



KANSAS CITY KANSAS PUBLIC SCHOOLS / USD 500

PURCHASING OFFICE | 2010 N. 59TH STREET | ROOM 370 \ KANSAS CITY, KS 66104

WEB SITE: WWW.KCKPS.ORG/PURCHASING

COOLING TOWER REPLACEMENT – WHITTIER ELEMENTARY

BID NO: IFB 16-031 ISSUE DATE: APRIL 29, 2016

Kansas City Kansas Public Schools will receive sealed bids, on this form at the Purchasing Office, 2010 N. 59th Street, Room 370, Kansas City, KS 66104 until **2:00 PM., May 19, 2016**, at which time bids received will be publicly opened and read, all in accordance with bid instructions, specifications and/or bid conditions attached hereto or as shown below.

Contact/Technical Contact:

Wayne C. Correll, Purchasing Manager | (913) 279-2270 | eMail: wayne.correll@kckps.org

BID INSTRUCTIONS:

FAXED BIDS WILL NOT BE ACCEPTED / EMAILED BIDS WILL NOT BE ACCEPTED.

Per attached specifications listed in this invitation to bid. Bidders must specify unit price on services/rates/deliverables on the Bid Form or bid may be determined to be non-responsive.

- Pricing shall be FOB Kansas City, KS (All freight and fuel charges must be included in the bid price).
- Award may be to more than ONE contractor.
- The District reserves the right to reject any or all bids, to waive any informalities, irregularities or technical defects in bids, and unless otherwise specified by the District to accept any item or groups of items in the bid, as may be in the best interest of the District.
- Time (days, weeks, etc.) required for delivery is a significant consideration with respect to this award process. The time required for delivery must be indicated in the space provided or your bid may be found non-responsive and may not be considered.
- Bid shall include copies of pertinent warranty information pertaining to the product or service offered. The bidder agrees that equipment furnished under any resultant purchase order issued by Kansas City Kansas Public Schools shall be covered by commercial warranties the contractor gives to any customer for such supplies. All warranty information and certificates shall be furnished and become the property of the District upon delivery and acceptance of said items and/or the contractor must honor services and all rights and remedies stated in the warranties.
- All items are new manufacture unless otherwise specifically stated in this bid.
- All products must have passed the first line quality standard as set by the manufacturer and no seconds, blemished articles or items having defective workmanship are included.

- Bid may not be considered if a service charge, minimum dollar or minimum quantity order is applied.
- The outcome of this bid will be posted on the District's Purchasing site www.kckps.org/purchasing under Awards Section and will include a bid tabulation/summary.
- Bidder shall acknowledge all addenda for this bid and include the form acknowledgements with their bid.

See Attachment B for Additional Terms & Conditions

COOLING TOWER REPLACEMENT – WHITTIER ELEMENTARY

The Kansas City Kansas Public Schools Facilities Department is accepting sealed bids from qualified contractors to provide labor and materials for the following work.

Scope of Work

Demolish the existing cooling tower, pipes, structure, etc., as necessary to prepare for a new cooling tower at Whittier Elementary School., and haul off debris. Detailed scope of work is attached hereto under Attachment A.

In the event a discrepancy is discovered between the Scope of Work and the Specifications, the Scope of Work shall take precedence. If the bidder is not able to resolve discrepancies questions should be directed to (appropriate District personnel) who will forward the question to the project engineer and post the resolution to all bidders.

Contractor will coordinate all activities with Doug Clements, Director of Facilities, or his designee. Contractor will be responsible for obtaining any and all required permits.

Project Location

Whittier Elementary School
295 S. 10th Street
Kansas City, KS 66102

Pre-Bid Meeting

A pre-bid meeting for bidders will be held at **1:30 p.m.** on **May 11, 2016**.
The Pre-bid meeting will be at:

Whittier Elementary School (Report to School Office)
295 S. 10th Street
Kansas City, KS 66102

A "walk-thru" to all review of the project area will follow the Pre-Bid meeting. Attendance at the Pre-Bid Meeting is recommended, but not mandatory.

Bid Security

Bid Bond: Bid security shall be submitted with each bid in the amount of five percent (5%) of the bid amount. No bids may be withdrawn for a period of sixty (60) days after opening of bids. Owner reserves the right to reject any and all bids and to waive informalities and irregularities.

Payment & Performance Bond: Bidder agrees to furnish a Payment & Performance Bond, in the amount of 100% (one hundred percent) of total contract value after receipt of contract.

Prevailing Wage

Prevailing Wage IS NOT required.

Time of Completion

Successful bidder shall begin the Work on receipt of the Notice to Proceed and shall complete the Work (Substantial Completion) no later than **July 29, 2016, or as soon as can be reasonable expected and agreed to by the District.**

Damage to District Property

Contractor at its own expense shall promptly remedy and repair all damages or loss to any property caused in whole or part by its employees, subcontractor(s), supplier or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable.

No Smoking: The District adheres to the mandatory "No Smoking" policy on school premises and/or at school functions. All bidders shall comply with this "No Smoking" policy.

BID FORM

By signing this bid form, the vendor certifies the forms being offered meets or exceeds all requirements and conditions of the bid, special provisions and specifications. In compliance with the above and subject to all the conditions hereof, the undersigned offers and agrees to furnish all items upon which prices are quoted, at the price set opposite each item.

The undersigned certifies that no Federal, State, County or Municipal tax is included in the above quoted prices and that none will be added. Public schools are TAX EXEMPT. Exemption certificates will be provided upon request.

Base Bid	
Cost of Cooling Tower Components & Structure	\$
Cost of Permits	\$
Cost to Terminate Connection, Demolish Existing, Install New Cooling Tower Components & Structure, Haul Off Debris, and Repair Any Damage Caused by Installation	\$
Total	\$
Number of Days After Receipt of Order to Start Project	Days
Number of Days to Complete Project	Days

Designations		If Yes, Please Identify Certified Designation
MBE/WBE/Other Certification		
Is your firm certified MBE/WBE or Other? (Circle One)>>	Yes / No	

WE HEREBY AGREE TO FURNISH THE ITEMS ON WHICH PRICES ARE QUOTED ABOVE IN ACCORDANCE WITH ALL TERMS AND CONDITIONS PREVIOUSLY LISTED AND ANY ATTACHED SPECIFICATIONS.

BY: _____ DATE: _____
 TITLE: _____ FIRM: _____
 PHONE: _____ EMAIL: _____

Deliver to:
 Kansas City Kansas Public Schools
 Attn: Purchasing Manager
 2010 N. 59th Street, Room 370
 Kansas City, KS 66104



PEARSON KENT MCKINLEY RAAF ENGINEERS
13300 W. 98TH STREET | LENEXA, KS 66215

April 18, 2016

16.131

**Project Scope for Replacement of Cooling Tower
KCK Whittier Elementary School
295 South 10th St, Kansas City, KS 66102**

This document is to outline the scope of work for a cooling tower replacement at the Whittier Elementary School.

Scope of Work:

1. Remove existing cooling tower and related piping, structure, etc as necessary to prepare for new tower. Properly dispose of tower and demolished items.
2. Existing VFD shall remain and be reused. Modify location of VFD as necessary.
3. Remove existing piping insulation and jacket on tower water piping and clean piping of rust and debris. Provide quality rust inhibiting paint primer and two coats of quality exterior epoxy paint on piping.
4. Verify flashing and weather proofing of existing penetration. Repair as necessary.
5. Provide new Marley NC8400 or equivalent BAC cooling tower with gravity distribution basins (system shall not require nozzles), high efficiency VFD rated motor, rated 80 tons at 95/85/78, 590gpm min. Cooling tower casing and structure frame shall be galvanized steel, distribution and collection basins shall be constructed of stainless steel. Cooling tower shall be provided with a steel ladder (to 60" below basin; verify exact dimension w/roof and structural framing prior to order) and service platform. Provide spring mounts for tower mounting to steel beams. Provide new galvanized steel beams to span atop existing steel columns through the roof to align with tower mounting configuration. Do not rely on existing horizontal steel members. New steel members and their connections to new and existing components shall be verified with a structural engineer. Existing fill and sump is indoors so no new float or fill valve is required.
6. Existing cooling tower is:
Ceramic Cooling Tower Company, Ft. Worth TX
Model - XL-75-6p3; SN - xl1588-10075090
7. Provide new condenser water pumps by Bell and Gossett. Existing name plates state 275gpm at 110ft head. 1750RPM, 15hp. Provide new triple duty valves, suction diffuser/strainers. Existing piping is 4". New pumps shall be 290gpm at 115" of head.
8. Make all electrical connections and reconfigure circuiting, piping, etc as required to align with new equipment.
9. Provide factory startup of new equipment. Test and balance pumps and tower.
10. Reconnect and insure proper operation with district DDC system is maintained or upgraded as required for proper operation. Coordinate with C&C group for any commissioning activities to assure the district of proper operation.
11. Fully clean system piping and work areas of any slag, debris or other construction items prior to turn over.

12. All work shall comply with codes as adopted by KCK/Unified Govt.
13. Coordinate work period and system shut downs with Owner.
14. Coordinate crane location with the district. Repair any damage done to paving or grassy areas and restore to condition prior to damage. Provide all safety precautions and management of site and work during lifting operations. Coordinate all work and locations with the KCK School District.
15. Protect the existing roof surfaces and repair any damage done by a roofing contractor approved by the district and maintain existing roof warranties.
16. Clean and de-lime existing heat exchanger during shutdown periods. Clean existing indoor sump, check operation of fill valve and level sensor and repair/replace as warranted during shutdown.



Existing Tower



Existing Tower Piping



Existing Tower Pumps



Existing Tower Pump nameplate

ATTACHMENT B – USD 500 STANDARD TERMS AND CONDITIONS

1. SCOPE: The following terms and conditions shall prevail unless otherwise modified by U.S.D. 500 within this bid document. U.S.D. 500 reserves the right to reject any bid which takes exception to these terms and conditions.
2. DEFINITIONS AS USED HEREIN:
 - a. The term "bid request" means a solicitation of a formal sealed bid.
 - b. The term "bid" means the price offered by the bidder.
 - c. The term "bidder" means the offeror or vendor.
 - d. The term "U.S.D. 500" means Unified School District No. 500.
 - e. The term "Board of Education" or "BOE" means the governing body of Unified School District No.500
3. COMPLETING BID: Bids must be submitted ONLY on the form provided in this bid document. All information must be legible. Any and all corrections and /or erasures must be initialed. Each bid sheet must be signed by the authorized bidder and required information must be provided.
4. CONFIDENTIALITY OF BID INFORMATION: Each bid must be sealed and submitted in or under cover of the enclosed envelope to provide confidentiality of the bid information prior to the bid opening. Supporting documents and/or descriptive literature may be submitted with the bid or in a separate envelope marked "Literature for Bid (Number)." Do NOT indicate bid prices on literature. All bids and supporting bid documents become public information after the bid opening and are available for inspection by the general public in accordance with the Kansas Open Records Act.
5. ACCURACY OF BID: Each bid is publicly opened and is made part of the public record of U.S.D. 500. Therefore, it is necessary that any and all information presented is accurate and/or will be that by which the bidder will complete the contract. If there is a discrepancy between the unit price and extended total, the unit price will prevail.
6. SUBMISSION OF BID: Bids are to be sealed and submitted to the Purchasing Department Office, 2010 North 59th Street, Room 370, Kansas City, Kansas, 66104, prior to the date and time indicated on the cover sheet.
7. ADDENDA: All changes in connection with this bid will be issued by the Purchasing Office in the form of a written addendum. Signed acknowledgement of receipt of each addendum must be submitted with the bid.
8. LATE BIDS AND MODIFICATION OR WITHDRAWALS: Bids received after the deadline designated in this bid document shall not be considered and shall be returned unopened.
9. BIDS BINDING: All bids submitted shall be binding upon the bidder if accepted by U.S.D. 500 within sixty (60) calendar days after the bid opening.
10. EQUIVALENT BIDS: When brand or trade names are used in the bid invitation, it is for the purpose of item identification and to establish standards for quality, style and features. Bids on equivalent items of substantially the same quality, style and features are invited unless items are marked "No Substitute." Equivalent bids must be accompanied by descriptive literature and/ or samples may be required and shall be supplied at no charge to the District.
11. NEW MATERIALS, SUPPLIES AND EQUIPMENT: Unless otherwise specified, all materials, supplies or equipment offered by a bidder shall be new, unused, of recent manufacture, first class in every respect, and suitable for their intended purpose. All equipment shall be assembled and fully serviced, ready for operation when delivered.
12. WARRANTY: Supplies or services furnished as a result of this bid shall be covered by the most favorable commercial warranties, expressed or implied, that the bidder and/or manufacturer gives to any customer. The rights and remedies provided herein are in addition to and do not limit any rights afforded to U.S.D. 500 by any other clause of this bid reserves the right to request from bidders a separate manufacturer certification of all statements made in the Proposal.
13. METHOD OF AWARD AND NOTIFICATION: Bids will be analyzed and the award made to the lowest and best, responsive and responsible bidder(s) whose bid conforms to the specifications and whose bid is considered to be the best value in the opinion of U.S.D. 500.
14. U.S.D. 500 reserves the right to reject any or all bids and any part of a bid: to waive informalities, technical defects, and minor irregularities in bids received: and to award the bid on an item by item basis by specified groups of items or to consider bids submitted on an "all or nothing "basis if the bid is clearly designed as such or when it is determined to be in the best interest of U.S.D. 500.
15. The signed bid shall be considered an offer on the part of the bidder: such offer shall be deemed accepted upon the issuance by U.S.D. 500 of a Purchase Order or other contractual document.
16. DELIVERY TERMS: All deliveries shall be F.O.B. Destination and all freight charges shall be included in the bid price.
17. DAMAGED AND/OR LATE SHIPMENTS: U.S.D 500 has no obligation to accept damaged shipments and reserves the right to return at the vendor's expense damaged merchandise even though the damage was not apparent or discovered until after receipt of the items. The Vendor is responsible to notify U.S.D. 500 Purchasing Office of any late or delayed shipments. U.S.D. 500 reserves the right to cancel all or any part of an order if the shipment is not made as promised.
18. CREDIT TERMS: Bidder shall indicate all discounts for full and/or prompt payment. Discounts shall be considered as a cost factor in the determination of award, except discounts offered for payment within less than ten (10) calendar days. Discounts offered shall be computed from date of receipt of correct invoice or receipt and acceptance of products, whichever is later.
19. SELLER'S INVOICE: Invoices shall be prepared and submitted in duplicate to address shown on the Purchase Order. Invoices shall contain the following information: Purchase Order number, contract number, item number, description of supplies or services, sizes, unit of measure, quantity, unit price and extended totals.

20. TAX EXEMPT: U.S.D. 500 is exempt from Federal, State and local taxes by KS-FZLEKBLQ. Sites of all transactions under the order(s) that shall be derived from this bid request shall be deemed to have been accomplished within the State of Kansas.
21. SAFETY: All practices, materials, supplies and equipment shall comply with the federal Occupational Safety and Health Act, as well as any pertinent Federal, State and/or local safety or environmental codes.
22. DISCLAIMER OR LIABILITY: U.S.D. 500 will not hold harmless or indemnify any bidder for any liability whatsoever.
23. TERMINATION RIGHTS: KCKPS shall have the right to terminate/cancel the Agreement for its convenience and without penalty upon thirty (30) days prior written notice to the contractor.
24. HOLD HARMLESS: The contractor agrees to protect, defend, indemnify and hold the Board of Education, its officers, employees and agents fee and harmless from and against any and all losses, penalties, damages, settlements, costs, charges, professional fees or other expenses or liabilities of every kind and character arising out of or relating to any and all claims, liens, demands, obligations, actions, proceedings or causes of action of every kind and character in connection with or arising directly or indirectly out of this agreement and/or the performance hereof. Without limiting the generality of the foregoing, any and all such claims, etc., relating to personal injury, infringement of any patent trademark, copyright (or application for any thereof) or of any other tangible or intangible personal or property right, or actual or alleged violation of any applicable statute, ordinance, administrative order, rule or regulation, or decree of any court, shall be included in the indemnity hereunder. The contractor further agrees to investigate, handle, respond to, provide defense for and defend any such claims, etc., at his/her sole expense and agrees to bear all other costs and expenses related thereto, even if such claim is groundless, false or fraudulent.

NO MUTUAL INDEMNIFICATION:

K.S.A.72-8201a: Contracts; indemnification or hold harmless provisions, void.

(a) It is the public policy of the state of Kansas that all contracts entered into by the board of education of a District, or any officers or employees thereof acting on behalf of the board, provide that the District and board of education shall be responsible solely for the district's or board's actions or failure to act under a contract.

(b) The board of education of a District or any officers or employees thereof acting on behalf of the board shall not have the authority to enter into a contract under which the District or board agrees to, or is required to, indemnify or hold harmless against damages, injury or death resulting from the actions or failure to act on the part of any party to a contract other than the board or district.

(c) The provisions of any contract entered into in violation of this section shall be contrary to the public policy of the state of Kansas and shall be void and unenforceable.

25. INSURANCE: Upon receipt of award, Contractor shall provide Certificate of Insurance as required within three (3) days after notification issued by the Purchasing Department.

A. The following general insurance requirements apply to any and all work under this contract by all Contractors and subcontractors of any tier.

- (1) Any and all insurance required by this contract with each and any and all insurance required by this contract shall be maintained during the entire length of this contract, including any extensions thereto, and until all work has been completed to the satisfaction of the Kansas City Kansas Public Schools/Kansas City Kansas Public Library. Any and all insurance must be on an occurrence basis.
- (2) No Contractor or subcontractor shall commence work under a contract until all insurance requirements contained within the solicitation have been complied with and until evidence of all insurance requirements in each and every contract with each and every subcontractor of any tier and shall require the same to comply with all such requirements.
- (3) The Kansas City Kansas Public Schools/Kansas City Kansas Public Library shall be covered as an Additional Insured under any and all insurance required by this contract. Confirmation of this shall appear on all certificates of insurance and on any and all applicable policies. The title of the awarded contract shall also appear on any and all applicable policies.
- (4) The Kansas City Kansas Public Schools/Kansas City Kansas Public Library shall be given no less than thirty (30) days' written notice of cancellation. The Kansas City Kansas Public Schools/Kansas City Kansas Public Library shall be given not less than thirty (30) days' prior written notice of material changes of any insurance required under this contract. The Kansas City Kansas Public Schools/Kansas City Kansas Public Library shall be given written notice of renewal of coverage not less than thirty (30) days prior to the expiration of any particular policy.
- (5) Each and every agent shall warrant when signing the certificate of insurance that he is acting as an authorized representative on behalf of the companies affording insurance coverage under the contract and that he is licensed by the State of Kansas to conduct insurance business in the State of Kansas and that the companies affording insurance coverage are currently licensed by the State of Kansas and are currently in good standing with the Commissioner of Insurance for the State of Kansas.
- (6) Any and all companies providing insurance required by this contract shall meet the minimum financial security requirements as set forth below. The rating for each company must be indicated on the certificate of insurance. For all contracts, regardless of risk, companies providing insurance under this contract must have a current:
 - (a) Best's Rating not less than A, and
 - (b) Best's Financial Size Category not less than Class VII

- (7) In the event the Contractor neglects, refuses, or fails to provide insurance required by the contract documents, or if such insurance is canceled for any reason, Kansas City Kansas Public Schools/Kansas City Kansas Public Library shall have the right, but not the duty, to procure the same, and the cost thereof shall be deducted from monies then due or thereafter to become due to the Contractor or Kansas City Kansas Public Schools/Kansas City Kansas Public Library shall have the right to cancel the contract.
- B. Worker's Compensation and Employer's Liability Insurance
 The Contractor shall procure and maintain Worker's Compensation and Employer's Liability Insurance in the following limits. Such insurance is to cover each and every employee who is or may be engaged in work under this contract.
- | Worker's Compensation | Statutory |
|--------------------------------|---------------------------|
| Employer's Liability | |
| Bodily Injury by Accident..... | \$1,000,000 each accident |
| Bodily Injury by Disease..... | \$1,000,000 each employee |
| Bodily Injury by Disease..... | \$1,000,000 policy limit |
- C. Comprehensive General Liability Insurance
 The Contractor shall procure and maintain Comprehensive Insurance in an amount not less than \$1,000,000 for bodily injury and property damage combined single limit. The following specific extensions of coverage shall be provided and indicated on the certificate of insurance:
- (1) Comprehensive Form
 - (2) Contractual Insurance
 - (3) Personal Injury
 - (4) Broad Form Property Damage
 - (5) Premises – Operations
 - (6) Completed Operations
- This coverage shall cover the use of all equipment, hoists, and vehicles on the site(s) not covered by Automobile Liability under this contract. Policy coverage must be on an occurrence basis.
- D. Automobile Liability Insurance
 The Contractor shall procure and maintain Automobile Liability Insurance in an amount not less than \$1,000,000 for bodily injury and property damage combined single limit. The following extensions of coverage shall be provided and indicated on the certificate of insurance.
- (1) Comprehensive Form
 - (2) Owned, Hired, Leased and non-owned vehicles
- If the Contractor does not own any vehicles in the corporate name, non-owned vehicles coverage shall apply and must be endorsed on either the Contractor's personal automobile policy or the Comprehensive General Liability coverage required under this contract.
- E. Commercial Crime insurance (when applicable)
 The Contractor shall procure and maintain Commercial Crime/Fidelity insurance in an amount not less than \$1,000,000.00, including coverage for theft or loss of KCKPS property.
26. LAW GOVERNING: All contractual agreements shall be subject to, governed by, and construed according to the laws of the State of Kansas.
27. ANTI-DISCRIMINATION CLAUSE: No bidder on this request shall in any way, directly or indirectly, discriminate against any person because of age, race, color handicap, sex, national origin, or religious creed.

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SECTION 15010 - MECHANICAL PROVISIONS

PART 1 - GENERAL

A. RELATED DOCUMENTS

1. All contract documents including drawings, alternates, addenda and modifications and general provisions of the Contract, including General and Supplementary Conditions and all other Division Specification Sections, apply to work of this section. All preceding and following sections of this specification division are applicable to the Mechanical Contractor, all sub-contractors, and all material suppliers.

B. SCOPE OF WORK

1. This DIVISION requires the furnishing and installing of complete functioning Mechanical systems, and each element thereof, as specified or indicated on Drawings or reasonably inferred, including every article, device or accessory reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the Work include materials, labor, supervision, supplies, equipment, transportation, and utilities.
2. Refer to Architectural, Structural and Electrical Drawings and all other contract documents and to relevant equipment drawings and shop drawings to determine the extent of clear spaces and make all offsets required to clear equipment, beams and other structural members to facilitate concealing piping and ductwork in the manner anticipated in the design.

C. SPECIFICATION FORM AND DEFINITIONS

1. The Engineer indicated in these specifications is Pearson Kent McKinley Raaf Engineers LLC. 8801 Ballentine, Suite 200, Overland Park, KS 66214, PHONE 913-492-2400, FAX 913-492-2437, EMAIL admin@pkmreng.com.
2. Contractor, wherever used in these specifications, shall mean the Company that enters into contract with the Owner to perform this section of work.
3. When a word, such as "proper", "satisfactory", "equivalent", and "as directed", is used, it requires the Architect-Engineer's review.
4. "PROVIDE" means to supply, purchase, transport, place, erect, connect, test, and turn over to Owner, complete and ready for regular operation, the particular Work referred to.
5. "INSTALL" means to join, unite, fasten, link, attach, set up, or otherwise connect together before testing and turning over to Owner, complete and ready for regular operation, the particular Work referred to.
6. "FURNISH" means to supply all materials, labor, equipment, testing apparatus, controls, tests, accessories, and all other items customarily required for the proper and complete application for the particular Work referred to.
7. "WIRING" means the inclusion of all raceways, fittings, conductors, connectors, tape, junction and outlet boxes, connections, splices, and all other items necessary and/or required in connection with such Work.
8. "CONDUIT" means the inclusion of all fittings, hangers, supports, sleeves, etc.
9. "AS DIRECTED" means as directed by the Architect/Engineer, or his representative.
10. "CONCEALED" means embedded in masonry or other construction, installed behind wall furring or within double partitions, or installed above hung ceilings.

D. QUALIFICATIONS

1. The contractors responsible for work under this section shall have completed a job of similar scope and magnitude within the last 3 years. The contractors shall employ an experienced, competent and adequate work force licensed in their specific trade and properly supervised at all times. Unlicensed workers and general laborers shall be adequately supervised to insure competent and quality work and workmanship required by this contract and all other regulations, codes and practices. At all times the contractors shall comply with all applicable local, state and federal guidelines, practices and regulations. Contractor may be required to submit a statement of qualifications upon request before any final approval and selection. Failure to be able to comply with these requirements is suitable reason for rejection of a bid.

E. LOCAL CONDITIONS

1. The contractor shall visit the site and determine the existing local conditions affecting the work required. Failure to determine site conditions or nature of existing or new construction will not be considered a basis for granting additional compensation.

F. CONTRACT CHANGES

1. Changes or deviations from the contract documents; including those for extra or additional work must be submitted in writing for review of Architect-Engineer. No verbal change orders will be recognized.

G. LOCATIONS AND INTERFERENCES

1. Locations of equipment, piping and other mechanical work are indicated diagrammatically by the mechanical drawings. The Contractor shall determine the exact locations on site, subject to structural conditions, work of other Contractors, and access requirements for installation and maintenance to approval of Architect-Engineer. Provide additional piping and ductwork offsets as required at no additional cost.
2. Study and become familiar with the contract drawings of other trades and in particular the general construction plans and details in order to obtain necessary information for figuring installation. Cooperate with other contractors and install work in such a way as to avoid interference with their work. Minor deviations, not affecting design characteristics, performance or space limitation may be permitted if reviewed prior to installation by Architect-Engineer.
3. Any pipe, ductwork, equipment, apparatus, appliance or other item interfering with proper placement of other work as indicated on drawings, specified, or required, shall be removed, relocated and reconnected without extra cost. Damage to other work caused by this Contractor, the Subcontractor, or workers shall be restored as specified for new work.
4. Do not scale mechanical and electrical drawings for dimensions. Contractor shall accurately layout work from the dimensions indicated on the Architectural drawings unless they are found to be in error.

H. PERFORMANCE

1. Final acceptance of work shall be subject to the condition that all systems, equipment, apparatus and appliances operate satisfactorily as designed and intended. Work shall include required adjustment of systems and control equipment installed under this specification division.
2. The Contractor warrants to the Owner and Architect-Engineer the quality of materials, equipment, workmanship and operation of equipment provided under this specification division for a period of one year from and after completion of building and acceptance of mechanical systems by Owner.

I. WARRANTY

1. The Contractor warrants to the Owner and Architect-Engineer that upon notice from them within a one year warranty period following date of acceptance, that all defects that have appeared in materials and/or workmanship, will be promptly corrected to original condition required by contract documents at Contractor's expense.
2. Warranty for all equipment shall take effect from the date of substantial completion regardless of the date equipment was installed.
3. The above warranty shall not supersede any separately stated warranty or other requirements required by law or by these specifications.

J. ALTERNATES

1. Refer to General Requirements for descriptions of any alternates that may be included.

K. MATERIALS, EQUIPMENT AND SUBSTITUTIONS

1. The intent of these specifications is to allow ample opportunity for Contractor to use his ingenuity and abilities to perform the work to his and the Owner's best advantage, and to permit maximum competition in bidding on standards of materials and equipment required.
2. Material and equipment installed under this contract shall be first class quality, new, unused and without damage.
3. In general, these specifications identify required materials and equipment by naming one or more manufacturer's brand, model, catalog number and/or other identification. The first named manufacturer or product is used as the basis for design; other manufacturers named must furnish products consistent with specifications of first named product as determined by Engineer. Base bid proposal shall be based only on materials and equipment by manufacturers named, except as hereinafter provided.
4. Where materials or equipment are described but not named, provide required items of first quality, adequate in every respect for intended use. Such items shall be submitted to Architect-Engineer for review prior to procurement.
5. Materials and equipment proposed for substitutions shall be equal to or superior to that specified in construction, efficiency, utility, aesthetic design, and color as determined by Architect-Engineer whose decision shall be final and without further recourse. Physical size of substitute brand shall be no larger than

space provided including allowances for access for installation and maintenance. Requests must be accompanied by two copies of complete descriptive and technical data including manufacturer's name, model and catalog number, photographs or cuts, physical dimensions, operating characteristics and any other information needed for comparison.

6. If the Contractor wishes to incorporate products other than those named in the Base Bid Specifications they shall submit a request for approval of equivalency in writing no later than (10) ten calendar days prior to bid date. Substitutions after this may be refused at Engineers option. Equivalents will ONLY be considered approved when listed by addendum.
7. In proposing a substitution prior to or subsequent to receipt of bids, include in such bid the cost of altering other elements of this project, including adjustments in mechanical or electrical service requirements necessary to accommodate such substitution.
8. Within 10 working days after bids are received, the apparent low bidder shall submit to the Architect-Engineer for approval, three copies of a list of all major items of equipment they intend to provide. Within 30 working days after award of Contract, Contractor shall submit shop drawings for equipment and materials to be incorporated in work, for Architect-Engineer review. Where 30-day limit is insufficient for preparation of detailed shop drawings on major equipment or assemblies, Contractor shall submit manufacturer's descriptive catalog data and indicate date such detailed shop drawings will be submitted along with manufacturer's certification that order was placed within 30 working day limit.

L. ELECTRONIC PLAN FILES

1. Electronic files of the contract documents may be available from the Engineer to successful bidders and manufacturers for a fee of \$50 per sheet, \$100 minimum and \$25 email/shipping charge. A release of liability form will be required along with payment prior to release of files.

M. TEMPORARY USE OF PERMANENT HVAC UNITS

1. If the Contractor elects to use permanent equipment for temporary conditioning only that permanent equipment associated with the heating system shall be allowed for use as space conditioning during the construction period. The Mechanical Contractor shall take full responsibility for all permanent equipment used for temporary conditioning during the construction period and shall provide a total of two years warranty covering all parts and labor on all permanent equipment utilized for temporary conditioning. This warranty shall cover all piping, fittings, valves, pipe and equipment insulation, pumps, boilers, chillers, condensing units, cooling towers, air handling units, exhaust and relief air fans, ductwork, ductwork insulation, diffusers, temperature controls, all electric motors, starters, disconnect switches, fuses, wire and conduit. This warranty shall cover all required maintenance on the system with the exception of filter changes, and shall start on the date shown on the final completion certificate.
2. CAUTION: The Contractor is being warned that the Architect-Engineer will not accept dirty equipment caused by construction contamination.

N. OPENINGS, ACCESS PANELS AND SLEEVES

1. This Contractor shall include the installation of all boxes, access panels and sleeves for openings required to install this work, except structural openings incorporated in the structural drawings. Sleeves shall be installed for all pipes passing through structural slabs and walls. Contractor shall set and verify the location of sleeves that pass through beams, as shown on structural plans. All floor and wall penetrations shall be sealed to meet fire-rating requirements.
2. All penetrations through interior or exterior and rated or non-rated walls and floors shall be appropriately sealed prevent entry and movement of rodents and insects. Contractor shall coordinate their work with all other trades.

O. ARCHITECTURAL VERIFICATION AND RELATED DOCUMENTS

1. Contractor shall consult all Architectural Drawings and specifications in their entirety incorporating and certifying all millwork, furniture, and equipment rough-in including utility characteristics such as voltage, phase, amperage, pipe sizes, duct sizes, including height, location and orientation. Shop drawings incorporating these requirements should be submitted to the Architect for approval prior to installation or rough in.

P. EXTENT OF CONTRACT WORK

1. Provide mechanical systems indicated on drawings, specified or reasonably implied. Provide every device and accessory necessary for proper operation and completion of mechanical systems. In no case will claims for "Extra Work" be allowed for work about which Contractor could have been informed before bids were taken.
2. Contractor shall become familiar with equipment provided by other contractors that require mechanical

connections and controls.

3. Electrical work required to install and control mechanical equipment, which is not shown on plans or specified under Division 16, shall be included in Contractor's base bid proposal.
4. All automatic temperature control devices shall be mounted as indicated in automatic temperature control section of specifications.
5. The cost of larger wiring, conduit, control and protective devices resulting from installation of equipment which was not used for basis of design as outlined in specifications shall be paid for by Mechanical Contractor at no cost to Owner or Architect-Engineer.
6. Contractor shall be responsible for providing supervision to Electrical Contractor to insure that required connections, interlocking and interconnection of mechanical and electrical equipment are made to attain intended control sequences and system operation.
7. Furnish four complete sets of electrical wiring diagrams to Architect-Engineer to be included in the maintenance manuals and three complete sets to Electrical Contractor. Diagrams shall show factory and field wiring of components and controls. Control devices and field wiring to be provided by Electrical Contractor shall be clearly indicated by notation and drawing symbols on wiring diagrams.
8. Contractor shall obtain complete electrical data on mechanical shop drawings and shall list this data on an approved form that shall be presented monthly or on request, to Electrical Contractor. Data shall be complete with wiring diagrams received to date and shall contain necessary data on electrical components of mechanical equipment such as HP, voltage, amperes, watts, locked rotor current to allow Electrical Contractor to order electrical equipment required in his contract.

Q. WORK NOT INCLUDED IN CONTRACT

1. Consult Division 16 of specifications for work to be provided by Electrical Contractor in conjunction with installation of mechanical equipment.

R. CODES, RULES AND REGULATIONS

1. Provide Work in accordance with applicable codes, rules and regulations of Local and State, Federal Governments and other authorities having lawful jurisdiction.
2. Conform to latest editions and supplements of following codes, standards or recommended practices.

S. SAFETY CODES:

1. National Electrical Safety Code Handbook H30 - National Bureau of Standards.
2. Occupational Safety and Health Standard (OSHA) - Department of Labor.

T. NATIONAL FIRE CODES:

1. NFPA No. 13 Standard for the installation of Sprinkler Systems
2. NFPA No. 14 Standard for the installation of Standpipe and Hose Systems
3. NFPA No. 54 Gas Appliance & Gas Piping Installation
4. NFPA No. 70 National Electrical Code
5. NFPA No. 89M Clearances, Heat Producing Appliances
6. NFPA No. 90A Air Conditioning and Ventilating Systems
7. NFPA No. 91 Blower & Exhaust System
8. NFPA No. 101 Life Safety Code
9. NFPA No. 204 Smoke & Heating Vent Guide

U. UNDERWRITERS LABORATORIES INC:

1. All materials, equipment and component parts of equipment shall bear UL labels whenever such devices are listed by UL.

V. MISCELLANEOUS CODES:

1. ANSI A117.1 - Handicapped Accessibility
2. Applicable State Boiler Codes
3. Americans with Disabilities Act (ADA)

W. ENERGY EFFICIENCY REQUIREMENTS:

1. All mechanical systems and components shall be manufactured and installed in compliance with ASHRAE 90.1 – 2007 and latest adopted version of IECC.

X. STANDARDS

1. Drawings and specifications indicate minimum construction standard. Should any work indicated be sub-standard to any ordinances, laws, codes, rules or regulations bearing on work, Contractor shall promptly notify Architect-Engineer in writing before proceeding with work so that necessary changes can be made. However, if the Contractor proceeds with work knowing it to be contrary to any ordinances, laws, rules, and regulations, Contractor shall thereby have assumed full responsibility for and shall bear all costs required to correct non-complying work.

Y. PERMITS/FEES

1. The Contractor shall secure and pay for necessary permits and certificates of inspection required by governmental ordinances, laws, rules or regulations. Keep a written record of all permits and inspection certificates and submit two copies to Architect-Engineer with request for final inspection.
2. The Contractor shall include in their base bid any fees or charges by the local utility providers to establish new services to the structure. Coordinate with the utility suppliers to verify exactly which part of the work required for the new utility service, is to be performed by the contractor and which part will be supplied by the utility company.

PART 2 - PRODUCTS

A. Not Used

PART 3 - EXECUTION

A. COORDINATION

1. Certain materials will be provided by other trades. Examine the Contract Documents to ascertain these requirements.
2. Carefully check space requirements with other trades and the physical confines of the area to insure that all material can be installed in the spaces allotted thereto including finished suspended ceilings and the spaces within the existing building. Make modifications thereto as required and approved.
3. Transmit to other trades all information required for work to be provided under their respective Sections in ample time for installation.
4. Wherever work interconnects with work of other trades, coordinate with other trades to insure that all trades have the information necessary so that they may properly install all the necessary connections and equipment.
5. Provide equipment information for all pieces of equipment to be wired to the E/C clearly indicating wiring, overcurrent protection, configurations, voltage, phase, and similar requirements. Provide this information in ample time to coordinate electrical equipment coordination. Where wiring requirements differ from that on plans or differs from provisions made in the E/C's work, immediately notify the Architect/Engineer.
6. Identify all items of work that require access so that the ceiling trade will know where to install access doors and panels.
7. Coordinate, project and schedule work with other trades in accordance with the construction sequence.
8. The Drawings show only the general run of piping and ductwork and approximate location of outlets. Any significant changes in location of items necessary in order to meet field conditions shall be brought to the immediate attention of the Architect/Engineer and receive his approval before such alterations are made. All such modifications shall be made without additional cost to the Owner.
9. Adjust location of piping, ductwork, etc. to prevent interferences, both anticipated and encountered. Determine the exact route and location of each item prior to fabrication.
 - 9.1. Right-of-Way:
 - 9.1.1. Lines that pitch have the right-of-way over those that do not pitch. For example: steam, condensate, and plumbing drains normally have right-of way. Lines whose elevations cannot be changed to have right-of-way over lines whose elevations can be changed.
 - 9.1.2. Make offsets, transitions and changes in direction in raceways as required to maintain proper headroom in pitch of sloping lines whether or not indicated on the Drawings.
10. Wherever the work is of sufficient complexity, prepare additional Detail Drawings to scale similar to that of the bidding Drawings, prepared on tracing medium of the same size as Contract Drawings. With these layouts, coordinate the work with the work of other trades. Such detailed work to be clearly identified on the Drawings as to the area to which it applies. Submit for review Drawings clearly showing the work and its relation to the work of other trades before commencing shop fabrication or erection in the field.
11. Coordinate with the local Utility Companies to their requirements for service connections and provide all

necessary materials, labor and testing.

12. Coordinate with contractors for work under other Divisions of this specification for all work necessary to accomplish this contractor's work.

B. SHOP DRAWINGS

1. Contractor shall furnish a minimum of six sets of shop drawings of all materials and equipment. Architect-Engineer will retain three sets.
2. Contractor shall submit two sets of prints of all fabrication drawings. Cost of drawing preparation, printing and distribution shall be paid for by the contractor and included in his base bid.
3. Where catalog cuts are submitted for review, conspicuously mark or provide schedule of equipment, capacities, controls, fitting sizes, etc. that are to be provided. Mark each submitted item with applicable section and sheet number of these specifications, or plan sheet number when item does not appear in the specifications. Where equipment submitted does not appear in base specifications or specified equivalent, mark submittals with applicable alternate numbers, change order number or letters of authorization. Each submittal shall contain at least two sets of original catalog cuts. Each catalog sheet shall bear the equipment manufacturer's name and address. All shop drawings on materials and equipment listed by UL shall indicate UL approval on submittal.
4. Contractor shall check all shop drawings to verify that they meet specifications and/or drawings requirements before forwarding submittals to the Architect-Engineer for their review. All shop drawings submitted to Architect-Engineer shall bear contractor's approval stamp that shall indicate that Contractor has reviewed submittals and that they meet specification and/or drawing requirements. Contractor's submittal review shall specifically check for but not be limited to the following: equipment capacities, physical size in relation to space allowed; electrical characteristics, provisions for supply, return and drainage connections to building systems. All shop drawings not meeting Contractor's approval shall be returned to their supplier for re-submittal.
5. No shop drawing submittals will be considered for review by the Architect-Engineer without Contractor's approval stamp, or that have extensive changes made on the original submittal as a result of the Contractor's review.
6. The shop drawing submittal dates shall be at least as early as required to support the project schedule and shall also allow for two weeks Architect-Engineer review time plus mailing time plus a duplication of this time for re-submittal if required. Submittal of all shop drawings as soon as possible before construction starts is preferred. Submit the number of shop drawings required by the General Conditions but not less than 6 copies. All shop drawings submitted shall contain the following: The project name, the applicable specification section and paragraph, the submittal date, the Contractor's stamp which shall certify that the stamped drawings have been checked by the Contractor, comply with the drawings and specifications and have been coordinated with other trades. Submittals not so identified will be returned without action for re-submittal.
7. The Architect's-Engineer's checking and subsequent approval of such drawings, schedules, literature, or illustrations shall not relieve the Contractor from responsibility for deviations from Drawings or Specifications unless he has, in writing, called the Architect's-Engineer's attention to such deviations at the time of submission, and secured their written approval; nor shall it relieve the contractor from responsibility for errors in dimensions, details, size of members, or omissions of components for fittings; or for coordinating items with actual building conditions and adjacent work.
8. Any corrections or modifications made by the Architect-Engineer shall be deemed acceptable to the Contractor at no change in price unless written notice is received by the Architect-Engineer prior to the performance of any work incorporating such corrections or modifications.
9. Shop drawings that require re-submission shall have the items that were revised "flagged" or in some other manner marked to call attention to what has been changed.
10. Before submitting shop drawings and material lists, verify that all equipment submitted is mutually compatible and suitable for the intended use. Verify that all equipment will fit the available space and allow ample room for maintenance. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.
11. Sheet metal shop drawings for duct fabrication shall be a minimum of 1/4" scale. Sheet metal shop drawings shall not be a reproduction of the contract document and shall show details of the following: Fabrication, assembly, and installation, including plans, elevations above finished floor, sections, components, and attachments to other work. Duct layout indicating pressure classifications and sizes on plans, fittings, reinforcement and spacing, seam and joint construction, penetrations through fire-rated and other partitions, hangers and supports, including methods for building attachment, vibration isolation, seismic restraints, and

duct attachment.

12. Architect-Engineer's review of shop drawings will not relieve Contractor of responsibility for deviations from drawings and specifications unless the Architect-Engineer has specifically approved such deviations in writing, nor shall it relieve the Contractor of responsibility for errors in shop drawings. No work shall be fabricated until Architect-Engineer's review has been obtained. Any time delay caused by correcting and re-submitting shop drawings will be the Contractor's responsibility.

C. SUBMITTALS

1. Contractor shall provide the following submittal sections that apply to this project:
 - 1.1. SECTION 15050 - BASIC MECHANICAL MATERIALS AND METHODS:
 - 1.1.1. Test methods and pressures
 - 1.1.2. Sterilization of domestic water systems
 - 1.1.3. Piping, and fittings
 - 1.2. SECTION 15100 - PIPING:
 - 1.2.1. Piping specialties
 - 1.2.2. Supports, anchors
 - 1.2.3. Sleeves and seals
 - 1.2.4. Valves
 - 1.2.5. Piping and equipment insulation
 - 1.2.6. Thermometers and gauges
 - 1.3. SECTION 15500 - HVAC HYDRONIC EQUIPMENT:
 - 1.3.1. Cooling Towers
 - 1.4. SECTION 15990 - SYSTEM TESTING & BALANCING:
 - 1.4.1. Testing Contractor
 - 1.4.2. Balance Report

D. OPERATING AND MAINTENANCE INSTRUCTIONS (O & M MANUALS)

1. Submit with shop drawings of equipment, four copies of installation, operating, maintenance instructions, and parts lists for equipment provided. Equipment manufacturer shall prepare instructions.
2. Keep in safe place, keys and wrenches furnished with the equipment provided under this contract. Present to the Owner and obtain a receipt for them upon completion of project.
3. Prepare a complete brochure, covering systems and equipment provided and installed under this contract. Submit brochures to Architect-Engineer for review before delivery to Owner. Brochures shall contain following:
4. Certified equipment drawings/or catalog data with equipment provided clearly marked as outlined above.
5. Complete installation, operating, maintenance instructions and parts lists for each item of equipment.
6. Special emergency operating instructions with a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to various parts of mechanical system.
7. Record Set Drawings:
 - 7.1. The Contractor shall mark up a set of contract documents during construction all changes and deviations including change orders. These will be delivered to Architect-Engineer at the end of the project. After the originals are changed to reflect the blue line set, a copy shall be included in the brochure.
8. Provide brochures bound in three-ring binders with metal hinge. Reinforce binding edge of each sheet of loose-leaf type brochure to prevent tearing from continued usage. Clearly print on label insert of each brochure:
 - 8.1. Project name and address.
 - 8.2. Section of work covered by brochure, i.e., "Heating, Ventilating and Air Conditioning", and "Plumbing", etc.

E. RECORD DOCUMENTS

1. A. During construction, keep an accurate record of all deviations between the work as shown on Drawings and that which is actually installed. Keep this record set of prints at the job site for review by the Architect/Engineer.
2. Upon completion of the installation and acceptance by the owner, transfer all record drawing information to one neat and legible set of prints. Then deliver them to the Architect/Engineer for transmittal to the Owner.

3. Media shall be a high quality presentation type paper. Blueprints or other media which fade shall not be used.

F. CLEANING UP

1. Contractor shall take care to avoid accumulation of debris, boxes, crates, etc., resulting from the installation of his work. Contractor shall remove from the premises each day all debris, boxes, etc., and keep the premises clean.
2. Contractor shall clean up all ductwork and equipment at the completion of the project.
3. All equipment, cabinets and enclosures shall be thoroughly vacuumed clean prior to energizing equipment and at the completion of the project. Equipment shall be opened for observation by the Architect/Engineer as required.

G. WATERPROOFING

1. Avoid, if possible, the penetration of any waterproof membranes such as roofs, machine room floors, basement walls, and the like. If such penetration is necessary, perform it prior to the waterproofing and furnish all sleeves or pitch-pockets required. Advise the Architect/Engineer and obtain written permission before penetrating any waterproof membrane, even where such penetration is shown on the Drawings.
2. If Contractor penetrates any walls or surfaces after they have been waterproofed, he shall restore the waterproof integrity of that surface as directed by the Architect/Engineer at his own expense

H. CUTTING AND PATCHING

1. Contractor shall do cutting and patching of building materials required for installation of work herein specified. Do not cut or drill through structural members including wall, floors, roofs, and supporting structure, without the Architect's and Structural Engineer's approval and in a manner approved by them.
2. Make openings in concrete with concrete hole saw or concrete drill. Use of star drill or air hammer for this work will not be permitted.
3. Patching shall be by the contractors of the particular trade involved and shall meet approval of Architect-Engineer. Damage to building finishes, caused by installation of mechanical work shall be repaired at Mechanical Contractor's expense to approval of Architect-Engineer.

I. SETTING, ADJUSTMENT AND EQUIPMENT SUPPORTS

1. Work shall include mounting, alignment and adjustment of systems and equipment. Set equipment level on adequate foundation and provide proper anchor bolts and isolation as shown, specified or required by manufacturers in installation instructions. Level, shim and grout equipment bases as recommended by manufacturer. Mount motors, align and adjust drive shafts and belts according to manufacturer's instructions.
2. Equipment failures resulting from improper installation or field alignment shall be repaired or replaced by Contractor at no cost to Owner.
3. Floor or pad mounted equipment shall not be held in place solely by its own dead weight. Include anchor fastening in all cases.
4. Provide floor or slab mounted equipment with 3-1/2" high concrete bases unless specified otherwise. Mechanical contractor shall form all pads; General contractor shall provide and place all concrete and reinforcing for said pads. Individual concrete pad shall be no less than 4" wider and 4" longer than equipment, and shall extend no less than 2" from each side of equipment.
5. Provide each piece of equipment or apparatus suspended from ceiling or mounted above floor level with suitable structural support, platform or carrier in accordance with best-recognized practice. Verify that structural members of buildings are adequate to support equipment and unless otherwise indicated on plans or specified, arrange for their inclusion and attachment to building structure. Provide hangers with vibration isolators.
6. Submit details of hangers, platforms and supports together with total weights of mounted equipment to Architect-Engineer for review before proceeding with fabrication or installation.
7. Provide any necessary miscellaneous steel angles or supports to trim out roof/deck openings and to support roof mounted equipment.

J. START-UP, CHANGEOVER, TRAINING AND OPERATIONAL CHECK

1. Contractor shall perform the initial start-up of the systems and equipment and shall provide necessary supervision and labor to make the first seasonal changeover of systems. Personnel qualified to start-up and service this equipment, including manufacturer's technicians, and the Owner's operating personnel shall be present during these operations.
2. Contractor shall be responsible for training Owner's operating personnel to operate and maintain the systems and equipment installed. Keep a record of training provided to Owner's personnel listing the date, subject

covered, instructors name, names of Owner's personnel attending and total hours of instruction given each individual.

3. All owner-training sessions shall be orderly and well organized and shall be video recorded digitally. At the end of the owner training, the "training" session recording shall be transmitted to the owner via DVD and shall become property of the owner.

K. FINAL CONSTRUCTION REVIEW

1. At final construction review, each respective Contractor and major subcontractors shall be present or shall be represented by a person of authority. Each Contractor shall demonstrate, as directed by the Architect-Engineer, that the work complies with the purpose and intent of the contract documents. Respective Contractor shall provide labor, services, instruments or tools necessary for such demonstrations and tests.

END OF SECTION 15010

SECTION 15020 - MECHANICAL DEMOLITION

PART 1 - GENERAL

A. RELATED DOCUMENTS

1. Reference Section 15010.
2. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. SUMMARY

1. This Section requires the selective removal and subsequent offsite disposal of the following:
 - 1.1. Mechanical and electrical equipment, devices, piping, conduits, ductwork, insulation, lighting, etc in existing building indicated on drawings and as required to accommodate new construction.
 - 1.2. Removal of MEP items in interior partitions as indicated on drawings.
 - 1.3. Removal and protection of existing fixtures, materials, and equipment items indicated to be removed, salvaged, relocated, reinstalled, etc.

C. SUBMITTALS

1. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
2. Schedule indicating proposed sequence of operations for selective demolition work to Architect for review prior to start of work. Include coordination for shutoff, capping, and continuation of utility services as required, together with details for dust and noise control protection.
 - 2.1. Provide detailed sequence of demolition and removal work to ensure uninterrupted progress of Owner's on-site operations.
 - 2.2. Coordinate with Owner's continuing occupation of portions of existing building and with Owner's partial occupancy of completed remodeled areas.
3. Photographs of existing conditions of structure surfaces, equipment, and adjacent improvements that might be misconstrued as damage related to removal operations. File with Architect prior to start of work.

D. JOB CONDITIONS

1. Occupancy:
 - 1.1. Owner will occupy portions of the building immediately adjacent to areas of selective demolition. Conduct selective demolition work in such a manner that will minimize need for disruption of Owner's normal operations. Provide minimum of 72 hours advance notice to Owner of demolition activities that will affect Owner's normal operations.
2. Condition of Structures:
 - 2.1. Owner assumes no responsibility for actual condition of items or structures to be demolished. Conditions existing at time of Contractor's inspection for bidding purposes will be maintained by Owner insofar as practicable. However, minor variations within structure may occur by Owner's removal and salvage operations prior to start of selective demolition work.
 - 2.2. Partial Demolition and Removal: Items indicated to be removed but of salvageable value to Contractor may be removed from structure as work progresses. Transport salvaged items from site as they are removed. Storage or sale of removed items on site will not be permitted. D. Protections: Provide temporary barricades and other forms of protection to protect Owner's personnel and general public from injury due to selective demolition work.
 - 2.3. Provide protective measures as necessary and required to provide free and safe passage of Owner's personnel and general public to any occupied portions of building.
 - 2.4. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities or work to remain.
 - 2.5. Protect from damage existing finish work that is to remain in place and becomes exposed during demolition operations.
 - 2.6. Construct temporary insulated dustproof partitions where required to separate areas where noisy or extensive dirt or dust operations are performed. Equip partitions with dustproof doors and security locks.
 - 2.7. Provide temporary weather protection during interval between demolition and removal of existing construction on exterior surfaces and installation of new construction to ensure that no water leakage or damage occurs to structure or interior areas of existing building.

- 2.8. Remove protections at completion of work.
3. Damages:
 - 3.1. Promptly repair damages caused to adjacent facilities by demolition work.
4. Traffic:
 - 4.1. Conduct selective demolition operations and debris removal to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close, block, or otherwise obstruct streets, walks, or other occupied or used facilities without written permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
5. Flame Cutting:
 - 5.1. Do not use cutting torches for removal until work area is cleared of flammable materials. At concealed spaces, such as interior of ducts and pipe spaces, verify condition of hidden space before starting flame-cutting operations. Maintain portable fire suppression devices during flame-cutting operations. H. Utility Services: Maintain existing utilities indicated to remain in service and protect them against damage during demolition operations.
6. Do not interrupt utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.
7. Maintain fire protection services during selective demolition operations.
8. Environmental Controls:
 - 8.1. Use water sprinkling, temporary enclosures, and other methods to limit dust and dirt migration. Comply with governing and/or approved regulations pertaining to environmental protection. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

A. PREPARATION

1. General:
 - 1.1. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of areas to be demolished and adjacent facilities to remain.
 - 1.2. Cease operations and notify Architect immediately if safety of structure appears to be endangered. Take precautions to support structure until determination is made for continuing operations.
2. Erect and maintain dust-proof partitions and closures as required to prevent spread of dust or fumes to any occupied portions of the building.
3. Where selective demolition occurs immediately adjacent to any occupied portions of the building, construct dust-proof partitions of minimum 4-inch studs, 5/8-inch drywall (joints taped) on occupied side, 1/2-inch fire-retardant plywood on demolition side. Fill partition cavity with sound-deadening insulation as required by Architect.
 - 3.1. Provide weatherproof closures for exterior openings resulting from demolition work.
4. Locate, identify, stub off, and disconnect utility services that are not indicated to remain. Provide bypass connections as necessary to maintain continuity of service to any occupied areas of building. Provide minimum of 72 hours advance notice to Architect if shutdown of service is necessary during changeover.

B. DEMOLITION

1. General:
 - 1.1. Perform selective demolition work in a systematic manner. Use such methods as required to complete work indicated on Drawings in accordance with demolition schedule and governing regulations.
2. Demolish concrete and masonry in small sections. Cut concrete and masonry at junctures with construction to remain using power-driven masonry saw or hand tools; do not use power-driven impact tools.
3. Locate demolition equipment throughout structure and promptly remove debris to avoid imposing excessive loads on supporting walls, floors, or framing.
4. Provide services for effective air and water pollution controls as required.
5. Completely fill below-grade areas and voids resulting from demolition work. Provide fill consisting of approved earth, gravel, or sand, free of trash and debris, stones over 6 inches in diameter, roots, or other organic

matter.

6. If unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure both nature and extent of the conflict. Submit report to architect in written accurate detail. Pending receipt of directive from Architect, rearrange selective demolition schedule as necessary to continue overall job progress without undue delay.

C. DISPOSAL OF DEMOLISHED MATERIALS

1. Remove debris, rubbish, and other materials resulting from demolition operations from building site. Transport and legally dispose off site.
2. If hazardous materials are encountered during demolition operations, comply with applicable regulations, laws, and ordinances concerning removal, handling, and protection against exposure or environmental pollution.
3. Burning of removed materials is not permitted on Project site.

D. CLEANUP AND REPAIR

1. General:
 - 1.1. Upon completion of demolition work, remove tools, equipment, and demolished materials from site. Remove protections and leave interior areas broom clean. Repair demolition performed in excess of that required. Return elements of construction and surfaces to remain to condition existing prior to start operations. Repair adjacent construction or surfaces soiled or damaged by selective demolition work.

END OF SECTION 15020

SECTION 15050 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

A. RELATED DOCUMENTS

1. Reference Section 15010.
2. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

A. MOTORS

1. Motors shall be installed in strict accordance with rules set forth by NEC and equipment manufacturer.
2. **ELECTRIC MOTORS (Less than ½ HP)**
 - 2.1. Motors 1/3 horsepower and smaller shall be selected by manufacturer of driven equipment with motor speed and torque characteristics best suited for application.
 - 2.2. Motors shall have a minimum service factor of 1.15 for open dripproof enclosure and 1.00 for totally enclosed motors. Wherever applicable provide motors with cushion bases. Motor enclosure shall be proper type required for operating environment.
 - 2.3. Motors shall have a plus or minus 10% voltage tolerance and plus or minus 5% frequency tolerance. Motors shall operate satisfactorily in ambient temperature range of 0 degrees C (32°F) to 140°C (104°F) at altitudes below 3300 feet.
 - 2.4. Provide motors with built-in thermal overload protection. Motors readily accessible to operating personnel shall have manual reset protector. All other shall have automatic reset protectors.
 - 2.5. Motors shall have AFBMA standard double-shielded ball bearings sized for average life of at least 100,000 hours under normal loading conditions. Bearings housing shall have provisions for adding new lubricant without major disassembly and shall have seals to prevent entrance of foreign matter and leakage of bearing lubricant.
 - 2.6. Motor bolts, screws and other external hardware shall be treated with corrosion resistant plating and motor enclosure prime painted with corrosion resistant metal primer finished with a durable machinery enamel.
 - 2.7. Unless indicated otherwise motors shall be rated for continuous operation at 115, 200, or 277 volt single phase 60 hertz. Where equipment manufacturer offers a choice provide permanent split capacitor motors in lieu of shaded pole motors.
 - 2.8. Motor leads shall be marked throughout entire length for easy identification and terminate with brass or copper terminal lugs. Motor shall have permanently attached nameplate with electrical characteristics and wiring connection diagram.
3. **ELECTRIC MOTORS (1/2 HP and Larger)**
 - 3.1. Provide equipment requiring electric motors with NEMA Standard motors. Shop drawings, submitted and equipment provided with electric motors shall include motor manufacturer, horsepower, voltage, full load amperes, NEMA design type, insulation class, shaft bearing type, mounting base type, and enclosure type. To greatest extent possible motors for this project shall be by one manufacturer.
 - 3.2. Motors shall conform to current NEMA Standard MG1. Motor shall operate successfully without derating under the following conditions.
 - 3.3. 40 degrees C (104°F) maximum ambient temperature, 3,300 Ft. maximum altitude, voltage variations of plus or minus 10% of nameplate rating, frequency variations of plus or minus 5% of nameplate rating, combined voltage and frequency variation of plus or minus 10% total as long as frequency does not exceed plus or minus 5%.
 - 3.4. Motors shall meet or exceed locked rotor (Starting) and breakdown (maximum) torques specified for the NEMA design rating. Lock rotor currents shall not exceed NEMA maximum values for motor NEMA design rating.
 - 3.5. Motor service factors shall be 1.15 for open dripproof motors and 1.00 for totally enclosed motors.
 - 3.6. Unless indicated otherwise, motor insulation may be manufacturers standard for Class A, B or F provided that maximum permissible temperature for insulation is not exceeded when motor is operating at its service factor load in a 40 Degrees C (104°F) ambient.
 - 3.7. Motor frame/HP relationship shall conform to current NEMA Standard for "T" frames. Motors shall have antifriction ball or roller bearings sized for average life of at least 100,000 hours under normal

v-belt loading conditions. Bearings shall be AFBMA Standard and shield mounted ball bearings of ample capacity for motor rating. Bearing housing shall have provisions for adding new lubricant and draining out old lubricant without major motor disassembly. Bearing housing shall have seals to protect bearing from entrance of foreign matter and to prevent leakage of bearing lubricant.

- 3.8. Conduit box mounting shall rotate to allow conduit entrance from top, bottom or either side. Conduit holes shall conform to NEC Standards.
- 3.9. Motor leads shall have same insulation class as motor windings. Leads shall be marked throughout entire length for easy identification and terminated with brass or copper terminal lugs. Motor shall have permanently attached nameplate with electrical characteristics and wiring connection diagram.
- 3.10. Motor bolts, screws and other external hardware shall be treated with a corrosion resistant plating. Motor enclosure shall be prime painted with corrosion resisting metal primer and finished with a durable machinery enamel paint.
- 3.11. Unless indicated otherwise motors shall be rated for continuous operation at rated voltage, three phase, 60 hertz. Motors shall be T-frame squirrel cage induction. Type NEMA design B with Class B insulation. Motors shall be dripproof totally enclosed or explosion-proof as required by motor environment.

PART 3 - EXECUTION

A. TESTING PROCEDURES FOR PIPING SYSTEMS

1. Test all lines and systems before they are insulated, painted or concealed by construction or backfilling. Provide fuel, water, electricity, materials, labor and equipment required for tests.
2. Where entire system cannot be tested before concealment, test system in sections. Verify that system components are rated for maximum test pressures to be applied. Where specified test pressures exceed component ratings, remove or isolate components from system during tests. Upon completion, each system shall be tested as an entire system.
3. Repair or replace defects, leaks and material failures revealed by tests and then retest until satisfactory. Make repairs with new materials.
4. All systems shall hold scheduled test pressures for specified time without loss of initial test pressure.
5. Upon completion of testing submit five copies of a typewritten report to A/E. Report shall list systems tested, test methods, test pressures, holding time and all failures with corrective action taken.
6. For test pressure schedules see Section 15100 of this specification.

B. TEST METHODS AND PRESSURES

1. Test methods and pressures shall be as follows:
 - 1.1. Hydrostatic Test (Closed Systems):
 - 1.1.1. Hydrostatic test shall be performed using clean unused domestic water. Test pressures shall be as scheduled for system or 150% of operating pressure where not specified.
 - 1.2. Hydrostatic Test (Open System):
 - 1.2.1. Test entire system with 10-foot head of water. Where system is tested in sections each joint in building except uppermost 10 feet of system shall be submitted to at least 10-foot head of water. Water shall be held in system for 15 minutes before inspection starts. System shall hold test pressure without leaks.
 - 1.3. Pneumatic Test:
 - 1.3.1. Test entire system with compressed air. Systems operating above 25 PSI shall be tested at 75 PSI or 15% of operating pressure or whichever is greater.
 - 1.3.2. Allow at least 1 hour after test pressure has been applied before making initial test.
 - 1.3.3. Curing test, completely isolate entire system from compressor or other sources of air pressure.
 - 1.4. Pressure Relief and Safety Valve:
 - 1.4.1. Before installation, test pressure temperature, and safety relief valves to confirm relief settings comply with specifications.
 - 1.4.2. Tag items that pass test with date of test, observed relief pressure setting and inspector's signature.
 - 1.4.3. Items installed in systems without test tag attached will be rejected.

C. TESTING OF REFRIGERANT LINES

1. After the system is installed and before any piping is insulated, the entire refrigeration circuit must be thoroughly leak tested. Test all pipe joints for leaks. Make certain that all joints are inspected thoroughly. Mark carefully any spots where leaks occur.
2. Leaks are repaired by disassembling the connection, cleaning the fitting and remaking. No attempt should be made to repair a leak by simply adding brazing material.

D. STERILIZATION OF DOMESTIC WATER SYSTEMS

1. After final pressure testing of distribution system thoroughly flush entire system with water until free of dirt and construction debris. Fill system with solution of liquid chlorine or hypochlorite of not less than 50 PPM. Retain treated water in system until test indicates non-spore-forming bacteria have been destroyed or for 24 hours whichever is greater.
2. All points in systems shall have at least 10 PPM of solution at end of retention period. Open and close each valve at least six times in system during sterilization process to sterilize valve parts.
3. When time and concentration conditions have been met, drain system and flush with fresh domestic water until residual cleaning solution is less than 1.0 PPM. Open and close each valve in system six times during flushing operation.
4. Test samples taken from several points in system shall indicate absence of pollution for two full days. Repeat sterilization as required. Acceptance of system will not be given until satisfactory bacteriological results are obtained.

E. CLEANING OF SYSTEMS AND EQUIPMENT

1. After pressure testing of systems and equipment and before operational test thoroughly clean interiors of piping and equipment. Clean equipment as recommended by equipment manufacturers. Where specific instructions are not provided clean equipment systems as follows:
 - 1.1. Air Handling Systems:
 - 1.1.1. Before starting any air system clean all debris, foreign matter and construction dirt from air system and fan. Provide equipment requiring filters, such as air handling units, fan coil units, blower, etc., with throw-away filters. After cleaning air system install temporary filters and run continuously for a minimum of eight hours at full volume before installing permanent filters. Provide temporary throw-away filters in all permanent heating and air conditioning equipment systems being utilized during construction. Prior to testing and balancing systems remove temporary filter media and install clean unused filters of the type specified. Clean filters shall be installed in equipment by mechanical contractor before final acceptance inspection by Architect and Engineer.

F. MAINTENANCE OF SYSTEMS

1. Contractor shall be responsible for operation, maintenance and lubrication of equipment installed under this contract.
2. Keep a complete record of equipment maintenance and lubrication and submit two copies with request for final construction review.
3. Records shall indicate types of lubricants used and date or time when next maintenance or lubrication will need to be performed by Owner. Where special lubricants are required, Contractor shall provide Owner with a one year supply as determine by Equipment Manufacturer's recommendations.

G. PAINTING OF MATERIALS AND EQUIPMENT

1. Touch-up painting and refinishing of factory applied finishes shall be by Mechanical Contractor. Contractor shall be responsible for obtaining proper type of painting materials and color from equipment manufacturer.
2. Unless specified otherwise factory built equipment shall be factory painted. Paint shall be applied over surfaces only after they have been properly cleaned and coated with a corrosion resistant primer.
3. After installation, damage to painted surfaces shall be properly prepared and primed with primers equal to factory materials. Finish coating shall be same color and type as factory finish.
4. Where extensive refinishing is required equipment shall be completely repainted.

H. PIPING IDENTIFICATION

1. Provide pipe markers at 10'-0" maximum spacing to identify piping in mechanical rooms and 20'-0" maximum spacing in all other areas with Seaton Setmark pipe markers with letters and flow direction arrows.
2. Colors and wording shall be of standard pipe markers as available from Seaton or equal. Submit for approval

list of colors and wording prior to purchase of pipe markers.

3. Pipe marker nomenclature/colors shall meet applicable ANSI Standard and OSHA requirements.

I. VALVE IDENTIFICATION

1. Mark all valves with Seton No. 300-BL brass identification tags with system legend, valve number and size stamped on tag. Lettering shall be black ½" high. Tags shall be minimum 2" in diameter and attached to valve with Seton No. 16 brass jack chain.
2. Prepare four copies of typewritten list of valve tags. List shall be typed in upper case and contain tag number, valve size, type, function and location. Frame one list under glass and mount near operating instruction in main equipment rooms.

J. EXCAVATION AND BACKFILL

1. Perform necessary excavation to receive Work. Provide necessary sheathing, shoring, cribbing, tarpaulins, etc. for this operation, and remove it at completion of work. Perform excavation in accordance with appropriate section of these specifications, and in compliance with OSHA Safety Standards.
2. Excavate trenches of sufficient width to allow ample working space, and no deeper than necessary for installation work.
3. Conduct excavations so no walls or footings are disturbed or injured. Backfill excavations made under or adjacent to footing with selected earth or sand and tamp to compaction required by Architect-Engineer. Mechanically tamp backfill under concrete and pavings in six inch layers to 95% standard density, Reference Division 2.
4. Backfill trenches and excavations to required heights with allowance made for settlement. Tamp fill material thoroughly and moistened as required for specified compaction density. Dispose of excess earth, rubble and debris as directed by Architect.
5. When available, refer to test hole information on Architectural or Civil drawings or specifications for types of soil to be encountered in excavations.

K. FIRE BARRIERS

1. Provide sleeves through all fire-rated walls and fill voids surrounding sleeves and interior to sleeves around piping with Nelson "Flameseal" fire stop putty with U.L. listed 3 hour rating installed as per manufacturers recommendations.
2. Equivalent by Dow, Chemelex, 3M.
3. All holes or voids created by the mechanical contractor to extend piping or ductwork through fire rated floors and walls shall be sealed with an intumescent material capable of expanding up to 8 to 10 times when exposed to temperatures of 250 degrees F. It shall have ICBO, BOCAI and SBCCI (NRB 243) approved ratings to 3 hours per ASTM E-814 (UL 1479). Acceptable Material: 3M Fire Barrier Caulk, Putty, Strip and sheet forms.

L. EQUIPMENT ANCHORS

1. Provide floor or foundation mounted equipment such as pumps, boilers, air handling units, etc. with Decatur Engineering Company concrete anchors.
2. Where equipment anchors cannot be installed during forming of floors or foundations anchor equipment with McCulloch Kwik-Bolt concrete anchors.
3. Anchors shall be proper type and size recommended by manufacturer for equipment to be anchored.

M. WELDING

1. Contractor shall be responsible for quality of welding and suitability of welding procedures. All welding shall be in accordance with American Welding Society Standard B3.0 and ANSI Standard B31.1.
2. Welded pipe joints shall be made by certified welding procedures and welders. Welding electrodes shall be type and material recommended by electrode manufacturer for materials to be welded. All pipe and fittings ends shall be beveled a minimum of 30 degrees prior to welding.
3. Only welders who have successfully passed welder qualifications tests in previous 12 months for type of welding required shall do welding. Each welder shall identify his work with a code marking before starting any welded pipe fabrication. Contractor shall submit three copies of a list of welders who will work on project listing welders' code, date and types of latest qualification test passed by each welder.
4. Welded joints shall be fusion welded in accordance with Level AR3 of American Welding Society Standard AWS D10.9 "Standard for Qualification of Welding Procedures and Welders for Pipe and Tubing". Welders qualified under National Certified Pipe Welding Bureau will be acceptable.

5. Bevel all piping and fittings in accordance with recognized standards by flame cutting or mechanical means. Align and position parts so that branches and fittings are set true. Make changes in direction of piping systems with factory made welding fittings. Make branch connections with welding tees or forged weldolets.

END OF SECTION 15050

SECTION 15090 - MOTOR CONTROL AND EQUIPMENT DISCONNECTS

PART 1 - GENERAL

A. RELATED DOCUMENTS

1. Reference Section 15010.
2. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

A. DISCONNECT SWITCHES

1. General
 - 1.1. Provide heavy-duty horsepower rated Safety Switches rated in accordance with NEMA enclosed Switch Standard KS 1-1969 and L98 Standard.
 - 1.2. Equivalents by: G.E., Cutler Hammer, or I.T.E. Siemens, or Square D.
2. Product
 - 2.1. Enclosure shall be NEMA type and material required by switch location and environment. Enclosure door shall latch with means for padlocking and cover interlock with defeater to prevent opening door when switch is energized or closing switch with door open. Switch shall have an embossed nameplate permanently attached to door front with switch rating, short circuit interrupting capacity and application information.
 - 2.2. Line terminals shall be permanently marked and shielded. Contact shall be tin plated, equipped with arch chutes and have movable contacts visible in off position with door open. Wiring terminals shall be pressure type suitable for copper or aluminum wire. Switching mechanism shall be quick-make, quick-break spring driven anti-tease mechanism and shall be integral part of box. All current carrying parts shall be plated.
 - 2.3. Fuse holders shall be high pressure suitable for use with dual element fuses or rejection type current limiting fuses where required. Fuse holders shall be completely accessible from front of switch and fuses shall be installed so that the label may be easily read from the front and without removing the fuse.
3. Execution
 - 3.1. All fuse holders shall have rejection clips installed.
 - 3.2. Mount switch enclosure rigidly and with proper alignment on building structure or steel supports with centerline of operating handle not more than 6 feet above finished floor unless otherwise required. Use steel supports fabricated from standard rolled structural steel shapes or framing channel to provide one-inch separation between enclosure and building wall for vertical flow of air.
 - 3.3. Furnish and install a nameplate for each disconnect switch engraved with the equipment designation which the disconnect serves.
 - 3.4. All disconnect switches as specified shall be installed in strict accordance with rules set forth by NEC.

B. MOTOR STARTERS

1. General
 - 1.1. Provide motor starters rated in accordance with NEMA and as specified and shown on plans.
 - 1.2. Equivalents by: G.E., Cutler Hammer, or I.T.E. Siemens, Square D.
2. Product
 - 2.1. MAGNETIC MOTOR STARTERS
 - 2.1.1. Provide 600 volt, 60 hertz AC across-the-line magnetic type rated in accordance with NEMA Standards and listed and labeled in accordance with UL Standard 508 Eleventh Edition.
 - 2.1.2. Enclosures shall be NEMA type required by starter location and environment.
 - 2.1.3. Starter shall have permanently affixed to inside of enclosure cover an easy to read wiring diagram, including alternate control variations and a warning sign indicating maximum current limiting fuse size that may be installed in disconnect switch which will limit fault current to starters withstand rating with 100,000 RMS fault current available at disconnect switch.
 - 2.1.4. Starter contacts shall be silver alloy double break replacement without removal of power wiring or starter from enclosure.

- 2.1.5. Provide starter with solid state type overload relays on all phases. Overload thermal unit shall be one piece interchangeable construction. Overload relays shall provide phase loss and phase failure protection. Starter shall be inoperative with overload unit removed. Starters shall not be furnished to Electrical Contractor with jumper straps in overload units.
- 2.1.6. Ampere rating for overload relays shall be selected by multiplying motor nameplate running amperes at connected voltage by .90 for motors with 1.0 service and by .95 for motors with 1.15 service factor. Use resulting amperes to enter manufacturer's overload selection tables. Keep record of thermal unit number and current range.
- 2.1.7. Provide starter with internal wiring and control circuits prewired with only line, load, and external control circuit wiring connections required. When starter voltage exceeds 120 volts, provide 120 volt control circuit transformer with two Dual Element Fuses in transformer primary and one fuse in the secondary.
- 2.1.8. Starter shall be suitable for addition of at least four electrical interlocks of any arrangement of normally open or closed contacts.
- 2.1.9. Provide starter with the following accessories: auxiliary contacts, pilot light, and H.O.A. switch.
- 2.1.10. Starter applications requiring disconnect switch at starter shall be combination type motor starters in lieu of separate devices.
- 2.2. COMBINATION MAGNETIC MOTOR STARTERS
 - 2.2.1. Provide 600 volt, 60 hertz AC across-the-line fusible or non-fusible as scheduled magnetic type rated in accordance with NEMA Standards and listed and labeled in accordance with UL Standard 508 Eleventh Edition.
 - 2.2.2. Starter NEMA enclosure type shall be type required for starter location and environment.
 - 2.2.3. Combination starter shall be a factory assembled unit with internal wiring and control circuits prewired with only line, load, and external control circuit wiring connections required.
 - 2.2.4. Where fusible CMS are called for fuse holders shall be high pressure suitable for use with dual element fuses or rejection type current limiting fuses where required.
 - 2.2.5. Fuse holders shall be completely accessible from front of switch and fuses shall be installed so that the fuse type and size may be easily read from the front and without removing the fuse.
 - 2.2.6. All fuse holders shall have rejection clips installed.
 - 2.2.7. See plans for combination magnetic starters.
- 2.3. MANUAL MOTOR CONTROL (1 HP Maximum)
 - 2.3.1. Provide 300 volt, 60 cycle, AC manually operated motor starting switch meeting current NEMA Standards with proper NEMA enclosure required by starter location and environment.
 - 2.3.2. Starter shall have heavy silver alloy contacts with quick-make, quick-break mechanism manually operated by toggle switch.
 - 2.3.3. Thermal unit shall be melting alloy type, resettable, one-piece interchangeable construction.
 - 2.3.4. Provide starter with all accessories such as pilot light, H.O.A. or two speed switches required to provide control sequence shown on drawings or specified. Selector switches contact shall have same ampere rating as starter switch.
- 3. Execution
 - 3.1. All fuse holders shall have rejection clips installed.
 - 3.2. Mount starter enclosure rigidly and with proper alignment on building structure or steel supports with operating switches not more than 6 feet above finished floor unless otherwise required. Use steel supports fabricated from standard rolled structural steel shapes or framing channel to provide one-inch separation between enclosure and building wall for vertical flow of air.
 - 3.3. Furnish and install a nameplate for each starter/switch engraved with the equipment designation which the disconnect serves.
 - 3.4. All starters/disconnect switches as specified shall be installed in strict accordance with rules set forth by NEC.
 - 3.5. Install starters in locations as shown on plans, installation shall be in strict accordance with NEC, and manufacturer's installation requirements.

END OF SECTION 15090

SECTION 15095 - VARIABLE FREQUENCY CONTROLLERS

PART 1 - GENERAL

A. RELATED DOCUMENTS

1. Reference Section 15010.
2. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. DESCRIPTION

1. This specification is to cover a complete Adjustable Frequency motor Drive (AFD) consisting of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor. The drive shall be designed specifically for variable torque applications. It is required that the drive manufacturer have an existing:
 - 1.1. Sales representative exclusively for HVAC products, with expertise in HVAC systems and controls.
 - 1.2. An independent service organization.
2. The drive and all necessary controls as herein specified shall be factory built and supplied by the drive manufacturer in an ISO 9000 approved environment. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of ten years. AFD's that are manufactured by a third party and "name branded" shall not be acceptable.

C. QUALITY ASSURANCE

1. Referenced Standards:
 - 1.1. Institute of Electrical and Electronic Engineers (IEEE)
 - 1.1.1. Standard 519-1992, IEEE Guide for Harmonic Content and Control.
 - 1.2. Underwriters laboratories
 - 1.2.1. UL508C
 - 1.3. National Electrical Manufacturer's Association (NEMA)
 - 1.3.1. ICS 7.0, AC Adjustable Speed Drives
 - 1.4. IEC 16800 Parts 1 and 2
2. Testing:
 - 2.1. All printed circuit boards shall be completely tested and burned-in before being assembled into the completed AFD. The AFD shall then be subjected to a computerized systems test (cold), burn-in, and computerized systems test (hot). The burn-in shall be at 104 °F (40°C), at full rated load.
 - 2.2. All testing and manufacturing procedures shall be ISO 9001 certified.
3. Failure Analysis:
 - 3.1. AFD manufacturer shall have an analysis laboratory to evaluate the failure of any component. The failure analysis lab shall allow the manufacturer to perform complete electrical testing, x-ray of components, and decap or delaminate of components and analyze failures within the component.
4. Qualifications:
 - 4.1. AFDs and options shall be UL listed as a complete assembly.
 - 4.2. AFDs and options shall be cUL listed as a complete assembly.
 - 4.3. AFD's and options shall be CE labeled as a component.

D. SUBMITTALS

1. Submittals shall include the following information:
 - 1.1. Outline Dimensions
 - 1.2. Weight
 - 1.3. Compliance to IEEE 519 – harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion.
 - 1.3.1. The AFD manufacture shall provide calculations; specific to this installation, showing total harmonic voltage distortion is less than 5%. Input line filters shall be sized and provided as required by the AFD manufacturer to ensure compliance with IEEE standard 519 (latest version), guide for Harmonic Control and Reactive Compensation for Static Power Converters. The acceptance of this calculation must be completed prior to AFD installation.

- 1.3.2. Prior to installation, the AFD manufacturer shall provide the estimated total harmonic distortion (THD) caused by the AFDs. The results shall be based on a computer aided circuit simulation of the total actual system, with information obtained from the power provider and the user.
- 1.3.3. If the voltage THD exceeds 5%, the AFD manufacturer is to provide the additional equipment required, at no cost to the owner, to reduce the voltage THD to this level.
- 1.3.4. The AFD shall be acceptable for use with motor output wiring lengths up to 200 feet, when using a motor that complies with NEMA MG1, part 31. AFD's that do not meet this requirement must provide a tuned dv/dt output filter, factory mounted and wired, in the AFD enclosure.

E. WARRANTY

1. Warranty shall be 24 months from the date of certified start-up, not to exceed 30 months from the date of manufacturer. The warranty shall include all parts, labor, travel time and expenses.

PART 2 - PRODUCTS

A. ADJUSTABLE FREQUENCY DRIVES

1. The adjustable frequency drives (AFDs) shall be solid state, with a Pulse Width Modulated (PWM) output. The AFD package as specified herein shall be enclosed in a NEMA 1 enclosure, completely assembled and tested by the manufacturer. The AFD shall employ a full wave rectifier (to prevent input line notching), Integral Line Reactor(s), Capacitors, and Insulated Gate Bipolar Transistors (IGBT's) as the output-switching device. The drive efficiency shall be 97% or better at full speed and full load. Fundamental power factor shall be 0.98 at all speeds and loads.
2. Specifications for the 3 HP to 400 HP at 480 volts and 2 to 100 HP at 240 volts:
 - 2.1. Input 380/415/440/460/480 VAC +/- 10%, 3 phase, 48-63 Hz or input 200/208/220/230/240 VAC +/- 10%, 3 phase, 48-63 Hz. Undervoltage trip @ rated input -35%, Overvoltage trip @ rated input +35%.
 - 2.2. Interrupt rating 65 kAIC, suitable for use on a circuit capable of delivering not more than 65,000 RMS symmetrical amps, 480 V maximum.
 - 2.3. Output Frequency 0 to 250 Hz. Operation above 60 Hz shall require programming changes to prevent inadvertent high-speed operation.
 - 2.4. Environmental operating conditions: 0 to 40°C, 0 to 3300 feet above sea level, less than 95% humidity, non-condensing.
 - 2.5. Enclosure shall be rated NEMA 1 or NEMA 12 per the notes on equipment schedule.
3. All AFDs shall have the following standard features:
 - 3.1. All AFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad is to be used for local control, for setting all parameters, and for stepping through the displays and menus. The keypad shall be removable, capable of remote mounting, and shall have it's own non-volatile memory. The keypad shall allow for uploading and downloading of parameter settings as an aid for start-up of multiple AFDs.
 - 3.2. The keypad shall include Hand-Off-Auto membrane selections. When in "Hand", the AFD will be started and the speed will be controlled from the up/down arrows. When in "Off", the AFD will be stopped. When in "Auto", the AFD will start via an external contact closure and the AFD speed will be controlled via an external speed reference. The drive shall incorporate "bumpless transfer" of speed reference when switching between "Auto" and "Hand" modes.
 - 3.3. The AFD's shall utilize pre-programmed application macros specifically designed to facilitate start-up. The Application Macros shall provide one command to reprogram all parameters and customer interfaces for a particular application to reduce programming time.
 - 3.4. The AFD shall have the ability to automatically 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 shall be programmable.
 - 3.5. The AFD shall be capable of starting into a rotating load (forward or reverse) and accelerate or decelerate to setpoint without safety tripping or component damage (flying start). The AFD shall also be capable of DC injection braking at start to stop a reverse spinning motor prior to ramp.
 - 3.6. The AFD shall be equipped with an automatic extended control power ride-through circuit, which will utilize the inertia of the load to keep the drive powered. Typical control power ride-through for a fan load shall be 2 seconds minimum.
 - 3.7. If the input reference (4-20mA or 2-10V) is lost, the AFD shall give the user the option of either (1)

- stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the AFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communication bus.
- 3.8. The customer terminal strip shall be isolated from the line and ground.
 - 3.9. The drive shall employ current limit circuits to provide trip free operation:
 - 3.9.1. The Slow Current Regulation limit circuit shall be adjustable to 150% (minimum) of the AFD's normal duty current rating. This adjustment shall be made via the keypad, and shall be displayed in actual amps, and not as percent of full load.
 - 3.9.2. The Current Switch-off limit shall be fixed at 350% (minimum, instantaneous) of the AFD's normal duty current rating.
 - 3.10. The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute in every 10 minutes
 - 3.11. The AFD shall have integral Input Reactor(s) with a minimum of 3% impedance in the form of AC or DC reactors. DC reactors shall be located on both the positive and negative bus rails to reduce the harmonics to the power line and to increase the fundamental power factor.
 - 3.12. The AFD shall be capable of sensing a loss of load (broken belt / no water in pump) and signal the loss of load condition. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay outputs shall include programmable time delays that will allow for drive acceleration from zero speed without signaling a false underload condition.
 - 3.13. The AFD shall have programmable "Sleep" and "Wake up" functions to allow the drive to be started and stopped from the level of a process feedback or follower signal.
4. All AFDs to have the following adjustments:
- 4.1. Two (2) programmable critical frequency lockout ranges to prevent the AFD from operating the load continuously at an unstable speed.
 - 4.2. PID Setpoint controller shall be standard in the drive, allowing a pressure or flow signal to be connected to the AFD, using the microprocessor in the AFD for the closed loop control. The AFD shall have 250 mA of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The auxiliary power supply shall have overload and over current protection. The PID setpoint shall be adjustable from the AFD keypad, analog inputs, or over the communications bus.
 - 4.3. Two (2) programmable analog inputs shall accept a current or voltage signal for speed reference, or for reference and actual (feedback) signals for PID controller. Analog inputs shall include a filter; programmable from 0.01 to 10 seconds to remove any oscillation in the input signal. The minimum and maximum values (gain and offset) shall be adjustable within the range of 0 - 20 ma and 0 - 10 Volts. Additionally, the reference must be able to be scaled so that maximum reference can represent a frequency less than 60 Hz, without lowering the drive maximum frequency below 60 Hz. Process variables shall be modifiable by math functions such as multiplication and division between the two signals (fan tracking), high/low select, as well as inverted follower.
 - 4.4. Five (5) programmable digital inputs for maximum flexibility in interfacing with external devices. One digital input is to be utilized as a customer safety connection point for fire, freeze, and smoke interlocks (Enable). Upon customer reset (reclosure of interlock) drive is to resume normal operation.
 - 4.5. One (1) programmable analog output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, and other data.
 - 4.6. Two (2) programmable digital relay outputs. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; Continuous current rating 2 amps RMS. Outputs shall be true form C type contacts; open collector outputs are not acceptable. Relays shall be capable of programmable on and off delay times.
 - 4.7. Seven (7) programmable preset speeds.
 - 4.8. Two independently adjustable accel and decel ramps. These ramp times shall be adjustable from 1 to 1800 seconds.
 - 4.9. The AFD shall Ramp or Coast to a stop, as selected by the user.
5. The following operating information displays shall be standard on the AFD digital display. All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of two operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable):

- 5.1. Output Frequency
 - 5.2. Motor Speed (RPM, %, or Engineering units)
 - 5.3. Motor Current
 - 5.4. Calculated Motor Torque
 - 5.5. Calculated Motor Power (kW)
 - 5.6. DC Bus Voltage
 - 5.7. Output Voltage
 - 5.8. Heatsink Temperature (^oF)
 - 5.9. Analog Input Values
 - 5.10. Analog Output Value
 - 5.11. Keypad Reference Values
 - 5.12. Elapsed Time Meter (resettable)
 - 5.13. kWh meter (resettable)
 - 5.14. mWh meter
 - 5.15. Digital input status
 - 5.16. Digital output status
6. The AFD shall have the following protection circuits. In the case of a protective trip, the drive shall stop, and announce the fault condition in complete words (alphanumeric codes are not acceptable).
- 6.1. Overcurrent trip 350% instantaneous (170% RMS) of the AFD's variable torque current rating.
 - 6.2. Overvoltage trip 130% of the AFD's rated voltage
 - 6.3. Undervoltage trip 65% of the AFD's rated voltage
 - 6.4. Overtemperature +90° C, Heatsink Temperature
 - 6.5. Ground Fault either running or at start
 - 6.6. Adaptable Electronic Motor Overload (I2t). The Electronic Motor Overload protection shall protect the motor based on speed, load curve, and external fan parameter. Circuits, which are not speed dependant, are unacceptable. The electronic motor overload protection shall be UL Listed for this function.
7. Speed Command Input shall be via:
- 7.1. Keypad.
 - 7.2. Two Analog inputs, each capable of accepting a 0-20mA, 4-20mA, 0-10V, 2-10V signal.
 - 7.3. Floating point input shall accept a three-wire input from a Dwyer Photohelic (or equivalent type) instrument.
 - 7.4. Serial Communications
8. Serial Communications
- 8.1. The AFD shall have an RS-485 port as standard. The standard protocol shall be Modbus.
 - 8.2. The AFD shall be able to communicate with PLC's, DCS's, and DDC's.
 - 8.3. Serial communication capabilities shall include, but not be limited to, run-stop control; speed set adjustment, proportional/integral/derivative PID control (Set Point) adjustments, current limit, and accel/decel time adjustments. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed/frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), relay outputs, digital inputs and diagnostic warning and fault information. Additionally, remote (LAN) VFD fault reset shall be possible. A minimum of 15 field parameters shall be capable of being monitored.
 - 8.4. The AFD shall allow the DDC to control the drive's digital and analog outputs via the serial interface. The serial communications interface shall allow for DO (relay) control and AO (analog) control without being tied to a VFD function. In addition, all drive digital and analog inputs shall be capable of being monitored by the DDC system.
 - 8.5. The AFD shall have the capability of accepting fiber optic cables for connection to standard ABB fieldbus adapters. Communications between the drive and fieldbus adapters shall be at 1Mega Baud.
 - 8.6. The AFD shall be connectable to a PC based software tool capable of operating, programming,

monitoring the drive as well as diagnosing faults.

9. OPTIONAL FEATURES Optional features to be furnished and mounted by the drive manufacturer. All optional features shall be UL Listed by the drive manufacturer as a complete assembly. Bypass package must be factory built.
 - 9.1. Microprocessor based Bypass Controller - Manual or automatic (selectable) transfer to line power via contactors. A keypad to control the bypass controller is to be mounted on the enclosure door. The bypass keypad shall include a one line diagram and status LEDs to indicate the mode of operation, drive and bypass status and ready & enable conditions. When in the "Normal" mode, the bypass contactor is open and the drive output contactor is closed. In the "Test" position, the drive output contactor is open, in the "Bypass" position, the drive output contactor is open, and the bypass contactor is closed via Start/stop command. Start/stop via customer supplied maintained contact shall be 24V or 115V compatible and shall function in both the "Normal" and "Bypass" modes. The voltage tolerance of the bypass power supply shall be +30/-35% to eliminate the problem of contactor coil burnout. The design shall include single-phase protection in both the AFD and bypass modes.
 - 9.1.1. Customer Interlock Terminal Strip – provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in Hand, Auto, Drive or Bypass modes.
 - 9.1.2. Automatic / manual bypass operation shall be selectable in the standard microprocessor based bypass design.
 - 9.1.3. Door / cover interlocked disconnect switch which will disconnect all input power from the drive, bypass and all internally mounted options. The disconnect handle shall be through the door, and be padlock able in the "Off" position.
 - 9.1.4. Fast acting semi-conductor fuses exclusive to the AFD – fast acting semi-conductor fuses allow the AFD to disconnect from the line prior to clearing upstream branch circuit protection, maintaining bypass capability. Bypass designs, which have no such fuses, or that, incorporate fuses common to both the AFD and the bypass will not be accepted. In such designs, a fuse clearing failure would render the bypass unusable.

PART 3 - EXECUTION

A. INSTALLATION

1. Installation shall be the responsibility of the mechanical contractor. The contractor shall install the drive in accordance with the recommendations of the AFD manufacturer as outlined in the installation manual.
2. Power wiring shall be completed by the electrical contractor. The contractor shall complete all wiring in accordance with the recommendations of the AFD manufacturer as outlined in the installation manual.
3. When the AC drive is applied to a motor that has motor leads exceeding 100 feet, the manufacturer shall supply an output filter (LC) on the load side of the drive which reduces voltage spikes at the motor to comply with NEMA motor standards.

B. INSPECTION

1. Verify that the location is ready to receive work and the dimensions are as indicated. Do not install controller until the building environment can be maintained within the service conditions required by the manufacturer.
2. Before and during installation, the AC drive shall be protected from site contaminants.

C. START-UP

1. Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the owner, and a copy kept on file at the manufacturer.

D. PRODUCT SUPPORT

1. Factory trained application engineering and service personnel that are thoroughly familiar with the drive products offered shall be locally available at both the specifying and installation locations.

E. WARRANTY

1. Warranty shall be 24 months from the date of certified start-up, not to exceed 30 months from the date of manufacturer. The warranty shall include all parts, labor, travel time and expenses.

F. ACCEPTABLE PRODUCTS

1. A. Acceptable current technology AFD products are ABB ACH400 (Asea Brown Boveri), Eaton HV9000 , Graham VLT6000, or prior approved equal products

END OF SECTION 15095

SECTION 15100 - PIPING

PART 1 - GENERAL

A. RELATED DOCUMENTS

1. Reference Section 15010.
2. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

A. PIPING MATERIALS

1. Piping used throughout project shall conform to the following specifications. Piping shall be plainly marked with manufacturers name and weight. See piping material schedule for materials and joining methods to be used for each piping system. Piping fitting used throughout project shall be proper type for installation method used and shall be compatible with piping system material and shall be installed per manufacturers recommendations.
 - 1.1. Carbon Steel Pipe (1/8" thru 2"):
 - 1.1.1. Pipe:
 - a. Provide seamless carbon steel conforming to ASTM specification A-106.
 - b. Pipe joints shall be threaded conforming to ANSI Standard B2.1.
 - 1.1.2. Carbon Steel Welding Fittings:
 - a. Provide carbon low alloy seamless steel welding fittings conforming to current ANSI Standard B16.9 and ASTM Specification A234.
 - 1.1.3. Branch Connection Welding Fittings:
 - a. Provide carbon steel weldolet fittings conforming to ANSI Standards B16.9, B16.11, B31.1.0 and ASTM specification A105, Grade 11.
 - 1.1.4. Branch Connection, Welding to Screwed Fitting:
 - a. Provide carbon steel threadolet fitting conforming to ANSI Standards B16.9, B16.11, B31.1, and ASTM Specification A105, Grade 11.
 - 1.1.5. Carbon Steel Flanges:
 - a. Provide carbon steel flanges conforming to ASTM Specification A181, Grade 1, and ANSI Standard B16.5.
 - 1.1.6. Malleable Iron Screwed Fittings:
 - a. Provide screwed malleable iron fittings conforming to ANSI Standard B16.3, and ASTM Specification A-47 grade 32510.
 - 1.1.7. Cast Iron Screwed Fittings:
 - a. Provide screwed cast iron fittings conforming to ANSI Standard B16.4, B2.1, and ASTM Specification A-126, Class A.
 - 1.1.8. Roll Grooved Pipe Couplings:
 - a. Provide Victaulic style #107 or approved equal style (zero flex) couplings with Grade "E" gasket (EPDM compound) in mechanical areas. Provide Victaulic style #177 or approved equal style (flexible) couplings with Grade "E" gasket in other areas. Provide with ductile iron housing and nuts and bolts.
 - b. Equivalent by Grinnell.
 - 1.2. Carbon Steel Pipe (2-1/2" and above):
 - 1.2.1. Pipe:
 - a. Provide electric resistance welded carbon steel pipe conforming to ASTM Specification A-53.
 - b. Pipe ends shall be beveled for welding.
 - 1.2.2. Carbon Steel Welding Fittings:
 - a. Provide carbon low alloy seamless steel welding fittings conforming to current ANSI Standard B16.9 and ASTM Specification A234.
 - 1.2.3. Branch Connection Welding Fittings:

- a. Provide carbon steel weldolet fittings conforming to ANSI Standards B16.9, B16.11, B31.1.0 and ASTM specification A105, Grade 11.
- 1.2.4. Branch Connection, Welding to Screwed Fitting:
 - a. Provide carbon steel threadolet fitting conforming to ANSI Standards B16.9, B16.11, B31.1, and ASTM Specification A105, Grade 11.
- 1.2.5. Carbon Steel Flanges:
 - a. Provide carbon steel flanges conforming to ASTM Specification A181, Grade 1, and ANSI Standard B16.5.
- 1.2.6. Malleable Iron Screwed Fittings:
 - a. Provide screwed malleable iron fittings conforming to ANSI Standard B16.3, and ASTM Specification A-47 grade 32510.
- 1.2.7. Cast Iron Screwed Fittings:
 - a. Provide screwed cast iron fittings conforming to ANSI Standard B16.4, B2.1, and ASTM Specification A-126, Class A.
- 1.2.8. Pipe Flange Gaskets:
 - a. Provide 1/16" thick asbestos free gaskets full face or ring type as required. Gaskets shall be factory cut.
 - b. Gaskets by Durable Mfg. Co. or Garlock Company.
- 1.2.9. Roll Grooved Pipe Couplings:
 - a. Provide Victaulic style #107 or approved equal style (zero flex) couplings with Grade "E" gasket (EPDM compound) in mechanical areas. Provide Victaulic style #177 or approved equal style (flexible) couplings with Grade "E" gasket in other areas. Provide with ductile iron housing and nuts and bolts.
 - b. Equivalent by Grinnell.

B. PIPING AND EQUIPMENT INSULATION

- 1. Provide necessary materials and accessories for installation of insulation for plumbing and mechanical systems as specified and/or detailed on drawings insulation type, jacket, and thickness for specific piping systems or equipment shall be as listed in insulation schedule. Provide insulation materials manufactured by Armstrong Industries, Dow Chemical, Schuller, Knauf Fiberglass or Owens-Corning Fiberglas.
- 2. Insulation, except where specified otherwise, shall have composite fire and smoke hazard ratings as rested by ASTM E-84, NFPA 255, and UL 723 procedures not exceeding:

FLAME SPREAD	25
SMOKE DEVELOPED	50
FUEL CONTRIBUTED	50

- 3. Provide insulation accessories such as adhesives, mastics, cements, tape and glass fabric with same component ratings as listed above. Products or their shipping cartons shall bear label indicating their flame and smoke safety shall be permanent. Use of water soluble treatments such as corn paste or wheat paste is prohibited. This does not exclude approved lagging adhesives.
- 4. Install insulation over clean dry surfaces with joints firmly butted together. Insulation at equipment, flanges, fittings, etc. shall have straight edges with box type joints with corner beads as required. Where plumbing and heating insulation terminates at equipment or unions, taper insulation at 30 degree angle to pipe with one coat finishing cement and finish same as fittings. Total insulation system shall have neat smooth appearance with no wrinkles, or folds in jackets, joint strips or fitting covers.
- 5. Undamaged insulation systems on cold surface piping and equipment shall perform their intended functions as vapor barriers and thermal insulation without premature deterioration of insulation or vapor barrier. Contractor shall take every reasonable precaution to provide insulation systems with continuous unbroken vapor barriers.
- 6. Where glass fabric is specified in the following insulation methods provide resin impregnated white open weave glass fabric with 10/20 thread count. Provide glass cloth similar to Alpha Martex wettable glass cloth.
- 7. Abbreviations for manufacturers of adhesive, mastics and coating specified shall be C.M. for Chicago Mastic Company and B.F. for Benjamin Foster Company.
- 8. Insulation of removable heads, manholes access covers, etc., shall be fabricated to allow removal without

damage to insulation. Provide removable units with vapor-proof cover fabricated to be sealed to equipment vapor barrier.

- 9. Insulation failing to meet workmanship and appearance standards shall be replaced with an acceptable installation before final acceptance of project will be given. Insulation failing to meet performance requirements of this specification for a period of one year after date of final acceptance or through one heating season and one cooling season, whichever is longer shall be replaced with an acceptable installation. All costs to correct insulation deficiencies and costs to repair damages to other work shall be at Mechanical Contractors expense at no cost to owner.

C. INSULATION MATERIALS AND APPLICATION METHODS (PIPING)

- 1. Pipe insulation by type shall be as follows:

1.1. TYPE P1

- 1.1.1. Insulation for hot and cold surface piping systems with -20 degrees F to +850 degrees F operating range shall be by Owens-Corning Fiberglass, Schuller, or Knauf ASJ/SSL-11, 4.2 lb. density pipe insulation with white fire retardant ASJ jacket and self-sealing lap. Average thermal conductivity shall not exceed .23 BTU/Hr. at 75 degrees F mean temperature. Seal longitudinal jacket laps and butt strips with C.M. No. 17-465 or B.F. No. 85-75 vapor barrier adhesive. Insulate valves and fittings as follows:
- 1.1.2. Insulate exposed and concealed valves and fittings with 2" thick glass fiberglass inserts or blankets. Cover fittings with Zeston Products PVC fitting covers or approved equal. PVC fitting covers shall be secured with mechanical fasteners such as tacks or staples for temperatures above 75 degrees F. For cold service all joints shall be sealed with vapor barrier adhesive or by pressure sensitive vapor barrier vinyl tape.

D. INSULATION MATERIALS AND APPLICATION METHODS (EQUIPMENT)

- 1. Equipment insulation materials and application methods shall be as follows:

1.1. TYPE 2

- 1.1.1. Insulation for cold surface equipment insulation shall be by Owens-Corning Fiberglass, Schuller, or Knauf for external surfaces with +40 degrees F to +220 degrees F operating temperature range shall be pipe or sheet insulation as required with 5.5 or 6.0 lb. density. Average thermal conductivity shall not exceed .27 BTU/HR at 75 F mean temperature. Apply insulation directly to metal surfaces and seal insulation joints. Insulation shall be mitered, beveled and built-up as required to provide a smooth and neat exterior surface. On large pumps and equipment provide joints in insulation at points where equipment casing must be disassembled for maintenance and repair. Insulate these joint areas so that insulation can be easily removed from casing joints without removing or damaging adjacent insulation. Finish insulation with two coats of vinyl-lacquer finish.

E. INSULATION MATERIALS AND APPLICATIONS METHODS (HANGERS, SUPPORTS, ANCHORS, GUIDES, EXPANSION JOINTS, ETC.)

- 1. Insulation materials and application methods for piping hangers supports, anchors, guides expansion joints, etc., shall be as follows:
 - 1.1. Insulate hangers and supports from direct contact with cold or hot surfaces (-120°F to 450°F) with "Buckaroos Inc." or approved equal pipe insulation support system or similar rigid calcium silicate insulation at suspension points to prevent crushing of insulation.
 - 1.2. The length or thickness of the insulation support same as the pipe insulation thickness. Provide ASJ type discs or otherwise reestablish vapor barrier.

F. INSULATION SCHEDULE

INSULATION SERVICE	SIZE	TYPE	THICKNESS	JACKET
*Tower Water Piping	All	1	1/2"	ASJ

*Provide a minimum of .016" thick aluminum jacket with band clamps and aluminum fitting covers over all pipe insulation located on the exterior of the building.

G. LAVATORIES AND SINK INSULATION

- 1. Insulate all exposed hot, cold and waste piping associated with lavatories and sinks with Truebro "Handi Lav-Guard" insulation kit model no. 102. Equivalent by Brocar Products Inc. or Proto P-trap and valve covers.

PART 3 - EXECUTION

A. PIPING INSTALLATION

1. Piping systems materials and installation shall conform to the following standards and codes.
 - 1.1. System: Heating and Air Conditioning Piping
 - 1.1.1. Code: ANSI Standard B31.1.0 "Power Piping"
 - 1.2. System: Natural Gas Piping
 - 1.2.1. Code: ANSI Standard B31.12 "Fuel Gas Piping"
2. No piping containing water shall be located in areas subject to freezing temperatures, including: unheated attics, unheated plenums, chases wall spaces or cavities within exterior walls, under slabs, or in concrete.
3. Pipe sizes indicated on plans and as specified refer to nominal size in inches, unless otherwise indicated. Pipes are sized to nearest ½". In no case shall piping smaller than size specified be used.
4. Contractor shall provide and be responsible for proper location of pipe sleeves, hangers, supports, and inserts. Install hangers, supports, inserts, etc., as recommended by manufacturer and as specified and detailed on drawings.
5. Verify construction types and provide proper hangers, inserts and supports for construction used. Install inserts, hangers and supports in accordance with manufacturers load ratings and provide for thermal expansion of piping without exceeding allowable stress on piping or supports. Provide solid type hangers and supports where pipe travel exceeds manufacturer's recommendations for fixed hanger and supports.
6. Install piping parallel with building lines and parallel with other piping to obtain a neat and orderly appearance of piping system. Secure piping with approved anchors and provide guides where required to insure proper direction of piping expansion. Piping shall be installed so that allowable stress for piping, valves and fittings used are not exceeded during normal operation or testing of piping system.
7. Install piping so that systems can be completely drained. Provide piping systems with valve drain connections at all low pipe and ahead of all sectionalizing valves whether shown on plans or not. Drain lines shall be ¾".
8. Drain valves on closed piping systems such as chilled water system shall have lock shields and plugged or capped outlets to protect system from inadvertent drainage.
9. Pitch all piping and where possible make connections from horizontal piping so that air can be properly vented from system. Provide air vents as specified at all system high points and at drop in piping in direction of flow. Use eccentric reducers where necessary to avoid air pockets in horizontal piping.
10. Provide unions or flanged joints in each pipe line preceding connections to equipment to allow removal for repair or replacement. Provide all screwed and control valves with unions adjacent to each piping connection. Provide screwed end valves with union adjacent to valve unless valve can be otherwise easily removed from line.
11. Fittings pressures and temperature ratings shall be equal to or exceed maximum operating temperature and working pressure of piping system. No mitered or field fabricated pipe fittings will be permitted.
12. All pipe threads shall meet ANSI Standard B2.1 for taper pipe threads. Lubricate pipe threads with Teflon thread sealant and lubricating compound applied full strength. Powdered or made-up compound will not be permitted. Pipe thread compound shall be applied only to male pipe threads.
13. Brazed socket type joints shall be made with suitable brazing alloys. Minimum socket depth shall be sufficient for intended service. Brazing alloy shall be end fed into socket, and shall fill completely annular clearance between socket and pipe or tube. Brazed joints depending solely upon a fillet rather than a socket type joint will not be acceptable.
14. Soft soldered socket type joints shall be made with sill-floss or 95-5 tin-antimony solder as required by temperature and pressure rating of piping system. Soldered socket-type joints shall be limited to systems containing non-flammable and non-toxic fluids. Soldered socket-type joints shall not be used on piping systems subject to shock vibration. Soldered joints depending solely upon a fillet rather than a socket-type joint will not be acceptable.
15. Make changes in piping size and direction with approved factory made fittings. Provide fittings suitable for at least 125 PSI working pressure or of pressure rating required for maximum working pressure of system whichever is greater.

B. PIPING SUPPORTS, ANCHORS, SLEEVES AND SEALS

1. Furnish proper type and size pipe sleeves to General Contractor for installation in concrete or masonry walls or floors. Sleeves are not required for supply and waste piping through wall supporting plumbing fixtures or for cast iron soil pipe passing through concrete slab or grade except where penetrating a membrane

waterproof floor.

2. Mechanical Contractor shall supervise installation of sleeves to insure proper location and installation.
3. Each sleeve shall be continuous through wall floor or roof and shall be cut flush on each side except where indicated otherwise. Sleeves shall not be installed in structural member except where indicated or approved.
4. Sleeves passing through above grade floors subject to flooding such as toilet rooms, bathrooms, equipment rooms and kitchens shall be cast iron with integral flanges and shall extend 1 inch above finished floor. Size sleeves for and seal space between pipe sleeve with Thunderline Link-Seal.
5. Provide steel pipe sleeves in bearing walls and masonry walls. Opening in non-bearing walls, floors and ceilings may be 20 gauge galvanized pipe sleeves or openings cut with concrete core drill.
6. Pipe insulation shall run continuous through pipe sleeves with ¼" minimum clearance between insulation and pipe sleeve. Provide metal jackets over insulated pipes passing through fire walls, floors and smoke partitions. Jacket shall be 0.018 stainless steel extending 12 inches on either side of barrier and secured to insulation with 3/8" wide band. Seal annular space between jacket and pipe sleeves with Thunderline High Temperature Link Seal.
7. Pipe wall penetrations exposed to view shall have tight fitting escutcheons or flanges to cover all voids around openings.
8. All below grade and exterior wall penetrations shall be installed in a pipe sleeve and sealed between the pipe and pipe sleeve with Thunderline High Temperature Link Seal.
9. Provide sleeves through all fire-rated walls and fill voids surrounding sleeves and interior to sleeves around cables with Nelson "Flameseal" fire stop putty with U.L. listed 3 hour rating installed as per manufacturers recommendations.
10. Equivalent by Dow, Chemelex, 3M.

C. PIPE HANGERS AND SUPPORTS

1. Provide and be responsible for locations of piping hangers, supports and inserts, etc., required for installation of piping under this contract. Design of hangers and supports shall conform to current issue of Manufacturers Standardization Society Specification (MSS) SP-58.
2. Pipe hangers shall be capable of supporting piping in all conditions of operation. They shall allow free expansion and contraction of piping, and prevent excessive stress resulting from transferred weight being induced into pipe or connected equipment. Support horizontal or vertical pipes at locations of least vertical movement.
3. Where horizontal piping movements are such that hanger rod angularity from vertical is greater than 4 degrees from cold to hot position of pipe, offset hanger, pipe, and structural attachments to that rod is vertical in hot position.
4. Hangers shall not become disengaged by movements of supported pipe.
5. Provide sufficient hangers to adequately support piping system at specified spacing, at changes in piping direction and at concentrated loads. Hangers shall provide for vertical adjustment to maintain pitch required for proper drainage, and for longitudinal travel due to expansion and contraction of piping. Fasten hangers to building structural members wherever practicable.
6. Unless indicated otherwise on drawings support horizontal steel piping as follows:

PIPE SIZE	ROD DIAMETER	MAXIMUM SPACING
Up to 1-1/4"	3/8"	8 Ft.
1-1/2" to 2"	3/8"	10 Ft.
2-1/2" to 3-1/2"	1/2"	12 Ft.
4" and 5"	5/8"	15 Ft.

7. Unless indicated otherwise on drawings support horizontal copper tubing as follows:

NOM. TUBING SIZE	ROD DIAMETER	MAXIMUM SPACING
Up to 1"	3/8"	6 Ft.
1-1/4" to 1-1/2"	3/8"	8 Ft.

2"	3/8"	9 Ft.
2-1/2"	1/2"	9 Ft.
3" and 4"	1/2"	10 Ft.

8. Support horizontal cast iron soil pipe with two hangers for each section located close to each hub.
9. Support vertical cast iron soil pipe at every floor, steel and copper tubing at every other floor except where indicated otherwise on drawings.
10. Provide continuous threaded hanger rods wherever possible. No chain, wire, or perforated straps shall be used.
11. Hanger rods shall be subject to tensile loading only, where lateral or axial pipe movement occurs provide suitable linkage to permit swing. Provide pipe support channels with galvanized finish for concealed locations and painted finish for exposed locations. Submit design for multiple pipe supports indicating pipe sizes, service and support detail to Architect-Engineer for review prior to fabrication.
12. Provide Grinnell pipe hangers for vertical pipe risers as follows:

PIPE MATERIAL	PIPE SIZE	HANGER FIG. NO.
Copper	1/2" thru 4"	CT-121
Steel	3/4" thru 20"	261

13. Provide Grinnell Fig. 194, 195 or 199 steel wall brackets for piping suspended or supported from walls. Brackets shall be prime coated carbon steel.
14. Mount hangers for insulated piping on outside of pipe insulation sized to allow for full thickness of pipe insulation.
15. Provide Grinnell Fig. 167 insulation protection shields sized so that line compressive load does not exceed one-third of insulation compressive strength. Shield shall be galvanized steel and support lower 180 degrees of pipe insulation on copper tubing. Provide wood block at each pipe hanger in thickness of insulation. Insulation vapor barrier jacket shall overlap wood block to maintain vapor barrier.
16. Structural attachments for pipe hangers shall be as follows:
17. Concrete Structure: Provide Grinnell Fig. No. 285 cast in concrete insert for loads up to 400 lbs. and Grinnell Fig. 281 wedge cast in type concrete insert for loads up to 1200 lbs.
18. Provide Grinnell pipe hangers for horizontal single pipe runs as follows:

PIPE MATERIALS	PIPE SIZE	HANGER FIG. NO.
Copper	1/2" thru 4"	CT-65
Steel	3/8" thru 4"	65
Steel	5" thru 30"	260

19. Provide Fee and Mason Fig. 600 channel trapeze pipe hangers for horizontal multiple pipe runs with pipe clamps or pipe rollers as follows:

PIPE MATERIALS	PIPE SIZE	CLAMP NO.	ROLLER NO.
Copper	3/8" thru 4"	8600 CP*	8010 CP*
Steel	3/8" thru 6"	8500	8010

*Copper Plated

20. Pipe supports for horizontal piping mounted on pipe racks or stanchions shall be Advanced Thermal Systems low friction graphite slide supports or equivalent by Elcen or Grinnell. Where racks and supports are not detailed on drawings submit detailed support drawings to Architect-Engineer for review prior to fabrication.
21. Provide Fee and Mason Fig. 404 vibration control hangers at locations where piping vibrations would be transmitted to building structure by conventional hangers. Apply hangers within their load supporting range.
22. Provide Elcen Fig. 50 pipe saddle with adjuster to support piping from floor. Provide complete with pedestal type floor stand.
23. Provide necessary structural steel and attachment accessories for installations of pipe hangers and supports. Where heavy piping loads are to be attached to building structure verify structural loading with

Architect-Engineer prior to installations.

- 24. Equivalent hangers and supports by Auto-Grip, Basic Engineer, Bee Line, Elcen, Fee & Mason, Fluorocarbon Company, Unistrut or Super Strut Inc.
- 25. Provide polycarbonate pipe support for piping located on flat roofs, unless otherwise indicated on drawings. Support will be of modular stackable design with a nylon roller bearing directly supporting pipe and a preformed saddle to keep piping on roller bearing. Maximum pipe support spacing shall be 10'. Provide pipe supports from Miro Industries, or approved equivalent, in the following sizes:

PIPE SIZE	MODEL NUMBER
Up to 2"	02
2 ½" thru 4"	24R

D. FIELD QUALITY CONTROL – HYDRONIC PIPING

- 1. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1.1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 1.2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 1.3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 - 1.4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 - 1.5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- 2. Perform the following tests on hydronic piping:
 - 2.1. Procedures in subparagraphs below are paraphrased from ASME B31.9.
 - 2.2. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - 2.3. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 - 2.4. Isolate expansion tanks and determine that hydronic system is full of water.
 - 2.5. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 - 2.6. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 - 2.7. Prepare written report of testing.
- 3. Perform the following before operating the system:
 - 3.1. Open manual valves fully.
 - 3.2. Inspect pumps for proper rotation.
 - 3.3. Set makeup pressure-reducing valves for required system pressure.
 - 3.4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 - 3.5. Set temperature controls so all coils are calling for full flow.
 - 3.6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
 - 3.7. Verify lubrication of motors and bearings.

E. ADJUSTING

- 1. Perform the following adjustments before operation:
 - 1.1. Close drain valves, hydrants, and hose bibbs.

- 1.2. Open shutoff valves to fully open position.
- 1.3. Open throttling valves to proper setting.
- 1.4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - 1.4.1. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
 - 1.4.2. Adjust calibrated balancing valves to flows indicated.
- 1.5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
- 1.6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
- 1.7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
- 1.8. Check plumbing specialties and verify proper settings, adjustments, and operation.

F. CLEANING

1. Clean and disinfect domestic water piping as follows:
 - 1.1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 1.2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - 1.2.1. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - 1.2.2. Fill and isolate system according to either of the following:
 - a. Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.
 - b. Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
 - 1.2.3. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - 1.2.4. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

G. Refer to piping schedule for additional information.

END OF SECTION 15100

PIPING MATERIAL SCHEDULE												
PIPING							FITTINGS		MAXIMUM NORMAL WORKING		FIELD TEST	
SYSTEM	SIZE	TYPE	SCHED.	GRADE	ASTM	MATERIAL	MATERIAL	TYPE	PRESS.	TEMP.	PRESSURE	TIME
Tower Water Piping	1/2"-2"	SL	--	--	A-106	CS	CI	T	85	40 to 90	125	1 hr.
Tower Water Piping	2-1/2"-8"	ERW	40	--	A-53	CS	CS	W	85	40 to 90	125	1 hr.
Drain Line	All	M	--	--	B-88	CP	CP	SJ	0	40 to 80	--	--

ABBREVIATIONS:

BLK – Black	ERW - Electric Resistant Weld	MJ - Mechanical Joint	PE - Polyethylene	SS - Silver Solder
BS - Bell & Spigot	F - Fusion Weld	NG - Neoprene Gasket	PP - Polypropylene	SV - Service Weight
CI - Cast Iron	GLV - Galvanized	NH - No Hub	S - Socket Joint	SW - Solvent Weld
CP – Copper	MECH - Mechanical	PVC - Polyvinyl Chloride	SJ - Solder Joint 95-5 Tin-antimony	T - Threaded
CS - Carbon Steel	MI - Malleable Iron	PC - Rolled Grooved Pipe Coupling	SL - Seamless	W - Welded
DI - Ductile Iron				V - Victaulic

SECTION 15120 - PIPING SPECIALTIES

PART 1 - GENERAL

A. RELATED DOCUMENTS

1. Reference Section 15010.
2. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

A. INSULATING UNIONS AND FLANGES

1. Provide insulating unions and flanges conforming to following specifications and plainly and permanently marked with manufacturers name and pressure class rating. Unions and flanges shall be as follows:
 - 1.1. Steel pipe to steel pipe screwed end:
 - 1.1.1. Provide Stockham malleable iron No. 693-1/2 insulating union with high dielectric strength insulating sleeve and gasket.
 - 1.2. Steel pipe to steel pipe flanged end:
 - 1.2.1. Provide two weld neck flanges of proper pressure rating insulated on both sides with Central or Klingerit Flange Insulation Kit.
 - 1.3. Iron or steel pipe to copper pipe:
 - 1.3.1. Provide Epco Dielectric union or flange with screwed or solder joint as required. Union shall have 250 PSI rating and flange 175 PSI rating at 190 degrees F.

B. UNIONS

1. Provide unions or flanged joint in each line preceding connections to equipment or valves requiring maintenance.
2. Provide Stockham brass seat unions of material and pressure rating required by piping system.
3. Where piping systems of dissimilar materials are jointed together provide proper insulating union as specified under this specification.
4. Equivalent unions by Fairbanks or Grinnell.

C. THERMOMETERS AND GAUGES

1. Provide thermometers and wells and pressure test plugs as hereinafter specified and shown on the plans so that proper testing and balancing and trouble shooting can be accomplished.
2. THERMOMETERS
 - 2.1. Thermometers shall be red reading mercury type having scale length of not less than 9", and scale divisions of 2 degrees F, or less similar and approved equal to Moeller Instrument Company, Inc., Style AJ. Range shall be as specified or as required for the duty. Thermometers and wells must be of at least the quality and design specified. If it complies with these specifications, equipment manufactured by one of the following manufacturers will be acceptable: Moeller, Trerice or Weksler.
 - 2.2. Install thermometers at eye level (5'-0") at easily readable locations.
3. GAUGES
 - 3.1. Gauges shall be bourdon tube with minimum 4-1/2" dial and die cast aluminum case with black enamel finish. The movement shall be all stainless steel with Grade A phosphor bronze bourdon tube brazed at socket and tip. The accuracy of the gauge shall be within 1/2 percent of the scale range. The pointer shall be the micrometer adjustment type recalibrated from the front. Pressure, compound, and differential pressure gauges shall have suitable scale ranges, shall be submitted and are subject to the review of the Engineer. Graduations shall be one pound or less on all gauges where this is standard for the required range.
 - 3.2. Gauges shall have 1/4" IPS connections and shall be Moeller "Vantage" gauges with Case Style No. 2, or approved equal. If it complies with these specifications, equipment manufactured by one of the following manufacturers will be acceptable: Ashcroft, Marsh, Trerice, Moeller, Weksler, Taylor, Weiss, or Midwest.
 - 3.3. Install a Sisco 1/4" or 1/2" NPT fitting (Test Plug) of solid brass at desired indicated locations. Test plug shall be capable of receiving either a pressure or temperature probe 1/8" o.d. Dual seal core shall be neoprene for temperature to 200°F and shall be rated zero leakage from vacuum to 1000 psig.

- 3.4. Contractor shall also furnish the following: (2) two 2 ½” test gauges with appropriate adapters for test plugs, (2) two 5” stem pocket testing thermometers for 0° to 125°F range and (2) two for 0° to 220°F range.
- 3.5. Install gauges vertically.
- 4. INSTALLATION
 - 4.1. Thermometers shall be installed as hereinafter specified. Where thermometer is scheduled, a thermometer well shall be provided.
 - 4.2. All thermometer wells shall be constructed of brass or stainless steel and where installed in insulated piping shall have at least 2-1/2” lagging extension. Gauges shall be installed as hereinafter specified.
 - 4.3. Gauge cocks shall be polished brass A10 ¼” tee handle type with threaded ends. 125 psi rated.
 - 4.4. Provide gauge cock with ¼” pipe nipple for connection to gauge cock.
 - 4.5. Pressure temperature ratings of each well shall be suitable for the system in which it is installed in accordance with specifications and as indicated on the drawings. All wells shall be filled with Silicon and be complete with caps and chains.
 - 4.6. Thermometers shall have the temperature ranges as required for the intended application and shall be installed as scheduled.

5. THERMOMETER & TEST GAUGE COCK INSTALLATION SCHEDULE

SERVICE	Thermometer & Well	Press Gauge & Gauge Cock	Pete's Plug
Water entering and leaving cooling tower	X	X	

END OF SECTION 15120

SECTION 15140 - VALVES

PART 1 - GENERAL

A. RELATED DOCUMENTS

1. Reference Section 15010.
2. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. EQUIVALENTS

1. Equivalent valves shall be used only from the following specified valve manufacturers and listed on current comparison charts by Apollo, Hammond, Hays, Milwaukee, Muessco, Nibco, Rockwell-Nordstrom, Stockham, and Watts.

PART 2 - PRODUCTS

A. VALVES

1. BALL VALVES

- 1.1. Ball valves shall be scheduled as type "BLV" valves. Valve specifications by type number shall be as follows:
- 1.2. Provide ball handle with extension or offset as required to clear piping insulation.
 - 1.2.1. BLV-1: 2-1/2" valves and smaller, Hammond #8501 (screwed) or 8511 (solder) series bronze two piece large port ball valve 600 PSI-WOG/150 PSI-WSP reinforced TFE seats, chrome plate brass ball (tunnel or drilled design), silicon bronze stem vinyl-covered steel lever handle. Stainless steel ball and stem shall be provided for steam applications.
 - 1.2.2. BLV-2: Ball valve shall be flexible lip seat to assure positive shut off (in both directions) and self compensates for wear. Material - fiberglass reinforced teflon, single piece. Self-adjusting, low friction teflon box ring stem seals pre-loaded by Belleville washers. Two-piece carbon steel body. Four bolt design with locking fasteners for vibration resistance and joint integrity, one piece teflon body seal. Valve shall be rated for 250 PSI steam service. 316 stainless steel ball and stem. Provide with insulated handle. Neles Jamesbury Model 21-2236MT. Equivalent by Worchester. MCF Series 56-HT.

2. GATE VALVES

- 2.1. Gate valves shall be scheduled as type "GTV" valves. Valve specifications by type number shall be as follows:
 - 2.1.1. GTV-1: 2" and smaller Hammond #IB640 (screwed) or IB635 (solder) ASTM B 62 bronze body and bonnet with malleable iron handwheel, 200 PSI-WOG/125 PSI-WSP.
 - 2.1.2. GTV-2: 2 1/2" and larger Hammond #IR1140 HI, flanged, bolted bonnet, O.S. & Y., ASTM 126 iron body, bronze trimmed, 200 PSI-WOG/125 PSI-WSP.

3. CHECK VALVES

- 3.1. Check valves shall be scheduled as type "SCV" valves. Valve specifications by type number shall be as follows:
 - 3.1.1. SCV-1: 2" valves and smaller Hammond #IB940 (screwed) or IB912 (solder) bronze check valve, 200 PSI-WOG/125 PSI-WSP, Teflon or bronze disc and seat ring.
 - 3.1.2. SCV-2: 2-1/2" and larger Hammond #IR1124 HI flanged, ASTM 126 iron body, bronze trimmed, 200PSI-WOG/125 PSI-WSP.

4. BUTTERFLY VALVES

- 4.1. Butterfly valves shall be scheduled as Type "BFV" valves. Valve specifications by type number shall be as follows:
 - 4.1.1. BFV-1: Size 3" and larger Hammond #6211-01 (lever) or 6211-03 (gear) ASTM A 126 cast iron drilled and tapped full lug body, 200 PSI-WOG 12" and smaller, 150 PSI-WOG 14" and larger, extended neck, bronze disc, stainless steel stem, field-replaceable EPDM or (buna for oil or lubricated service) sleeve and stem seals.
 - 4.1.2. BFV-2: Butterfly valves shall be installed as stop valves in locations indicated on drawings in lines 2-1/2" through 8".
 - a. Butterfly valve shall be flexible lip seat to assure positive shut off (in both directions) and self compensates for wear.

- b. Materials – fiberglass reinforced teflon, single piece. Eccentric disc and offset shaft to prevent pivoting on seat and reduce wear. One piece single diameter shaft. Material – 316 stainless steel.
- c. Positive shaft retention. Chevron teflon packing. Body insert to protect seat from abrasion and erosion. Insert also allows for seat removal without disassembly of shaft and disc. Pinning of shaft to disc to minimize shear stress and prevent through leakage. Stainless backed teflon shaft bearings to provide high corrosion resistance and are self lubricating. No metal-to-metal moving parts. Full lug type body rated for ANSI Class 150. Material – carbon steel. Provide with fully enclosed gear operator, factory lubricated with pointer. Neles Jamesbury Model 815L-11-2136MT. Equivalent by Posiseal. Watts Model QF.

5. MANUAL BALANCING VALVES

5.1. Balancing valves shall be scheduled as Type “BAV” valves. Contractor shall provide bronze balancing valves with provisions for connecting differential pressure meter for purposes of setting flow rate through valve. Contractor shall install balancing valves in a manner that allows access to the setting indicator and the gauge connections. Valves shall be shipped in polyurethane block to be used as insulation. Equivalent valves by Armstrong, Bell and Gossett, Tour and Anderson, Nibco. Valves shall be as follows:

5.1.1. BAV-1 Sizes ½” through 6” Armstrong Model CBV I or CBV II circuit balance valve, 125 PSI-WP at 250 degrees F., meter connections with built-in check valves screwed or flanged ends. Provide complete with polyurethane insulation cover.

B. VALVE SCHEDULE

SYSTEM	SIZE	STOP	CHECK	BALANCE
Condenser Water	½” - 2-1/2”	BLV-1	SCV-1	BAV-1
Condenser Water	3”-12”	BFV-1	SCV-2	BAV-1

PART 3 - EXECUTION

A. INSTALLATION

1. Install necessary valves within piping systems to provide required flow control, to allow isolation for inspection, maintenance and repair of each piece of equipment or fixture, and on each main and branch service loop.
2. Each valve shall be installed so that it is easily accessible for operation, visual inspection, and maintenance and wherever possible, gate, check and ball valves shall be installed on a horizontal run with the handle upright and within 15 degrees of vertical. Butterfly valves shall be installed with the stem in the horizontal position and the handle at 90 degrees from vertical.
3. Valves installed in piping systems shall be compatible with system maximum test pressure, pipe materials, pipe joining method, and fluid or gas conveyed in system.
4. Valves 2-1/2” and smaller shall have soldered or screwed end connections as required by piping materials unless otherwise specified or shown on drawings. Install union connection in the line within two feet of each screw end valve unless valve can be otherwise easily removed from line. Valves 3” and over shall have flange end connections.
5. Non-rising stem valves shall not be installed at any point in the piping systems. With permission of Architect-Engineer non-rising stem valve may be installed at particular points where space is restricted.
6. Provide butterfly valves 6” and smaller with 10 position lever handle for on-off application and infinite position handle for throttling applications. Provide butterfly valves 8” and up with fully enclosed all weather gear operators.
7. Gate valves shall not be installed in pipelines where intended for throttling service or where piping is subject to vibration as part of normal operating conditions.
8. Valves shall be designed for repacking under pressure when fully opened and backseated.
9. Balancing valves installed by means of sweating or soldering shall have their interiors removed before installation and reinstalled upon dissipation of the heat associated with installation. Using a wet rag in lieu of removing the valve interior as a means of heat dissipation during installation is not acceptable.

END OF SECTION 15140

SECTION 15575 - COOLING TOWERS

PART 1 - GENERAL

A. RELATED DOCUMENTS

1. Reference Section 15010.
2. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

PART 2 PRODUCTS

A. INDUCED-DRAFT, CROSSFLOW COOLING TOWERS

1. Subject to compliance with requirements, provide or comparable product by one of the following:
Baltimore Aircoil Company. Base Bid
Marley Cooling Technologies; an SPX Corporation. Alternate Bid

1.2 Thermal Capacity: The cooling tower(s) shall be warranted by the manufacturer to cool to the capacities on the drawings.. Additionally, 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 the Cooling Technology Institute or other qualified independent third party testing agency. 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.

1.3 EVERTOUGH™ Construction: All steel panels and structural members shall be protected with a thermosetting hybrid polymer. In addition, the cold water basin shall be protected with the TriArmor® Corrosion Protection System. The system shall consist of G-235 galvanized steel encapsulated with a thermosetting hybrid polymer further protected by a polyurethane barrier applied to all submerged surfaces exposed to circulating system water. The polyurethane barrier shall seal all factory seams in the cold water basin to ensure a corrosion resistant and water tight construction, and shall be warranted against leaks and corrosion for five (5) years. Standard basin accessories shall include: a corrosion resistant make-up valve with large diameter polystyrene filled plastic float for easy adjustment of the operating water level, removable anti-vortexing device to prevent air entrainment, and large area lift out strainers with perforated openings sized smaller than the water distribution system nozzles. The strainer and anti-vortexing device shall be constructed from Type 304 stainless steel to prevent corrosion. A welded Type 316 stainless steel basin shall be an acceptable alternative; provided the basin is warranted against leaks and corrosion for a period of at least 5 years. A bolted Series 300 stainless steel basin shall not be an acceptable alternative. The hot water basins shall be constructed of UV and corrosion resistant pultruded fiberglass reinforced polyester (PFRP) with Type 304 stainless steel covers. Type 304 or 316 stainless steel basin shall be an acceptable alternative. The entire cooling tower, including fan motor, drive system, bearings, and structure, shall be backed by a comprehensive Louver-to-LouverSM Five-Year warranty.

1.4 Quality Assurance: The cooling tower manufacturer shall have a Management System certified by an accredited registrar as complying with the requirements of ISO9001:2000 to ensure consistent quality of products and services. Manufacturers that are not ISO9001 Certified shall not be acceptable.

1.5 Wind and Seismic Forces: Seismic Rating: The structure shall be designed, tested and certified in accordance with IBC 2006 regulations to meet a minimum unrestricted seismic design of the area. The unit shall be certified by the manufacturer for operation after an event, up to SDS and the wind load ratings listed above, and verify that such rating is based on actual shake-table testing. Experience or calculation data is not acceptable to verify operation. Units not provided with a certificate of IBC 2006 compliance shall not be an acceptable alternative.

2.0 Construction Details

2.1 Structure: The cooling tower shall be constructed with a sturdy structural frame designed to transmit all wind, seismic and mechanical loads to the equipment anchorage. The frame shall be constructed of heavy-gauge steel angles and channels.

2.2 Casing Panels: Casing panels shall be constructed of galvanized steel protected with a thermosetting hybrid polymer. Corrosion resistant Type 304 stainless steel casing panels are an acceptable alternative.

2.3 Cold Water Basin: The cold water basin shall be constructed of heavy-gauge Type 304 stainless steel panels and structural members. All factory seams shall be welded to ensure watertight construction and welded seams shall be warranted against leaks for a period of five (5) years from date of shipment. Stainless steel basins with bolted seams are not acceptable. Basin shall include a depressed center section with drain/clean-out connection. The basin area under the fill shall be sloped toward the depressed center section to facilitate cleaning. Standard basin accessories shall include a corrosion resistant make-up valve with large diameter plastic float for easy adjustment of the operating water level, removable anti-vortexing device to prevent air entrainment, and large area lift out strainers with perforated openings sized smaller than the water distribution system nozzles.

2.4 Water Outlet: The water outlet connection shall be beveled for welding and grooved for mechanical coupling or bolt hole circle designed to accept an ASME Class 150 flat face flange. The outlet shall be provided with large-area lift out strainers with perforated openings sized smaller than the water distribution nozzles and an anti-vortexing device to prevent air entrainment. The strainer and vortex device shall be constructed of the same materials as the cold water basin to prevent dissimilar metal corrosion.

2.5 Water Distribution System: The hot water distribution basins shall be open and gravity fed for easy cleaning, and constructed of pultruded fiberglass reinforced polyester (PFRP) or Type 304 or 316 stainless steel. The basins must be accessible from outside the unit and serviceable during tower operation. Basin weirs and plastic metering devices shall be provided to assure the even distribution of water over the fill. Lift-off distribution covers shall be constructed of heavy-gauge Type 304 stainless steel and designed to withstand 50 psf (244 kg/m²) live load or a 200 pound (90.7 kg) concentrated load. Gravity flow nozzles shall be snap-in type for easy removal. Should pressurized nozzles be used, they shall utilize grommets, which ensure easy removal.

2.6 EASY CONNECT® Piping Arrangement (Optional): Each tower cell shall be furnished with a single water inlet connection complete with the means to automatically balance flow rates to the hot water basins.

3.0 Mechanical Equipment

3.1 Fan(s): Fan(s) shall be heavy-duty, axial flow with aluminum alloy blades selected to provide optimum cooling tower thermal performance with minimal sound levels. Air shall discharge through a fan cylinder designed for streamlined air entry and minimum tip clearance for maximum fan efficiency. The top of the fan cylinder shall be equipped with a conical, non-sagging removable fan guard.

3.2, 3.3 & 3.4 Fan Drive: Fan(s) are driven by a (Close-Coupled (internal) TEAO fan motor gear drive) (gear drive with the TEFC fan motor mounted outside the airstream). The gear shall be a right angle, industrial duty, oil-lubricated, geared speed reducer. Spiral bevel or spiral bevel/helical gears are designed in accordance with the Cooling Technology Institute STD-111, "Gear Speed Reducers". All gears have a minimum service factor of 2.0 based on design fan horsepower and are suitable for both forward and reverse operation. An oil level fill port and sight glass are located on the gear drive to facilitate routine inspection and maintenance. The gear is doweled in position after alignment of the mechanical equipment.

3.5 Fan Motor: Fan motor(s) shall be totally enclosed fan cooled (TEFC) and mounted outside the airstream. The motor shall be furnished with special moisture protection on windings, shafts and bearings. Fan motors shall be premium efficient/inverter duty type designed per NEMA Standard MG1, Section IV Part 31. and suitable for VFD control.

3.6 Mechanical Equipment Warranty: The fan(s), fan shaft(s), sheaves, bearings, mechanical equipment support and fan motor shall be warranted against defects in materials and workmanship for a period of five (5) years from date of shipment.

4.0 Fill and Drift Eliminators

4.1 Fill and Drift Eliminators: The fill and integral drift eliminators shall be formed from self-extinguishing (per ASTM-568) polyvinyl chloride (PVC) having a flame spread rating of 5 per ASTM E84 and shall be impervious to rot, decay, fungus and biological attack. The fill shall be suitable for entering water temperatures up to and including 130°F (54.4°C). The fill shall be manufactured, tested and rated by the cooling tower manufacturer and shall be elevated above the cold water floor to facilitate cleaning. Spacing between fill sheets shall be a minimum of 3/4 inches (19.1 mm) to reduce the tendency for fouling and scaling, and to ensure proper airflow for maximum cooling capacity.

5.0 Air Inlet Louvers

5.1 Air Inlet Louvers: Air Inlet louvers shall be separate from the fill and removable to provide easy access for inspection of the air/water interface at the louver face. Louvers shall prevent water splash out during fan cycling and be constructed of maintenance free, corrosion and UV resistant, fiberglass reinforced polyester (FRP).

6.0 Access

6.1 Plenum Access: Two hinged access doors shall be provided for access into the plenum section.

7.0 Sound

7.1 Sound Level: To maintain the quality of the local environment, the maximum sound pressure levels (dB) measured 50 ft (15240 mm) from the cooling tower operating at full fan speed shall not exceed the sound levels detailed below. If the tower exceeds these conditions the tower must be either oversized and reduced in horsepower, provided with a low sound fan, or provided with sound attenuation.

8.0 Accessories

8.1 Balancing Valves: Heavy-duty butterfly valves shall be provided at the hot water inlet connections. These valves shall include cast iron bodies, elastomer seat and steel operating stems. There shall be a locking handle to maintain the valve setting in any position. Wafer type field supplied spool piece is required between the inlet connection and the valve.

8.2 Vibration Cutout Switch: Provide a mechanical local reset vibration switch. The mechanical vibration cutout switch will be guaranteed to trip at a point so as not to cause damage to the cooling tower. To ensure this, the trip point will be set in a frequency range of 0 to 3,600 RPM and a trip point of 0.2 to 2.0 g's.

8.3 Basin Sweeper Piping: The cold water basin of the cooling tower shall be equipped with PVC sump sweeper piping with plastic eductor nozzles.

8.4 Air intake Option: Provide removable hot dip galvanized steel 1"x1" (25.4 mm x 25.4 mm) mesh air intake screens.

8.5 Ladder: An aluminum ladder (with galvanized steel safety cage) shall be provided for access to the fan deck. Access door or service platforms are not acceptable.

8.6 Handrails: 1-1/4" (31.75 mm) galvanized steel pipe handrail shall be provided around the perimeter of the cooling tower cells. The handrails shall be provided with knee and toe rails and shall conform to the requirements of OSHA applicable at the time of shipment.

8.7 Access Door Platform: A galvanized steel platform and aluminum ladder to grade shall be provided at all access doors to access the plenum section of the cooling tower. All working surfaces shall be able to withstand 50 psf (244 kg/m²) live load or 200 pound (90.72 kg) concentrated load.

8.8 Platform to Access External Motor (available on gear drives equipped with TEFC external motors only): A galvanized steel platform and ladder to grade shall be provided for access to the external fan motor. All working surfaces shall be able to withstand 50 psf (244 kg/m²) live load or 200 pound (90.72 kg) concentrated load.

8.9 Internal Walkway: An internal walkway shall be provided in the plenum section to provide for inspection and maintenance. All working surfaces shall be able to withstand 50 psf (244 kg/m²) live load or 200 pound (90.7 kg) concentrated load. Other components of the cooling tower, i.e. basin and fill/drift eliminators, shall not be considered an internal working surface. Cooling tower manufacturers that promote these surfaces to be used as a working platform shall provide a two-year extended warranty to the Owner to repair any damage to these surfaces caused during routine maintenance.

PART 3 EXECUTION

A. EXAMINATION

1. 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.
 - 1.1. Cooling tower locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.
 - 1.2. Proceed with installation only after unsatisfactory conditions have been corrected.
2. INSTALLATION
 - 2.1. Install cooling towers on support structure indicated.
 - 2.2. Equipment Mounting: Install cooling tower on concrete bases using elastomeric mounts. Comply with requirements in Division 3 Section Cast-in-Place Concrete. Comply with requirements for vibration isolation devices specified in Division 15 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
 - 2.2.1. Minimum Deflection: 1/2 inch.
 - 2.2.2. Provide galvanized-steel plate to equally distribute weight over elastomeric pad.
 - 2.2.3. 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.
 - 2.2.4. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 2.2.5. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2.3. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 2.4. Maintain manufacturer's recommended clearances for service and maintenance.
 - 2.5. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.
3. CONNECTIONS
 - 3.1. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
 - 3.2. Install piping adjacent to cooling towers to allow service and maintenance.
 - 3.3. Install flexible pipe connectors at pipe connections of cooling towers mounted on vibration isolators.
 - 3.4. Provide drain piping with valve at cooling tower drain connections and at low points in piping.
 - 3.5. Connect cooling tower overflows and drains, and piping drains to sanitary sewage system.
 - 3.6. Domestic Water Piping: Comply with applicable requirements in Division 15 Section "Domestic Water Piping." Connect to water-level control with shutoff valve and union, flange, or mechanical coupling at each connection.
 - 3.7. Supply and Return Piping: Comply with applicable requirements in Division 15. Connect to entering cooling tower connections with shutoff valve, balancing valve, thermometer, plugged tee with pressure gage, and drain connection with valve. Connect to leaving cooling tower connection with shutoff valve. Make connections to cooling tower with a union, flange, or mechanical coupling.
4. FIELD QUALITY CONTROL
 - 4.1. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
 - 4.2. Manufacturer's Field Service: Engage a factory-authorized service representative to perform field tests and inspections.
 - 4.3. Perform tests and inspections.
 - 4.3.1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 - 4.3.2. Tests and Inspections: Comply with CTI ATC 105, "Acceptance Test Code for Water Cooling Towers."
 - 4.3.3. Cooling towers will be considered defective if they do not pass tests and inspections.
 - 4.3.4. Prepare test and inspection reports.
5. STARTUP SERVICE

- 5.1. Perform startup service.
- 5.2. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.
- 5.3. Obtain performance data from manufacturer.
- 5.4. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
 - 5.4.1. Clean entire unit including basins.
 - 5.4.2. Verify that accessories are properly installed.
 - 5.4.3. Verify clearances for airflow and for cooling tower servicing.
 - 5.4.4. Check for vibration isolation and structural support.
 - 5.4.5. Lubricate bearings.
 - 5.4.6. Verify fan rotation for correct direction and for vibration or binding and correct problems.
 - 5.4.7. Retain first subparagraph below for cooling towers with belt drives.
 - 5.4.8. Adjust belts to proper alignment and tension.
 - 5.4.9. Retain first subparagraph below for towers with gear drives.
 - 5.4.10. Verify proper oil level in gear-drive housing. Fill with oil to proper level.
 - 5.4.11. Retain first subparagraph below for cooling towers with variable-speed fans.
 - 5.4.12. Operate variable-speed fans through entire operating range and check for harmonic vibration imbalance. Set motor controller to skip speeds resulting in abnormal vibration.
 - 5.4.13. Retain first subparagraph below for cooling towers with vibration switches.
 - 5.4.14. Check vibration switch setting. Verify operation.
 - 5.4.15. Verify water level in tower basin. Fill to proper startup level. Check makeup water-level control and valve.
 - 5.4.16. Retain first subparagraph below for cooling towers with basin heaters.
 - 5.4.17. Verify operation of basin heater and control.
 - 5.4.18. Verify that cooling tower air discharge is not recirculating air into tower or HVAC air intakes. Recommend corrective action.
 - 5.4.19. Replace defective and malfunctioning units.
- 5.5. Start cooling tower and associated water pumps. Follow manufacturer's written starting procedures.
- 5.6. Prepare a written startup report that records the results of tests and inspections.
6. ADJUSTING
 - 6.1. Set and balance water flow to each tower inlet.
 - 6.2. Adjust water-level control for proper operating level.
7. DEMONSTRATION
 - 7.1. Train Owner's maintenance personnel to adjust, operate, and maintain cooling towers.

END OF SECTION 15575

SECTION 15990 - SYSTEM TESTING & BALANCING

PART 1 - GENERAL

A. RELATED DOCUMENTS

1. Reference Section 15010.
2. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. TESTING AND BALANCING CONTRACTORS

1. Testing and balancing (TAB) of the building air and hydronic systems will be to be completed near the end of construction. The Mechanical Contractor has responsibility to cooperate with, make adjustments for, and provide any equipment necessary for the TAB contractor to complete the job.

PART 2 - PRODUCTS

1. Not Used

PART 3 - EXECUTION

A. SYSTEM PREPARATION FOR TESTING AND BALANCING

1. Prior to requesting testing and balancing contractor to perform their work the installing contractor shall make all necessary inspections and adjustments to insure that systems are completely installed and operating in accordance with the manufacturer's recommendations and the contract documents.
2. The following checks shall be performed on each system installed under this contract. A report sheet shall be prepared for each system indicating checks made, corrective action taken where required, date, and name of person making inspection. Submit one copy to testing and balancing contractor and two to A/E. Testing and balancing contractor will not begin until checklist has been received and reviewed.

B. TEMPERATURE CONTROLS CONTRACTOR COORDINATION

1. The temperature control contractor shall have a technical representative present with the balancing contractor on the first day of balancing for a minimum of four hours of active balancing and temperature controls coordination.
2. For the remainder of the balancing the temperature contractor may either have a technical representative present, or may furnish the balancer with the latest DDC software and all required interface devices. This includes instructions and coordination in the use of all interface devices, including laptop computers. There shall be no charge to the balancing contractor for the use of these interface devices and they shall be returned to the temperature controls contractor at the end of the balancing process.

C. HYDRONIC SYSTEMS:

1. Verify that all pump vibration isolators are properly adjusted and that flexible connections are properly restrained and aligned.
2. Check pump bearing for proper lubrication and condition.
3. Verify pump rotation and impeller size.
4. Confirm that total system has been hydrostatically tested, flushed, filled, vented and water treated as required.
5. Confirm that all strainer baskets are in place, clean and are the proper type.
6. Verify that all pressure reducing and control valves are operating properly.
7. Confirm that all expansion tanks are installed and contain proper air charge.
8. Verify that access to all balancing valves and flow stations in walls and ceilings have been provided.
9. Inspect and clean all coils and correct fin damage.
10. Confirm that fittings have been provided for flow and temperature measurements at all coils, heat exchangers and pumps.
11. Verify that all piping connections to 3-way valves and coils are proper for flow direction as indicated by manufacturer and temperature control contractor.

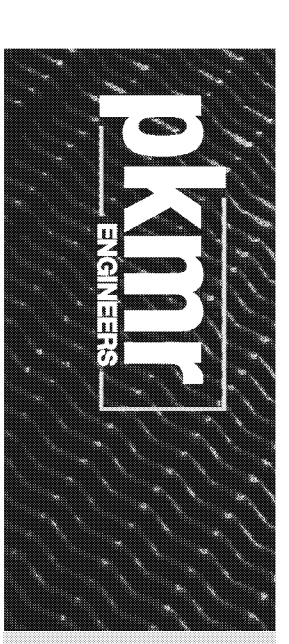
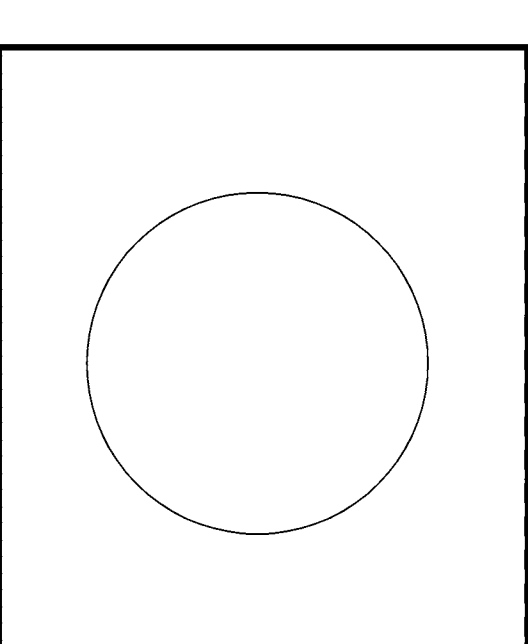
D. AIR AND WATER BALANCE

1. The Contractor shall procure the services of an independent air balance and testing contractor, approved by the A/E, which specializes in the balancing and testing of heating, ventilating and air conditioning systems, to balance, adjust, and test air moving equipment and air distribution and exhaust systems and all water flow circuits. All work by this contractor shall be done under engineer employed by them. All instruments used by

this contractor shall be accurately calibrated and maintained in good working order. If requested the tests shall be conducted in the presence of the A/E responsible for the project and/or his representative. The testing and balancing contractor shall be certified by NEBB or AABC and all work shall be performed in accordance with these organizations' published procedure manuals.

2. The balancing contractor shall prepare a certified report of all tests performed. The report shall be written on standard forms prepared by NEBB or AABC or facsimiles thereof. The balancing contractor shall submit 3 copies of this report to the Mechanical Contractor who shall submit them to the A/E for review and distribution.
3. Air balance and testing shall not begin until systems have been completed and are in full working order. All heating, ventilation, and air conditioning systems and equipment shall be in full operation during each working day of testing and balancing.
4. The Balancing reports shall include the line drawing of each ductwork system as installed, a line drawing of the heating and cooling water piping as installed; an elevation of each air handling unit as installed showing outdoor air return air an supply air ductwork connections, coil arrangements and damper arrangements, a psychometric chart on each air handling unit, with a cooling coil, showing outdoor temperature, return air temperature, mixed air temperature at a minimum outdoor air condition, coil leaving air condition at full cooling coil water flow. The balancing report shall also include all NEBB or AABC forms completed as required by each respective certification.
5. The TAB contractor shall cycle each air handling unit through its control sequence of operation to verify proper operation. Any inconsistency with contract documents shall be reported to A/E and temperature control contractor. Temperature control contractor shall take prompt action to correct any control inconsistency as reported by the TAB contractor.
6. During installation of the mechanical systems the testing and balancing contractor shall make no less than (3) inspection visits to the project site. Proper placement and installation of all control and balancing devices shall be verified by these inspections. The mechanical contractor shall make all corrections in control and balancing device locations as requested by the TAB contractor. Following each inspection visit the TAB contractor shall report to the A/E all items noted, action taken, and progress of control device installation. The last inspection and balancing shall be performed in the presence of a professional engineer active in the design of mechanical building systems.

END OF SECTION 15990



Parsons Kent McKinley Roof Engineers LLC
8801 Baltimore, Suite 200 Overland Park, Kansas 66214
P 913.492.2400 F 913.492.2457 www.pkmr.com

COOLING TOWER REPLACEMENT KCK SCHOOLS

WHITTIER ELEMENTARY
2010 N. 59 STREET
KANSAS CITY, KS 66104

REVISIONS	DESCRIPTION	REVISED DATE
1		
2		
3	DESIGN NOT MONITOR RAE ENGINEERS, LLC	

DESIGNED BY: _____
CHECKED BY: _____

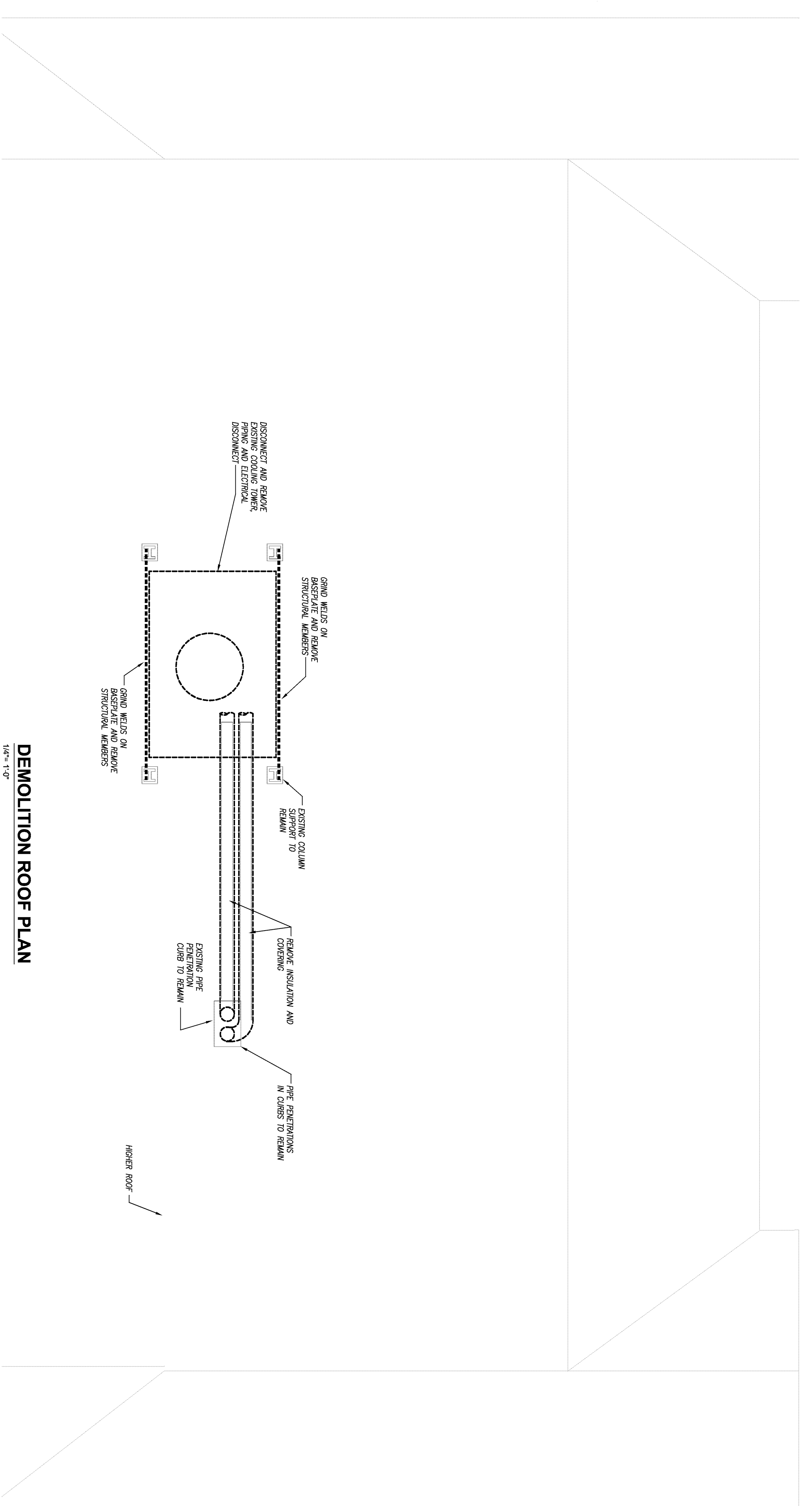
SHEET TITLE:
**MECHANICAL
ROOF PLAN**

DATE: **12.14.12** DRAW PROJECT: **12.374**
SHEET NUMBER: _____

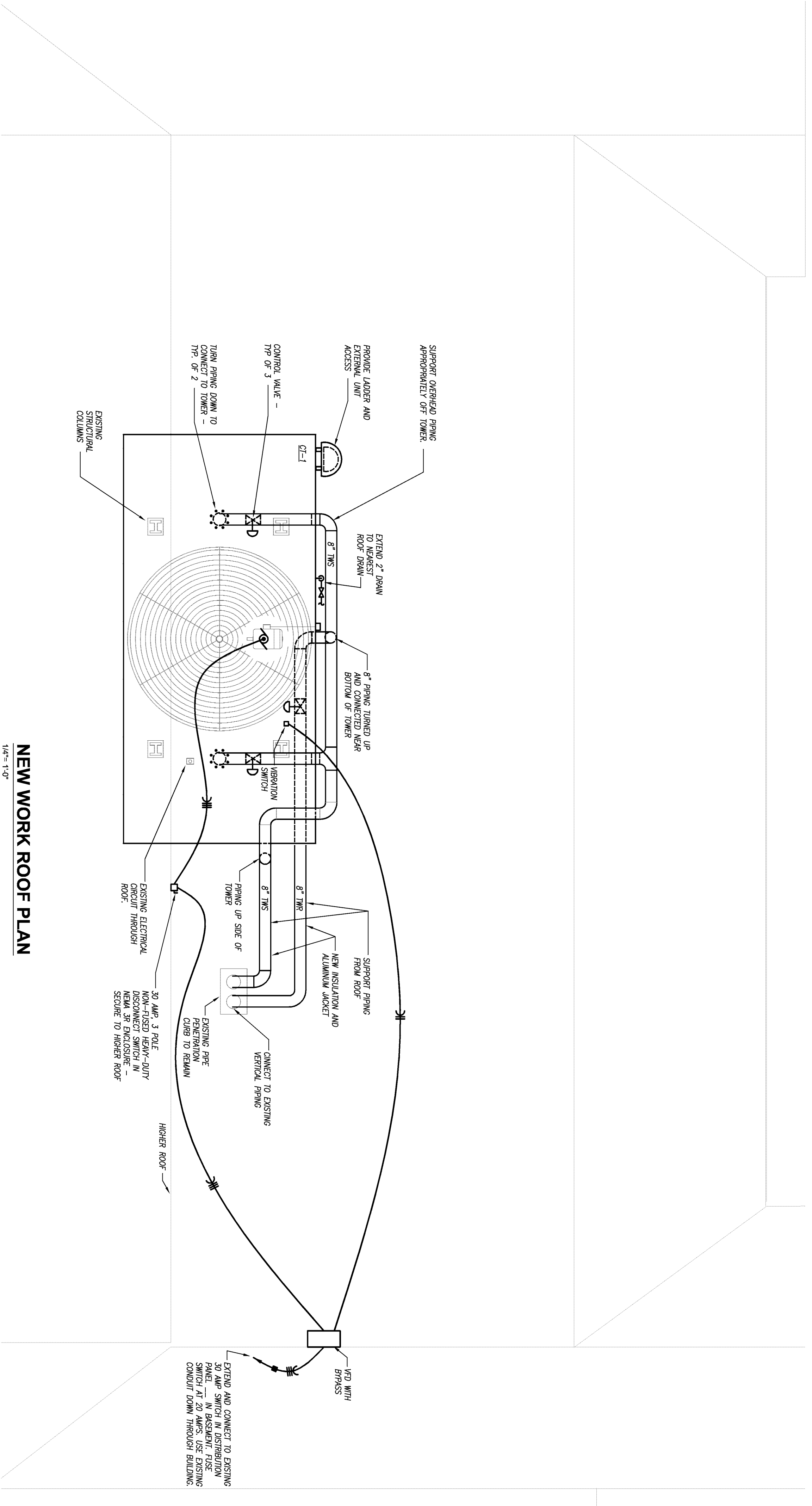


SITE LOCATION PLAN

- ### DEMOLITION NOTES
1. ALL WORK SHOWN HEREIN AND NOTES IS TO BE DEMOLISHED. WORK SHOWN LIGHT IS EXISTING TO REMAIN.
 2. REFER TO ARCHITECTURAL PLANS FOR FURTHER EXTENT OF DEMOLITION REQUIREMENTS.
 3. ALL EXISTING PIPING SCHEDULED FOR DEMOLITION THAT ROUTES BELOW SLAB SHALL BE GROUND ELEVATION WITH FLOOR FINISHED AND THE FLOOR FINISHED TO MATCH SURROUNDING FLOORING.
 4. COORDINATE ALL DEMOLITION WORK WITH OWNER.
 5. CONTACT UTILITY LOCATING SERVICE TO LOCATE EXACT LOCATION OF UTILITIES BELOW GRADE.
 6. MAINTAIN ALL EXISTING EXTERIOR FINISHES, EXPOSED CORNERS ETC. THROUGHOUT DEMOLITION. EXTERIOR FINISHES TO BE REFINISHED TO MATCH SURROUNDING FLOORING.
 7. CONTRACTOR SHALL REMOVE LIVE-IN CEILING, LIGHT FIXTURES, ETC. AS REQUIRED FOR DEMOLITION. WHERE NEEDED PRIOR TO DEMOLITION CEILING SHALL BE RELOCATED AND/OR TEMPORARILY REINFORCED TO MAINTAIN THE INSULATION OF NEW EQUIPMENT.
 8. THE OWNER SHALL REMOVE ALL ITEMS THEY DESIRED TO SALVAGE PRIOR TO DEMOLITION. REMOVED ITEMS TO BE SALVAGED BY THE OWNER.
 9. THE CONTRACTOR SHALL REMOVE ALL EXISTING STRUCTURE OF THE SITE AND NOT RECONSTRUCT THEM. THE CONTRACTOR SHALL NOT RECONSTRUCT OR REPAIR EXISTING STRUCTURE WHICH IS DAMAGED OR WHICH IS IMPROPER OR COULD BE REASONABLY ANTICIPATED FROM A HAZARD TO THE SITE. SHALL NOT BE THE BASIS FOR A CHANGE IN THE CONTRACT.
 10. REFER TO NEW WORK PLANS FOR ANY ITEMS THAT MAY REQUIRE REMOVAL AFTER DEMOLITION.
 11. PROPERLY INSURE OF ALL DEMOLISHED ITEMS OFF SITE.
 12. REMOVE ALL HAZARDOUS MATERIALS, SUCH AS ASBESTOS, LEAD, PCB'S, ETC. FROM THE SITE AND REMOVE FROM THE SITE AND THE CONTRACTOR SHALL NOT RECONSTRUCT OR REPAIR EXISTING STRUCTURE WHICH IS DAMAGED OR WHICH IS IMPROPER OR COULD BE REASONABLY ANTICIPATED FROM A HAZARD TO THE SITE. SHALL NOT BE THE BASIS FOR A CHANGE IN THE CONTRACT.
 13. CONTRACTOR SHALL REMOVE ALL EXISTING STRUCTURE AND EQUIPMENT REMOVED FROM DEMOLITION AND NEW CONSTRUCTION WORK SHALL BE INSTALLED AND FINISHED TO REMAIN. ALL NEW CONSTRUCTION WORK SHALL BE INSTALLED AND FINISHED TO REMAIN. ALL NEW CONSTRUCTION WORK SHALL BE INSTALLED AND FINISHED TO REMAIN. ALL NEW CONSTRUCTION WORK SHALL BE INSTALLED AND FINISHED TO REMAIN.
 14. VERIFY ANY HOLES IN STRUCTURE CREATED BY REMOVAL OF DUCTWORK, CONDUITS, PIPES, ETC.
 15. REMOVE ALL TRUCK SHOWN IN NOTES TO BE DEMOLISHED. ALL TRUCKS SHALL BE REMOVED FROM THE SITE AND THE CONTRACTOR SHALL NOT RECONSTRUCT OR REPAIR EXISTING STRUCTURE WHICH IS DAMAGED OR WHICH IS IMPROPER OR COULD BE REASONABLY ANTICIPATED FROM A HAZARD TO THE SITE. SHALL NOT BE THE BASIS FOR A CHANGE IN THE CONTRACT.
 16. SAW OUT FLOOR FOR THE INSTALLATION OF NEW SWAMPY PUMP.
 17. SAW, CLEAN, AND RE-FLAME ALL LEAKY FITTINGS NOTED AS BEING DAMAGED OR IMPROPER. ALL DAMAGED OR IMPROPER FITTINGS SHALL BE RE-FLAMED OR RE-USED.



DEMOLITION ROOF PLAN



NEW WORK ROOF PLAN

ELECTRICAL SPECIFICATIONS

SECTION 16000 - ELECTRICAL EQUIPMENT

GENERAL REQUIREMENTS

A. ALL MATERIALS AND EQUIPMENT SHALL BE NEW & SHALL BEWARE OF LABELS WHICH APPLICABLE FROM MANUFACTURER'S EQUIPMENT INSTRUCTIONS WHERE APPLICABLE.

B. ALL MATERIALS & EQUIPMENT SHALL BE NEW & SHALL BEWARE OF LABELS WHICH APPLICABLE FROM MANUFACTURER'S EQUIPMENT INSTRUCTIONS WHERE APPLICABLE.

C. ALL MATERIALS & EQUIPMENT SHALL BE NEW & SHALL BEWARE OF LABELS WHICH APPLICABLE FROM MANUFACTURER'S EQUIPMENT INSTRUCTIONS WHERE APPLICABLE.

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J. ALL MATERIALS & EQUIPMENT SHALL BE NEW & SHALL BEWARE OF LABELS WHICH APPLICABLE FROM MANUFACTURER'S EQUIPMENT INSTRUCTIONS WHERE APPLICABLE.

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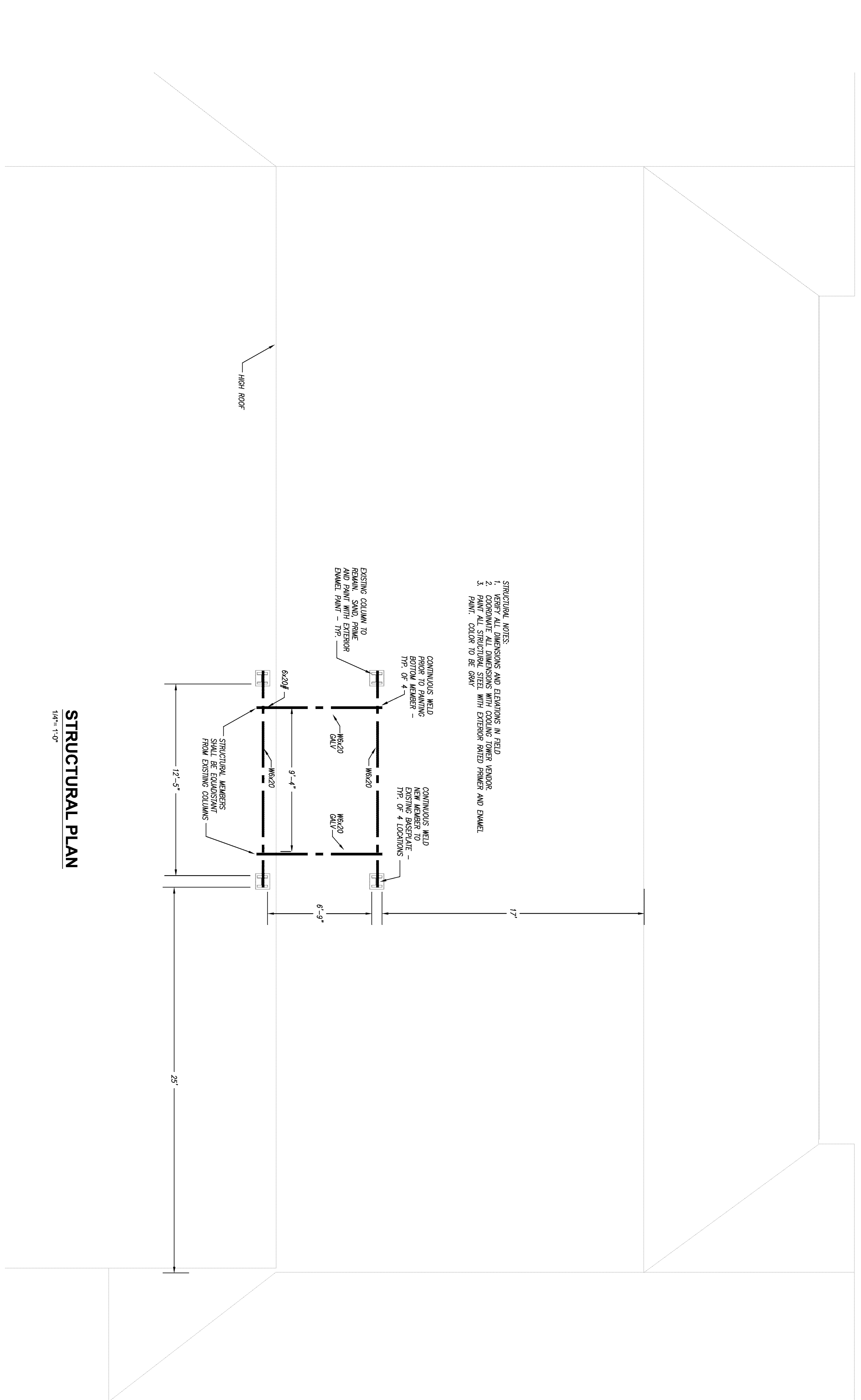
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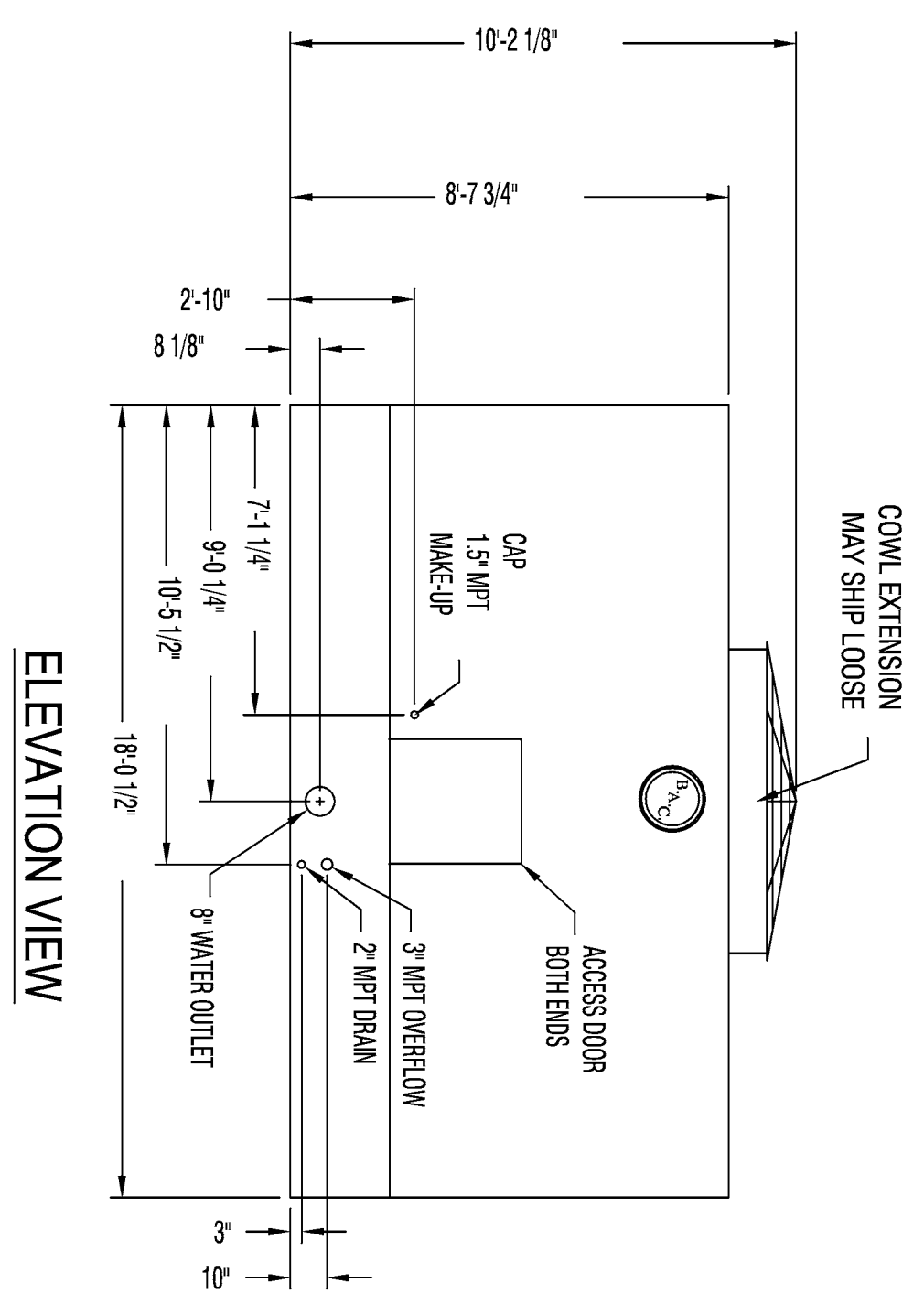
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Y. ALL MATERIALS & EQUIPMENT SHALL BE NEW & SHALL BEWARE OF LABELS WHICH APPLICABLE FROM MANUFACTURER'S EQUIPMENT INSTRUCTIONS WHERE APPLICABLE.

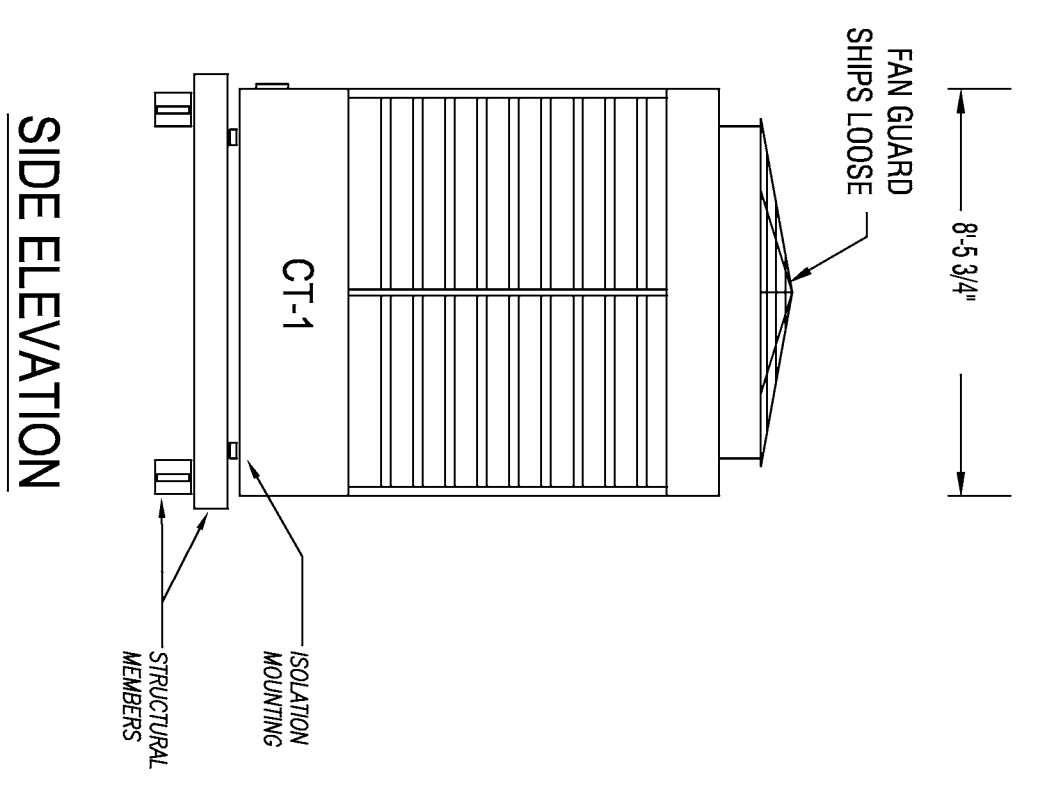
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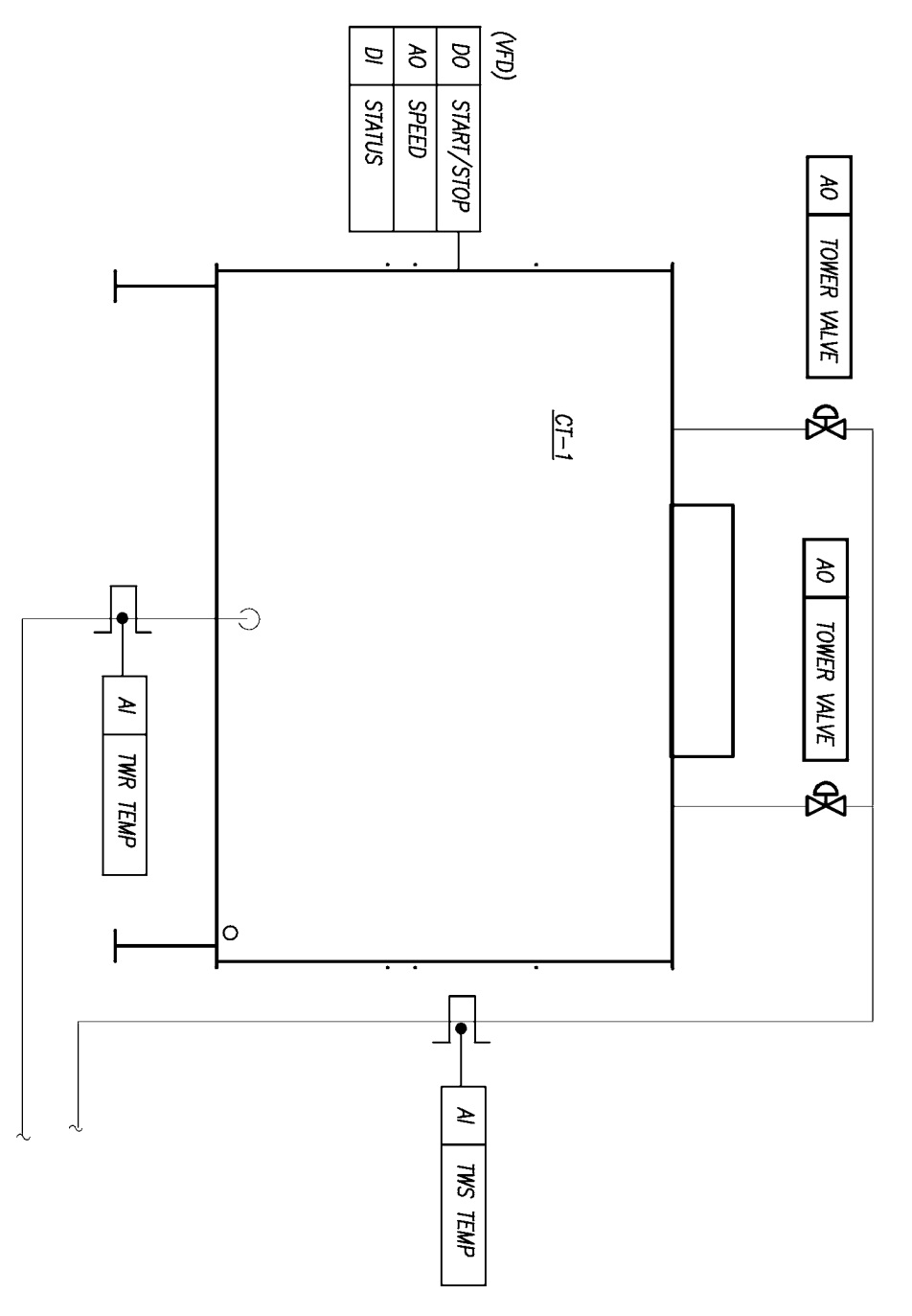
STRUCTURAL PLAN
1/4" = 1'-0"



ELEVATION VIEW



SIDE ELEVATION



TOWER WATER CONTROL SCHEMATIC
NO SCALE

SEQUENCE OF OPERATIONS

THE CONTROL SYSTEM SHALL FULLY CONTROL THE COOLING TOWER AND THE DRUMS SHALL BE OPERATED AS FOLLOWS:

1. WHEN THE TOWER WATER SUPPLY IS LOW, THE CONTROL SYSTEM SHALL OPEN THE TOWER WATER SUPPLY VALVE AND THE TOWER WATER SUPPLY SHALL BE OPENED/CLOSED BY THE BAS WHEN THE TOWER PLUMPS ARE ENGAGED. AS A MEANS OF FREEZE PROTECTION THE TOWER SHALL HAVE THE CAPABILITY TO OPERATE WITH ONLY ONE SIDE TO ALLOW FOR WARMER WATER IN SYSTEM.

MECHANICAL SYMBOL LEGEND

CHS	CHILLED WATER SUPPLY	NO POSITION CONTROL VALVE
CHW	CHILLED WATER RETURN	40 GAL/ MIN
SW	SHUT-OFF VALVE	40 GAL/ MIN

COOLING TOWER SCHEDULE

MARK	MANUFACTURER	MODEL NUMBER	STYLE	NOMINAL TONS	QPM	EWTF (°)	AWT (°)	WATER PUMP	VOLTS/PH	FLC	KW/HP	REMARKS
CT-1	BOC	SCRS 3000 - 3200C-JW	CROSSFLOW	200	397	55.0	65.0	75.0	480/3	18	20	1.2

MECHANICAL ROOF DETAILS

DATE: 12.14.12
 DRAWN BY: [Name]
 CHECKED BY: [Name]

COOLING TOWER REPLACEMENT KCK SCHOOLS

WHITTIER ELEMENTARY
 2010 N. 59 STREET
 KANSAS CITY, KS 66104

REVISIONS:

NO.	DESCRIPTION	REVISION DATE
1		
2		
3		

DESIGNED BY: [Name]
 DRAWN BY: [Name]

pkmr ENGINEERS

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 19314 492-2437
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