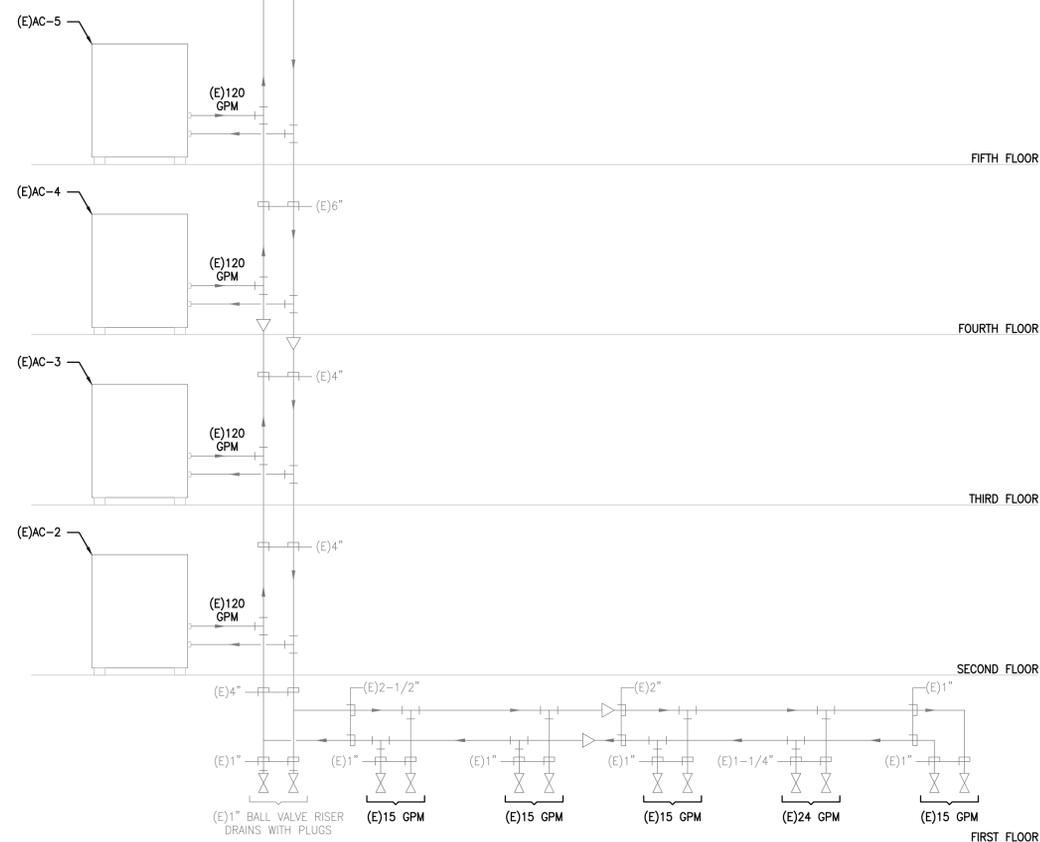
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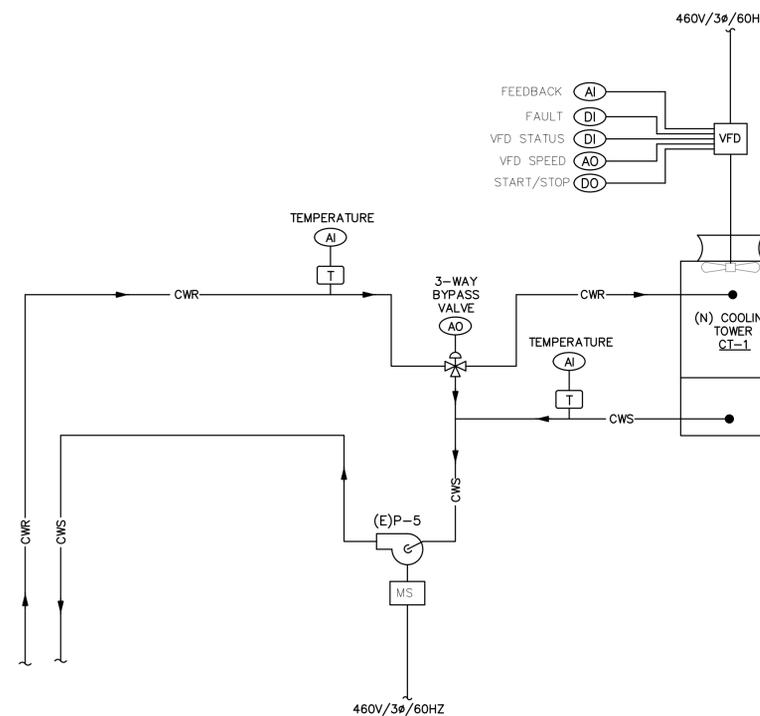




2 CONDENSER WATER PIPING SCHEMATIC-NEW
NOT TO SCALE



1 CONDENSER WATER PIPING SCHEMATIC-DEMOLITION
NOT TO SCALE



SEQUENCE OF OPERATION:

1. COOLING TOWER TEMPERATURE
 - a. SUPPLY TEMPERATURE SHALL BE SET AND MAINTAINED AT 82°F (ADJUSTABLE).
 - b. RETURN WATER TEMPERATURE SHALL BE MONITORED AT 92°F (ADJUSTABLE).
2. COOLING TOWER FAN OPERATION:
 - a. THE COOLING TOWER FAN SHALL MODULATE TO MAINTAIN THE CONDENSING WATER SUPPLY TEMPERATURE SET POINT (82°F +/- 3, ADJUSTABLE). WHEN CWS TEMPERATURE GOES DOWN TO 79°F (82°F - 3°F), THE COOLING TOWER FAN SPEED SHALL SLOW DOWN THROUGH THE VFD. WHEN CWS TEMPERATURE CONTINUES TO GO DOWN, THE VFD SHALL CONTINUE TO SLOW THE FAN SPEED DOWN.
 - b. WHEN CWS TEMPERATURE REACHES 94°F (ADJUSTABLE) FOR 10 MINUTES, THE FAN MOTOR SPEED SHALL BE COMMANDED THROUGH THE VFD TO SPEED UP.

2 COOLING TOWER CONTROL DIAGRAM
NOT TO SCALE

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**COOLING TOWER
REPLACEMENT**

**MECHANICAL
PIPING DIAGRAMS AND
SCHEMATICS**

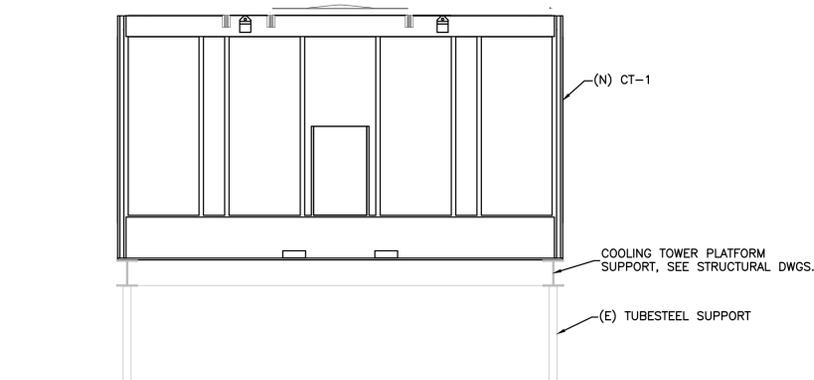
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DRAWN BY
KV

SCALE

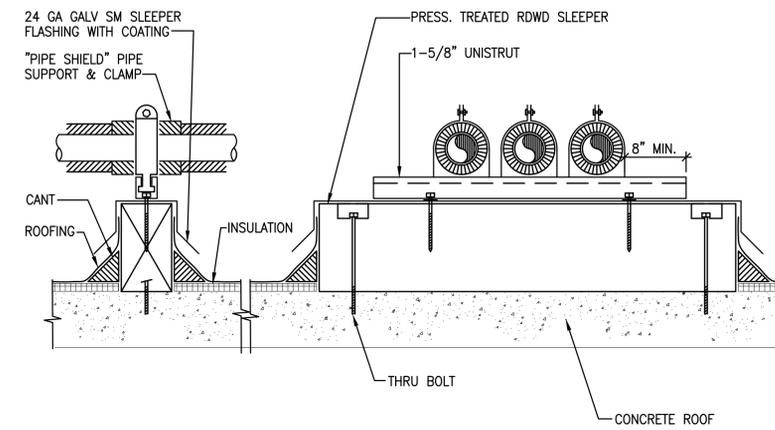
M3.1



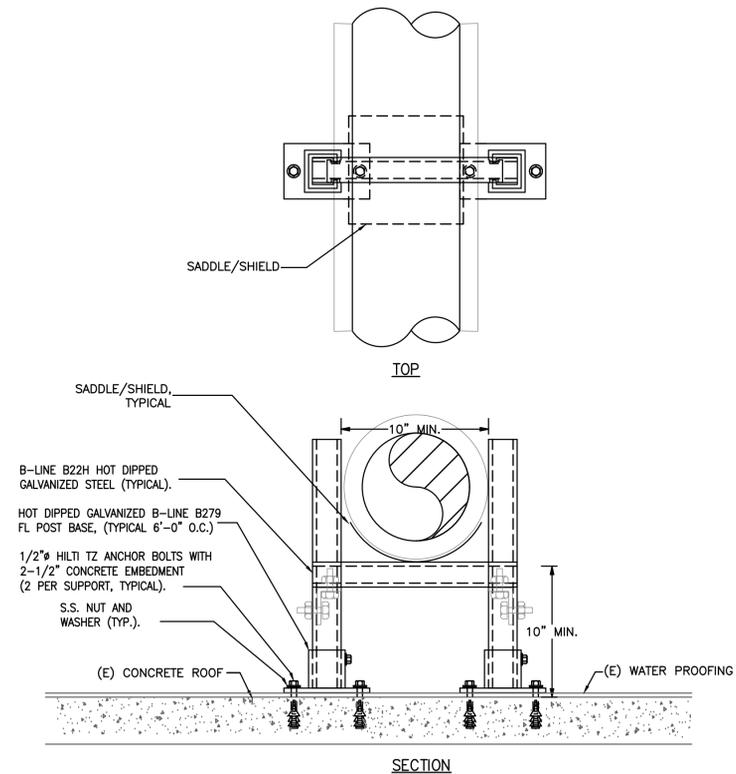


NOTE:
FOR COOLING TOWER SUPPORT, SEE STRUCTURAL DRAWINGS.

③ COOLING TOWER SUPPORT DETAIL
NOT TO SCALE



① PIPE SUPPORT ON ROOF
SCALE: NONE



② PIPE SUPPORT ON ROOF
NOT TO SCALE

ISSUE	INFORMATION	DATE
1.	ISSUE FOR PERMIT	10.24.19
2.	ISSUE FOR BID	12.19.19

ARCHITECT

CONSULTANT



Cengineers

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**COOLING TOWER
REPLACEMENT**

**MECHANICAL
DETAILS**

JOB NUMBER
CCE 19149

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SCALE

M4.1



