Northern Kentucky University

Procurement Services

Invitation to Bid # NKU-32-17

Invitation to Bid

For

Norse Commons Chiller Replacement

February 20, 2017

Invitation to Bid
NKU-32-17
Norse Commons Chiller Replacement

Proposal NO:	NKU-32-17
Issue Date:	February 20, 2017
Title:	Norse Commons Chillller Replacement
Purchasing Officer:	Blaine Gilmore
Phone:	859.572.6449

RETURN ORIGINAL COPY OF PROPOSAL TO:

Northern Kentucky University
Procurement Services
1 Nunn Drive
617 Lucas Administrative Center
Highland Heights, KY 41099

IMPORTANT: BIDS MUST BE RECEIVED BY: 03/06/2016 BEFORE 2:00 P.M. HIGHLAND HEIGHTS, KY time.

NOTICE OF REQUIREMENTS

1. The University's General Terms and Conditions and Instructions to Bidders, viewable at http://procurement.nku.edu/policies/terms-and-conditions.html, apply to this Request for Proposal.
2. Contracts resulting from this RFP must be governed by and in accordance with the laws of the Commonwealth of Kentucky.
3. Any agreement or collusion among Offerors or prospective Offerors, which restrains, tends to restrain, or is reasonably calculated to restrain competition by agreement to bid at a fixed price or to refrain from offering, or otherwise, is prohibited.
4. Any person who violates any provisions of KRS 45A.325 shall be guilty of a felony and shall be punished by a fine of not less than five thousand dollars nor more than ten thousand dollars, or be imprisoned not less than one year nor more than five years, or both such fine and imprisonment. Any firm, corporation, or association who violates any of the provisions of KRS 45A.325 shall, upon conviction, may be fined not less than ten thousand dollars or more than twenty thousand dollars.

AUTHENTICATION OF BID AND STATEMENT OF NON-COLLUSION AND NON-CONFLICT OF INTEREST

I hereby swear (or affirm) under the penalty for false swearing as provided by KRS 523.040:

1. That I am the offeror (if the offeror is an individual), a partner, (if the offeror is a partnership), or an officer or employee of the bidding corporation having authority to sign on its behalf (if the offeror is a corporation);
2. That the attached proposal has been arrived at by the offeror independently and has been submitted without collusion with, and without any agreement, understanding or planned common course of action with, any other Contractor of materials, supplies, equipment or services described in the Request for Proposal, designed to limit independent bidding or competition;
3. That the contents of the proposal have not been communicated by the offeror or its employees or agents to any person not an employee or agent of the offeror or its surety on any bond furnished with the proposal and will not be communicated to any such person prior to the official closing of the RFP:
4. That the offeror is legally entitled to enter into contracts with the Northern Kentucky University and is not in violation of any prohibited conflict of interest, including those prohibited by the provisions of KRS 45A.330 to .340, 164.390, and
5. That the Offeror, and its affiliates, are duly registered with the Kentucky Department of Revenue to collect and remit the sale and use tax imposed by Chapter 139 to the extent required by Kentucky law and will remain registered for the duration of any contract award
6. That I have fully informed myself regarding the accuracy of the statement made above.

SWORN STATEMENT OF COMPLIANCE WITH FINANACE LAWS

In accordance with KRS45A.110 (2), the undersigned hereby swears under penalty of perjury that he/she has not knowingly violated any provision of the campaign finance laws of the Commonwealth of Kentucky and that the award of a contract to a bidder will not violate any provision of the campaign finance laws of the Commonwealth of Kentucky.

CONTRACTOR REPORT OF PRIOR VIOLATIONS OF KRS CHAPTERS 136, 139, 141, 337, 338, 341 & 342

The Contractor by signing and submitting a proposal agrees as required by 45A.485 to submit final determinations of any violations of the provisions of KRS Chapters 136, 139, 141, 337, 338, 341 and 342 that have occurred in the previous five (5) years prior to the award of a contract and agrees to remain in continuous compliance with the provisions of the statutes during the duration of any contract that may be established. Final determinations of violations of these statutes must be provided to the University by the successful Contractor prior to the award of a contract.

CERTIFICATION OF NON-SEGREGATED FACILITIES

The Contractor, by submitting a proposal, certifies that he/she is in compliance with the Code of Federal Regulations, No. 41 CFR 60-1.8(b) that prohibits the maintaining of segregated facilities.

SIGNATURE REQUIRED: This proposal cannot be considered valid unless signed and dated by an authorized agent of the offeror. Type or print the signatory's name, title, address, phone number and fax number in the spaces provided. Offers signed by an agent are to be accompanied by evidence of his/her authority unless such evidence has been previously furnished to the issuing office. Your signature is acceptance to the Terms and conditions above.

DELIVERY TIME:	**NAME OF COMPANY:**	**DUNS #**
PROPOSAL FIRM THROUGH:	**ADDRESS:**	**Phone/Fax:**
PAYMENT TERMS:	**CITY, STATE & ZIP CODE:**	**E-MAIL:**
SHIPPING TERMS: F.O.B. DESTINATION - PREPAID AND ALLOWED	**TYPED OR PRINTED NAME:**	**WEB ADDRESS:**
FEDERAL EMPLOYER ID NO.:	**SIGNATURE:**	**DATE:**

Contents

General Terms and Conditions and Instructions to Proposers:

http://procurement.nku.edu/policies/terms-and-conditions.html

NOTICE OF ADVERTISEMENT

BRIEF SCOPE OF WORK:

Northern Kentucky University is seeking a contractor to provide all labor, materials, equipment, fixtures, excavation, backfill and related items required to completely install, test, place in service and deliver to NKU the complete mechanical systems in accordance with the accompanying plans and all provisions of the attached specs**.** This **does** include the purchase of a new chiller and cooling tower. Please see the appendices for complete scope of work.

PROJECT TIMETABLE*:*

Invitation for Bid Issued	February 20, 2017
Pre-Bid Meeting	February 23, 2017 at 1:30 pm EST
Last Day for Questions	February 27, 2017 at 12:00 pm EST
BIDS DUE	**March 6, 2016 at 2:00 PM EST**

Pre Bid Conference:

There will be a pre-bid meeting held on February 23, 2016 at 1:30 pm EST for to view the location of the chiller and cooling tower and to answer any questions. We will be meeting at Norse Commons. Please email Ryan Straus, Bid Specialist, strausr2@nku.edu with any questions.

SUBMITTAL OF BID:

The bidder shall submit, by the time and date specified via US Postal Service, courier or other delivery service, its bid response in a **sealed package** addressed to:

Blaine Gilmore, MPA
Associate Director, Procurement
Lucas Administrative Center, Suite 617
1 Nunn Drive
Northern Kentucky University
Highland Heights, KY 41099

Both inner and outer envelopes/packages should bear respondent's name and address, and clearly marked on package(s) as follows:

ITB NKU-32-17
Norse Commons Chiller Replacement

***All questions regarding this invitation to bid should be directed, in writing, to*:**

Ryan Straus
Bid Specialist, Procurement
Lucas Administrative Center, Suite 617
Northern Kentucky University
Highland Heights, KY 41099
Strausr2@nku.edu

Special Conditions to Proposers

GENERAL TERMS AND CONDITIONS TO PROPOSERS:

The general terms and conditions linked below shall be applicable to this Bid and take precedence over any Contractor terms and conditions:

http://procurement.nku.edu/policies/terms-and-conditions.html

PARKING PERMITS:

Contractor must obtain parking permits for all vehicles that will be parked on campus. Permits can be obtained at the welcome center for $28.75/month.

http://parking.nku.edu/rules/guidelines.html

GOVERNING LAW:

Proposers shall conform to and observe all laws, ordinances, rules and regulations of the United States of America, Commonwealth of Kentucky, and all other local governments, public authorities, boards or offices relating to the Project Site or the improvements upon same, or the use thereof, and will not permit the same to be used for any illegal or immoral purposes, business or occupation. The resulting Contract shall be governed by Kentucky Law and any claim relating to this Contract shall only be brought in the Franklin Circuit Court in Accordance with KRS 45A-245.

TOBACCO FREE CAMPUS

Effective January 1st, 2014, NKU will be a tobacco free campus. The use of all tobacco products shall be prohibited in all campus buildings and outside areas on campus.

STATUTORY AUTHORITY

Selection of firms to provide professional services to Northern Kentucky University are governed by the provisions of the Kentucky Revised Statutes, KRS 45A.085, http://www.lrc.ky.gov/KRS/045A00/085.PDF

FOREIGN CORPORATIONS

Foreign corporations are defined as corporations that are organized under laws other than the laws of the commonwealth of Kentucky. Foreign corporations doing business within the commonwealth of Kentucky are required to be registered with the Secretary of State, New Capitol Building, Frankfort, Kentucky and must be in good standing.

The Foreign Corporate Proposer, if not registered with the Secretary of State at the time of the bid submittal, shall be required to become registered and be declared in good standing prior to the issuance or receipt of a contract.

DOMESTIC CORPORATIONS

Domestic corporations are required to be in good standing

OCCUPATIONAL LICENCSE

Northern Kentucky University was annexed by the city of Highland Heights in 2008. All contractors performing work for NKU must possess a Campbell County Occupational License and a city of Highland Heights Occupational License (administered by Campbell County) and must also pay applicable payroll taxes. For further information, call 859-572-6605.

BID BONDS:

A 5% bid bond is required with submission of this ITB.

PERMITS

The Contractor shall obtain all permits necessary for any or all parts of the work from the authorities governing such work. The Contractor shall procure building permits, when required but no fee shall be applicable on projects for the Commonwealth. Evidence that such permits have been issued shall be furnished to the Owner before beginning work.

COMPLETION DATES

It is understood and agreed that time is of the essence. The Contractor will efficiently, diligently, and expeditiously conduct the work in a manner that will satisfy compliance with approved project schedules and completion by the completion date appearing in the body of this bid.

COORDINATION OF WORK

The Vendor shall be responsible for coordinating all work with the **NKU Project Manager**. The Contractor shall cooperate completely with the Owner's security forces and measures.

DAMAGE AND REPAIRS

The Contractor shall exercise particular care to avoid damage to his own work, the Owner's property, and adjacent property of every description. He shall make good any damage resulting from or caused by the work under this contract at his sole expense in a manner satisfactory and without extra cost to the Owner including, but not limited to, finishes, furnishings, and landscaping.

HAZARDOUS MATERIALS

No asbestos containing materials, lead based paints, or other hazardous materials shall be furnished or installed in this work.

PAYMENT AND PERFORMANCE BONDS: 100% Payment and Performance Bonds will be required for work arising from this ITB.

EXAMINATION OF SITE

Each vendor shall fully acquaint and familiarize themselves with the conditions as they exist and the character of the operation to be carried on under the proposed contract and has made such investigation as may be reasonably necessary so that the vendor shall fully understand the facilities, physical conditions and restrictions attending to the work under the contract. The specifications furnished represent a fair approximation of the material needed but all quotations submitted should take into account knowledge gained as a result of the above referenced visual inspection.

HOURS OF WORK

Working days at Northern Kentucky University are Monday through Friday, 8:00am to 4:30pm. Deviation from these working hours must be approved by said project manager.

FIELD VERIFICATION

It is the Vendor's responsibility to verify all measurements.

WARRANTY

Please see the Scope of Work / Specifications in Appendix 1 for specific warranty information. When notified in writing from Owner, Manufacturer shall, promptly and without inconvenience and cost to Owner correct said deficiencies.

EXAMINATION OF CONTRACT

Each vendor shall also thoroughly examine and become familiar with the specifications and associated contract documents. By submitting a bid, the vendor agrees that they have carefully examined the specifications and have thereupon decided that from their own investigation Contractor has satisfied themselves as to the nature and location of work, the general and local conditions and all matters which may in any way affect the work or its performance and that as a result of such examination and investigation, vendor fully understands the intent and purpose of the documents and conditions of the bidding. Claims for additional compensation and/or extension of time because of the vendor's failure to follow the foregoing procedure and to familiarize themselves with the Contract Documents and all conditions which might affect work will not be allowed.

CANCELLATION

The resulting contract from this ITB may be cancelled by the University for non-compliance with the terms and conditions of any part of the agreement.

TERMINATION FOR CONVENIENCE

Northern Kentucky University reserves the right to terminate the resulting contract without cause with a 30-day written notice. Upon receipt by the Contractor of "notice of termination" the Contractor shall discontinue all services with respect to the applicable contract. The cost of any agreed upon services provided by the Contractor will be calculated at the agreed upon rate prior to "notice of termination" and a fixed fee contract will be pro-rated (as appropriate).

REFERENCES

Bidder Qualifications: The bidder is required to submit a list of completed projects where he has performed **similar work** to that specified herein.

Organization:_____

Contact Name:_____

Phone Number:_____

Date Work Completed:_____ **Value of Contract:**_____

Project Manager assigned to this project: _____

Brief Project Description: _____

_____

_____

Organization:_____

Contact Name:_____

Phone Number:_____

Date Work Completed:_____ **Value of Contract:**_____

Project Manager assigned to this project: _____

Brief Project Description: _____

_____

_____

Organization:_____

Contact Name:_____

Phone Number:_____

Date Work Completed:_____ **Value of Contract:**_____

Project Manager assigned to this project: _____

Brief Project Description: _____

_____

_____

SUBCONTRACTORS

SUBCONTRACTORS: The following is a list of subcontractors proposed by the bidder to be used to complete the project. All subcontractors are subject to approval by Northern Kentucky University. Failure to submit this list completely filled out may invalidate bid**. SUBCONTRACTORS MAY NOT BE CHANGED AFTER CONTRACT AWARD WITHOUT APPROVAL BY NKU.**

BRANCH OF WORK	NAME, ADDRESS AND TELEPHONE OF SUBCONTRACTORS
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

NKU-32-17 Norse Commons Chiller Replacement

List of Materials and Equipment
(Must be submitted within 24 hours after bid opening)

Every item listed under the different phases of this project must be clearly identified so that Northern Kentucky University will definitely know what the bidder proposes to furnish. Bidders be hereby advised that this list shall be required to be filled out completely by the apparent low bidder within twenty-four (24) hours from the close of the official reading of the bids.

The above requirement does not preclude any bidder from submitting this list, fully executed, at the time the bids are submitted.
The use of the manufacturers' dealer's name only, or stating "as per plans and specifications", will not be considered as sufficient identification. Where more than one "Make or Brand" is listed for any one item, the Owner has the right to select the one to be used.
Failure to submit a proper list may result in rejection of the Bidder's Proposal.

Material And / Or Equipment	Manufacturer and Brand Name

NKU GENERAL SAFETY & COORDINATION REQUIREMENTS

1. The University strives to continuously maintain both a safe and secure work environment for its students, employees, and the employees of all Contractors assigned to our campus. Therefore, it is essential the following criteria be met by all Contractors (and all their subcontractors) working at NKU.

2. **BACKGROUND CHECKS:** The Contractor shall furnish the University upon request with written documentation that verifies each of their employees working on the property of the University has cleared a background check, has no felony convictions, is not a sex offender, and has the legal right to work in the United States.

3. **DRUG-FREE WORKPLACE:** Northern Kentucky University is a drug-free and alcohol-free workplace, and all employees of Contractors and subcontractors are subject to this policy while working on University property. If there is verifiable suspicion or probable cause that an employee of the contractor or subcontractor is under the influence of drugs or alcohol, the University reserves the right to require the Contractor to have the employee tested immediately at no expense to the University. If the test results are positive the employee will be prohibited from working on University property for a period of one (1) year from the positive test, or the duration of the project, whichever is longer. The banned employee of the Contractor must pass a drug and alcohol test before working again on university property. Effective January 1st, 2014, NKU will be a tobacco free campus. The use of all tobacco products shall be prohibited in all campus buildings and outside areas on campus.

4. **CONTRACTOR PRESENCE ON CAMPUS:** All persons working for (or on behalf of) the Contractor whose duties bring them on campus shall obey the rules and regulations that are established by the University and shall comply with the reasonable directions of the University representatives. Contractor's employees shall never enter or use existing areas of campus where they are not required to be performing work. Contractors and subcontractors are always responsible for providing and maintaining portable restroom facilities for all their workers working on the project. Contractor shall be responsible for the acts of his employees and agents while on campus. Accordingly, Contractor agrees to take all necessary measures to prevent injury and loss to persons or property located on campus. Contractor shall be responsible for all damages to persons or property caused by Contractor or any of his agents or employees. Contractor shall promptly repair any damage that he, or his employees or agent may cause to the campus or to the University equipment. Contractor agrees that in event of an accident of any kind on university property, Contractor will immediately notify the University's Department of Public Safety (859) 572-5770 and furnish a full written report of the accident. All Contractor employees and subcontractors shall present a neat and clean appearance while on University property, and be able to present proper identification upon request.

5. **PROJECT WORK SITE SAFETY & SECURITY:** The University does not, and will not, assume any responsibility for any tools, materials, equipment, or property belonging to the Contractor, his employees or agents, which may be lost or stolen from University property. All contractors and subcontractors are solely responsible for properly securing and protecting their tools and equipment. When working within or on top of an existing building, the Contractor shall work with the assigned University project manager in developing a strategy for securing the project work site and protecting the campus staff and community from the project work site. When working in an open area on campus, the Contractor shall provide securable barricades/fencing around the project site to protect the campus community from the dangers within the project work site. The Contractor shall maintain this project work site 24 hour a day, 7 days a week for the duration of the project.

6. **PARKING:** All Contractors and their subcontractors are required purchase a monthly parking pass from NKU at the rate of $28.75/month, or at a daily rate of $5.00/day. Weekly passes are also available. This will entitle workers to park at all NKU campus lots and garages, EXCEPT for faculty and staff lots which are noted accordingly. This pass also allows for parking in any of the garages if your vehicles will fit. Parking within the jobsite WILL NOT BE PERMITTED. Workers who do so will be subject to immediate towing, without warning, and at their cost. Vehicles may be parked near a worksite for reasonable times for loading and unloading, providing normal access and egress to buildings is not hindered. All workers shall park their personal vehicles in the Welcome Center parking garage, which is located just north of the Power Plant across from the Bank of Kentucky Center.

7. **GENERAL PROJECT COORDINATION:** All work and information requests by the Contractor shall be coordinated through the assigned NKU Project Manager. Any direction provided by the campus Operations & Maintenance Staff and/or the project user group shall NOT be considered official direction from the University unless authorized in writing from the assigned NKU Project Manager. Contractor will NOT be compensated for work performed without written authorization from the assigned NKU Project Manager.

8. **TEMPORARY USE OF CAMPUS UTILITIES:** As a general rule, utilities required by the Contractor to perform their work can be obtained from the University. However, the University reserves the right to require the Contractor to furnish a meter to record the usage of each provided utility for the duration of the project. For projects requiring utility metering, a deduct change order will be issued at the end of the Project to reimburse the University for the Contractor utility usage. The Contractor is responsible for determining and coordinating the procurement of any utility where the University cannot reasonably provide.

9. **CAMPUS UTILITY SHUTDOWNS:** Unless noted otherwise for a specific project, at least seven (7) calendar days notice is required for any campus utility shutdowns and/or any road/parking lot closures necessary for the Contractor to perform their work. All utility shutdowns and closures shall be coordinated with the assigned NKU Project Manager, and the University reserves the right to schedule these shutdowns and closures at night and/or on weekends to minimize disruptions to the campus community. All requests for assistance from NKU's Operations & Maintenance staff in locating existing utilities shall also be submitted to the assigned NKU project manager at least (7) calendar days in advance.

Bid Bond

5% of Contract Price

KNOW ALL MEN BY THESE PRESENTS, that we (here insert full name and address or legal title of Contractor)

as Principal, hereinafter called the Principal, and (here insert full name and address or legal title of Surety)

a corporation duly organized under the laws of the State of Kentucky as Surety, hereinafter called Surety, are held and firmly bound unto **Northern Kentucky University** as Obligee, hereinafter called Obligee, in the sum of :

_____ Dollars ($_____),

representing 5% of the Principal's total bid price and for the payment of which sum well and truly to be made, the said Principal and the said Surety, bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a bid for (Here insert full name, address and description of project)

NOW THEREFORE, if the Obligee shall accept the bid of the Principal within the period specified, or if no period is specified, within 45 days after its opening, and the Principal shall enter into a Contract with the Obligee in accordance with the terms of such bid, and give such bid or bonds as may be specified in the bidding or Contract Documents with good and sufficient surety for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof, or in the event of the failure of the Principal to enter such Contract and give such bonds or bonds, if the Principal shall pay to the Obligee the difference not to exceed the penalty hereof between the amount specified in said bid and such larger amount for which the Obligee may in good faith contract with another party to perform the Work covered by said bid, then this obligation shall be null and void, otherwise to remain in full force and effect.

Signed and sealed this day of 2011

(Principal) (Seal) _____ (Witness)

(Title)

(Surety) (Seal) _____ (Witness)

(Title)

THIS DOCUMENT MUST BE NOTORIZED

This is only an example. Other forms may be used.

FORM OF PROPOSAL

LUMP SUM BASE BID

The Bidder agrees to furnish all labor, materials, supplies, supervision and services required to perform this contract in a workmanlike manner. These services to be provided in accordance with Specifications and Contract Documents, and any duly issued Addenda for the LUMP SUM BASE BID set forth below:

_____Dollars _____ Cents
(USE WORDS) (USE WORDS)

$ _____
(USE NUMBERS)

Alternate #1: Contractor shall remove existing condenser pump, and provide and install new condenser pump.

_____Dollars _____ Cents
(USE WORDS) (USE WORDS)

$ _____
(USE NUMBERS)

Alternate # 2: Contractor shall provide five year parts and labor warranty in lieu of one year parts and labor warranty.

_____Dollars _____ Cents
(USE WORDS) (USE WORDS)

$ _____
(USE NUMBERS)

Alternate # 3: Contractor shall provide connector pipe from chilled water system to the hot water system serving Kentucky Hall.

_____Dollars _____ Cents
(USE WORDS) (USE WORDS)

$ _____
(USE NUMBERS)

Continued

This offer is for, at minimum, _____ calendar days from the date this offer is opened. In submitting the above it is expressly agreed that upon proper acceptance by Northern Kentucky University of any or all items offered, a contract shall thereby be created with respect to the items accepted.

THIS BID SUBMITTED BY:

_____
(Name and Address of Bidder)

DATE: _____ AUTHORIZED SIGNATURE:_____

NOTE*:* *The Authentication of Bid and Statement of Non-Collusion and Non-Conflict of Interest must be properly executed for this Bid to be valid.*

This Bidder, in compliance with this Request for Bid, and having carefully examined the complete contract documents, as well as the specifications for the work as prepared by Northern Kentucky University, hereby proposes to furnish all labor, supervision, materials, supplies and services required to perform the specifics of the Contract Documents, within the time set forth herein and for the final negotiated price.

The Bidder, hereby acknowledges receipt of the following Addenda:

ADDENDUM NO. _____ DATED _____ ADDENDUM NO. _____ DATE _____

ADDENDUM NO. _____ DATED _____ ADDENDUM NO. _____ DATE _____

MECHANICAL INDEX

SECTION 200100 - GENERAL PROVISIONS - MECHANICAL

1. GENERAL

A. The Advertisement for Bids, Instructions to Bidders, Bidding Requirements, General, Special and Supplementary Conditions, and all other contract documents shall apply to the Contractor's work as well as to each of his Sub-Contractor's work. All manufacturers, suppliers, fabricators, contractors, etc. submitting proposals to any part if for work, services, materials or equipment to be used on or applied to this project are hereby directed to familiarize themselves with all documents pertinent to this Contract. In case of conflict between these General Provisions and the General and/or Special Conditions, the affected Contractor shall contact the Engineer for clarification and final determination.

B. Contractor shall provide equipment shop drawings with bid proposals.

C. Existing chilled water system shall remain operational until May 8, 2017. Chilled water system shall be fully operational and turned on by May 22, 2017.

D. Bid alternates listed as follows:

1. Alternate #1: Contractor shall remove existing condenser pump, and provide and install new condenser pump.

2. Alternate # 2: Contractor shall provide five year parts and labor warranty in lieu of one year parts and labor warranty.

3. Alternate # 3: Contractor shall provide connector pipe from chilled water system to the hot water system serving Kentucky Hall.

E. Each Proposer shall also be governed by any unit prices and Addenda insofar as they may affect his part of the work or services.

F. The work included in this division consists of the furnishing of all labor, equipment, transportation, excavation, backfill, supplies, material, appurtenances and services necessary for the satisfactory installation of the complete and operating Mechanical System(s) indicated or specified in the Contract Documents.

G. Any materials, labor, equipment or services not mentioned specifically herein which may be necessary to complete or perfect any part of the Mechanical Systems in a substantial manner, in compliance with the requirements stated, implied or intended in the drawings and/or specifications, shall be included as part of this Contract.

H. It is not the intent of this section of the specifications to make any Contractor, other than the General Contractor, responsible to the Owner, and Engineer. All transactions such as submittal of shop drawings, claims for extra costs, requests for equipment or materials substitution, shall be routed through the General Contractor to the Engineer. Also, this section of the specifications shall not be construed as an attempt to arbitrarily assign responsibility of work, material, equipment or services to a particular trade or Contractor. Unless stated otherwise, the subdivision and assignment of work under the various sections shall be optional.

I. It is the intent of this Contract to deliver to the Owners a "like new" project once work is complete. Although plans and specifications are complete to the extent possible, it shall be the responsibility of the Contractors involved to remove and/or relocate or re-attach any existing or new systems which

interfere with new equipment or materials required for the complete installation without additional cost to the Owner.

J. In general, and to the extent possible, all work shall be accomplished without interruption of existing facilities operations. The Contractor shall advise the Owners at least two weeks prior to the interruption of any services or utilities. The Owners shall be advised of the exact time that interruption will occur and the length of time the interruption will last. Failure to comply with this requirement may result in complete work stoppage by the Contractors involved until a complete schedule of interruptions can be developed.

K. Definitions and Abbreviations

(1) Contractor - Any Contractor whether proposing or working independently or under the supervision of a General Contractor and/or Construction Manager and who installs any type of mechanical work (Controls, Plumbing, HVAC, Sprinkler, Gas Systems, etc.) or, the General Contractor.

(2) Engineer - The Consulting Mechanical-Electrical Engineers either consulting to the Owners, Architect, other Engineers, etc. In this case: CMTA, Inc., Consulting Engineers.

(3) Architect - The Architect of Record for the project.

(4) Furnish - Deliver to the site in good condition and turn over to the Contractor who is to install.

(5) Provide - Furnish and install complete, tested and ready for operation.

(6) Install - Receive and place in satisfactory operation.

(7) Indicated - Listed in the Specifications, shown on the Drawings or Addenda thereto.

(8) Typical - Where indicated repeat this work, method or means each time the same or similar condition occurs whether indicated or not.

(9) Contract Documents - All documents pertinent to the quality and quantity of work to be performed on this project. Includes, but not limited to: Plans, Specifications, Instructions to Bidders, General and Special Conditions, Addenda, Alternates, Lists of Materials, Lists of Sub-Contractors, Unit Prices, Shop Drawings, Field Orders, Change Orders, Cost Breakdowns, Schedules of Value, Periodical Payment Requests, Construction Contract with Owners, etc.

(10) Proposer - Any person, agency or entity submitting a proposal to any person, agency or entity for any part of the work required under this contract.

(11) OSHA - Office of Safety and Health Administration.

(12) KBC - Kentucky Building Code.

(13) The Project - All of the work required under this Contract.

(14) NEC - National Electrical Code.

(15) NFPA - National Fire Protection Association.

(16) ASME - American Society of Mechanical Engineers.

(17) AGA - American Gas Association.

(18) SMACNA - Sheet Metal and Air Conditioning Contractors National Association.

(19) ANSI - American National Standards Institute.

(20) ASHRAE - American Society of Heating, Refrigeration and Air Conditioning Engineers.

(21) NEMA - National Electrical Manufacturers Association.

(22) UL - Underwriters Laboratories.

(23) ADA - Americans with Disabilities Act.

(24) IMC - International Mechanical Code.

(25) IECC - International Energy Conservation Code.

(26) IFGC - International Fuel Gas Code.

L. Required Notices:

(1) Ten days prior to the submission of a proposal, each proposer shall give written notice to the Engineer of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of work omitted. In the absence of such written notice, Proposers signify that they have included the cost of all required items in the proposal and that the Proposer will be responsible for the safe and satisfactory operation of the entire system.

2. INTENT

A. It is the intention of the Contract Documents to call for finished work, tested and ready for operation.

B. Details not usually shown or specified, but necessary for the proper installation and operation of systems, equipment, materials, etc., shall be included in the work, the same as if herein specified or indicated.

3. DRAWINGS AND SPECIFICATIONS

A. The drawings are diagrammatic only and indicate the general arrangement of the systems and are to be followed. If deviations from the layouts are necessitated by field conditions, detailed layouts of the proposed departures shall be submitted to the Engineer for approval before proceeding with the work. The drawings are not intended to show every item which may be necessary to complete the systems. All proposers shall anticipate that additional items may be required and submit their bid accordingly.

B. The drawings and specifications are intended to supplement each other. No Proposer shall take advantage of conflict between them, or between parts of either. Should this condition exist, the Proposer shall request a clarification not less than twelve days prior to the submission of the proposal so that the condition may be clarified by Addendum. In the event that such a condition arises after work is started, the interpretation of the Engineer shall be final.

C. The drawings and specifications shall be considered to be cooperative and anything appearing in the specifications which may not be indicated on the drawings or conversely, shall be considered as part of the Contract and must be executed the same as though indicated by both.

D. Contractor shall make all his own measurements in the field and shall be responsible for correct fitting. He shall coordinate this work with all other branches of work in such a manner as to cause a minimum of conflict or delay.

E. The Engineer shall reserve the right to make adjustments in location of piping, ductwork, equipment, etc. where such adjustments are in the interest of improving the project.

F. Should conflict or overlap (duplication) of work between the various trades become evident, this shall be called to the attention of the Engineer. In such event neither trade shall assume that he is to be relieved of the work which is specified under his branch until instructions in writing are received from the Engineer.

G. Unless dimensioned, the mechanical drawings only indicate approximate locations of equipment, piping, ductwork, etc. Dimensions given in figures on the drawings shall take precedence over scaled dimensions and all dimensions, whether given in figures or scaled, shall be verified in the field to ensure no conflict with other work.

H. Each Proposer shall review all drawings including Mechanical, Electrical, Structural, etc., to ensure that the work he intends to provide does not encroach a conflict with or affect the work of others in any way. Where such effect does occur it shall be the Proposer's responsibility to satisfactorily eliminate any such encroachment conflict or effect prior to the submission of his proposal. Each Proposer shall in particular ensure that there is adequate space to install his equipment and materials. Failure to do so shall result in the correction of such encroachment conflict or effect of any work awarded the proposer and shall be accomplished fully without expense to others and that they are reasonably accessible for maintenance. Check closely all mechanical and electrical closets, chases, ceiling voids, wall voids, crawl spaces, etc., to ensure adequate spaces.

I. Where on the drawings a portion of the work is drawn out and the remainder is indicated in outline, or not indicated at all, the parts drawn out shall apply to all other like portions of the work. Where ornamentation or other detail is indicated by starting only, such detail shall be continued throughout the courses or parts in which it occurs and shall also apply to all other similar parts of the work, unless otherwise indicated.

J. Details not usually shown or specified, but necessary for the proper installation and operation of systems, equipment, materials, etc., shall be included in the work, the same as if herein specified or indicated.

K. Where on the Drawings or Addenda the word typical is used, it shall mean that the work method or means indicated as typical shall be repeated in and each time it occurs whether indicated or not.

L. Special Note: Always check ceiling heights indicated on Architectural Drawings and Schedules and ensure that they may be maintained after all mechanical and electrical equipment is installed. Do not install equipment in the affected area until the conflict is resolved.

4. EXAMINATION OF SITE AND CONDITIONS

A. Each Proposer shall inform himself of all of the conditions under which the work is to be performed, the site of the work, the structure of the ground, above and below grade, the obstacles that may be encountered, the availability and location of necessary facilities and all relevant matters concerning the work. Each Proposer shall also fully acquaint himself with all existing conditions as to ingress and egress, distance of haul from supply points, routes for transportation of materials, facilities and services, availability of utilities, etc. His proposal shall cover all expenses or disbursements in

connection with such matters and conditions. No allowance will be made for lack of knowledge concerning such conditions after bids are accepted.

5. EQUIPMENT AND MATERIALS SUBSTITUTIONS OR DEVIATIONS

A. When any Contractor requests approval of materials and/or equipment of different physical size, capacity, function, color, access, it shall be understood that such substitution, if approved, will be made without additional cost to anyone other than the Contractor requesting the change regardless of changes in connections, space requirements, electrical characteristics, electrical services, etc., from that indicated. In all cases where substitutions affect other trades, the Contractor requesting such substitutions shall advise all such Contractors of the change and shall remunerate them for all necessary changes in their work. Any drawings, Specifications, Diagrams, etc., required to describe and coordinate such substitutions or deviations shall be professionally prepared at the responsible Contractor's expense. Review of Shop Drawings by the Engineers does not in any way absolve the Contractor of this responsibility.

B. Notwithstanding any reference in the specifications to any article, device, product, material, fixture, form, or type of construction by name, make or catalog number, such reference shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition; any devices, products, materials, fixtures, forms, or types of construction which, in the judgment of the Engineer, are equivalent to those specified are acceptable, provided the provisions of Paragraph (A) immediately preceding are met. Requested substitutions shall be submitted to the Engineer a minimum of twelve days prior to bids.

C. Wherever any equipment and material is specified exclusively only such items shall be used unless substitution is accepted in writing by the Engineers.

D. Each Proposer shall furnish along with his proposal a list of specified equipment and materials which he is to provide. Where several makes are mentioned in the specifications and the Contractor fails to state which he proposes to furnish, the Engineer shall choose any of the makes mentioned without change in price. Inclusion in this list shall not ensure that the Engineers will approve shop drawings unless the equipment, materials, etc., submitted in shop drawings is satisfactorily comparable to the items specified and/or indicated.

6. SUPERVISION OF WORK

A. The Contractor shall personally supervise the work for which he is responsible or have a competent superintendent, approved by the Engineers, on the work at all times during progress with full authority to act for him.

7. CODES, RULES, PERMITS, FEES, INSPECTIONS, REGULATIONS, ETC.

A. The Contractor shall give all necessary notices, obtain and pay for all permits, government sales taxes, fees, inspections and other costs, including all utility connections, meters, meter settings, taps, tap fees, extensions, water and/or sewer system development charge, etc. in connection with his work. He shall also file all necessary plans, prepare all documents and obtain all necessary approvals of all governmental departments and/or the appropriate municipality or utility company having jurisdiction, whether indicated or specified or not. He shall hire an independent Registered Engineer to witness installations and provide necessary certifications where required by utility companies, municipal agencies or others that have review authority. He shall also obtain all required certificates of inspection for his work and deliver same to the Engineers before request for acceptance and final payment for the work. Ignorance of Codes, Rules, Regulations, Laws, etc. shall not render the Contractor irresponsible for compliance. The Contractor shall also be versed in all Codes, Rules and Regulations pertinent to his part of the work prior to submission of a proposal.

B. The Contractor shall include in his work, without extra cost, any labor, materials, services, apparatus and drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether or not indicated or specified.

C. All materials furnished and all work installed shall comply with the National Fire Codes of the National Fire Protection Association, with the requirements of local utility companies, or municipalities and with the requirements of all governmental agencies having jurisdiction.

D. All materials and equipment so indicated and all equipment and materials for the electrical portion of the mechanical systems shall bear the approval label of, or shall be listed by the Underwriters' Laboratories (UL), Incorporated. Each packaged assembly shall be approved as a package. Approval of components of a package shall not be acceptable. Where required by the Code and/or the Authority Having Jurisdiction, provide the services of a field labeling agency to provide a UL label for the entire system in the field under evaluation.

E. All Heating, Ventilation and Air Conditioning work shall be accomplished in accordance with the Kentucky Building Code (KBC) and amendments thereto, the latest standards recognized by the American Society of Heating, Refrigerating and Air Conditioning and the National Fire Protection Association. Contractor shall secure a permit from the Division of HVAC. Final inspection certificate shall be provided by Contractor and a copy included in Operation and Maintenance Manuals.

F. The Contractor shall furnish three (3) copies of all Final Inspection Certificates obtained to the Engineer when work is complete. Final payment for work will be contingent upon compliance with this requirement.

G. Where minimum code requirements are exceeded in the Design, the Design shall govern.

H. The Contractor shall ensure that his work is accomplished in accord with the OSHA Standards and that he conducts his work and the work of his personnel in accord with same.

I. All work relating to the handicapped shall be in accord with regulations currently enforced by the Department of Housing, Buildings and Construction, Commonwealth of Kentucky and the American Disabilities Act.

J. All work relating to the handicapped shall be in accord with regulations currently enforced by the Department of Housing, Buildings, and Construction, Commonwealth of Kentucky and the American Disabilities Act.

8. EQUIPMENT AND PIPING SUPPORT

A. Each piece of equipment, apparatus, piping, or conduit suspended from the structure or mounted above the floor level shall be provided with suitable structural support, pipe stand, platform or carrier in accordance with the best recognized practice. Such supporting or mounting means shall be provided by the Contractor for all equipment and piping. Exercise extreme care that structural members of building are not overloaded by such equipment. Provide any required additional bracing, cross members, angles, support, etc., as indicated or required by the Structural Engineer. This, in some instances, will require the Contractor to add an angle to a joist to transfer the load to a panel point. If in doubt, contact the Structural Engineer.

9. DUCT AND PIPE MOUNTING HEIGHTS

A. All exposed or concealed ductwork, piping, etc., shall be held as high as possible unless otherwise noted and coordinated with all other trades. Exposed piping and ductwork shall, insofar as possible, run perpendicular or parallel to the building structure.

10. COST BREAKDOWNS (SCHEDULE OF VALUES)

A. Within thirty days after acceptance of the Contract, the Contractor shall furnish to the Engineer, one copy of a detailed cost breakdown on each respective area of work. These cost breakdowns shall be made in a format approved by the Engineer. Payments will not be made until satisfactory cost breakdowns are submitted.

11. CORRECTION PERIOD

A. All equipment, apparatus, materials, and workmanship shall be the best of its respective kind. The Contractor shall replace all parts at his own expense, which are proven defective as described in the General Conditions. The effective date of completion of the work shall be the date of the Architect's or Engineer's Statement of Substantial Completion. Items of equipment which have longer guarantees, as called for in these specifications, shall have warranties and guarantees completed in order, and shall be in effect at the time of final acceptance of the work by the Engineer. The Contractor shall present the Engineer with such warranties and guarantees at the time of final acceptance of the work. The Owner reserves the right to use equipment installed by the Contractor prior to date of final acceptance. Such use of equipment shall not invalidate the guarantee except that the Owner shall be liable for any damage to equipment during this period, due to negligence of his operator or other employees. Refer to other sections for any special or extra warranty requirements.

B. It is further clarified that all required and specified warranties shall begin on the date of Substantial Completion, not at the time of equipment start-up.

12. COMPUTER-BASED SYSTEM SOFTWARE

A. For all equipment, controls, hardware, computer-based systems, programmable logic controllers, and other materials provided as a part of the work, software that is installed shall be certified in writing to the Engineer and Owner by the manufacturer and/or writer to be free of programming errors that might affect the functionality of the intended use.

13. CHANGES IN MECHANICAL WORK

REFER TO GENERAL AND SPECIAL CONDITIONS.

14. CLAIMS FOR EXTRA COST

REFER TO GENERAL AND SPECIAL CONDITIONS.

15. SURVEY, MEASUREMENTS AND GRADE

A. The Contractor shall lay out his work and be responsible for all necessary lines, levels, elevations and measurements. He must verify the figures shown on the drawings before laying out the work and will be held responsible for any error resulting from his failure to do so.

B. The Contractor shall base all measurements, both horizontal and vertical from established bench marks. All work shall agree with these established lines and levels. Verify all measurements at the site and check the correctness of same as related to the work.

C. Should the Contractor discover any discrepancy between actual measurements and those indicated, which prevents following good practice or the intent of the contract documents, he shall promptly notify the Engineer and shall not proceed with this work until he has received instructions from the Engineer on the disposition of the work.

16. TEMPORARY SERVICES

A. The Contractor shall arrange any temporary water, electrical and other services which he may require to accomplish his work. Refer also to General and Special Conditions.

17. RECORD DRAWINGS

A. The Contractor shall ensure that any deviations from the Design are as they occur recorded in red, erasable pencil on record drawings kept at the jobsite. The Engineer shall review the record documents from time to time to ensure compliance with this specification. Compliance shall be a contingency of final payment. Pay particular attention to the location of under floor sanitary and water lines, shut-off valves, cleanouts and other appurtenances important to the maintenance and operation of Mechanical Systems. Also, pay particular attention to Deviations in the Control Systems and all exterior utilities. Keep information in a set of drawings set aside at the job site especially for this purpose. Deliver these record drawings electronically in AutoCAD 2000 format along with the hand marked field set to the Engineer. Electronic bid drawings will be furnished to the Contractor for his use.

18. MATERIALS AND WORKMANSHIP

A. All equipment, materials and articles incorporated in the work shall be new and of comparable quality to that specified. Each Proposer shall determine that the materials and/or equipment he proposes to furnish can be brought into the building(s) and installed within the space available. In certain cases, it may be necessary to remove and replace walls, floors and/or ceilings and this work shall be the responsibility of the Contractor. All equipment shall be installed so that all parts are readily accessible for inspection, maintenance, replacement of filters, etc. Extra compensation will not be allowed for relocation of equipment for accessibility or for dismantling equipment to obtain entrance into the building(s). Ensure, through coordination, that no other Contractor seals off access to space required for equipment, materials, etc.

B. Materials and equipment, where applicable, shall bear Underwriters' Laboratories label where such a standard has been established.

C. Use extreme care in the selection of equipment and its installation to ensure that noise and vibration are kept at a minimum. The Engineer's determination shall be final and corrections to such discrepancies shall be made at the cost of the Contractor.

D. All equipment shall bear the manufacturer's name and address. All electrically operated equipment shall bear a data plate indicating required horsepower, voltage, phase and ampacity.

19. COOPERATION AND COORDINATION WITH OTHER TRADES

A. The Contractor shall give full cooperation to all other trades and shall furnish in writing with copies to the Engineer, any information necessary to permit the work of other trades to be installed satisfactorily and with the least possible interference or delay.

B. Where any work is to be installed in close proximity to, or will interfere with work of other trades, each shall cooperate in working out space conditions to make a satisfactory adjustment. If so directed by the Engineer, the Contractor shall prepare composite working drawings and sections at a suitable

scale not less than 1/4" = 1'-0", clearly indicating how his work is to be installed in relation to the work of other trades, or so as not to cause any interference with work of other trades. He shall make the necessary changes in his work to correct the condition without extra charge.

C. The Contractor shall furnish to other trades, as required, all necessary templates, patterns, setting plans, and shop details for the proper installation of work and for the purpose of coordinating adjacent work.

20. QUALIFICATIONS OF WORKMEN

A. All mechanical work shall be accomplished by qualified workmen competent in the area of work for which they are responsible. Untrained and incompetent workmen, as evidenced by their workmanship, shall be summarily relieved of their responsibilities in areas of incompetency. The Engineer shall reserve the right to determine the quality of workmanship of any workman and unqualified or incompetent workman shall refrain from work in areas not satisfactory to him. Requests for relief of a workman shall be made through the normal channels of Architect, Contractor, etc.

B. All insulation and pipe fitting work shall be installed by workmen normally engaged or employed in these respective trades, except where only small amounts of such work are required and are within the competency of workmen directly employed by the Contractor involved.

C. All automatic control systems shall be installed by workmen normally engaged or employed in this type work, except in the case of minor control requirements (residential type furnaces, packaged HVAC equipment with integral controls, etc.) in which case, if a competent workman is the employee of this Contractor, he may be utilized subject to review of his qualifications by the Engineer and after written approval from same.

D. All electrical work shall be installed only by competent workmen under direct supervision of a fully qualified Electrician.

21. CONDUCT OF WORKMEN

A. The Contractor shall be responsible for the conduct of all workmen under his supervision. Misconduct on the part of any workman to the extent of creating a safety hazard, or endangering the lives and property of others, shall result in the prompt relief of that workman. The consumption of alcoholic beverages or other intoxicants, narcotics, barbiturates, hallucinogens or debilitating drugs on the job site is strictly forbidden.

22. PROTECTION OF MATERIALS AND EQUIPMENT

A. The Contractor shall be entirely responsible for all material and equipment furnished by him in connection with his work and special care shall be taken to properly protect all parts thereof from physical, sun, and weather damage during the construction period. Such protection shall be by a means acceptable to the manufacturer and Engineer. All rough-in soil, waste, vent and storm piping, ductwork, etc., shall be properly plugged or capped during construction in a manner approved by the Engineer. Equipment damaged, stolen or vandalized while stored on site, either before or after installation, shall be repaired or replaced by the Contractor at his own expense.

23. SCAFFOLDING, RIGGING AND HOISTING

A. The Contractor shall furnish all scaffolding, rigging, hoisting and services necessary for erection and delivery onto the premises of any equipment and apparatus furnished. All such temporary

appurtenances shall be set up in strict accord with OSHA Standards and Requirements. Remove same from premises when no longer required.

24. BROKEN LINES AND PROTECTION AGAINST FREEZING

A. No conduits, piping, troughs, etc. carrying water or any other fluid subject to freezing shall be installed in any part of the building where danger of freezing may exist without adequate protection being given by the Contractor whether or not insulation is specified or indicated on the particular piping. All damages resulting from broken and/or leaking lines shall be replaced or repaired at the Contractor's own expense. If in doubt, contact the Engineer. Do not install piping across or near openings to the outside whether they are carrying static or moving fluids or not. Special Note: Insulation on piping does not necessarily ensure that freezing will not occur.

25. CLEANING

A. The Contractor shall, at all times, keep the area of his work presentable to the public and clean of rubbish and debris caused by his operations; and at the completion of the work, shall remove all rubbish, debris, all of his tools, equipment, temporary work and surplus materials from and about the premises, and shall leave the area clean and ready for use. If the Contractor does not attend to such cleaning upon request, the Engineer may cause cleaning to be done by others and charge the cost of same to the Contractor. The Contractor shall be responsible for all damage from fire which originates in, or is propagated by, accumulations of his rubbish or debris.

B. After completion of all work and before final acceptance of the work, the Contractor shall thoroughly clean all equipment and materials and shall remove all foreign matter such as grease, dirt, plaster, labels, stickers, etc., from the exterior of piping, equipment, fixtures and all other associated or adjacent fabrication.

26. CONCRETE WORK

A. The Contractor shall be finally responsible for the provisions of all concrete work required for the installation of any of his systems or equipment. He may, at his option, arrange with the others to provide the work. This option, however, will not relieve the Contractor of his responsibilities relative to dimensions, quality of workmanship, locations, etc. In the absence of other concrete specifications, all concrete related to Mechanical work shall be 3000 psi minimum compression strength at 28 days curing and shall conform to the standards of the American Concrete Institute Publication AC1-318. Heavy equipment shall not be set on pads for at least seven (7) days after pour. Insert 6-inch steel dowel rods into floors to anchor pads.

B. All mechanical equipment (chillers, pumps, etc.) shall be set on a minimum of 4” tall concrete pads. All concrete pads shall be complete with all pipe sleeves, anchor bolts, reinforcing steel, concrete, etc. as required. Pads larger than 18” in width shall be reinforced with ½” round bars on 6” centers both ways. Bars shall be approximately 3” above the bottom of the pad. All parts of pads and foundations shall be properly rodded or vibrated. If exposed parts of the pads and foundations are rough or show honeycomb after removing forms, all surfaces shall be rubbed to a smooth surface. Chamfer all square edges one-half inch.

C. In general, concrete pads for equipment shall extend four (4) inches beyond the equipment's base dimensions. Where necessary, extend pads 30 inches beyond base or overall dimensions to allow walking and servicing space.

27. NOISE, VIBRATION OR OSCILLATION

A. All work shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the Engineer. In case of moving machinery, sound or vibration noticeable outside of room in which it is installed, or annoyingly noticeable inside its own room, will be considered objectionable. Sound or vibration conditions considered objectionable by the Engineer shall be corrected in an approved manner by the Contractor at his expense.

B. All equipment subject to vibration and/or oscillation shall be mounted on vibration supports whether indicated or not suitable for the purpose of minimizing noise and vibration transmission, and shall be isolated from external connections such as piping, ducts, etc. by means of flexible connectors, vibration absorbers, or other approved means. Unitary equipment, such as small room heating units, small exhaust fans, etc., shall be rigidly braced and mounted to wall, floor or ceiling as required and tightly gasketed and sealed to mounting surface to prevent air leakage and to obtain quiet operation. Flush and surface mounted equipment such as diffusers, grilles, etc., shall be gasketed and affixed tightly to their mounting surface.

C. The Contractor shall provide supports for all equipment furnished by him. Supports shall be liberally sized and adequate to carry the load of the equipment and the loads of attached equipment, piping, etc. All equipment shall be securely fastened to the structure either directly or indirectly through supporting members by means of bolts or equally effective means. If strength of supporting structural members is questionable, contact Engineers.

28. ACCESSIBILITY

A. The Contractor shall locate and install all equipment so that it may be serviced, and maintained as recommended by the manufacturer. Allow ready access and removal of the entire unit and/or parts such as valves, filters, fan belts, motors, prime shafts, etc.

29. RESTORATION OF NEW OR EXISTING SHRUBS, PAVING, SURFACES, ETC.

A. The Contractor shall at his expense restore to their original conditions all paving, curbing, surfaces, drainage ditches, structures, fences, shrubs, existing or new building surfaces and appurtenances, and any other items damaged or removed by his operations. Replacement and repairs shall be in accordance with good construction practice and shall match materials employed in the original construction of the item and shall be to the satisfaction of the Architect and/or Engineer.

30. MAINTENANCE OF EXISTING UTILITIES AND LINES

A. The locations of all piping, conduits, cables, utilities and manholes existing, or otherwise, that comes within the contract construction site, shall be subject to continuous uninterrupted service with no other exception than the Owner of the utilities permission to interrupt same temporarily.

B. Cutting into existing utilities and services where required shall be done in coordination with and only at times designated by the Owner of the utility.

C. The Contractor shall repair to the satisfaction of the Engineer, any surfaces or subsurface improvements damaged during the course of the work, unless such improvement is shown to be abandoned or removed.

D. Machine excavation shall not be permitted with ten feet of electrical lines or lines carrying combustible and/or explosive materials. Hand excavate only.

31. SMOKE AND FIRE PROOFING

A. The Contractor shall fire and smoke stop all openings made in fire or smoke rated walls, chases, ceilings and floors in accord with the KBC. Patch all openings around ductwork and piping with appropriate type material to stop smoke at smoke walls and provide commensurate fire rating at fire walls, floors, ceilings, roofs, etc. Back boxes in rated walls shall be a minimum distance apart as allowed by code to maintain the rating. If closer provide rated box or fireproofing in code approved manner.

32. MOTORS

A. Motors shall be built in accordance with the latest standards of NEMA and as specified. Motors shall be tested in accordance with standards of A.S.A. C50, conforming to this and all applicable standards for insulation resistance and dielectric strength.

B. Each motor shall be provided by the equipment supplier, installer or manufacturer with conduit terminal box, and N.E.C. required disconnecting means as specified or required. Three-phase motors shall be provided with external thermal overload protection in their starter units. Single-phase motors shall be provided with thermal overload protection, integral to their windings or external, in control unit. All motors shall be installed with NEMA-rated starters as specified and shall be connected per the National Electrical Code.

C. The capacity of each motor shall be sufficient to operate associated driven devices under all conditions of operation and load and without overload, and at least of the horsepower indicated or specified. Each motor shall be selected for quiet operation, maximum efficiency and lowest starting KVA per horsepower. Motors producing excessive noise or vibration shall be replaced by the responsible contractor. See Division 26 of Specifications for further requirements related to installation of motors.

33. CUTTING AND PATCHING

A. The Contractor shall provide his own cutting and patching necessary to install his work. Patching shall match adjacent surfaces and shall be to the satisfaction of the Architect and Engineer.

B. No structural members shall be cut without the approval of the Engineer and all such cutting shall be done in a manner directed by him/her.

34. CURBS, PLATES, ESCUTCHEONS & AIR TIGHT PENETRATIONS

A. Escutcheon plates shall be provided for all pipes and conduit passing thru walls, floors and ceilings. Plates shall be nickel plated, of the split ring type, of size to match the pipe or conduit. Where plates are provided for pipes passing thru sleeves which extend above the floor surface, provide deep recessed plates to conceal the pipe sleeves.

B. Seal all duct, pipe, conduit, etc., penetrations through walls and floors air tight. If wall or floor assembly is rated then use similarly rated sealing method.

35. WEATHERPROOFING

A. Where any work pierces waterproofing including waterproof concrete, the method of installation shall be as approved by the Engineer before work is done. The Contractor shall furnish all necessary sleeves, caulking and flashing required to make openings permanently watertight.

36. OPERATING INSTRUCTIONS, MAINTENANCE MANUALS AND PARTS LISTS

A. Upon completion of all work tests, the Contractor shall instruct the Owner or his representative(s) fully in the operations, adjustment and maintenance of all equipment furnished. The time and a list of representatives required to be present will be as directed by the Engineer. Turn over all special wrenches, keys, etc., to the owner at this time.

B. The Contractor shall furnish three (3) complete bound sets for delivery to the Engineer of typewritten and/or blueprinted instructions for operating and maintaining all systems and equipment included in this contract. All instructions shall be submitted in draft, for approval, prior to final issue. Manufacturer's advertising literature or catalogs alone will not be acceptable for operating and maintenance instructions.

C. The Contractor, in the instructions, shall include a preventive maintenance schedule for the principal items of equipment furnished under this contract and a detailed, parts list and the name and address of the nearest source of supply.

D. The Contractor shall frame under Lexan in the main mechanical room all temperature control diagrams and all piping diagrams.

37. PAINTING

A. In general, all finish painting shall be accomplished under the Painting Section of the specifications by the Contractor; however, unless otherwise specified under other sections of these specifications, the following items shall be painted:

(1) All exposed piping, valve bodies and fittings (bare and insulated), including hangers, platforms, etc.

(2) All mechanical equipment not factory finished. Aluminum and stainless steel equipment, motors, identification plates, tags, etc. shall not be painted. All rust and foreign matter shall be thoroughly removed from surfaces prior to painting. All baked enamel factory finish of equipment which may have been scratched or chipped shall be touched up with the proper paint as recommended and supplied by the manufacturer.

38. ELECTRICAL CONNECTIONS

A. The Contractor shall furnish and install all (1) temperature control wiring; (2) equipment control wiring and (3) interlock wiring. The Contractor shall furnish and install all power wiring complete from power source to motor or equipment junction box, including power wiring thru starters, and shall furnish and install all required starters not factory mounted on equipment.

B. The Contractor shall, regardless of voltage, furnish and install all temperature control wiring and all associated interlock wiring, all equipment control wiring and conduit for the equipment that the Contractor furnishes. He may, at his option, employ at his own expense, the Electrical Contractor to accomplish this work.

C. After all circuits are energized and completed, the Contractor shall be responsible for all power wiring, and all control wiring shall be the responsibility of the Contractor. Motors and equipment shall be provided for current characteristics as shown on the drawings.

D. The Contractor shall furnish motor starters of the type and size required by the manufacturer for all equipment provided by him, where such starters are necessary. Starters shall have overloads for each phase.

39. FINAL CONNECTIONS TO EQUIPMENT

A. The Contractor shall finally connect to mechanical services, any terminal equipment, appliances, etc., provided under this and other divisions of the work. Such connections shall be made in strict accord with current codes, safety regulations and the equipment manufacturer's recommendations. If in doubt, contact the Engineers prior to installation.

40. REQUIRED CLEARANCE FOR ELECTRICAL EQUIPMENT

A. The NEC has specific required clearances above, in front, and around electrical gear, panels etc. The Contractor shall not install any piping, ductwork, etc., in the required clearance. If any appurtenance is located in the NEC required clearance, it shall be relocated at no additional cost.

41. INDEMNIFICATION

A. The Contractor shall hold harmless and indemnify the Engineer, employees, officers, agents and consultants from all claims, loss, damage, actions, causes of actions, expense and/or liability resulting from, brought for, or on account of any personal injury or property damage received or sustained by any person, persons, (including third parties), or any property growing out of, occurring, or attributable to any work performed under or related to this contract, resulting in whole or in part from the negligence of the Contractor, any subcontractor, any employee, agent or representative.

42. ABOVE-CEILING AND FINAL PUNCH LISTS

(1) The Contractor shall review each area and prepare a punch list for each of the subcontractors, as applicable for review of all other work as the project nears substantial completion.

B. After all corrections have been made from the Engineer's punch list, the Contractor shall review and initial off on <u>each</u> item. This signed-off punch list shall be submitted to the Engineer. The Engineer shall return to the site <u>once</u> to review each punch list and all work <u>prior to</u> the ceilings being installed and at the final punch list review.

C. If additional visits are required by the Engineer to review work not completed by this review, the Engineer shall be reimbursed directly by the Contractor at a rate of $140.00 per hour for extra trips required to complete the final punch lists.

Phone: (859) 253-0892 Fax: (859) 231-8357

The following is CMTA's guide for Division 20-25 required information relative to the Schedule of Values. Please utilize all items that pertain to this project and add any specialized system as required. A thorough and detailed schedule of values will allow for fair and equitable Pay Application approval and minimize any discrepancies as to the status of the job.

DIVISION 20-25 – MECHANICAL **Field Representative:** _____
Project Engineer: _____

Description of Work	Scheduled Value	Labor	Material
Shop Drawings			
Mobilization/Permits			
Demolition			
Mechanical Shop Drawings			
Pumps & Assoc. Equipment			
Hydronic Piping			
Insulation			
Controls			
Water Balance			
Factory Start-Up Reports			
Record Drawings			
O & M Manuals			
Punchlist/Closeout			
Controls Check-out			

END OF SECTION

SECTION 200200- SCOPE OF THE MECHANICAL WORK

1. GENERAL

A. The Mechanical work for this Contract shall include all labor, materials, equipment, fixtures, excavation, backfill and related items required to completely install, test, place in service and deliver to the Owner the complete mechanical systems in accordance with the accompanying plans and all provisions of these specifications. This work shall primarily include, but is not necessarily limited to the following:

(1) All insulation associated with mechanical systems.

(2) Final connection of all mechanical equipment furnished by others (e.g., cooling tower, chiller).

(3) Complete balancing of water systems.

(4) All applicable services and work specified in Section 200100; General Provisions - Mechanical.

(5) All specified or required control work.

(6) Provide all required motor starters, etc. not provided under the electrical sections.

(7) In base bid, one year guarantee of all mechanical equipment, materials and workmanship. If Alternate #2 is accepted, five year guarantee of all mechanical equipment materials, and workmanship.

(8) Thorough instruction of the owner's maintenance personnel in the operation and maintenance of all mechanical equipment.

(9) Thorough coordination of the installation of all piping, equipment and any other material with other trades to ensure that no conflict in installation.

(10) Approved supervision of the mechanical work.

(11) Excavation, backfilling, cutting, patching, sleeving, concrete work, etc., required to construct the mechanical systems.

(12) Procurement of all required permits and inspections, including fees for all permits and inspection services and submission of final certificates of inspection to the Engineers (Plumbing, Boiler, HVAC, etc.).

(13) Factory start-up of all major equipment and submission of associated factory start-up reports to the Engineer.

END OF SECTION

SECTION 200300 - SHOP DRAWINGS, DESCRIPTIVE LITERATURE, MAINTENANCE MANUALS, PARTS LISTS, SPECIAL KEYS & TOOLS

1. GENERAL

A. The Contractor's attention is directed also to the General and Special Conditions and Section 200100 - General Provisions - Mechanical as well as to all other Contract Documents as they may apply to his work.

B. The Contractor shall prepare and submit to the Engineer, through the General Contractor, **on bid day**, within thirty (30) days after the date of the Contract, a minimum of seven (7) copies of all shop drawings, certified equipment drawings, installation, operating and maintenance instructions, samples, wiring diagrams, etc. on all items of equipment specified hereinafter.

C. Submittal data shall include specification data including metal gauges, finishes, accessories, etc. Also, the submittal data shall include certified performance data, wiring diagrams, dimensional data, and a spare parts list. Submittal data shall be reviewed by the Engineer before any equipment or materials is ordered or any work is begun in the area requiring the equipment.

D. All submittal data shall have the stamp of approval of the Contractor submitting the data as well as the General Contractor to show that the drawings have been reviewed by the Contractor. Any drawings submitted without these stamps of approval may not be considered and will be returned for proper resubmission.

E. It shall be noted that review of shop drawings by the Engineer applies only to conformance with the design concept of the project and general compliance with the information given in the contract documents. In all cases, the Contractor alone shall be responsible for furnishing the proper quantity of equipment and/or materials required, for seeing that all equipment fits the available space in a satisfactory manner and that piping, electrical and all other connections are suitably located.

F. The Engineers review of shop drawings, schedules or other required submittal data shall not relieve the Contractor from responsibility for: adaptability of the item to the project; compliance with applicable codes, rules, regulations and information that pertains to fabrication and installation; dimensions and quantities; electrical characteristics; and coordination of the work with all other trades involved in this project. Any items that differ from the Drawings or Specifications shall be flagged by the Contractor so the Engineer will be sure to see the item. Do not rely on the Engineer to “catch” items that do not comply with the Drawings or Specifications. The Contractor is responsible for meeting the Drawings and Specification requirements, regardless of whether or not something does not get caught by the Contractor or Engineer during shop drawing reviews.

G. Equipment shall not be ordered and no final rough-in connections, etc., shall be accomplished until reviewed equipment shop drawings are in the hands of the Contractor. It shall be the Contractor's responsibility to obtain reviewed shop drawings and to make all connections, etc. in the neatest and most workmanlike manner possible. The Contractor shall coordinate with all the other trades having any connections, roughing-in, etc. to the equipment.

H. If the Contractor fails to comply with the requirements set forth above, the Engineer shall have the option of selecting any or all items listed in the Specifications or on the drawings; and the Contractor shall be required to furnish all materials in accordance with this list.

I. Shop Drawing Submittals

(1) All submittals for HVAC equipment shall include all information specified. This shall include air and water pressure drops, RPM, noise data, face velocities, horsepower, voltage motor type, steel or aluminum construction, and all accessories clearly marked.

(2) All items listed in the schedules shall be submitted for review in a tabular form similar to the equipment schedule.

(3) All items submitted shall be designated with the same identifying tag as specified on each sheet.

(4) Any submittals received in an unorganized manner without options listed and with incomplete data will be returned for resubmittal.

2. SHOP DRAWINGS

Shop Drawings, descriptive literature, technical data and required schedules shall be submitted on the following:

(1) Cooling Tower
(1) Chiller
Pipe Insulation (2) Controls
(1) Pumps and Circulators (HVAC)

SPECIAL NOTES:

(1) Upon substantial completion of the project, the Contractor shall deliver to the Engineers (in addition to the required Shop Drawings) three (3) complete copies of operation and maintenance instructions and parts lists for each item marked (1) above. These documents shall include at least:

(a) Detailed operating instructions
(b) Detailed maintenance instructions including preventive maintenance schedules.
(c) Addresses and phone numbers indicating where parts may be purchased.

(2) Shop drawings for the Control Systems shall include detailed, scaled plans and schematic diagrams indicating the function and operation of the system.

3. SPECIAL WRENCHES, TOOLS, ETC.

(1) The Contractor shall furnish, along with equipment provided, any special wrenches or tools necessary to dismantle or service equipment or appliances installed under the Contract. Wrenches shall include necessary keys, handles and operators for valves, cocks, hydrants, etc. A reasonable number of each shall be furnished.

4. BALANCE REPORTS

A. Upon substantial completion of the project, the Contractor shall submit to the Engineers four (4) bound copies of the Certified Air and Hydronic Balance Report.

END OF SECTION

SECTION 200400 - DEMOLITION AND SALVAGE

1. GENERAL

A. The Contractor's attention is directed to the General and Special Conditions, General Conditions-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.

2. DEMOLITION

A. INTENT

It is the intent of this section to completely remove all components of any existing mechanical system no longer in use that will be open to view in, or will interfere with the operations of the completed building, or which will, in any way, interfere with project construction. Components of the existing mechanical systems which do not meet the above criteria, may be abandoned in place in a safe, workmanlike, code approved manner.

B. HVAC

(1) Remove from the project area all piping not to be reused and hangers, specialties, etc. that are accessible or that become accessible during construction and/or interfere in any way with any part of the construction or would be exposed in the completed building.

(2) Remove all temperature controls and related items that are accessible or become accessible during construction.

(3) The Contractor shall be responsible for the removal and/or relocation of any HVAC piping, equipment, fittings, valves, etc. which may, in the course of construction, interfere with the installation of any new and/or relocated Architectural, Structural, Mechanical or Electrical Systems at no increase in the contract price.

(4) Unless otherwise indicated, the Contractor shall be responsible for the patching and repairing of all holes, etc. in the ceiling, wall and floors where HVAC equipment is removed.

(5) Unless otherwise noted, when removing equipment sitting on a concrete pad, also remove the concrete pad and patch and repair floor to match adjacent surfaces.

C. REFRIGERANT RECOVERY

(1) The Contractor shall have a licensed refrigerant recovery technician evacuate all refrigerants from all refrigeration equipment being removed in accordance with EPA guidelines and regulations. The Contractor shall take all necessary precautions to not accidentally vent refrigerants to the atmosphere. The recovered refrigerant shall be offered to the Owner. If the Owner refuses it then it becomes the property of the Contractor.

D. THERMOSTAT, THERMOMETER, AND MERCURY BEARING DEVICE DISPOSAL

(1) The Contractor shall dispose of all mercury bearing materials in accordance with state and federal guidelines. The Contractor shall take all necessary precautions to not accidentally allow mercury to be released from the device during demolition.

3. SALVAGE

A. It is the intent of this section to deliver to the owner all components of any mechanical system which may be economically reused by him. The Contractor shall make every effort to remove reusable components without damage and deliver them to a location designated by the Owner.

END OF SECTION

SECTION 200500 - COORDINATION AMONG TRADES, SYSTEMS INTERFACING AND CONNECTION OF EQUIPMENT FURNISHED BY OTHERS

1. COORDINATION

   A. The Contractor is expressly directed to read the General Conditions and all detailed sections of these specifications for all other trades and to study all drawings applicable to his work, including Structural drawings, to the end that complete coordination between trades will be affected. Special attention shall be given to the points where ducts or piping must cross other piping, where lighting fixtures must be recessed in ceilings, and where ducts, piping and conduit must fur into walls, soffits, columns, etc. It shall be the responsibility of the Contractor to leave the necessary room for other trades. No extra compensation will be allowed to cover the cost of removing piping, conduit, ducts, etc., or equipment found encroaching on space required by others.

   B. The Contractor shall be responsible for coordination with the Electrical trade to insure that he has made provision for connections, operational switches, disconnect switches, fused disconnects, etc. for electrically operated equipment provided under this division of the specifications, or called for on the plans.

   C. If any discrepancies occur between accompanying drawings and these specifications and drawings and specifications covering other Contracts, each trade shall report such discrepancies to the Architect far enough in advance so that a workable solution can be presented. No extra payment will be allowed for relocation of piping, ductwork, conduit, and equipment not installed in accordance with the above instructions, and which interfered with work and equipment of other trades.

2. INTERFACING

   The Contractor shall insure that coordination is affected relative to interfacing of systems. Some interface points are (but not necessarily all):

   A. Connection of all controls to equipment.

   B. Electrical power connections to electrically operated (or controlled) equipment.

   C. Connection of Emergency Engine Exhaust System.

3. CONNECTION OF EQUIPMENT FURNISHED BY OTHERS

   A. The Contractor shall make all connections to equipment furnished by others, whenever such equipment is shown on any part of the drawings or mentioned in any part of the Specifications, unless otherwise specifically specified hereinafter.

   B. Supervision to assure proper functioning and operation shall be provided by the Contractor.

   C. Items indicated on the drawings as rough-in only (RIO) will be connected by others. The Contractor shall be responsible for rough-in provisions only.

   D. For items furnished by others, relocated, or RIO, the Contractor shall obtain from the supplier or shall field determine as appropriate, the exact rough-in locations and connection sizes for the referenced equipment.

   E. The Contractor shall be responsible for coordinating to determine any and all final connections that he is to make to equipment furnished by others.

END OF SECTION

SECTION 201100 - SLEEVING, CUTTING, PATCHING AND REPAIRING

1. GENERAL

   A. The Contractor's attention is directed to the General and Special Conditions, General Conditions-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.

   B. The Contractor shall be responsible for all openings, sleeves, trenches, etc., that he may require in floors, roofs, ceilings, walls, etc., and shall coordinate all such work with the General Contractor and all other trades. Coordinate with the General Contractor, any openings which he is to provide before submitting a bid proposal in order to avoid conflict and disagreement during construction. Improperly located openings shall be reworked at the expense of the Contractor.

   C. The Contractor shall plan his work ahead and shall place sleeves, frames or forms through all walls, floors and ceilings during the initial construction, where it is necessary for piping, ductwork, conduit, etc., to go through; however, when this is not done, the Contractor shall do all cutting and patching required for the installation of his work, or he shall pay other trades for doing this work when so directed by the Engineer. Any damage caused to the buildings by the workmen of the responsible Contractor must be corrected or rectified by him at is own expense.

   D. The Contractor shall notify other trades in due time where he will require openings or chases in new concrete or masonry. He shall set all concrete inserts and sleeves for his work. Failing to do this, he shall cut openings for his work and patch same as required at his own expense.

   E. The Contractor shall be responsible for properly shoring, bracing, supporting, etc., any existing and/or new construction to guard against cracking, settling, collapsing, displacing or weakening while openings are being made. Any damage occurring to the existing and/or new structures, due to failure to exercise proper precautions or due to action of the elements shall be promptly and properly made good to the satisfaction of the Engineer.

   F. All work improperly done or not done at all as required by the Mechanical Trades in this section, will be performed by the Contractor at the direction of the trade whose work is affected.

2. SLEEVES, PLATES AND ESCUTCHEONS

   A. The Contractor shall provide and locate all sleeves and inserts required for his work before the floors and surface being penetrated are built, otherwise the Contractor shall core drill for pipes where sleeves and inserts were not installed, or where incorrectly located. Core drilling is the only acceptable alternative to sleeves. Do not chisel openings. Where sleeves are placed in exterior walls or in slabs on grade, the space between the pipe or conduit and the sleeves shall be made completely and permanently water tight.

   B. Pipe that penetrates fire and/or smoke rated assemblies shall have sleeves installed as required by the manufacturer of the rating seal used.

   C. At all other locations either pipe sleeves or core drilled openings are acceptable.

   D. Where thermal expansion does not occur, the wall may be sealed tight to the pipe or insulation.

   E. Insulation, that requires a vapor barrier (i.e., cold water or refrigerant piping, etc.), must be continuous through the sleeve/cored hole. For other piping, insulation may stop on either side of the sleeve.

F. Sleeves shall be constructed of 24 gauge galvanized sheet steel with lock seam joints or Schedule 40 pipe. Sleeves in floors shall extend 1" above finished floor level.

G. Escutcheon plates shall be provided for all pipes and conduit passing thru walls, floors and ceilings. Plates shall be nickel plated, of the split ring type, of size to match the pipe or conduit. Where plates are provided for pipes passing thru sleeves which extend above the floor surface, provide deep recessed plates to conceal the pipe sleeves.

3. CUTTING

A. All rectangular or special shaped openings in plaster, stucco or similar materials, including gypsum board, shall be framed by means of plaster frames, casing beads, wood or metal angle members as required. The intent of this requirement is to provide smooth even termination of wall, floor and ceiling finishes.

B. Mechanical, contractor shall coordinate all openings in new and existing masonry walls with the General Contractor; and, unless otherwise indicated on the Structural drawings, provide lintels for all openings required for the work (Louvers, wall boxes, exhaust fans, etc.). Lintels shall be sized as follows:

(1) New Openings under 48" in width: Provide one 3-1/2"x3-1/2"x3/8" steel angle for each 4" of masonry width. Lintel shall have 8" bearing on either side.

C. No cutting is to be done at points or in a manner that will weaken the structure and unnecessary cutting must be avoided. If in doubt, contact the Engineer.

D. Pipe openings in slabs and walls shall be cut with core drill. Hammer devices will not be permitted. Edges of trenches and large openings shall be scribe cut with a masonry saw.

4. PATCHING AND REPAIRING

A. Patching and repairing made necessary by work performed under this division shall be included as a part of the work and shall be done by skilled mechanics of the trade or trades for work cut or damaged, in strict accordance with the provisions herein before specified for work of like type to match adjacent surfaces and in a manner acceptable to the Engineer.

B. Where portions of existing lawns, shrubs, paving, etc. are disturbed for installation of work of this Division, such items shall be repaired and/or replaced to the satisfaction of the Engineer.

C. Where the installation of conduit, piping, etc. requires the penetration of fire or smoke rated walls, ceilings or floors, the space around such conduit, duct, pipe, etc., shall be tightly filled with an approved non-combustible fire insulating material satisfactory to maintain the rating integrity of the wall, floor or ceilings affected.

D. Stainless steel collars shall be provided around all ducts, large pipes, etc., at all wall penetrations; both sides.

E. Where ducts, pipes, and conduits pass through interior or exterior walls, the wall openings shall be sealed air tight. This shall include sealing on both sides of the wall to insure air does not enter or exit the wall cavity. This is especially critical on exterior walls where the wall cavity may be vented to the exterior.

END OF SECTION

SECTION 201300 - PIPE, PIPE FITTINGS AND PIPE SUPPORT

1. GENERAL

A. The Contractor's attention is directed to the General and Special Conditions, General Conditions-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.

B. When a pipe size is not indicated, the Contractor shall request the pipe size from the Engineers. All piping shall be installed straight and true, parallel or perpendicular to the building construction. Piping shall be installed so as to allow for expansion without damage to the building finishes, structure, pipe, equipment, etc., use offsets, U-bends or expansion joints as required. Where a section of piping is not indicated but is obviously required for completion of the system, the Contractor shall provide same at no additional cost to the project. No mitered joints or field fabricated pipe bends shall be accepted. Pipe shall clear all windows, doors, louvers and other building openings.

C. All pipe shall be supported in a neat and workmanlike manner and wherever possible, parallel runs of horizontal piping shall be grouped together on trapeze type hangers. Vertical risers shall be supported at each floor line with approved steel pipe riser clamps. The use of wire or perforated metal to support pipes will not be permitted. Hanging pipes from other pipes shall not be permitted. Spacing of pipe supports shall not exceed eight feet for pipes up to 1-1/4 inches and ten feet on all other piping. Small vertical pipes (1 inch and less) shall be bracketed to walls, structural members, etc. at four (4) foot intervals so as to prevent vibration or damage by occupants. Insulated piping shall be supported on a rigid insulation block at each hanger so as to prevent crushing of insulation by hangers. Hangers shall pass completely around the insulation jacket and a steel protective saddle shall be applied to prevent compression of the insulation. (Refer to Specifications Section entitled INSULATION-MECHANICAL).

D. Where piping rests directly on a hanger, clip, bracket or other means of support, the support element shall be of the same material as the pipe, (e.g., copper to copper, ferrous to ferrous, etc.) or shall be electrically isolated one from the other so as to prevent pipe damage by electrolysis. Pay particular attention and do not allow copper pipe to rest on ferrous structural members, equipment, etc. without electrolytic isolation.

E. In general, piping shall be installed concealed except in Mechanical, Janitor Rooms, etc. unless otherwise indicated, and shall be installed underground or beneath concrete slabs only where indicated. All lines at ceilings shall be held as high as possible and shall run so as to avoid conflicts with other trades, and to facilitate the Owner's use and maintenance. Location of pipe in interior partitions shall be carefully coordinated with whoever will construct the partitions after the piping is in place. Where exposed risers occur they shall be kept as close to walls as possible.

F. Installation of pipe shall be in such a manner as to provide complete drainage of the system toward the source. Drain valves shall be provided at all drainage points on pipes. Drain valves shall be 1/2" size gate type with 3/4" hose thread end and vacuum breaker. Label each drain valve.

G. Piping carrying water or other fluids subject to freezing shall not be installed in locations subject to freezing; if in doubt, consult Engineer.

H. All cast iron soil pipe and fittings shall be coated inside and out with coal tar varnish.

I. Non-metallic piping shall be installed in strict accordance with the manufacturer's instructions. If no such instructions are available, consult Engineers.

J. Nipples shall be of the same material, composition and weight classification as pipe with which installed.

K. Where piping is not indicated on the plans, but is obviously or apparently required, contact the Engineers prior to submission of a bid proposal.

L. Pay particular attention to conflict of piping with other work. Do not install until conflict is resolved. If necessary, contact Engineers.

M. Piping materials in each system shall, to the extent practicable, be of the same material. Frequent changes of material (for example, from copper to steel) shall be avoided and in no case shall be accomplished without use of insulating unions and permission of the Engineers.

N. Apply approved pipe dope (for service intended) to all male threaded joints. Pay particular attention to dope for fuel gas lines. The dope shall be listed for such use.

O. High points of closed loop hot water heating systems shall have manual or automatic air vents as indicated or required unless automatic air vents are specifically indicated. Pipe to suitable drainage point.

P. All piping shall be capped or plugged during erection as required to keep clean and debris and moisture free.

Q. Foam Core PVC is not permitted

R. Where piping penetrates interior or exterior walls, the wall shall be sealed air tight. Refer to the sleeving, cutting, patching and repairing section of the specifications for additional requirements.

2. UNIONS AND FLANGES AND WELDED TEES

A. Screwed unions, soldered unions or bolted flanges shall be provided as required to permit removal of equipment, valves and piping accessories from the piping system. Keep adequate clearances for coil removal, rodding, tube replacement, motor lubrication, filter replacement, etc. Flanged joints shall be assembled with appropriate flanges, gaskets and bolting. Gaskets for steam piping systems shall be flexitalic spiral wound type. The clearance between flange faces shall be such that the connections can be gasketed and bolted tight without imposing undue strain on the piping system.

B. Dielectric insulating unions or couplings shall be used wherever the adjoining materials being connected are of dissimilar metals such as connections between copper and steel pipe.

C. Tee connections for welded pipe shall be made up with welding fittings. Where the size of the side outlet is such that a different connection technique than on the run is required, a weldolet, sockolet, or threadolet type fitting may be used for the branch in place of reducing tees only where the branch is 2/3 the run size or smaller.

3. SPECIFICATIONS STANDARDS

All piping and material shall be new, made in the United States and shall conform to the following minimum applicable standards:

A. Steel pipe; ASTM A-120, A-53 Grade A, A-53 Grade B.

B. Copper tube; Type K, L, M; ASTM B88-62; Type DWV ASTM B306-62.

C. Cast iron soil pipe; ASA A-40.l and CS 188-59.

D. Cast iron drainage fittings; ASA B16.12.

E. Cast iron screwed fittings; ASA B16.4.

F. Welding fittings; ASA B16.9.

G. Cast brass and wrought copper fittings; ASA B16.18.

H. Cast brass drainage fittings; ASA B16.23.

I. Reinforced concrete pipe; ASTM-C-76-64T.

J. Solder; Handy and Harmon, United Wire and Supply; Air Reduction Co. or equivalent.

4. PITCH OF PIPING

All piping systems shall be installed so as to drain to a low point. Certain minimum pitches shall be required for this drainage. For proper flow and/or for proper operation, the following pitches shall be required:

A. Condensate Drain Lines From Cooling Equipment:

Not less than 1/4 inch per foot in direction of flow.

B. All Other Lines:

Provide ample pitch to a low point to allow 100 percent drainage of the system.

5. APPLICATIONS

A. General Notes

(1) Where plastic piping penetrates a fire rated assembly, it shall be replaced with a threaded metal adapter and metal pipe or whatever means necessary to maintain the separation rating in accordance with local plumbing and fire codes.

(2) Plastic piping or any materials with a flame and smoke spread rating not approved for plenum use shall not be permitted in supply, return, relief or exhaust plenums.

B. Hydronic Piping

(1) 2" and Smaller: Schedule 40 black steel pipe with screwed fittings or Type "L" hard copper tubing with wrought copper fittings and 95/5 solder.

(2) 2-1/2" and Larger: Schedule 40 black steel pipe with 125# welded or flanged joints. Weldolets may be used for branch line connections to pipe mains. Type "L" hard copper piping with wrought copper fittings and 95/5 solder may be installed.

(3) Special Notes:

a. Dielectric unions shall be provided at all connections of dissimilar materials.

b. Copper and steel piping shall not be mixed in the mechanical room.

C. Condensate Drain Lines

(1) Type "DWV" copper, wrought copper, lead free solder.

(2) Schedule 40 PVC with solvent welded fittings.

END OF SECTION

SECTION 202100 - VALVES AND COCKS

1. GENERAL

   A. The Contractor's attention is directed to the General and Special Conditions, General Conditions-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified herein.

   B. The Contractor shall provide all valves required to control, maintain and direct flow of all fluid systems indicated or specified. This shall include, but may not be limited to all valves of all types including balancing cocks, air cocks, lubricated plug cocks, packed plug cocks, special valves for special systems, etc., for all Mechanical Systems.

   C. All valves shall be designed and rated for the service to which they are applied.

   D. The following type valves shall not be acceptable: Zinc, plastic, fiber or non-metallic.

   E. Ball valves with temperature and pressure ports are not an acceptable alternative to the balancing valves specified herein. Valves that do not comply with these specifications shall be removed and replaced by the Contractor with no increase in contract price.

   F. Each type of valve shall be of one manufacturer, i.e., gate valves, one manufacturer, globe valves, one manufacturer, silent check valves, one manufacturer, etc. The following valve manufacturers shall be acceptable: Lunkenheimer, Tour & Anderssen, Powell, Nibco, Crane, Jenkins, T & S Brass, Walworth, Milwaukee, DeZurik, Consolidated Valve Industries, Inc., Victaulic, Bell & Gossett, Flow Design, Watts.

   G. All valves shall comply with current Federal, State and Local Codes.

   H. All valves shall be new and of first quality.

   I. All valves shall be full line size. Valves and hydronic specialties shall not be reduced to coil or equipment connection size. Size reductions shall be made at the connection to the equipment.

2. LOCATION OF MAINTENANCE VALVES

   Maintenance valves and unions, installed so as to isolate equipment from the system shall be installed at the following locations:

   A. At all other locations indicated on the drawings.

3. WORKMANSHIP AND DESIGN

   A. Handwheels for valves shall be of a suitable diameter to allow tight closure by hand with the application of reasonable force without additional leverage and without damage to stem, seat and disc. Seating surfaces shall be machined and finished to insure tightness against leakage for service specified and shall seat freely. All screwed valves shall be so designed that when the screwed connection is properly made, no interference with, nor damage to the working parts of the valve shall occur. The same shall be true for sweat valves when solder or brazing is applied.

4. TYPES AND APPLICATION

   A. CHECK VALVES

Check Valves shall be horizontal swing type with two piece hinges, disc construction seats to be bronze and bronze discs or with composition face depending on service and provide silent operation. Valves 1-1/2 inches and smaller shall be bronze with ends to suit piping, have full area "Y" pattern body and integral seats. Valves 2 inches and larger shall be iron body brass mounted and with flanged ends. Working pressure for bronze valves shall be 150 psi and iron valves 125 psi when installed in piping with system pressures up to 100 psi and 250 psi for 100 psi and over. 3" and under NIBCO T433Y, greater than 3" NIBCO F918B (for less than 100 psi systems) greater than 3" NIBCO F968B (for 100 psi or greater systems).

B. BALL VALVES (NON-POTABLE)

Ball Valves shall have removable lever handle with vinyl grip, adjustable stem gland screw, reinforced Teflon stuffing box ring, blow out proof stem, bronze body, reinforced Teflon seats, chrome plated steel ball as manufactured by Consolidated Valve Industries, Inc., Lunkenheimer, Apollo, Jenkins, Nibco or equivalent. Provide a stem extension so that the base of the handle is 1/4" above the insulation similar to Nibseal. NIBCO T5800-70.

C. BUTTERFLY VALVES

Butterfly valves shall be line sized cast iron body, lug style, 200 PSI rating (bubble tight) EPT or Viton seat, cartridge type; high strength stem. Disc to have ground and polished seating surface. Operator shall be locking lever style. Quality equivalent to Crane Monarch series. 3" and under NIBCO LD3222-3, greater than 3" NIBCO LD322-5. Valves 6" and over shall have gear driven operators.

D. BALANCING VALVES

Bell & Gossett, Model CB circuit setter balancing valve or approved equivalent. Calibrated balancing valve shall have flanged connections suitable for 125# working pressure at 250°F. 4" and up shall be rated at 175# at 250°F working pressure. Provide with brass readout valves fitted with an integral EPT insert and check valve. Each balance valve shall have a calibrated nameplate to assure specific valve settings and be constructed with internal seals to prevent leakage.

E. AIR COCKS

Straight nose; Lunkenheimer Fig. 476; bronze; tee handle; bent nose; Lunkenheimer Fig. 478, 125#; bronze; tee handle.

F. GAUGE COCKS

Straight, Lunkenheimer, Fig. 1178; 125#; bronze; tee handle. FIP.

G. LUBRICATED PLUG COCKS

2" and under; Homestead Fig. 601; 150#; semi-steel; screwed; 2-1/2" and over; Homestead Fig. 602; ±50#; semi-steel; flanged.

H. PACKED PLUG COCKS

2" and under; DeZurik Fig. 425-S; 175#; semi-steel; screwed. 2-1/2" and over; DeZurik Fig. 425-F; 175#; semi-steel; flanged.

END OF SECTION

SECTION 202110 - ACCESS TO VALVES, EQUIPMENT, FILTERS, ETC.

1. GENERAL

   A. The Contractor's attention is directed to the General and Special Conditions, General Requirements-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified herein.

   B. All mechanical equipment shall be installed in a manner which allows ready access to all components requiring service, adjustments, shutoff, etc.

   C. Filters shall be accessible, removable and replaceable without disconnecting mounting brackets, piping, wiring, etc.

   D. All oil cups, grease cups, grease fittings, etc. shall be accessible without disassembly of equipment, piping, ductwork, etc. (Extended oilers or grease fittings may be required).

   E. Provide access doors or panels for all equipment, valves, etc. in concealed spaces not otherwise provided with suitable access. (Lay-in ceilings shall be considered acceptable access; splined or drywall ceilings shall not).

   F. All valves, unions, strainers, cleanouts, and test points shall be accessible.

   G. Access panels in lay-in ceilings shall be labeled with a lamacoid plate to indicate location of equipment, filters, valves, etc.

   H. Access panels in fire rated walls shall bear the same rating as the wall.

   I. Each fire damper shall be provided access through the duct to allow reset of the damper. This may be either a gasketed sheet metal panel over a suitable opening or a factory built access panel. The panel shall be at least one and one-half (12) inch larger than the opening all around and shall be held in place with sheet metal screws sufficiently to insure that it is air tight. Manually check the size and location of each of these openings to insure that the fire damper may be manually reset by use of hand only.

2. ACCESS DOORS

   Refer to Sheet Metal and Flexible Duct section of the specifications.

END OF SECTION

SECTION 202200 - INSULATION - MECHANICAL

1. GENERAL

   A. The Contractor's attention is directed to the General and Special Conditions, General Conditions-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified herein.

   B. Work under this section shall include all labor, equipment, accessories, materials and services required to furnish and install all insulation, fittings and finishes for all mechanical systems specified herein and/or as indicated.

   C. Application of insulation materials shall be done in accordance with manufacturer's written recommendations. Where thickness of insulation is not specified, use applicable thickness recommended by manufacturer for specific use. Insulation shall be applied by a company regularly engaged in the application of insulation and any work deemed unacceptable by the Engineers shall be removed and properly installed at the expense of the Contractor.

2. MANUFACTURERS

   A. Insulation shall be as manufactured by Manville, Knauf, CertainTeed, Owens-Corning, Armacell or other approved equivalent. Insulation sundries, adhesives, and jackets/covers shall be as made by Benjamin Foster, Zeston, Speedline, Proto, Childers, Vimasco or approved equivalent.

3. FIRE RATINGS AND STANDARDS

   A. Insulations, jackets and facings shall have composite fire and smoke hazard ratings as tested by ASTM E-84, NFPA 255 and UL 723 procedures not exceeding Flame Spread 25, Smoke Developed 50.

   B. Adhesives, mastics, tapes and fitting materials shall have component ratings as listed above.

   C. All products and their packaging shall bear a label indicating above requirements are not exceeded.

   D. Duct linings shall meet the Erosion Test Method in compliance with UL Publication No. 181.

4. GENERAL APPLICATION REQUIREMENTS

   A. Insulation shall be applied on clean, dry surfaces in a neat and workmanlike manner reflecting the best current practices in the trade. Insulation shall not be applied to piping equipment until tested, inspected and released for insulation.

   B. All insulation shall be continuous through walls, ceiling openings and sleeves. However, insulation shall be broken through fire walls. All covered pipe is to be located a sufficient distance from walls, other pipe, ductwork and other obstacles to permit the application of the full thickness of insulation specified. If necessary, extra fittings and pipe are to be used. No noticeable deformation of insulation or discontinuity of vaporseal, where required, will be accepted.

   C. "Concealed", where used herein, shall mean hidden from sight as in trenches, chases, furred spaces, pipe shafts, or above hung finished ceilings. "Exposed" shall mean that piping or equipment is not "concealed" as defined above. Piping and equipment in service tunnels, mechanical equipment rooms, storage areas, or unfinished rooms is to be considered as "exposed".

   D. Existing and/or new insulation removed and/or damaged during course of construction shall be repaired or replaced as directed by the Engineer.

E. Vapor barrier jackets shall be applied with a continuous unbroken vapor seal. Do not use staples thru the jacket. NO EXCEPTIONS!

F. All insulation shall be installed with joints butted firmly together.

G. The Contractor shall insure that all insulation (piping, equipment, etc.) is completely continuous along all conduits, equipment, connection routes, etc. carrying cold fluids (air, water, other) and that condensation can, in no way, collect in or on the insulation, equipment, conduits, etc. Any such occurrence of condensation collection and/or damage therefrom shall be repaired solely at the expense of the Contractor.

5. PIPING SYSTEMS

A. GENERAL

(1) Pipe insulation shall extend around valve bodies to above drain pans in hydronic equipment over pumps, etc. to ensure no condensation drip or collection.

(2) Factory molded fittings may be installed in lieu of built-up fittings. Jackets to be the same as adjoining insulation. Insulated fittings must have same or better K factors than adjoining straight run insulation.

(3) Valves, flanges and unions shall only be insulated when installed on piping whose surface temperature will be at or below the dew point temperature of the ambient air.

(4) Insulation shall not extend through fire and smoke walls. A UL-listed penetration system shall be used for each fire or smoke wall penetration in accordance with KBC. Materials used such as caulk, sleeves, etc. shall be manufactured by 3M, Hilti, or equal.

B. INSULATION SHIELDS

(1) Metal insulation shields are required at all pipe hangers where the piping is insulated. Metal shields shall be constructed of galvanized steel, formed to a 180 degree arc. Insulation shields shall be the following size:

PIPE SIZE	SHIELD GAUGE	SHIELD LENGTH
2" AND LESS	20	12"
2 1/2" TO 4"	18	12"
5" TO 10"	16	18"
12" AND GREATER	14	24"

C. INSULATION MATERIAL (FOR THE FOLLOWING SYSTEMS)

Insulation shall be Owens-Corning Model 25ASJ/SSL, or approved equivalent fiberglass pipe insulation with an all service jacket. The insulation shall be a heavy density, pipe insulation with a K factor .23 at 75°F mean temperature. The insulation shall be wrapped with a vapor barrier jacket approved manufacturers are listed in section 2. Manufacturers. The jacket shall have an inside foil surface with self sealing lap and a water vapor permeability of .02 perm/inch. All circumferential joints shall be vapor sealed with butt strips. All insulation shall be installed in strict accordance with the

manufacturers' recommendations. The following pipes shall be insulated with the thickness of insulation as noted.

(1) Chilled Hydronic Water

a. Piping 1 ½'' or less – use 1 ½'' thick insulation.

b. Piping 2" and larger - use 2" thick insulation.

(2) Exterior Above Ground Condenser Water

a. Piping 1/2" to 1-1/4" use 1" thick insulation.

b. Piping 1 ½'' to 5" use 1 ½'' thick insulation.

c. Piping 6" and larger use 2" thick insulation.

(3) Condensate Drain Lines.

a. Piping 1 ½'' or less – use 1/2" thick insulation

b. Piping 2'' or greater – use 1'' thick insulation

D. JACKETS

(1) Exposed (Mechanical Rooms, Interior Finished Rooms and Storage Rooms)

All insulated piping installed in the above areas shall have a canvas or PVC jacket:

a. 6 oz. canvas jacket with fire retardant lagging. Apply to the insulation specified for the piping.

b. For all systems plenum rated PVC jacket equal to LoSmoke PVC jacket with flame/smoke rating of 25/50, ASTM-E84 test method. Minimum thickness 0.04 inches. Jackets shall be applied over top of specified pipe insulation. Approved equal manufacturers are Zeston and Speedline. Approved equal manufacturers are Zeston and Speedline.

(2) Exposed (Exterior)

In addition to the insulation specified for the exterior pipe, provide .016" aluminum jacket or PVC jacket 0.05" thick. The jackets shall be installed as recommended by the manufacturer to maintain water tight seal. All longitudinal and transverse seams to be sealed water tight. PVC jacket shall be Ceel-Co, Proto, or Zeston.

END OF SECTION

SECTION 202300 - THERMOMETERS & OTHERS, MONITORING INSTRUMENTS

1. GENERAL

   A. The Contractor shall include all thermometers, pressure gauges and/or compound gauges at the locations indicated.

2. THERMOMETERS AND PRESSURE GAUGES

   A. All thermometers and gauges shall be readable from a standing position on the floor.

   B. Thermometers shall be linear, alcohol filled, graduated in 1°F. Or less and shall have adequate range for service intended.

   C. Pressure gauges shall be Bourdon Type, circular, 3" face, black letters on white face graduated in 2 PSI or less and shall have adequate range and shall be manufactured for service intended. Provide with pig tail connectors and gauge cocks.

   D. Pressure gauges and thermometers subject to vibration shall be mounted remotely away from vibrating pipe surface, etc., with flexible tubing.

   E. Mount thermometers in approved wells and install with thermal grease. Do not make direct contact of base with fluid in pipe.

   F. Gauges and thermometers shall be Marsh, Marshalltown, Weksler or equivalent.

3. Provide, when indicated on the plans, on the inlet and outlet of each terminal unit, a “Pete’s Plug” or equivalent pressure/temperature test station. Furnish two (2) matching thermometers and pressure gauges to the owner upon project completion.

END OF SECTION

SECTION 202400 – IDENTIFICATIONS, TAGS, CHARTS, ETC.

1. GENERAL

   A. The Contractor's attention is directed to the General and Special Conditions, General Conditions-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other Contract Documents which affect the work of this section and which are hereby made a part of the work specified herein.

2. VALVE TAGS AND CHARTS

   A. Provide and install on each valve in the Mechanical Systems a 1-1/2" diameter circular brass tag fitted to each valve so that it cannot be removed. Each tag shall be embossed consecutively with letter and number identifiers as to system and purpose respectively. Letter identifiers shall be as follows:

      H Heating
      C Cooling
      HC Combination Heating/Cooling

      Number identifiers shall be determined by the Contractor sequentially. For example, valve No. HC-1 may be maintenance stops for fan coil units. HC-2 maintenance stops for air heaters, etc.

   B. Provide three (3) copies of typewritten valve charts indicating each valve identifier, the valves purpose and its location. For example: "HC-1 Fan Coil Maintenance Stop-one valve at supply and return of each fan coil unit." One (1) copy of this chart shall be mounted in suitable wood frame(s) with clear plastic or glass covers in a conspicuous location in the Mechanical Room. Two other copies shall be turned over to the Engineers.

   C. Where more than one major Mechanical room is indicated for the project, install mounted valve schedule in each major Mechanical Room, and repeat only main valves which are to be operated in conjunction with operations of more than single Mechanical Room.

3. PIPING IDENTIFICATION

   A. GENERAL

      (1) Provide stenciled markers and arrows indicating direction of flow on all piping installed under this Contract. Markers and arrows shall be painted on the piping using machine cut stencils. All letters shall be sprayed using fast drying lacquer paint. All markers and arrows shall be properly oriented so that descriptive name may be easily read from the floor. At the Contractor's option, Setmark or equivalent manufactured marking system may be substituted for field marking. The following table describes the size of the color field and size of the identification letter which shall be used for pipes of different outside pipe diameters.

OUTSIDE DIAMETER OF PIPE OR COVERING	LENGTH OF COLOR FIELD	SIZE OF LETTERS
INCHES	INCHES	INCHES
3/4 TO 1-1/4	8	1/2
1-1/2 TO 2	8	3/4
2-1/2 TO 6	12	1-1/4
8 TO 10	24	2-1/2
OVER 10	32	3-1/2

(2) "Concealed", where used herein, shall mean hidden from sight as in trenches, chases, furred spaces, pipe shafts, or above hung finished ceilings. "Exposed" shall mean that piping or equipment is not "concealed" as defined above. Piping and equipment in service tunnels, mechanical equipment rooms, storage areas, or unfinished rooms is to be considered as "exposed".

(3) All piping shall be marked not less than every 15 linear feet above a ceiling system, every 10 feet in a mechanical room, and at all points where lines pass through walls or floors.

(4) Provide pipe marker colors as indicated in the following table where manufactured marking systems are used:

PIPE+	MARKER COLOR+	ABBREVIATION
Chilled Water Supply	Green with Black Letters	C.W.S.
Chilled Water Return	Green with Black Letters	C.W.R.
Hot Water Supply	Yellow with Black Letters	H.W.S.
Hot Water Return	Yellow with Black Letters	H.W.R.
Chilled/Hot Water Supply	Green with Black Letters	C.H.W.S.
Chilled/Hot Water Return	Green with Black Letters	C.H.W.R.

A. Piping, whether exposed or concealed, shall be marked not less than every 15 linear feet and at the points where the piping passes through wall or floors.

4. EQUIPMENT IDENTIFICATION

A. All equipment, except in finished rooms, shall be identified by stenciling the title of the equipment as taken from the plans in a position that is clearly visible from the floor. The letters shall be made with black paint and shall be not less than two inches high. The titles shall be short and concise and abbreviations may be used as long as the meaning is clear. Lamacoid plates are also acceptable. In finished rooms or outdoors, equipment shall be identified by engraved nameplates.

END OF SECTION

SECTION 202500 - HANGERS, CLAMPS, ATTACHMENTS, ETC.

1. GENERAL

   A. The Contractor's attention is directed to the General and Special Conditions, General Provisions - Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.

   B. Each Contractor's attention is also directed to Section 201300, Pipe, Pipe Fittings and Pipe Support.

   C. This section includes, but is not limited to, furnishing and installing dampers, supports, anchors, and accessories for piping, ductwork, equipment, etc. Furnishing and installing shall be by each trade for the completion of their work.

   D. Power driven anchors and expansion anchors shall be permitted only when permission is granted in writing by the Engineer.

2. MATERIALS AND EQUIPMENT

   A. Hangers, Clamps, Attachments, Etc.:

	SIZE	SPECIFICATION
1. Pipe Rings	2" pipe and smaller	Adjustable swivel split ring or split pipe ring, Grinnell Figures 104 and 108, Elcen, Fee & Mason, or approved equivalent.
2. Pipe Clevis	2-1/2" pipe and larger	Adjustable wrought Clevis type, Grinnell Figure 260, Elcen, Fee & Mason, or approved equivalent.
3. Pipe Clevis	All	Steel Clevis for insulated pipe, Elcen Figure 12A, Grinnell, Fee & Mason or approved equivalent.
4. Rise Clamps	All	Extension pipe or riser clamp, Grinnell Figure 261, Elcen, Fee & Mason or approved equivalent.
5. Beam Clamps and Attachments	All	Grinnell Figure numbers listed or, Elcen, Fee & Mason, or approved equivalent. Malleable beam clamp with extension piece figure 229; I-beam clamp figure 131; C-clamp figures 83, 84, 85, 86, 87, and 88.
6. Brackets	All	Welded steel brackets medium weight, Grinnell Figure 195, Elcen, Fee & Mason or approved equivalent.
7. Concrete Inserts	All	Grinnell Figure numbers listed or, Elcen, Fee & Mason or approved equivalent. Wrought steel insert Figure 280 and wedge type insert Figure 281.

8. Concrete Fasteners	All	Self-drilling concrete inserts, Phillips, Grinnell, Elcen or approved equivalent.
9. Ceiling	All	Grinnel Figure numbers listed or Elcen, Fee & Mason, or approved equivalent. Pipe hanger flange Figure 153, adjustable swinging hanger flange Figure 155, ceiling flanges Figures 128 and 128R, and adjustable ceiling flange Figure 116.
10. Rod Attachments	All	Grinnel Figure numbers listed or Elcen, Fee & Mason, or approved equivalent. Extension piece Figure 157, rod coupling Figure 136, and forged steel turnbuckle Figure 230.
11. U-Bolts	All	Standard, U-bolt, Grinnell Figure 137, Elcen, Fee & Mason, or approved equivalent.
12. Welded Pipe Saddles	All	Pipe covering protection saddle sized for thickness of insulation, Grinnell Figure 186, Elcen, Fee & Mason or approved equivalent.
13. Pipe Roll	All	Adjustable swivel pipe roll, Grinnell Figure 174, Elcen, Fee & Mason, or approved equivalent.
14. Protection Saddle	All	18 gauge sheet metal pipe protection saddle, Elcen Figure 219, Fee & Mason, Power Strut, or approved equivalent.
15. Hanger Rods	All	Steel, diameter of the hanger threading, ASTM A-107.
16. Miscellaneous Steel	All	Steel angles, rods, bars, channels, etc., used in framing for supports and fabricated brackets, anchors, etc., shall conform to ASTM-A-7.
17. Concrete Channel Inserts	All	Continuous slot inserts, Unistrut, or approved equivalent. Heavy duty Series P-3200 or Light Duty Series P-3300 as required.
18. Adjustable Spot Insert	All	Adjustable spot insert Unistrut, or approved equivalent, P-3245. Design load 1000 lbs.

3. INSTALLATION

A. Unless otherwise specifically indicated or hereinafter specified in the specifications, all supporting, hanging and anchoring of piping, equipment, etc., shall be done by each trade as is necessary for completion of the work and shall be as directed in the following paragraphs:

(1) Supporting and hanging shall be done so that excessive load will not be placed on any one hangers so as to allow for proper pitch and expansion of piping. Hangers and supports shall be placed as near as possible to joints, turns and branches.

(2) For concrete construction, utilize adjustable concrete inserts for fasteners. Expansion anchors and power driven devices may be used when approved in writing by the Engineer. Utilize beam clamps for fastening to steel joists and beams and expansion anchors in masonry construction. When piping is run in joists, piping shall be top mounted on trapeze type hangers with each pipe individually clamped to trapeze hanger.

(3) Trapeze hangers shall be supported by steel rods of sufficient diameter to support piping from joists or concrete construction. Where desired or required, piping may be double mounted on trapeze hangers. Where conditions permit, trapeze hangers may be surface mounted on exposed joists by means of approved beam clamps, or to concrete construction by means of approved adjustable inserts or expansion anchors.

(4) Install all miscellaneous steel other than designed building structural members as required to provide means of securing hangers, supports, etc., where piping does not pass directly below or cross steel joists.

(5) Piping shall not be supported by the equipment to which it is connected. Support all piping so as to remove any load or stress from the equipment.

(6) Where piping, etc., is run vertically, approved riser clamps, brackets or other means shall be utilized at approximately 10'-0" center to center minimum and an approved adjustable base stand or fitting on concrete support base shall be utilized at the base of the vertical run.

(7) Where piping is run along walls, knee braced angle frames or pipe brackets with saddles, clamps, and rollers (where required) mounted on structural brackets fastened to walls or columns shall be used.

(8) Support all ceiling hung equipment, with approved vibration isolators.

(9) Where copper tubing is specified, hangers shall be of copper clad type when piping is uninsulated.

(10) Uninsulated piping hung from above shall be supported with ring and clevis type pipe hangers. Uninsulated piping mounted on trapeze and wall bracket type support shall be held in place with U-bolts. U-bolts shall allow for axial movement in the piping.

(11) All insulated piping shall be supported with clevis type and/or pipe roll hangers. Hangers shall be sized to allow the pipe insulation to pass through the hangers. Install insulation protection saddles at all hanger locations. Welded pipe saddles shall be installed at all hangers on piping 5" and larger. The pipe saddles shall be sized for the thickness of insulation used. Hangers shall fit snugly around outside of insulation saddles.

(12) Under no conditions will perforated band iron or steel wire driven hangers be permitted.

(13) In general, support piping at the following spacing:

a. Steel and copper piping - 5 feet intervals for piping 3/4" and smaller. 6 feet intervals for 1 ¼" and 1" pipe. 8 foot intervals for piping 1 ½" to 3". 10 foot intervals piping 3 ½" and larger.

b. Polyethylene piping – 4 foot intervals for piping 2” and smaller. 5 foot intervals for 3” pipe. 6 foot intervals for 4”, 6”, and 8” pipe. 7 foot intervals for 10” and larger pipe.

c. Where the manufacturer of the pipe has more strict guidelines, the manufacturer’s recommendations shall be followed.

END OF SECTION

SECTION 203100 - TESTING, BALANCING, LUBRICATION AND ADJUSTMENTS

1. GENERAL

A. The General Conditions, Instructions to Bidders, Section 200100, and other Contract Documents are a part of this specification and shall be binding on all Mechanical Contractors. It shall be each Contractor's responsibility to apprize himself of all information pertinent to his work prior to submitting his proposal. No adjustments will be made in this Contract which is a result of failure to comply with this requirement.

B. The Engineer, or his authorized representative, shall be notified by the Contractor twenty-four (24) hours in advance of any tests called for in these specifications or required by others. Any leaks or imperfections found shall be corrected and a new tests run to the satisfaction of the Engineer or his authorized representative. Upon completion of a test, a written approval of that part of the work will be given to the Contractor. Only after written approval, signed by the Engineer, shall the Contractor apply insulation or paint or allow his work to be furred-in. This written approval, however, does not relieve the Contractor of the responsibilities for any failure during the guarantee period. The expense of all tests shall be borne by the Contractor, along with all temporary equipment, materials, gauges, etc. required for tests.

2. HEATING, VENTILATING AND AIR CONDITIONING

A. The test and balance of this system shall be by a contractor who employs only the services of a certified AABC or independent NEBB firm whose sole business is to perform test and balance services. The test and balance contractor shall report all deficiencies to the engineer.

B. The Mechanical Contractor shall test all piping before being insulated or concealed in any manner. Where leaks or defects develop, required corrections shall be made and tests repeated until systems are proven satisfactory. Water piping systems shall be subjected to a hydrostatic test of not less than one hundred pounds and shall be proven tight after a twenty-four (24) hour test.

C. All motors, bearings, etc. shall be checked and lubricated as required during start-up procedures. All automatic, pressure regulating and control valves shall be adjusted. Excessive noise or vibration shall be eliminated. Provide all start-up documents to Designer prior to any test and balance services.

D. System balancing, where required, shall be performed only by persons skilled in this work. The system shall be balanced as often as necessary to obtain desired system operation and results.

E. All deficiencies observed by the Test and Balance Contractor shall be reported immediately to the Engineer and Mechanical Contractor.

F. For the purpose of placing the heating, ventilating and air conditioning system in operation according to design conditions and certifying same, final testing and balancing shall be performed in complete accordance with AABC Standards for Total System Balance, Volume Six (2002), for hydronic systems as published by the Associated Air Balance Council. The following systems shall be test and balance:

I. Instruments used for testing and balancing of air and hydronic systems shall have been calibrated within a period of six months prior to balancing. All final test analysis reports shall include a letter of certification listing instrumentation used and last date of calibration.

J. Four (4) copies of the complete test reports shall be submitted to the Consulting Engineer prior to final acceptance of the project. Preliminary test reports shall be submitted when requested.

K. The Contractor shall provide and coordinate their work in the following manner:

(1) Provide sufficient time before final completion date so that tests and balancing can be accomplished.

(2) Provide immediate labor and tools to make corrections when required without undue delay.

L. Balance all water systems. Be sure to include:

M. Automatic Flow Control Balance Valves

(1) Verify that each installed automatic flow control device matches the GPM indicated on the drawings.

(2) Verify that the actual pressure at each automatic flow control device is within the pressure limits specified by the valve manufacturer.

END OF SECTION

SECTION 230100 - PUMPS

1. GENERAL

   A. The Contractor's attention is directed to the General and Special Conditions, General Provisions - Mechanical and to all other contract Documents as they apply to this branch of the work. Attention is also directed to other sections of the specifications which affect the work of this section and which are hereby made a part of the work specified herein.

   B. All required motor starters shall be furnished with the respective pump.

   C. Electric motors shall be furnished with the pumps and shall be of the size and type scheduled or otherwise specified. All motors shall be UL labeled and shall comply with applicable NEMA standard.

   D. Shop drawings shall be submitted as required by Section 200300 and shall include complete pump specifications, installation and start-up instructions, current and accurate pump performance curves with the selection points clearly indicated, maintenance data and spare parts lists.

   E. Pumps shall be factory tested, cleaned and painted prior to shipment. Size, type, capacity and electrical characteristics are listed in the pump schedule.

   F. Insofar as possible, all pumps shall be by the same manufacturer.

   G. Pump shall have data plate indicating horsepower, voltage, phase, ampacity, pressure head, and flow rate.

   H. Special notes for pumps controlled by variable frequency drives:

      (1) Supplier shall provide the largest non-overloading impeller size for the specified pump motor horsepower, regardless of the specified pump head given on the pump schedule(s).

      (2) Pumps less than 100 HP in size shall be furnished with shaft grounding kit, Aegis SGR Bearing Protection Ring or equal. One shaft grounding ring and related hardware shall be provided on drive end or non-drive end of motor per manufacturer's instructions. These shall be factory mounted and installed on the exterior of the motor to allow for visual inspection. Ground motor frame per manufacturer's instructions. Install kit in strict accordance with manufacturer's instructions.

2. MATERIAL

   A. BASE MOUNTED PUMPS

      (1) Type: Horizontal, base mounted, end suction, single stage, flexible coupled, 175 PSI working pressure.

      (2) Pump Body: Cast iron, flanged gauge and drain tappings, bronze fitted.

      (3) Shaft: Stainless steel. Refer to special notes for pumps controlled by VFD's above for shaft grounding kit specification.

      (4) Bearing: Re-lubricatable ball bearing. Provide insulated bearing journals for pumps greater than 100 HP.

      (5) Seal: Mechanical, carbon ring with ceramic seal.

(6) Motor: open, drip proof, re-lubricatable ball bearing. Minimum efficiency per NEMA Premium Induction Motor Efficiency.

(7) Impeller: Enclosed, balanced.

(8) Base: Structural steel.

(9) Coupling: Flexible with coupling guard.

(10) Manufacturers: Subject to compliance with the specified and scheduled requirements. Pumps by the following manufacturers will be considered:

Amtrol/Thrush
Armstrong/Aurora
Bell and Gossett
Federal Pump
Patterson
Sigmund
Worthington Pump
Weinman
Taco
FloFab

(11) SELECTIONS:

Refer to the schedule on the plans for base-mounted pump selections.

END OF SECTION

SECTION 230200 - HVAC EQUIPMENT AND HYDRONIC SPECIALTIES

1. GENERAL

A. The Contractor's attention is directed to the General and Special Conditions, General Conditions-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified herein.

B. The Contractor shall provide in complete working order the following heating, ventilation and air conditioning equipment located as indicated and installed, connected and placed in operation in strict accordance with the manufacturer's recommendations. All equipment shall be factory painted and, where applicable, factory insulated and shall, where such standards exist, bear the label of the Underwriters Laboratory.

C. Each subcontractor shall be responsible for their own completion of System Verification Checklists/Manufacturer’s Checklist.

D. Factory startup is required for all HVAC equipment. In general, as part of the verification process, equipment suppliers shall perform start-up by their factory authorized technicians and shall complete and submit start-up reports/checklists. This shall include chillers, cooling towers, VFDs, etc.

E. All HVAC equipment shall comply with the latest provisions of ASHRAE Standard 90 and/or International Energy Conservation Code 2012, whichever is more stringent.

F. Installation of all heating, ventilating and air conditioning systems shall be performed by a master HVAC contractor licensed in the state the work will be performed.

G. Note to Suppliers and Manufacturers Representative furnishing proposals for equipment for the project:

(1) Review the Controls Section of these Specifications (if applicable) to determine controls to be furnished by the equipment manufacturer, if any. The Contractor shall provide all controls with equipment unless specifically listed otherwise.

(2) Review the section of these specifications entitle: SHOP DRAWINGS, DESCRIPTIVE LITERATURE, MAINTENANCE MANUALS, PARTS LISTS, SPECIAL KEYS, TOOLS, ETC., and provide all documents called for therein.

(3) Insure that the equipment which you propose to furnish may be installed, connected, placed in operation and easily maintained at the location and in the space allocated for it.

(4) Determine from the Bid Documents the date of completion of this project and insure that equipment delivery schedules can be met so as to allow this completion date to be met.

(5) Where manufacturers’ temperature controls are specified, they shall be in full compliance with International Mechanical Code Section 606 including automatic smoke shut down provisions.

(6) Provide factory start-up on site by a factory representative (not a third party contractor) for all HVAC equipment, including pumps, VFDS, chillers, cooling towers, etc. Submit factory start-up reports to the Engineer.

(7) Provide training to the Owner by a factory representative for each type of equipment. Training shall be a minimum of eight (8) hours on site and the Engineer shall be notified one (1) week in advance of the training. Training shall only occur when the systems are complete and 100% functional. All training shall be video taped.

(8) Review the Section on Motor Starters and Electrical Requirements for Mechanical Equipment.

(9) Requirements for motors controlled by variable frequency drives:

a. All motors shall be inverter duty rated.

b. Motors less than 100 HP in size shall be furnished with shaft grounding kit, Aegis SGR Bearing Protection Ring or equal. One shaft grounding ring and related hardware shall be provided on drive end or non-drive end of motor per manufacturer's instructions. These shall be factory mounted and installed on the exterior of the motor to allow for visual inspection. Ground motor frame per manufacturer's instructions. Install kit in strict accordance with manufacturer's instructions.

c. Motors greater than 100 HP to 1000 HP in size shall be furnished with shaft grounding kit, Aegis SGR Bearing Protection Ring or equal. Provide shaft grounding ring on drive end and non-drive end of motor per manufacturer's instructions. Additionally provide insulated bearing journals to further reduce risk of current dissipation through bearings. Ground motor frame per manufacturer's instructions. Install kit in strict accordance with manufacturer's instructions.

(10) All equipment shall be furnished for a single point electrical connection unless specifically excluded as a requirement.

2. EQUIPMENT

A. COOLING TOWER

1. GENERAL

a) SUMMARY

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

2. DEFINITIONS

BMS: Building management system.

3. ACTION SUBMITTALS

Product Data: For each type of product indicated. Include rated capacities, pressure drop, fan performance data, rating curves with selected points indicated, furnished specialties, and accessories.

Maximum flow rate.
Minimum flow rate.
Drift loss as percent of design flow rate.
Volume of water in suspension for purposes of sizing a remote storage tank.

Sound power levels in eight octave bands for operation with fans off, fans at minimum, and design speed.

Performance curves for the following:

Varying entering-water temperatures from design to minimum.
Varying ambient wet-bulb temperatures from design to minimum.
Varying water flow rates from design to minimum.
Varying fan operation (off, minimum, and design speed).
Fan airflow, brake horsepower, and drive losses.
Pump flow rate, head, brake horsepower, and efficiency.
Motor amperage, efficiency, and power factor at 100, 75, 50, and 25 percent of nameplate horsepower.
Electrical power requirements for each cooling tower component requiring power.

Shop Drawings: Complete set of manufacturer's prints of cooling tower assemblies, control panels, sections and elevations, and unit isolation. Include the following:

Assembled unit dimensions.
Weight and load distribution.
Required clearances for maintenance and operation.
Sizes and locations of piping and wiring connections.
Wiring Diagrams: For power, signal, and control wiring.

4. INFORMATIONAL SUBMITTALS

Coordination Drawings: Floor plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

Structural supports.
Piping roughing-in requirements.
Wiring roughing-in requirements, including spaces reserved for electrical equipment.

Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.

5. CLOSEOUT SUBMITTALS

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

6. QUALITY ASSURANCE

Testing Agency Qualifications: Certified by CTI.

Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

ASME Compliance: Fabricate and label heat-exchanger coils to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

CTI Certification: Cooling tower thermal performance according to CTI STD 201, "Certification Standard for Commercial Water-Cooling Towers Thermal Performance."

FMG approval and listing in the latest edition of FMG's "Approval Guide."

7. COORDINATION

Coordinate sizes, locations, and anchoring attachments of structural-steel support structures.

Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

8. WARRANTY

Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace the following components of cooling towers that fail in materials or workmanship within specified warranty period:
All components of cooling tower.
Warranty Period: Five years from date of Substantial Completion.

a. Tower to be equal to the following:

SIZE	EWT/LWT	FLOW RATE	SUMMER WB	FAN HP	VOLTAGE	SOUND POWER							
						63 HZ	125 HZ	250 HZ	500 HZ	1000 HZ	2000 HZ	4000 HZ	8000 HZ
14'2"x8'5"x13'5"	85/95	750	78	15	460	98	95	92	91	87	83	79	70

9. PRODUCTS

10. OPEN-CIRCUIT, INDUCED-DRAFT, CROSSFLOW COOLING TOWERS

Products: Subject to compliance with requirements, provide one of the following:
Baltimore Aircoil Company; Series 3000.
Marley Cooling Technologies, an SPX Corporation; Models Aquatower, AV series, NC Class, Primus.

Cooling tower designed to resist wind load of 30 lbf/sq. ft.

Casing and Frame:
Frame Material: Galvanized steel, ASTM A 653/A 653M, G235 coating.
Fasteners: Galvanized steel.
Joints and Seams: Sealed watertight.
Welded Connections: Continuous and watertight.

Collection Basin:
Material: Stainless steel.
Removable stainless-steel strainer with openings smaller than nozzle orifices.
Overflow and drain connections.
Makeup water connection per basin.
Outlet Connection: ASME B16.5, Class 150 flange. 1 per cell.
Equalizer connection for field-installed equalizer piping.

Provide 1 Mechanically Operated, Collection Basin Water-Level Control: Manufacturer's standard adjustable, mechanical float assembly and valve per basin.

Electric Basin Heater: Manufacturer's standard offering to provide capacity indicated.

Gravity Water Distribution Basin: Non-pressurized design with head of water level in basin adequate to overcome spray nozzle losses and designed to evenly distribute water over fill throughout the flow range indicated.

Material: Stainless steel.
Location: Over each bank of fill with easily replaceable plastic spray nozzles mounted in bottom of basin.
Inlet Connection: ASME B16.5, Class 150 flange.

Joints and Seams: Sealed watertight.

Partitioning Dams: Same material as basin to distribute water over the fill to minimize icing while operating throughout the flow range indicated.

Removable Panels: Same material as basin to completely cover top of basin. Secure panels to basin with removable corrosion-resistant hardware.

Valves: Manufacturer's standard valve installed at each inlet connection and arranged to balance or shut off flow to each gravity distribution basin.

Single, Field Pipe Connection: Galvanized-steel pipe arranged to provide balancing of flow within cooling tower cell without the need for additional balancing valves. Pipe each cooling tower cell internally to a single, field connection suitable for mating to ASME B16.5, Class 150 flange and located on the side unless otherwise indicated.

Fill:

Materials: PVC, with maximum flame-spread index of 25 according to ASTM E 84.

Minimum Thickness: 20 mils, before forming.

Fabrication: Fill-type sheets, fabricated, formed, and bonded together after forming into removable assemblies that are factory installed by manufacturer.

Fill Material Operating Temperature: Suitable for entering-water temperatures up through 120 deg F.

Drift Eliminator:

Material: FRP or PVC; with maximum flame-spread index of 25 according to ASTM E 84.

UV Treatment: Inhibitors to protect against damage caused by UV radiation.

Configuration: Multi-pass designed and tested to reduce water carryover to achieve performance indicated.

Location: Integral to fill.

Air-Intake Louvers:

Material: Matching casing.

UV Treatment: Inhibitors to protect against damage caused by UV radiation.

Louver Blades: Arranged to uniformly direct air into cooling tower, to minimize air resistance, and to prevent water from splashing out of tower during all modes of operation including operation with fans off.

Location: Integral to fill.

Axial Fan: Balanced at the factory after assembly.

Blade Material: Aluminum.

Hub Material: Aluminum.

Blade Pitch: Field adjustable.

Protective Enclosure: Removable, galvanized-steel, wire-mesh screens complying with OSHA regulations.

Fan Shaft Bearings: Self-aligning ball or roller bearings with moisture-proof seals and premium, moisture-resistant grease suitable for temperatures between minus 20 and plus 300 deg F. Bearings designed for an L-10 life of 50,000 hours.

Bearings Grease Fittings: Extended lubrication lines to an easily accessible location.

Gear Drive: Right angle, reduced speed, and designed for cooling tower applications according to CTI STD 111. Motor and gear drive shall be aligned before shipment.

Gear Drive and Coupling Service Factor: 2.0 based on motor nameplate horsepower.

Housing: Cast iron, with epoxy or polyurethane finish, beveled high-strength steel gears continuously bathed in oil, and with lubrication to other internal parts at all operating speeds.

Mounting: Directly mounted to fan hub and connected to motor so motor shaft is in horizontal position.

Operation: Able to operate both forward and in reverse.

Drive-to-Motor Connection: Close coupled to motor using a flexible coupling.

Drive Shaft Material: Stainless steel, and fitted with flexible couplings on both ends. Provide exposed shaft and couplings with guards according to OSHA regulations.

Extend oil fill, drain, and vent to outside of cooling tower casing using galvanized-steel piping. Provide installation with oil-level sight glass.

Fan Motor:

Provide premium efficient motor.
Motor Enclosure: Totally enclosed fan cooled (TEFC).
Energy Efficiency: NEMA Premium Efficient.
Service Factor: 1.15.
Insulation: Class F.

Variable-Speed Motors: Inverter-duty rated per NEMA MG-1, Section IV, "Performance Standard Applying to All Machines," Part 31, "Definite-Purpose, Inverter-Fed, Polyphase Motors."

Motor Location: Mounted outside of cooling tower casing and cooling tower discharge airstream.

Severe-duty rating with the following features:
Rotor and stator protected with corrosion-inhibiting epoxy resin.
Double-shielded, vacuum-degassed bearings lubricated with premium, moisture-resistant grease suitable for temperatures between minus 20 and plus 300 deg F
Internal heater automatically energized when motor is de-energized.

Motor Base: adjustable or other suitable provision for adjusting belt tension.

Fan Discharge Stack: Material shall match casing, manufacturer's standard design.

Stack Termination: Wire-mesh, galvanized-steel screens; complying with OSHA regulations.

Vibration Switch: For each fan drive.

Enclosure: NEMA 250, Type 4.

Vibration Detection: Sensor with a field-adjustable, acceleration-sensitivity set point in a range of 0 to 1 g and frequency range of 0 to 3000 cycles per minute. Cooling tower manufacturer shall recommend switch set point for proper operation and protection.
Provide switch for field connection to a BMS and hardwired connection to fan motor electrical circuit.
Switch shall, on sensing excessive vibration, signal an alarm through the BMS and shut down thefan.

Controls: To be interfaced by the campus's existing control system via BACnet.

Personnel Access Components:

Doors: Large enough for personnel to access cooling tower internal components from both cooling tower end walls. Doors shall be operable from both sides of the door.

External Ladders with Safety Cages: Aluminum, galvanized- or stainless-steel, fixed ladders with ladder extensions to access external platforms and top of cooling tower from adjacent grade without the need for portable ladders. Comply with 29 CFR 1910.27.

External Platforms with Handrails: Aluminum, FRP, or galvanized-steel bar grating at cooling tower access doors when cooling towers are elevated and not accessible from grade. Platform shall extend all the way around the tower.

Internal ladder and platform: provide internal platform to be able to service the motor inside of the tower.

11. EXECUTION

12. EXAMINATION

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.
Cooling tower locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

Proceed with installation only after unsatisfactory conditions have been corrected.

13. INSTALLATION -(TO BE INSTALLED UNDER SEPARATE CONTRACT).

Install cooling towers on support structure indicated.

Install anchor bolts to elevations required for proper attachment to supported equipment.

Maintain manufacturer's recommended clearances for service and maintenance.

Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

14. CONNECTIONS

Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

Install piping adjacent to cooling towers to allow service and maintenance.

Install flexible pipe connectors at pipe connections of cooling towers mounted on vibration isolators.

Provide drain piping with valve at cooling tower drain connections and at low points in piping.

Connect cooling tower overflows and drains, and piping drains to sanitary sewage system.

Domestic Water Piping: Comply with applicable requirements in Section 22 11 16 "Domestic Water Piping." Connect to water-level control with shutoff valve and union, flange, or mechanical coupling at each connection.

Supply and Return Piping: Comply with applicable requirements in Section 23 21 13 "Hydronic Piping." 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.

Equalizer Piping: Piping requirements to match supply and return piping. Connect an equalizer pipe, full size of cooling tower connection, between tower cells. Connect to cooling tower with shutoff valve.

15. FIELD QUALITY CONTROL

Perform tests and inspections.

Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

Tests and Inspections: Comply with CTI ATC 105, "Acceptance Test Code for Water Cooling Towers."

Cooling towers will be considered defective if they do not pass tests and inspections.

Prepare test and inspection reports.

16. STARTUP SERVICE

Engage a factory-authorized service representative to perform startup service.

Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.

Obtain performance data from manufacturer.

Complete installation and startup checks according to manufacturer's written instructions and perform the following:

Clean entire unit including basins.

Verify that accessories are properly installed.

Verify clearances for airflow and for cooling tower servicing.

Check for vibration isolation and structural support.

Lubricate bearings.

Verify fan rotation for correct direction and for vibration or binding and correct problems.

Adjust belts to proper alignment and tension.

Operate variable-speed fans through entire operating range and check for harmonic vibration imbalance. Set motor controller to skip speeds resulting in abnormal vibration.

Check vibration switch setting. Verify operation.

Verify water level in tower basin. Fill to proper startup level. Check makeup water-level control and valve.

Verify operation of basin heater and control.

Verify that cooling tower air discharge is not re-circulating air into tower or HVAC air intakes. Recommend corrective action.

Replace defective and malfunctioning units.

Start cooling tower and associated water pumps. Follow manufacturer's written starting procedures.

Prepare a written startup report that records the results of tests and inspections.

17. ADJUSTING

Set and balance water flow to each tower inlet.

Adjust water-level control for proper operating level.

18. DEMONSTRATION

Train Owner's maintenance personnel to adjust, operate, and maintain cooling towers.

B. CENTRIFUGAL CHILLER

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Semi-hermetic, water-cooled, direct-drive centrifugal chillers that shall use HCFC-123.

1.02 SUBMITTALS

A. Acceptable refrigerants on which chiller performance is based are HCFC-123 and HFC-134a. All proposals for chiller performance must include an AHRI approved selection method for the specified refrigerants.

B. Submit drawings indicating assembled dimensions, operating weight, load distribution, and required service and access clearances.

C. Submit product data indicating options and specialties, electrical requirements, and wiring diagrams and connections. Indicate accessories, valves, strainers, and thermostatic valves required for the complete system.

D. Submit rigging, installation, and startup procedures. Include operations and maintenance data for both the chiller and starter or variable-speed drive. Include location, size, and type of field piping connections.

E. Submit performance data indicating energy input versus cooling load output from 100 to 25 percent of full load with constant entering condenser water temperature.

F. Submit compressor and product data in table form indicating impeller speed (RPM), number of bearings, type of bearings, high speed impeller shaft RPM, sound pressure level per AHRI 575-2008 (dB), number of stages, number of sets of inlet guide vanes, amount of refrigerant charge (lb), and amount of oil required (gal).

1.03 REGULATORY REQUIREMENTS

A. Conform to AHRI Standard 550/590 code for rating and testing of water chillers.

B. Conform to UL 1995 for Safety for Heating and Cooling Equipment..

C. Conform to ANSI/ASME SECTION VIII Boiler and Pressure Vessel Code for construction and testing of centrifugal chillers as applicable.

D. Conform to latest revision of ANSI/ASHRAE STANDARD 15 code for construction and operation of centrifugal chillers.

E. Unit shall bear the AHRI Certification Label for the specific type of water chiller as applicable.

F. Chiller manufacturer shall provide LEED-NC EA Credit Calculation for each chiller utilizing the following factors as specified by the U.S. Green Building Council based upon equipment life of 25 years:

1.04 DELIVERY, STORAGE, HANDLING AND EQUIPMENT ROOM REQUIREMENTS

A. Comply with manufacturer's installation instructions for rigging, chiller loading, local transportation requirements, unloading, storage, and final setting.

B. Protect chiller and controls from physical damage. Leave factory shipping covers in place until installation. The entire unit must be shrink wrapped with an environmentally recyclable material standard. The material shall include an imbedded desiccant to minimize/eliminate internal moisture.

C. The chiller shall ship with a dry nitrogen charge to eliminate potential charge loss during delivery and construction. The refrigerant must be shipped separately from the chiller. The refrigerant monitoring system shall be active at the job site prior to the charging of the chiller.

D. The chiller should ship with a full charge of oil.

1.05 WARRANTY

A. Provide a standard unit parts and labor warranty for one year from startup or 18 months from shipment, whichever occurs first.

B. Provide a 5 year compressor parts only replacement warranty on the unit compressor/motor.

C. Leak Tight Warranty: Provide as part of the chiller scope a refrigerant loss warranty for the lesser of 60 months from initial start-up or 66 months from date of shipment. During this period, manufacturer shall furnish replacement refrigerant which is lost due to a leak in the machine. Once a leak is determined, action must be taken (acceptable to the manufacturer) to eliminate the source of the leak.

PART 2 PRODUCTS

2.01 SUMMARY

A. Description: Factory-assembled and tested water chiller complete with compressor, evaporator, condenser, controls, starter or variable speed drive, interconnecting unit piping and wiring, indicating accessories, and mounting frame.

B. The contractor shall furnish and install centrifugal water chillers as shown and scheduled in the plans and specifications. The units shall produce the specified tonnage per the scheduled data in accordance with the latest revision of AHRI 550/590. The unit shall bear the AHRI certification label as applicable.

C. Approved Manufacturers:

1.Trane

2.Daikin

3.York – JCI

D. Unit shall be painted in accordance with the manufacturer's standard procedures and practices.

2.02 COMPRESSOR AND MOTOR

A. The compressor shall be centrifugal with single or multiple stages.

B. Low or medium pressure refrigerant machines shall be provided when available.

C. Chiller should be able to unload to 10% of design tonnage with constant entering water temperature.

D. Compressor assembly shall be vibration tested at the factory. Vibration shall not exceed 0.15 inches per second at full load design compressor speed as measured on the motor housing. The test data shall be recorded and provided to the customer for approval.

E. The motor shall be hermetic and either suction or liquid refrigerant cooled. Hot gas motor cooling is not acceptable.

F. Motors shall have winding 100 ohm platinum RTD's for temperature sensing on each phase. Thermistors and thermal overloads are not acceptable. These temperatures shall be furnished to the unit control panel for monitoring and alarm.

G. Manufacturers with speed increasing transmissions shall not exceed 10,000 RPM compressor speeds and shall annually inspect the gears and all bearings. A report shall be forwarded to the owner each year over the first five years to confirm completion.

H. If the manufacturer uses electronic (i.e. magnetic) bearings a 20 year warranty on all chiller compressor capacitors must be provided

I. The impellers shall be fully shrouded and made of a high strength aluminum alloy. Impellers shall be dynamically balanced and over-speed tested at 1.25 times impeller shaft speed.

2.03 EVAPORATOR (CHILLER BARREL)

A. The evaporator and condenser shall be built in accordance with ANSI/ASHRAE 15-2001 Safety Code for Mechanical Refrigeration and ASME section VIII as applicable.

B. Evaporator tubes shall be internally and externally enhanced with 0.75" thick (minimum) outer diameter. The tubes shall be securely supported at intermediate supports and physically expanded into both ends of the tube sheets. The evaporator tubes must also be removable from both ends to provide easy access for tube cleaning. The minimum evaporator tube wall thickness, root-to-root across the entire tube length shall be 0.025". It is unacceptable to provide this thickness at the intermediate supports only.

C. The evaporator water piping connections shall be Victaulic grooved

D. The evaporator waterboxes shall be standard non-marine type with connections per the schedule.

E. Supply and return head waterboxes shall be designed for a working pressure of 150 and shall be factory hydrostatic pressure tested at 150 percent of the design pressure. Provide drain and vent connections in water boxes.

F. Insulation will be 3/4" thick (minimum) insulation and cover all low-temperature surfaces to include the evaporator, waterboxes, and suction elbow. Economizer, if applicable, is insulated with 3/8" insulation.

G. Units with multi-stage compressors shall incorporate an interstage flash vessel "economizer". All units with single stage compressors shall have the condensers circuited for liquid subcooling and be provided with a thermometer well to monitor the amount of subcooling.

H. Adjustable or float type refrigerant metering devices and thermal expansion valves shall be inspected and adjusted by the manufacturer at the end of each year for the first five years of operation to assure equivalent reliability and maintenance to a fixed orifice system. A written report shall be forwarded to the owner each year to confirm completion.

2.04 CONDENSER

A. The condenser shall be built in accordance with ANSI/ASHRAE 15-2001 Safety Code for Mechanical Refrigeration and ASME section VIII as applicable.

B. Condenser tubes shall be internally and externally enhanced with a 0.75" thick (minimum) outer diameter. The tubes shall be securely supported at intermediate supports and physically expanded into both ends. The condenser tubes must also be removable from both ends to provide easy access for tube changeouts or tube cleaning. The minimum condenser tube wall thickness, root-to-root across the entire tube length shall be 0.025". It is unacceptable to provide this thickness at the intermediate supports only.

C. The condenser water piping connections shall be Victaulic grooved.

D. The condenser waterboxes shall be standard non-marine type with connections per schedule.

E. Supply and return head waterboxes shall be designed for a working pressure of 150 and shall be factory hydrostatic pressure tested at 150 percent of the design pressure. Provide drain and vent connections in water boxes.

2.05 REFRIGERANT

A. Acceptable Refrigerants on which chiller performance is based are HCFC-123, HFC-134a, or HFC-513a.

B. Low pressure chillers: Chillers that operate at low pressures must have a high efficiency purge system to ensure that any potential non-condensable leakage into the vessel is immediately eliminated. The purge run time shall be monitored by the main unit controller to act as a leak detector if required, and must have the following specifications:

1. The manufacturers of low pressure machines must provide a purge system. Acceptable purges are the Trane EarthWise Purge.

2. The purge efficiency must meet ASHRAE Standard 147-2002.

3. The purge shall be capable of operating when the chiller is idle in accordance with ASHRAE Standard 147-2002.

2.06 ELECTRICAL

A. Chiller shall be installed, wired, and functionally tested at the factory before being shipped.

B. Single point power connection - A control power transformer internal to the motor controller/frequency drive and of sufficient size to power all chiller mounted auxiliary loads shall be supplied. No separate power connection shall be required for chiller mounted equipment. The CPT shall tap from the main power connection.

C. Terminal blocks with numbered and color coded wiring to match the wiring diagram must be included.

2.07 CONTROLS

A. The chiller shall be controlled by a unit mounted, stand-alone Direct Digital Control (DDC) system. A dedicated chiller microprocessor control panel is to be supplied with each chiller by the chiller manufacturer.

B. Enclosure shall be unit mounted NEMA 250 Type 1.

C. The chiller manufacturer shall include a pressure, non-mechanical based flow switch that is of the thermal dispersion type for each evaporator and condenser to verify flow through the unit.

D. A color, touch sensitive liquid crystal display (LCD) shall be unit mounted and a minimum of 12.1" diagonal. The display shall be fully adjustable in height and viewing angle. Animated graphical representations of chiller subsystem operation shall be used to enhance the user interface.

E. Display shall consist of a menu driven interface with easy touch screen navigation to organized sub-system reports for compressor, evaporator, condenser, purge and motor information as well as associated diagnostics. The controller shall display all active diagnostics and a minimum of 20 historical diagnostics.

F. The chiller control panel shall provide control of chiller operation and monitoring of chiller modules, sensors, actuators, relays and switches. The chiller control panel shall include controls to safely and efficiently operate the chiller.

G. Control authority must be capable of handling at least four conditions: Off, local manual at the chiller, local automatic at the chiller and automatic control through a remote source.

H. Capability to connect a laptop to service utility with applicable software from manufacturer and obtain enhanced set-up and diagnostics.

I. The front of the chiller control panel shall display the following in clear language, without the use of codes, look-up tables, or gauges:

1. Run time.

2. Number of starts.

3. Current chiller operating mode.

4. Chilled water set point and set point source.

5. Electrical current limit set point and set point source.

6. Entering and leaving evaporator water temperatures.

7. Entering and leaving condenser water temperatures.

8. Saturated evaporator and condenser refrigerant temperatures.

9. Evaporator and condenser refrigerant pressure.

10. Oil tank temperature.

11. Oil tank pressure.

12. Oil pump discharge pressure.

13. Differential oil pressure.

14. Compressor motor current per phase.

15. Compressor motor percent RLA.

16. Compressor motor voltage per phase.

17. kW energy consumption and power factor.

18. Compressor motor winding temperatures per phase.

19. Purge operating mode.

20. Purge operating status.

21. Time until next purge run.

22. Daily pumpout - 24 hours.

23. Average daily pumpout - 7 Days.

24. Purge refrigerant compressor suction temp.

25. Purge liquid temp (chiller condenser saturated refrigerant temperature).

26. Daily pumpout limit/alarm.

27. Bearing oil temperatures.

28. Discharge temperature (compressor).

J. The chiller control panel shall provide password protection of all setpoints.

K. The controller shall have the ability to display all primary sub-system operational parameters on dedicated trending graphs. The operator must be able to create up to 6 additional custom trend graphs, choosing up to 10 unique parameters for each graph to trend log data parameters simultaneously over an adjustable period and frequency polling.

L. The chiller control panel shall provide individual relay outputs to start/stop the evaporator and condenser water pumps. The condenser water pump relay output can be used to enable the cooling tower temperature controls.

M. The chiller control panel shall provide leaving chilled water temperature reset based upon return water temperature.

N. The chiller control panel shall be capable of displaying system data in I-P or SI units.

O. Safeties - the chiller control panel shall provide the following safeties:

1. Low chilled water temperature.

2. Low evaporator refrigerant temperature or pressure.

3. High condenser refrigerant pressure.

4. Evaporator and condenser water flow status.

5. Low oil pressure.

6. Low oil temperature.

7. High oil temperature.

8. High motor winding temperatures.

9. High motor current.

10. Starter/AFD function faults.

11. Sensor faults.

12. Unit controls operation.

13. The chiller control panel or starter shall incorporate advanced motor protection to safeguard the motor throughout the starting and running cycles from the adverse effects of:

    a. Current phase loss.
    b. Current phase unbalance.
    c. Current phase reversal.
    d. Under/Over voltage.
    e. Motor current overload.
    f. Distribution fault protection with auto restart consisting of three-phase current sensing devices that monitor the status of the current.
    g. Starter contactor fault protection.
    h. Starter transition failure.
    i. AFD/VFD communication-control failure.

14. Compressor discharge temperature.

15. High bearing temperatures.

    a. Each of the compressor and motor bearings (including high speed, low speed, and thrust bearings) shall have factory installed, separate temperature sensors installed on the bearing or in the oil return line of each separate bearing.
    b. If any oil temperature reaches or exceeds a set value, the chiller control panel shall shut down the chiller, display the diagnostic, and activate the front panel alarm indicator.

P. The chiller control panel shall provide evaporator freeze protection and low limit control to avoid low evaporator refrigerant temperature trip-outs during critical periods of chiller

operation. Whenever this control is in effect, the controller shall indicate that the chiller is in adaptive mode. If the condition exists for more than 30 seconds, a limit warning alarm relay shall energize.

Q. The chiller control panel shall be capable of providing short cycling protection.

R. The chilled water controller of each chiller shall include variable water-flow capability to allow the chiller to respond quickly to accelerating or decelerating water, and have the following features:

1. The variable water-flow compensation capability shall allow control of the leaving chilled water temperature to within +/- 1.0°F (0.6°C) at a water flow rate change of 10% per minute and will stay online at a water flow rate change of 30% per minute.

S. The chiller control panel shall provide an analog output signal that shall indicate the condenser refrigerant pressure or condenser/evaporator differential refrigerant pressure.

T. The chiller controller shall communicate directly to to the direct digital control building automation system via BacNet MS/TP protocol.

2.08 VARIABALE FREQUENCY DRIVES

A. LOW VOLTAGE VARIABLE SPEED DRIVE - UNIT MOUNTED

1. The centrifugal water chiller shall be furnished with a unit mounted air cooled variable speed drive (VSD) as shown on the drawings. The VSD shall be chiller mounted and shipped completely factory assembled, wired and tested.

2. The VSD will be specifically designed to interface with the centrifugal water chiller controls and allow for the operating ranges and specific characteristics of the chiller. The VSD control logic shall optimize chiller efficiency by coordinating compressor motor speed and compressor inlet guide vane position to maintain the chilled water setpoint while avoiding surge. If a surge is detected, VSD surge avoidance logic will make adjustments to move away from and avoid surge at similar conditions in the future.

3. The VSD efficiency shall be 97% or better at full speed and full load. Fundamental displacement power factor shall be a minimum of 0.96.

4. The VSD shall be solid state, microprocessor based pulse-width modulated (PWM) design. The VSD shall be voltage and current regulated. Output power devices shall be IGBT transistors.

5. Power semi-conductor and capacitor cooling shall be from a liquid or air cooled heatsink.

6. The VSDs shall each be furnished in a NEMA 1 metal enclosure having as minimum a short circuit withstand rating of 65,000 amps per UL 508. It will include three phase input lugs plus a grounding lug for electrical connections, output motor connection via factory installed bus bars and all components properly segregated and completely enclosed in a single metal enclosure.

a. Enclosure shall include a padlockable, door-mounted circuit breaker with a minimum AIC rating of 65,000 amps.

b. The entire chiller package shall be UL/CUL listed.
c. The VSD shall be tested to ANSI/UL Standard 508 and shall be listed by a Nationally Recognized Testing Laboratory (NRTL) as designated by OSHA.

7. Compliance to recommendations for harmonic mitigation - The VSD design shall include a DC link reactor on positive and negative rails to minimize power line harmonics and protect the VSD from power line transients.

8. Input shall be nominal 480 volts, three phase, 60 Hertz AC power, +/- 10 percent of nominal voltage.

9. Frequency range 38-60 hertz.

10. The VSD shall include the following features:

a. All control circuit voltages are physically and electrically isolated from power circuit voltage.
b. 150% instantaneous torque available for improved surge control.
c. Soft start, adjustable linear acceleration, coast-to-stop.
d. Insensitivity to incoming power phase sequence.
e. Adjustable current limiting and U.L. approved electronic motor overload protection,Output line-to-line short circuit protectiong,Line-to-ground short circuit protection,Protection from phase loss at AFD input, Protection from phase reversal/imbalance, Protection from over/under-voltage, Protection from over-temperature.

11. The following VSD status indicators shall be available to the unit controller to facilitate startup and maintenance:

12. Input line voltage, Output/load amps, Fault.

13. Service Conditions:

a. Operating ambient temperature of 14°F - 104°F (-10°C - 40°C).
b. Room ambient up to 95% relative humidity.
c. Elevation to 3300 feet (1000 meters). For every 300 feet (90 meters) above 3300 feet, the rated output current shall be decreased by 4% up to 9900 feet.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide for connection to electrical service. Include for connection of oil pump if required.

C. Provide for connection of electrical wiring between starter and chiller control panel, oil pump, and purge unit.

D. Furnish and install necessary auxiliary water piping for oil cooling units if required.

E. Arrange piping for easy dismantling to permit tube cleaning.

F. Provide piping from chiller relief device to outdoors. Size as recommended by manufacturer.

G. Chiller vibration isolation and the base type (i.e. floor pad) will be in accordance with ASHRAE Handbook, 1995, HVAC Applications, Chapter 43 Table 42.

3.02 MANUFACTURER'S FIELD SERVICES

A. All Startup, maintenance and monitoring functions shall be performed by a manufacturer's commercial agent to confirm, (in writing), that equipment has been correctly installed and passes specification checklist prior to equipment becoming operational and covered under OEM warranty.

B. Applied chiller manufacturers shall maintain service capabilities no more than 25 miles from the job site.

C. The manufacturer shall furnish complete submittal wiring diagrams of the chiller(s) starter(s) and associated components like cooling towers, pumps, interlocks, etc. as applicable for field maintenance and service.

D. Earthwise Service Extension - Comprehensive startup and owner training are required.

1. EXECUTIVE COORDINATION - Prestart instructions and coordination is to be provided by senior lead technician or supervisor to:

   a. Review installation checklist with installing contractor.
   b. Review startup procedures and required support.
   c. Review training requirements, timing and logistics with the installing contractor.

2. STARTUP - Provide all labor and materials to perform the startup. This shall be done in strict accordance with manufacturer's specifications and requirements.

   a. Provide a complete log of all operating parameters.
   b. Assure actual performance matches with submittals and computerized selection programs for other than submittal conditions.
   c. Submit a hard copy of the service report and logs.

3. TRAINING - Provide a minimum of four hours of owner training that is a combination of classroom and hands on instruction.

C. COMBINATION VARIABLE FREQUENCY DRIVE / DISCONNECT (VFD) FOR MOTORS 50 HP AND LESS

(1) Manufacturers

a. Danfoss Graham VLT 6000 Series, Reliance, Yaskawa, Emerson, ABB, or approved equal.

(2) General

a. Furnish complete variable frequency VFDs as specified herein for the fans and pumps designated on the drawing schedules to be variable speed. All standard and optional features shall be included within the VFD enclosure, unless otherwise specified. VFD shall be housed in a metal NEMA enclosure of type according to the installation and operating conditions at the job site. The VFD's UL listing shall allow mounting in plenum or other air handling compartments. If a NEMA 12 enclosure is required for the plenum rating, the manufacturer must supply a NEMA 12 rated VFD.

b. The VFD shall have integral disconnecting means to disconnect power to device in accordance with NEC.

c. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC motors. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump and fan control and to eliminate the need for motor derating.

d. With the motor's rated voltage applied to the VFD input, the VFD shall allow the motor to produce full rated power at rated amps, RMS fundamental volts, and speed without using the motor's service factor. VFDs utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors will not draw more than full load current during full load and full speed operation.

e. The VFD shall include an input full-wave bridge rectifier and maintain a fundamental power factor near unity regardless of speed or load.

f. The VFD and options shall be tested to ANSI/UL Standard 508. The complete VFD, including all specified options, shall be assembled by the manufacturer, which shall be UL-508 certified for the building and assembly of option panels. Assembly of the option panels by a third-party panel shop is not acceptable. The appropriate UL stickers shall be applied to both the VFD and option panel, in the case where these are not contained in one panel. When these VFDs are to be located in Canada, CSA or C-UL certifications shall apply. Both VFD and option panel shall be manufactured in ISO 9001 certified facilities.

g. The VFD shall have a dual 5% DC link reactor on the positive and negative rails of the DC bus to minimize power line harmonics and protect the drive from power line transients. The reactor shall be non-saturating (linear) to provide full harmonic filtering throughout the entire load range. VFDs with saturating (non-linear) DC link reactors shall require an additional3% AC line reactor to provide acceptable harmonic performance at full load, where harmonic performance is most critical.

h. The VFD's full load amp rating shall meet or exceed NEC Table 430-150. The VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 160% of rated current for up to 0.5 second while starting.

i. The VFD shall be able to provide full torque at any selected frequency from 29 Hz to base speed to allow driving direct drive fans without derating.

j. An automatic energy optimization selection feature shall be provided standard in the VFD. This feature shall automatically and continually monitor the motor's speed and load and adjust the applied voltage to maximize energy savings and provide up to an additional 3% to 10% energy savings.

k. Input and output power circuit switching shall be able to be accomplished without interlocks or damage to the VFD. Switching rate may be up to 1 time per minute on the input and unlimited on the output.

l. An automatic motor adaptation test algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to run the motor or de-couple the motor from the load to run the test.

m. Galvanic and/or optical isolation shall be provided between the VFD's power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents. VFDs not including either galvanic or optical isolation on both analog I/O and discrete I/O shall include additional isolation modules.

n. VFD shall minimize the audible motor noise through the used of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD efficiencies while reducing motor noise.

o. VFD supplier shall coordinate with motor supplier to ensure that all motors 20 horsepower and greater are provided with grounding bushings.

(3) Protective Features

a. A minimum of Class 20 I^2t electronic motor overload protection for single motor applications and thermal-mechanical overloads for multiple motor applications shall be provided.

b. Protection against input transients, loss of AC line phase, output short circuit, output ground fault, overvoltage, undervoltage, VFD overtemperature and motor overtemperature. The VFD shall display all faults in plain English. Codes are not acceptable.

c. Protect VFD from sustained power or phase loss. The VFD shall provide full rated output with an input voltage as low as 90% of the nominal. The VFD will continue to operate with reduced output with an input voltage as low as 164 V AC for 208/230 volt units, 313 V AC for 460 volt units, and 394 volts for 600 volts units.

d. The VFD shall incorporate a motor preheat circuit to keep the motor warm and prevent condensation build up in the stator.

e. VFD package shall include semi-conductor rated input fuses to protect power components.

f. To prevent breakdown of the motor winding insulation, the VFD shall be designed to comply with IEC Part 34-17. Otherwise the VFD manufacturer must ensure that inverter rated motors are supplied.

g. VFD shall include a "signal loss detection" circuit to sense the loss of an analog input signal such as 4 to 20 mA or 2 to 10 V DC, and shall be programmable to react as desired in such an instance.

h. VFD shall function normally when the keypad is removed while the VFD is running and continue to follow remote commands. No warnings or alarms shall be issued as a result of removing the keypad.

i. VFD shall catch a rotating motor operating forward or reverse up to full speed.

j. VFD shall be rated for 100,000 amp interrupting capacity (AIC).

k. VFD shall include current sensors on all three output phases to detect and report phase loss to the motor. The VFD will identify which of the output phases is low or lost.

l. VFD shall continue to operate without faulting until input voltage reaches 300 V AC on 208/230 volt units, 539 V AC on 460 volt units, and 690 volts on 600 volt units.

(4) Interface Features

a. Hand/Start, Off/Stop and Auto/Start selector switches shall be provided to start and stop the VFD and determine the speed reference.

b. The VFD shall be able to be programmed to provide a 24 V DC output signal to indicate that the VFD is in Auto/Remote mode.

c. The VFD shall provide digital manual speed control. Potentiometers are not acceptable.

d. Lockable, alphanumeric backlit display keypad can be remotely mounted up to 10 feet away using standard 9-pin cable.

e. The keypads for all sizes of VFDs shall be identical and interchangeable.

f. To set up multiple VFDs, it shall be possible to upload all setup parameters to the VFD's keypad, place that keypad on all other VFDs in turn and download the setup parameters to each VFD. To facilitate setting up VFDs of various sizes, it shall be possible to download from the keypad only size independent parameters.

g. Display shall be programmable to display in 9 languages including English, Spanish and French.

h. The display shall have four lines, with a minimum of 20 characters on three lines and a minimum of eight large characters on one line.

i. A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.

j. A quick setup menu with factory preset typical HVAC parameters shall be provided on the VFD eliminating the need for macros.

k. As a minimum, the following points shall be controlled and/or accessible:

1) VFD Start/Stop
2) Speed reference
3) Fault diagnostics
4) Meter points
   (a) Motor power in HP
   (b) Motor power in kW
   (c) Motor kW-hr
   (d) Motor current
   (e) Motor voltage
   (f) Hours run
   (g) Feedback signal #1
   (h) Feedback signal #2

(i) DC link voltage
(j) Thermal load on motor
(k) Thermal load on VFD
(l) Heatsink temperature

l. Four additional Form C 230 volt programmable relays shall be available for factory or field installation within the VFD.

m. Two set-point control interface (PID control) shall be standard in the unit. VFD shall be able to look at two feedback signals, compare with two set-points and make various process control decisions.

n. Floating point control interface shall be provided to increase/decrease speed in response to contact closures.

o. Four simultaneous displays shall be available. They shall include frequency or speed, run time, output amps and output power. VFDs unable to show these four displays simultaneously shall provide panel meters.

p. Sleep mode shall be provided to automatically stop the VFD when its speed drops below set "sleep" level for a specified time. The VFD shall automatically restart when the speed command exceeds the set "wake" level.

q. The sleep mode shall be functional in both follower mode and PID mode.

r. Run permissive circuit shall be provided to accept a "system ready" signal to ensure that the VFD does not start until dampers or other auxiliary equipment are in the proper state for VFD operation. The run permissive circuit shall also be capable of sending an output signal as a start command to actuate external equipment before allowing the VFD to start.

s. The following displays shall be accessible from the control panel in actual units: Reference Signal Value in actual units, Output Frequency in Hz or percent, Output Amps, Motor HP, Motor kW, kWhr, Output Voltage, DC Bus Voltage, VFD Temperature in degrees, and Motor Speed in engineering units per application (in GPM, CFM, etc.). VFD will read out the selected engineering unit either in a linear, square or cubed relationship to output frequency as appropriate to the unit chosen.

t. The display shall be programmed to read in inches of water column (in-wg) for an air handler application, pressure per square inch (psi) for a pump application, and temperature (^{0}F) for a cooling tower application.

u. VFD shall be able to be programmed to sense the loss of load and signal a no load/broken belt warning or fault.

v. If the temperature of the VFD's heat sink rises to 80°C, the VFD shall automatically reduce its carrier frequency to reduce the heat sink temperature. If the temperature of the heat sink continues to rise the VFD shall automatically reduce its output frequency to the motor. As the VFD's heat sink temperature returns to normal, the VFD shall automatically increase the output frequency to the motor and return the carrier frequency to its normal switching speed.

w. The VFD shall have temperature controlled cooling fans for quiet operation and minimized losses.

x. The VFD shall store in memory the last 10 faults and related operational data.

y. Eight programmable digital inputs shall be provided for interfacing with the systems control and safety interlock circuitry.

z. Two programmable relay outputs, one Form C 240 V AC, one Form A 30 V AC, shall be provided for remote indication of VFD status.

aa. Three programmable analog inputs shall be provided and shall accept a direct-or-reverse acting signal. Analog reference inputs accepted shall include two voltage (0 to 10 V DC, 2 to 10 V DC) and one current (0 to 20 mA, 4 to 20 mA) input.

bb. Two programmable 0 to 20 mA analog outputs shall be provided for indication of VFD status. These outputs shall be programmable for output speed, frequency, current and power. They shall also be programmable to provide a selected 24 V DC status indication.

cc. Under fire mode conditions, the VFD shall be able to be programmed to automatically default to a preset speed.

dd. On motors connected to variable frequency drives, 20hp or greater in size. Provide grounding bushings to prevent archiny.

(5) Interface With Building Automation System/Direct Digital Control System

a. VFD manufacturer shall provide an interface to the BAS/DDC system. Manufacturer shall coordinate as required with the Controls Contractor. Provide Bacnet, Lonworks, FLN, Modbus, or any other interface required for a complete and operational system.

b. Provide mode of operation to BAS/DDC system (hand, off, auto, etc.). BAS/DDC graphic shall highlight or produce pop-up graphic when VFD is in hand or off. Also, provide all points to BAS/DDC identified in section (4).K of this Specification.

(6) Adjustments

a. VFD shall have an adjustable carrier frequency in steps of not less than 0.1 kHz to allow tuning the VFD to the motor.

b. Sixteen preset speeds shall be provided.

c. Four acceleration and four deceleration ramps shall be provided. Accel and decel time shall be adjustable over the range from 0 to 3,600 seconds to base speed. The shape of these curves shall be automatically contoured to ensure no-trip acceleration and deceleration.

d. Four current limit settings shall be provided.

e. If the VFD trips on one of the following conditions, the VFD shall be programmable for automatic or manual reset: undervoltage, overvoltage, current limit and inverter overload.

f. The number of restart attempts shall be selectable from 0 through 20 or infinitely and the time between attempts shall be adjustable from 0 through 600 seconds.

g. An automatic “on delay” may be selected from 0 to 120 seconds.

(7) Service Conditions

a. Ambient temperature, -10 to 40°C (14 to 104°F), without derating.

b. 0 to 95% relative humidity, non-condensing.

c. Elevation to 3,300 feet without derating.

d. AC line voltage variation, -10 to +10% of nominal with full output.

e. No side clearance shall be required for cooling of any units. All power and control wiring shall be done from the bottom.

(8) Quality Assurance

a. To ensure quality and minimize infantile failures at the jobsite, the complete VFD shall be tested by the manufacturer. The VFD shall operate a dynamometer at full load and speed and shall be cycled during the test.

b. All optional features shall be functionally tested at the factory for proper operation.

(9) Submittals

a. Submit manufacturer's performance data including dimensional drawings, power circuit diagrams, installation and maintenance manuals, warranty description, VFD's FLA rating, certification agency file numbers and catalog information.

The specification lists the minimum VFD performance requirements for this project. Each supplier shall list any exceptions to the specification. If no departures from the specification are identified, the supplier shall be bound by the specification.

a. Harmonic filtering. The seller shall, with the aid of the buyer's electrical power single line diagram, providing the data required by IEEE-519, perform an analysis to initially demonstrate the supplied equipment will met the IEEE standards after installation. If, as a result of the analysis, it is determined that additional filter equipment is required to meet the IEEE recommendations, then the cost of such equipment shall be included in the bid. A harmonic analysis shall be submitted with the approval drawings to verify compliance with the latest version of IEEE-519 voltage and current distortion limits as shown in table 10.2 and 10.3 at the point of common coupling (PCC). The PCC shall be defined as the consumer–utility interface or primary side of the main distribution transformer.

(10) Start-Up Service

a. The manufacturer shall provide on-site start-up commissioning of the VFD and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. Sales personnel and other agents who are not factory certified shall not be acceptable as commissioning agents. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system. Provide start-up report to Engineer.

(11) Warranty

a. The VFD shall be warranted by the manufacturer for a period of 36 months from date of shipment. The warranty shall include parts, labor, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service. The warranty shall be provided by the VFD manufacturer.

(12) Examination

a. Contractor to verify that job site conditions for installation meet factory recommended and code-required conditions for VFD installation prior to start-up, including clearance spacing, temperature, contamination, dust, and moisture of the environment. Separate conduit installation of the motor wiring, power wiring, and control wiring, and installation per the manufacturer's recommendations shall be verified.

b. The VFD is to be covered and protected from installation dust and contamination until the environment is cleaned and ready for operation. The VFD shall not be operated while the unit is covered.

D. HEAT-TRACING SYSTEM (HEAT TAPE)

Chemelex, "Auto-Trace, Self-Limiting Heating" Model 8BTV-CT or approved equivalent. The heat tape shall have a cross-linked polymer core with copper bus wire so that the heater output increases as the jacket temperature drops. Heat output shall be 8.0 watts per foot at 50 degrees F. surface temperature. The heat tape shall be installed as recommended by the manufacturer along the entire length of all exterior piping subject to freezing and where indicated on the drawings. All valves shall be wrapped additionally 2 foot of heat tape. Provide two tracings on each pipe, and each of the two fed from a different circuit. Heat tape electrical characteristics shall be as indicated on the electrical plans. Provide with power connection kits and end caps. Heat tape shall be placed in operation at the electrical circuit breaker. Normally power shall remain active to the heat tape.

2. FACTORY START-UP REPORTS

B. Provide factory start-up on site by a factory representative (not a third party contractor) for all HVAC equipment, including pumps, VFD's, chillers, cooling towers, etc. Submit factory start-up reports to the Engineer. The Mechanical Contractor and the Controls Contractor shall have a representative on site to correct all deficiencies noted by the factory representative. For each deficiency noted, documentation of corrective action taken shall be submitted to Engineer.

C. At a minimum, the report submitted to the Engineer shall include the following data:

(1) Cooling Tower

a. Inspect the following and verify all are clean of any debris, silt, or foreign materials.
   1) Air Inlet Screens
   2) Fans and Housing
   3) Drift Eliminators
   4) Strainer Screens
   5) Coil Section
   6) Pan Section
b. Inspect the following:
   1) Check locking collars and set screws on fan bearings. Note if lubrication is necessary.
   2) Fan Rotation
   3) Belt tension
   4) Pump rotation/operation.
   5) Belt alignment.
   6) Float for freedom of movement
   7) Make-up valve
   8) Drain valve and sump overflow
   9) Bleed rate
   10) Spray Distribution System and spray pattern (for even water pattern)

c. Note and set levels if necessary
   1) Low Water Level
   2) Operating Water Level
   3) Overflow Water Level
d. Check and note voltage and amp draw, note nameplate amps
   1) Fan(s)
   2) Pump
e. Energize at full speed and check for excessive vibration.

(2) Base-Mounted Pumps

a. With power off, note the following:
   1) pump properly secured, level, and grouted
   2) pipe installed so as not to transmit stress to pump
   3) coupler between pump and water shaft aligned
   4) pump and motor lubricated
b. With power on, note the following:
   1) impeller rotation
   2) Actual amps/volts vs. nameplate amps/volts.
   3) Inlet and outlet pressure

(3) Chiller

a. Volts – Comp. 1 and Comp. 2
b. Control Voltage
c. Comp. Amps #1 – Comp. Amps #2
d. Condenser Fan Amps
e. Condenser Performance
f. Ambient Temperature
g. Leaving Air Temp
h. Liquid Press.
i. Subcooling
j. Evaporator Performance
   (1) Evap. Air/Water Temp. IN
   (2) Evap. Air/Water Temp. OUT
   (3) Evap. ΔT or Δ P
   (4) Suction Pressure
   (5) Superheat
   (6) Suction Temp
   (7) Evap. Water Press. IN
   (8) Evap. Water Press. OUT
k. Lubrication System
   Oil Pressure
   Oil Level
   Acidity Test Per Contract
   Crank Case Heater OK
l. General Check
   Unusual noise or vibration
   Visual Leak Check
   Comp. Loading, Unloading
   Pumpdown Control – Cutout PSI – Cutout PSI
   Low Ambient Dampers
   Condenser Fan Belt

Condenser Coil Cleanliness
Evap. Coil Cleanliness
Moisture Indicator

END OF SECTION

SECTION 230300 - CONDENSATE DRAINAGE SYSTEM (FOR COOLING EQUIPMENT)

1. GENERAL

   A. The Contractor's attention is directed to the General and Special Conditions, General Conditions-Mechanical and to all other Contract Documents as they apply to this section of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.

   B. The Contractor shall provide a complete condensate drainage system to carry all condensate discharge from all cooling equipment from the building. Condensate system shall be installed in accordance with IMC. Provide condensate overflow switch for all condensate producing equipment.

   C. Pipe installation and fabrication shall be in accordance with the section of these specifications entitled PIPE, PIPE FITTINGS AND PIPE SUPPORT and as hereinafter specified.

   D. All piping shall be installed concealed, unless specifically noted otherwise and shall be installed under slabs or underground only when specifically indicated.

   E. Horizontal runs of condensate drain lines shall be supported at six (6) foot intervals maximum, or more frequently where required to prevent sags and low spots.

   F. Lengths of horizontal lines shall be held at a minimum due to potential lint collection.

   G. Provide condensate traps in accordance with the manufacturer’s recommendations.

2. MATERIAL

   A. Refer to Section of these Specifications entitled: PIPE, PIPE FITTINGS AND SUPPORT.

3. INSULATION

   A. Refer to Section of these Specifications entitled: INSULATION - MECHANICAL.

END OF SECTION

SECTION 250100 - MOTOR STARTERS AND OTHER ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

1. MOTOR STARTERS-GENERAL

   A. Where motor starters are required for mechanical equipment they are to be the responsibility of the Contractor furnishing the equipment as outlined herein.

   B. Motor starters shall be furnished by the Equipment Supplier with his equipment. Coordinate all requirements for starters with equipment suppliers and other trades.

   C. Motor starters shall be NEMA style. I.E.C.-style starters are not to be provided. Their sizing and installation shall be coordinated with the equipment manufacturer's requirements and in accordance with the National Electrical Code.

   D. Unless otherwise noted, provide combination starter/disconnects for all equipment requiring a starter.

2. ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

   A. All mechanical equipment shall be provided for single point electrical connection unless specifically noted to the contrary. Refer to schedules and other sections of these specifications for further requirements. It is the responsibility of the Contractor to coordinate the electrical characteristics of all equipment with the electrical provisions indicated on the Contract Documents. The Contractor shall notify the Engineer in writing ten calendar days prior to bid of any discrepancy so a written clarification by Addendum may be made. If such notice is not given, the Contractor shall be responsible for any and all costs or delays associated with any changes required. Specification of equipment characteristics made during review of shop drawings shall not relieve the Contractor of this responsibility.

   B. The equipment manufacturer shall provide internally mounted fuses with his equipment, as required, to comply with the U.L. listing on the equipment name plate. (i.e., hermetically sealed compressors or equipment with name plate data that recommends or requires fuse protection.) See also, National Electrical Code, Article 440, and other applicable sections of the N.E.C.

   C. It is the Contractor's responsibility to furnish and install fusible or non-fusible disconnect switches or circuit breakers for disconnecting means as required by the Code for <u>all</u> electrically powered equipment. All power wiring from source, thru disconnecting means and motor starters to motor terminals or equipment junction box is to be furnished and installed by the Contractor. Each separate contractor engaged for the project shall coordinate with all other trades to ensure all necessary equipment and labor is included for fully functioning mechanical systems, installed per code requirements. Unless otherwise notes, provide combination starter/disconnects for all equipment requiring a starter.

   D. Final electrical connection of equipment shall be verified for proper voltage requirements in conjunction with the motor nameplate patch and actual wiring configuration. Any costs associated with damage to appliances motors, equipment, etc., connected to incorrect supply voltage shall be borne by the Contractor.

   E. All interlock or other control wiring, unless specifically noted otherwise, is the responsibility of the Contractor.

   F. All equipment shall be suitably enclosed. All enclosures for equipment shall be rated and approved for the environment in which it operates. (i.e., NEMA 1, NEMA 3R, NEMA 7, NEMA 12, etc.) Verify the requirement with the installation condition if not indicated on the plans.

G. Observe the following standards for manufacturers of equipment and selection of components.

(1) Starters, control devices and assemblies: NEMA, U.L. - (I.E.C. style not acceptable)

(2) Enclosures for electrical equipment: NEMA, U.L.

(3) Enclosed switches: NEMA, U.L.

(4) All electrical work, generally: National Electrical Code

(5) All electrical work in industrial occupancies: J.I.C. standards

(6) All electrical components and materials: U.L. listing required.

H. Where required, the Contractor is to provide mounting rails or channels to install starters with code-required clearances. Framing shall be solidly anchored by welding expansion shields in masonry or other approved anchorage. Frames are to be constructed of steel angles or pre-manufactured channel systems such as Unistrut, Kindorf or B-Line Company. Framing material shall be pre-finished with corrosion-resistant material or painted with two coats corrosion-resistant oil-based enamel.

3. REQUIREMENTS FOR MECHANICAL EQUIPMENT, 1/2 H.P OR LESS

A. This section describes requirements for small mechanical equipment such as (but not limited to) package terminal heating/cooling units, (water source heat pumps, etc.) VAV boxes, unit heaters, vertical and horizontal unit ventilators, exhaust fans, in-line fans, fan coil units, cabinet heaters and the like.

B. Small equipment with motor(s) of 1/2 H.P., single phase or less are generally not required to be furnished with NEMA-style starter(s), unless otherwise noted.

C. For such equipment, provide integral contactor or horsepower-rated relay where controlled by thermostat or other type of switch. Contactors or relays shall be as recommended by the manufacturer of the equipment, suitable for the service duty.

D. Provide transformer within unit as required to derive low voltage A.C. for thermostat control or derive from temperature controls panel, if available.

E. Provide internal fusing for unit motor and other loads in fuse block or in-line fuseholder. See also Article 2-B, this Section.

F. Where externally-mounted disconnecting means is required and would be impractical, unsightly or inappropriate in the judgment of the Engineer, disconnects shall be located within the unit. These disconnects may be fusible H.P.-rated snap switches or manual starters with overload elements, as required. Locate this and other electrical equipment within enclosure where easily accessible behind access panel or door on unit, and as acceptable to the electrical inspector or local authority having jurisdiction. Refer to mechanical equipment schedules for further information.

G. Where fractional horsepower duplex pumps such as water circulators, sump pumps, etc. are provided, they shall be provided with alternators, cordsets, etc., as required for a complete installation.

4. REQUIREMENTS FOR MECHANICAL EQUIPMENT, 3/4 H.P. OR LARGER

A. This section describes requirements for mechanical equipment such as (but not limited to) exhaust fans, larger air handling units, cooling tower fans, water source heat pumps, chilled or hot water pumps, D.X. roof-top units, air compressors and the like.

B. Provide premium efficiency motors.

C. Equipment provided with motor(s) of 3/4 H.P. and larger, single or three-phase are required to be furnished with starters suitable for the load(s) specified. It is recommended that starters be furnished integrally with or mounted on equipment for field wiring by the Contractor. Where starters are furnished separate from equipment, furnish templates or rough-in diagrams to the appropriate contractor for his use in installation.

D. All starters shall be size 0 minimum. They shall be constructed and tested in accord with latest edition of NEMA standards. All starters shall be across-the-line magnetic type, unless indicated otherwise. On motors of 20 H.P. or greater rating, the supplier shall provide starters capable of limiting inrush currents. These shall be of the wye-delta, reduced voltage open-transition type, or electronic controlled, as required. Do not utilize closed transition starters unless specifically indicated.

E. Magnetic starters shall be furnished with the following characteristics and accessories as a minimum. See other sections of these specifications and mechanical schedules for further requirements.

(1) Contacts shall be silver-alloy, double-break type. Contacts shall be replaceable without removal of wiring or removal of starter from enclosure. Number of contacts shall be as required for service indicated. Contacts shall be gravity dropout type, positive operation.

(2) Coil voltage shall be 120 volts, A.C., 60 HZ or less, as required to suit control systems available voltages. Coils shall be of molded construction, rated for continuous duty. Provide coil clearing contact as required.

(3) Provide control transformer of adequate K.V.A. as required on all starters with line-to-line voltages higher than 120 volts A.C. Provide fuse block and slow-blow fuse to protect control transformer per NEMA, N.E.C. and U.L.

(4) Provide hand-off-auto selector switch in face of starter, wired into hand and off switch positions. Auto position (if needed) to be field wired as indicated on plans or schedules for automatic control. Provide a green run pilot light.

(5) Provide NEMA Class 20 resettable overload relays, accurately sized to the motor nameplate rating of the motor served and the temperature differential between motor and controller. Overloads shall be easily replaceable, and resettable without opening enclosure, via a push button or similar means. Class 10 or Class 30 overloads may be used, depending on the type of anticipated service.

(6) Provide at least one N.O. and one N.C. auxiliary contact (field-convertible to opposite operation) with each starter. Refer to mechanical details or schedules for additional requirements, if any. All starters shall have space for two additional single-pole contacts.

(7) All starters shall be thru-wiring type.

(8) Provide phase failure sensing relay to open starter coil circuit (on loss of one or more phases) on all three-phase starters controlling motors of 15 H.P. or larger.

(9) Provide power factor correction capacitors on motors of 15 H.P. or larger where predicted power factor based on manufacturer's data will fall below 0.90%. Capacitors shall be of the unit-cell

type, in single enclosure with discharge resistors and tank overpressure circuit interrupter for safety.

5. REQUIREMENTS FOR WIRING

A. All wiring, including controls, interlock, miscellaneous power, sensors, thermostats, etc., shall be installed in metallic raceway systems that are in compliance with all Division 26 requirements of these Specifications, unless specifically noted otherwise. Open cabling systems will only be permitted where specifically permitted within the Division 26 Specifications and if less than 50 volts A.C. peak-to-peak or 50 volts maximum D.C.

B. Where open cabling is permitted, it shall be installed with proper support as specified in the Division 26 Specifications.

C. Where open cabling is permitted, and installed in environmental air plenum (return, relief, supply, etc.), the materials installed shall be in compliance with N.E.C. Articles 700, 725, 770 (for fiber optic), 780 and 800.

D. Where open cabling is permitted, it shall only be installed open in accessible spaces. Where concealed in walls, it shall be routed through raceways to outlet boxe(s) for the terminal device.

6. INVERTER DUTY MOTORS

A. Motors which are controlled by variable frequency drive shall be:

(1) NEMA MG-1 Part 31 rated for Inverter Duty.

(2) Furnished with shaft grounding kit for all motors:

a. Motors less than 100 HP in size shall be furnished with shaft grounding kit, Aegis SGR Bearing Protection Ring or equal. One shaft grounding ring and related hardware shall be provided on drive end or non-drive end of motor per manufacturer's instructions. These shall be factory mounted and installed on the exterior of the motor to allow for visual inspection. Ground motor frame per manufacturer's instructions. Install kit in strict accordance with manufacturer's instructions.

END OF SECTION

SECTION 250200 - CONTROL - DIRECT DIGITAL (WEB BASED)

PART 1 – GENERAL:

1.1 The temperature controls for this project shall fully integrate and seamlessly interface to the existing the SmartStruxure front end system in the Physical Plant via BACnet IP protocol. NKU has an on-going service contract with Schneider Electric. Interface and graphics generation on the university's DDC system server is included in this project and shall be consistent with the existing. Windowing between different computers/systems, or loading separate building energy management system software on the existing Operator Workstations for interface to the existing Building Energy Management system will NOT be permitted or accepted.

1.2 All application specific controllers on all network controllers shall be configurable, commissionable and downloadable through the Server or Network Controller IP connection.

1.3 All unitary and field controllers shall be commissioned, uploadable and downloadable from the university SmartStruxure server. BACnet IP objects descriptions that are a jumble of letter/numbers are not acceptable. The TCC shall provide a list of points, object descriptions and coordinate with Schneider Electric.

1.4 All unitary and field controllers shall be commissioned, up-loadable and downloadable from the university host network automation engine. LON/BACnet/MODBUD object descriptions that are a jumble of letter/numbers are not acceptable.

1.5 The Temperature Control Contractor (TCC) shall furnish all labor, materials, equipment, and service necessary to interface with the operating Building Automation System (BAS), utilizing Web Based Direct Digital Controls. All labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned shall be included for the complete, fully functional and commissioned temperature controls system.

1.6 The TCC shall provide all items, articles, materials, devices, operations or methods listed, mentioned or scheduled on the drawings including all labor, materials, equipment and incidentals necessary and required for their completion interface with the operating temperature control system. This will include connecting to any mechanical equipment furnished with a control interface device and contacting the equipment suppliers and/or manufacturers for information for the proper interface to the equipment being furnished.

1.7 These apparatus' shall consist of, but not limited to, all necessary thermostats, sensing devices, valves, actuators, and with the necessary accessories for the complete control of all equipment hereinafter specified.

1.8 Control sequences are specified on the construction documents. Provide all control equipment required to perform sequences described.

1.9 Coordinate wells, flow meters, valves with mechanical contractor.

1.10 Include all power wiring and cabling for the operation of the controls system. Refer to Electrical Division Specifications for additional requirements.

1.11 Manufacturer's: Schneider, Johnson Controls factory Branch Office, and Siemens Factory Branch Office. These TCCs/manufacturers have prior approval with the Owner and Engineer and are the only allowed suppliers and/or installing TCCs.

1.12 The TCC shall have an established working relationship with the control manufacturer of not less than five years and shall have prior approval from the Owner and Engineer and are the only allowed suppliers and/or installing contractors. The TCC shall have a local office within 50 miles of the project site and provide service and/or replacement parts within a 24 hour notification of a control failure. The Building Management System contractor shall be staffed with engineers trained and certified by the manufacturer in the configuration, programming and service of the automation system. The contractor's technicians shall be fully capable of providing instructions and routine emergency maintenance service on all system components.

1.13 The installation shall comply with the Local Authorities and State Fire Marshal code requirements, including normal operating and smoke mode functions (where applicable). The installation shall comply with the requirements of the NEC, NFPA, UL and the Building Codes, including referenced mechanical, electrical, energy codes, etc.

1.14 Abbreviations
- TCC – Temperature Control Contractor
- BAS – Building Automation System

1.15 The TCC shall list the following cost breakdowns, material and labor, on the official project schedule of values:
- Controls shop drawings
- Controls materials and labor
- Controls startup, commissioning, testing, documentation (2.5% of controls contract value)
- Controls training and Owner acceptance (2.5% of controls contract value)

PART 2 – NOT USED:

PART 3 - GENERAL SYSTEM REQUIREMENTS:

3.1 All labeling for this system shall utilize actual room names and numbers. The room names and numbers on the Contract Documents may not be the Owner's exact requirements. Coordinate with the Owner to insure compliance.

3.2 All points of user interface shall be on standard PCs that do not require the purchase of any special software from the control's manufacturer for use as a building operations terminal. The primary point of interface on these PCs will be a standard Web Browser.

3.3 The TCC shall connect to any mechanical and electrical (power monitoring) equipment furnished with a control interface device. The TCC shall contact the equipment suppliers and/or manufacturers for information for the proper interface to the equipment being furnished. All points not provided with the equipment control interface are the responsibility of the TCC.

3.4 All building controllers, application controllers and all input/output devices shall communicate LonMark/LonTalk communication protocol. Network controller shall communicate via BACnet over Ethernet (IP). BACnet MS/TP is NOT an approved communication protocol.

3.5 The TCC shall all have access to various types of WEB browsers (i.e. Netscape, IE, etc.), which shall be included for access to the Direct Digital Control (DDC) system via the Owner's Wide Area Network (WAN) and/or Local Area Network (LAN).

3.6 The TCC shall be responsible for coordination with the Owner's IT staff to ensure that they integrate to their system will perform in the Owner's environment without disruption to any of the other activities taking place on that WAN/LAN.

PART 4 – SUBMITTALS:

4.1 The TCC shall not start the project installation until the shop drawing submittals have been reviewed by the Engineer.

4.2 Submittals shall include hardware, end devices, ancillary control components, a written operating sequence, unitary control wiring, as well as logic flow diagrams. All submittals shall be provided on paper and electronically in PDF format.

4.3 Submittals shall contain one control drawing per specified system and equipment. Drawing shall include point descriptors (DI, DO, AI, AO), addressing, and point names. Each point names shall be unique (within a system and between systems). The abbreviation or short hand notation shall be clearly defined in writing by the TCC.

4.4 Control diagrams shall identify: System being controlled (attach abbreviated control logic text, all digital points, analog points, virtual points, all functions (logic, math, and control) within control loop, legend for graphical icons or symbols, definition of variables or point names and detailed electric connections to all control devices and sensors.

4.5 Points list shall include all physical input/output. Points list shall be provided in both hard copy and in electronic format and shall include: Name, address, engineering units, high and low alarm values and alarm differentials for return to normal condition, default value to be used when the normal controlling value is not reporting, message and alarm reporting as specified, identification of all adjustable points and description of all points.

4.6 Submittals shall contain DDC system architecture diagram indicating schematic location of all control units, LAN Interface devices, etc. Indicate address and type for each control unit, Indicate protocol, baud rate, and type of LAN per control unit.

4.7 Electrical wiring diagrams shall include motor start, control, and safety circuits and detailed digital interface panel control point termination diagrams with all wire numbers and terminal block numbers identified. Indicate all required electrical wiring. Provide panel termination drawings on separate drawings. Clearly differentiate between portions of wiring that are existing, factory-installed and portions to be field-installed.

4.8 Show all electric connections of the controls system to equipment furnished by others complete to terminal points identified with manufacturer's terminal recommendations.

4.9 TCC shall provide one complete drawing that shows the control-wiring interface with equipment provided by others.

4.10 Submittals shall include TCC's hardware checkout sheets and test reports.

4.11 Provide complete panel drawings that are:

- Clearly labeled and schematic or drawn to scale.
- Show the internal and external component arrangement so that the operators can identify the components by their position if the labels come off.
- Wiring access routes shall also be identified so that Class 1 wiring is separated from Class 2 and 3 and so high voltage wiring is segregated from low voltage wiring.
- Complete identification of all control devices (manufacturer's type, number, and function).
- Provide details for labeling all wiring, control devices, and controllers.
- Material and equipment descriptive material such as catalog cuts, diagrams, performance curves, and other data to demonstrate conformance with specifications shall be provided.

4.12 Include control valve schedules including a separate line for each valve provided under this section and a column for each of the valve attributes: code number, configuration, fail position, pipe size, valve size, body configuration, close-off pressure, capacity, valve Cv, design pressure, and actuator type.

PART 5 – O&M MANUALS AND CLOSEOUT DOCUMENTS:

5.1 Refer to Mechanical Specification Section – REQUIRED SHOP DRAWINGS, ETC. for additional requirements.

5.2 Operating instructions, maintenance procedures, parts and repair manuals shall be supplied. Repair manuals shall include detailed instructions in the setup, calibration, repair and maintenance of all equipment furnished. Also supplied with these manuals will be a complete parts listing of all devices supplied which is to include part numbers and model numbers of all parts and component parts along with exploded views of devices.

5.3 All as built drawings (wiring diagrams, flowcharts, floor plans, etc.) shall also be supplied to the owner electronically in PDF format.

5.4 System specific wiring, control diagrams, sequence of operation and points lists shall be as installed in each control panel. This means as-built drawings, not design (submittal) drawings.

5.5 Supply all software necessary for configuration of, modification, editing or communicating to any of the unitary devices. Software shall be capable of uploading and down-loading the entire unitary data base or any part of the automated system for backup or archiving.

5.6 Supply one copy of the software programming manual (hard copy and PDF format). The manual shall describe all furnished software. The manual shall be oriented to programmers and shall describe calling requirements, data exchange requirements, data file requirements, and other information necessary to enable proper integration, loading, testing, and program execution.

5.7 Provide a Bill of Materials with each schematic drawing. List all devices/equipment and match to schematic and actual field labeling. Provide quantity, manufacturer, actual product ordering number, description, size, accuracy, operating ranges (voltage, temperature, pressure, etc.), input/output parameters, etc.

5.8 Maintenance manual shall include copies of signed-off acceptance test forms, commissioning reports, start-up reports, etc.

5.9 The TCC shall turn over to owner two (2) sets of computerized back-ups of the complete temperature control system.

PART 6 – NOT USED:

PART 7 – NOT USED:

PART 8 – NOT USED:

PART 9 – WIRE MANAGEMENT, ELECTRICAL POWER, ETC:

9.1 Refer to CABLING section of this specification for additional requirements.

9.2 Electrical work required for system interlock and installation of the temperature control system shall be included in the bid and installed per all applicable codes. Coordinate with other trades as required for installation of a complete system.

9.3 All wiring and cabling in mechanical and electrical rooms shall be in conduit. No wiring or conduit can be exposed to view in any other area. Route wiring directly to cable tray from control points above the ceiling. Rough-in for control devices shall be in compliance with the requirements of the ELECTRICAL SPECIFICATIONS.

9.4 Any power for controls shall be fed from dedicated circuits in emergency electrical panels, when provided for a project, and shall not be obtained from receptacles, lighting, or equipment circuits. Unitary control power may be obtained from the equipment served. If power is obtained from the equipment served, the power may not be interrupted to the electronics if the equipment is off for any reason.

9.5 The TCC shall be responsible for the power source to any unitary controllers, etc. on any controlled equipment and all other control power requirements. This includes circuit breakers, wiring, conduit, etc. installed in strict accordance with NEC. The TCC may contract with the electrical contractor for the power wiring installation.

9.6 Prior to installation, insure through coordination with all trades, that appropriate clearances (36" minimum) as required by the N.E.C. are maintained at all control panels, including unitary controllers for pumps, etc.

9.7 The TCC shall perform all temperature control interlock wiring. This shall include control valves, indoor/outdoor HVAC systems, etc. Electrical work required for system interlock and installation of the temperature control system shall be included in the bid and installed per all applicable codes. Coordinate with other trades as required for installation of a complete system.

9.8 The TCC shall be responsible for any power required for the unitary controls or control panels. This includes circuit breakers, wiring, conduit, etc. installed in strict accordance with NEC. The TCC may contract with the electrical contractor for the power wiring installation.

9.9 All wiring shall be continuous runs. Any junctions must be made in metal enclosure.

9.10 The Electrical Advisory Council for the State of Kentucky requires that only an electrical contractor licensed by the State of Kentucky with a licensed Master Electrician and a licensed on-site electrician can install the electrical wiring for Building Automation Systems (BAS).

PART 10 – NOT USED:

PART 11 – NOT USED:

PART 12 – NOT USED:

PART 13 – NOT USED:

PART 14 – NOT USED:

PART 15 – NOT USED:

PART 16 – UNITARY CONTROLLER

16.1 Unless otherwise specified, each piece of equipment shall have its own Unitary Controller (i.e., pump, etc.). The Unitary Controller for each piece of equipment shall be mounted on the side of the unit. The Unitary Controller for all other equipment shall be mounted in a panel and properly labeled.

16.2 Panels in mechanical rooms subject to water damage from above shall be installed in a surface mounted panel, NEMA type 12 enclosures, with a removable hinged door. Provide a flush mounted

key lock. All control panels must be painted the same color and identified. The boxes are to be made from 16 gauge material. Panels should not be provided with knockouts. NEMA 1 panels are acceptable in remaining locations.

16.3 Unitary Controllers used in conditioned ambient shall be mounted in dust-proof enclosures, and shall be rated for operation at 32 degrees F to 120 degrees F. All Unitary Controllers shall have an RJ-11 or similar type connection for monitoring or programming access by room or local equipment level with access to any unitary within the network without modification.

16.4 Control panels shall be constructed by a UL approved panel manufacturer. The standard used shall be UL508A. All proper labels are to be attached. Panel shall meet the requirements of UL512 and be arc flash compliant panels.

16.5 Unitary Controllers utilized in the network shall have full stand alone capability including time of day and holiday scheduling as well as all energy management functions such as optimal start/stop, duty cycling, etc. The terminal unit Unitary Controllers may be pre-programmed with the project specific sequence of operation as specified for the application. Any re-programming of the electronics shall be performed on location using a portable personal computer with appropriate software or through the Network Controller. The entire unitary data base shall have the capability of being backed up and or downloaded locally.

16.6 All points to have a unique digital input to the BAS system. The use of digital point count expanders is not an acceptable replacement to digital inputs to the unitary controller. The conversion of a single universal input channel to accept up to multiple voltage free contacts such as relay contacts, auxiliary starter contacts, differential pressure switches, etc. IS NOT ACCEPTABLE.

16.6.1 The Fieldbus layer shall be support all of the following types of Standalone Digital Unitary Controller's:

16.7 All Unitary Controllers shall be fully application programmable. All control sequences within or programmed into the unitary controller shall be stored in non-volatile memory, which is not dependent upon the presence of a battery shall be retained.

16.8 Unitary Controllers shall have a 10% spare point capacity to be provided for all applications.

16.9 After a power failure, the Unitary Controller shall operate the control application using the current setpoints and configuration. Reverting to default or factory setpoints are not acceptable.

PART 17 – SENSORS AND MISCELLANEOUS DEVICES:

17.1 SENSOR RESOLUTION: All temperature sensors shall have a minimum resolution of 1/10th of 1 degree F. (0.1 degree F.) Sensor stability shall be 0.24 degrees over a year period. Water sensors shall be tested and accurate to within 2.0 degrees F.

17.2 WATER SENSORS: Temperature sensors for water lines are to be the well type. Wells are to be threaded brass (same manufacturer as the temperature sensor) with the sensor coated with a heat transfer compound. Strap on sensors will not be acceptable.

17.3 LOW PRESSURE TRANSDUCERS: These devises shall be 100% solid state, linear and temperature compensated. Accuracy shall be no less than plus or minus 1% of its full range. Linearity, repeatability and hysteresis shall be no less that plus or minus 0.1%. All pressure sensors shall utilize output averaging/output clipping to adjust and stabilize any fluctuations in the output. The output of the device shall utilize a 0 - 10 VDC signal. The device shall use a power supply of 24 VAC or VDC. The enclosure 16 gauge steel. For sensing internal static pressure of air handling ducts utilize sensors with a rage of 0 to 5 inches water column. For sensing building static pressures (building compared to atmospheric) utilize a sensor with a range of -0.25 to +0.25 inches water column.

17.4 RELAYS: Relays for starting and stopping fractional horsepower motors shall be rated as follows:
- 1/4 horsepower motors or less use 15 ampere rated relays,
- 1/3 horsepower motors use 20 ampere rated relays,
- 1/2 horsepower motors use 30 ampere rated relays,
- Relays used for pilot duty service shall be rated at a minimum of 10 amperes.
- Provide auxiliary pilot duty relays on motor starters as required for control function.
- Do not install control and status relays in packaged equipment control panel enclosures containing Class 1 starters.

17.5 CURRENT SENSING DEVICES: Veris Industries model Hx08 Series and H701 or equal. All current sensors shall be capable of alarming to the BAS for belt losses, pump coupling shear or other mechanical failure on loads.

17.6 DIFFERENTIAL PRESSURE TRANSMITTERS: Provide Rosemount (ITT Bell & Gossett ST-102R) or Johnson Controls Setra DPT 2302-050-V field mounted differential pressure sensor transmitters as indicated on the plans. Range shall be 0-25 psig. Accuracy shall be .025% full span.

PART 18 - VALVES, DAMPERS AND ACTUATORS:

18.1 Unless otherwise specified, valves shall be furnished and sized by the TCC. The valves are to provide the required capacity and the close off rating shall be in excess of the system pressures encountered (minimum 40 psi differential). Proportioning-type valve bodies shall be packed type with throttling type inner valve (quick close plug shall not be acceptable). Proportional type valves to be rated at 125 psi static pressure. Modulating control valves shall be selected within a 3-5 psig pressure drop range. Two position control valves (open/close) shall be line size.

18.2 All valve actuators shall be fail safe spring return type with sufficient force to operate the dampers or valves under all normal operating conditions. They shall return to the normally open position upon a loss of power.

18.3 "ALL" Actuators shall be of the same manufacturer and have internal feedback circuitry to provide a positive action to insure proper positioning of the damper or valve through the entire sequence. Actuators shall have an adjustable starting point to accurately set the range of travel to the output of the controller. All actuators shall also utilize the same input signal (6-9 VDC, 0-010V, 2-10 VDC, 4-20 MA) in order to maintain some consistency in the control application. Analog actuation is 6-9 VDC, 0-010V, 2-10 VDC or 4-20 MA, floating point control with 2 digital outputs is NOT approved as analog actuation.

18.4 Actuators may be factory installed. If not factory installed they shall be installed as per instructions by the terminal equipment manufacturer.

PART 19 - VARIABLE FREQUENCY DRIVES (VFDs):

19.1 The work includes all labor, materials, and related items to completely furnish and install, start up and test, and place into service the Variable Frequency Drives (VFDs) indicated and scheduled on the Drawings and described in the Specifications.

19.2 VFDs shall be as manufactured by ABB or approved equal. This is the only acceptable manufacturers. All VFDs for the project shall be by the same manufacturer (no exceptions).

19.3 VFDs shall be consist of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor.

19.4 The VFD shall be capable of operation form AC voltage in two rages 208–240 VAC ± 10%, or 380–480 VAC ± 10%. 50/60 HZ operation, ± 2 hertz.

19.5 The VFD enclosure shall be rated UL type 1 and shall be UL listed as a plenum rated, suitable operating conditions: $0 – 40^0$ C continuous. Drives that have thermal cut out circuits, or that cannot operate continuously at 40^0 C shall not be acceptable. Altitude 0 to 3300 feet above sea level, up to 95% humidity, non-condensing.

19.6 The VFD shall produce an adjustable AC voltage/frequency output for step less motor speed control utilizing sine wave coded Pulse Width Modulation (PWM) The Drive shall provide automatic power factor correction and a .98 displacement power factor by incorporating a full wave diode bridge rectifier. The VFD shall have an overload rating of 110% of nominal rated current for 1 minute out of every 10 minutes of operation, which is an acceptable overload for centrifugal loads.

19.7 The VFD shall include a built-in first environment RFI/EMI filter and be CE and UL labeled. It shall also meet the CE requirement of EN61800-3 which provides an actual test procedure that shows that the VFD is immune from RFI/EMI interference and at the same time does not emit RFI/EMI noise that would interfere with other sensitive equipment near the VFD.

19.8 The VFD shall include as a minimum a 5% dual DC link or AC line reactor for a clean harmonic signature, which aides in complying with IEEE-519-1992 recommended levels. The VFD manufacturer and representative shall assist in ensuring that the VFD's applied meet IEEE-519-1992 by completing a computer aided Harmonic Analysis of the complete system.

19.9 The VFD shall include as a standard a built in digital keypad/display panel. This panel shall provide "Hand" off "Auto" selection, and a manual speed adjustment via up and down arrows. All faults and warnings shall be provided in "Plain English" for operation without a manual. The drive shall have a complete manual stored in memory that can be accessed with a single keystroke. This display shall be password protected and allow all setup parameters to be adjusted only by authorized personnel.

19.10 The VFD shall include built in Startup, Diagnostic, and Maintenance assistants, which allow for step-by-step startup procedures, troubleshooting, and the ability to indicate when the VFD and the system it is applied to needs preventive maintenance performed.

19.11 The VFD shall include a real time clock with a day/date stamp for troubleshooting purposes. In addition with the use of this clock the drive shall be capable of stand-alone operation and act as a unitary controller.

19.12 The VFD shall include (2) Analog inputs either 4–20 madc or 0-10 vdc, (6) programmable Digital Inputs, (2) Programmable analog Outputs, (3) Form C Relay output rated 2 amps continuous minimum, and (2) PID Process controllers.

19.13 The VFD keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (LED and alpha-numeric codes are not acceptable). All VFD faults shall be displayed in English words.

19.14 BYPASS – As scheduled on the drawings, the drive shall be provided with an integral Bypass circuit which includes a pair of 115V electrically interlocked contactors for drive and bypass operation. The drive shall include a main input circuit breaker, drive input service/isolation switch, and motor overload protection adjustable for either Class 10, 20 or 30 operation. The bypass shall include a built in status display which shows via colored LED's the system operational status including safeties and run permissives for ease of operation. The Bypass shall have its own interactive, programmable keypad. The Bypass shall provide single-phase protection for the motor while operating in bypass. Bypass that does not protect the motor from single-phase operation shall not be acceptable.

19.15 The drive and bypass system shall have embedded serial communication capabilities that allow direct connection to Modbus, Johnson Controls, Siemens and BACnet automation systems as part of the drives software suite without the need for extra hardware cards or gateways. The connection shall be tested by the BACnet Testing Labs (BTL) and be BTL Listed. The BACnet interface shall conform to

the BACnet standard device type of an Applications Specific Controller (B-ASC). In addition, the drive shall be capable of interfacing with Lonworks with the addition of a communication module.

19.16 All VFDs shall be provided and installed in strict accordance with the manufacturer's recommendations.

19.17 The VFDs serving RF-2 and RF-3shall be provided with auxiliary contact interlock

19.18 Factory-authorized startup for each drive is mandatory. Provide a written record of the startup of each unit. Start up and programming by a factory-authorized technician. At startup, lockout any speed with the VFD that does not meet the vibration allowanced of the equipment manufacturers.

19.19 A parts and labor warranty of 3 years from startup and 2 years from the date of substantial completion shall be included. Warranty shall include travel time and expenses.

PART 20 – POINTS LIST – SEE DRAWINGS.

END OF SECTION

MECHANICAL GENERAL NOTES

- COORDINATE THE LOCATION OF DRAINS, THERMOSTATS, GAS OUTLETS, ETC., WITH ALL CASEWORK EQUIPMENT, MECHANICAL ROOM EQUIPMENT, ETC., PRIOR TO COMMENCING INSTALLATION. WORK NOT SO COORDINATED SHALL BE REMOVED AND PROPERLY INSTALLED AT THE EXPENSE OF THE CONTRACTOR.
- THE CONTRACTOR SHALL EXERCISE EXTREME CARE IN THE COURSE OF THEIR WORK SO AS TO INSURE THAT THEY DO NOT INTERRUPT ANY EXISTING SERVICE. FOR SAFETY PURPOSES, PAY PARTICULAR ATTENTION TO THIS PRECAUTION RELATIVE TO NATURAL GAS AND ELECTRICAL LINES. VERIFY THE LOCATION, SIZE, TYPE, ETC., OF EACH UNDERGROUND OR OVERHEAD UTILITY. ALL WORK SHALL BE PERFORMED IN ACCORD WITH ALL FEDERAL, STATE AND/OR LOCAL RULES, REGULATIONS, STANDARD AND SAFETY REQUIREMENTS. UTILITIES SHALL BE INSTALLED IN ACCORD WITH THE APPLICABLE MUNICIPALITY OR UTILITY COMPANY STANDARDS. IN ALL CASES, THE MOST STRINGENT REQUIREMENT SHALL APPLY.
- ALL NEW WORK SHALL BE HUNG FROM STRUCTURE, NOT FROM THE WORK OF OTHER TRADES, WHETHER EXISTING OR NEW.
- COORDINATE ALL WORK WITH PROJECT PHASING REQUIREMENTS.
- PATCH, REPAIR AND PAINT OR PROVIDE WALL COVERING FOR (TO OWNER'S STANDARDS) EXISTING WALLS, CEILINGS, ETC., THAT ARE TO REMAIN IF DAMAGED DURING CONSTRUCTION. REPAIRS SHALL MATCH ADJACENT SURFACES TO THE SATISFACTION OF THE ARCHITECT AND OWNER.
- OBSERVE ALL APPLICABLE CODES, RULES AND REGULATIONS THAT MAY APPLY TO THE WORK UNDER THIS CONTRACT. (CITY, COUNTY, LOCAL, FEDERAL, MUNICIPALITY, UTILITY COMPANY, COMMONWEALTH OF KENTUCKY, ETC.)
- CONTRACTOR SHALL BE AWARE OF UNSEEN PLUMBING, HVAC AND ELECTRICAL WORK DURING DEMOLITION. IF ITEMS ARE UNCOVERED DURING DEMOLITION THEN FIELD VERIFY THE USE OF THE ITEMS AND PLAN AN ALTERNATE ROUTE TO RUN THESE ITEMS. THEN CONTACT THE ENGINEERS TO REVIEW THE ROUTING.
- WHERE FIRE PROOFING IS SPRAYED ON EXISTING STRUCTURE ALL EXISTING CONDUITS, WATER, HYDRONIC, STEAM, CHILLED WATER, FIRE PROTECTION LINES, MED GAS, ETC. SHALL BE LOWERED TO BE BELOW FULL THICKNESS OF FIRE PROOFING WITH NO INTERFERENCE.
- ALL PENETRATIONS OF FIRE AND SMOKE RATED ASSEMBLIES SHALL BE APPROPRIATELY FIRE STOPPED PER AN APPROVED U.L. LISTED STANDARD. CONTRACTOR SHALL PAY PARTICULAR ATTENTION TO INSULATED PIPING PENETRATIONS.
- ALL WORK REQUIRING DOWNTIME OF ANY AREA IN THE BUILDING SHALL BE SCHEDULED 2 WEEKS IN ADVANCE, AND SHALL COMPLY WITH INTERIM LIFE SAFETY MEASURES.
- INSTALL AIR VENTS AT HIGH POINTS IN PIPING AND DRAINS IN LOW POINTS. USE CARE TO AVOID FREEZING OF EXTERIOR VENTS.
- LOCATIONS OF PIPING AND EQUIPMENT ARE APPROXIMATE AND SUBJECT TO MINOR ADJUSTMENTS IN THE FIELD. DO NOT SCALE THE DRAWINGS.
- ALL OFFSETS IN PIPING ARE NOT NECESSARILY SHOWN. PROVIDE ADDITIONAL OFFSETS WHERE NECESSARY.
- COORDINATE ALL HVAC WORK WITH ELECTRICAL, PLUMBING AND OTHER TRADES TO AVOID INTERFERENCE WITH PIPING, DUCTS, CONDUIT AND OTHER EQUIPMENT.
- INSTALL ALL PIPING AND EQUIPMENT IN STRICT ACCORDANCE WITH MANUFACTURER'S INSTALLATION INSTRUCTION. IF IN CONFLICT WITH THE DESIGN INDICATED IN CONTRACT DOCUMENTS, ADVISE THE ENGINEERS PRIOR TO INSTALLATION FOR CLARIFICATION. PROVIDE RECOMMENDED ACCESS AND SERVICE CLEARANCES FOR ALL EQUIPMENT.
- SEAL AIRTIGHT AROUND ALL PIPING PENETRATIONS THROUGH WALLS, FLOORS AND ROOF. PROVIDE FIRE STOPPING IN FIRE PARTITION.
- ALL MOTOR DRIVEN EQUIPMENT SHALL BE INSTALLED WITH FLEXIBLE CONNECTIONS TO PIPING, ETC., UNLESS OTHERWISE NOTED.
- THE CONTRACTOR SHALL RELOCATE OR AVOID ANY EXISTING EQUIPMENT APPURTENANCES, ETC., THAT CONFLICT WITH NEW WORK.
- WHERE MOUNTING HEIGHTS ARE NOT INDICATED OR ARE IN CONFLICT WITH ANY OTHER BUILDING SYSTEM, CONTACT THE ENGINEERS BEFORE INSTALLATION. REFER ALSO TO ARCHITECTURAL WALL INTERIOR AND EXTERIOR WALL ELEVATIONS, CEILING HEIGHTS AND OTHER DETAIL OF THESE DOCUMENTS.
- ANY VIBRATING, OSCILLATING OR OTHER NOISE OR MOTION PRODUCING EQUIPMENT SHALL BE ISOLATED FROM SURROUNDING SYSTEMS IN AN APPROVED MANNER. NOISY OR STRUCTURALLY DAMAGING INSTALLATIONS SHALL BE SATISFACTORILY REPLACED OR REPAIRED AT THE INSTALLING CONTRACTOR'S EXPENSE. THE FINAL DECISION ON THE SUITABILITY OF A PARTICULAR INSTALLATION'S ACCEPTABILITY SHALL BE THAT OF THE ENGINEER.
- DEVIATIONS IN SIZE, CAPACITIES, FIT, FINISH, ETC. FOR EQUIPMENT FROM THAT USED AS BASIS OF DESIGN SHALL BE THE RESPONSIBILITY OF THE PURCHASER OF THAT EQUIPMENT. ANY PROVISIONS REQUIRED TO ACCOMMODATE A DEVIATION, WHETHER APPROVED BY THE ENGINEERS OR NOT, SHALL BE THE RESPONSIBILITY OF THE PURCHASER.
- VALVES, BALANCING DAMPERS OR ANY MECHANICAL/ELECTRICAL ITEM REQUIRING ACCESS SHALL NOT BE LOCATED AN UNREASONABLE DISTANCE ABOVE THE FINISHED FLOOR.
- WHEN RUNNING ANY TYPE OF PIPING BELOW A FOOTER, OR IN THE ZONE OF INFLUENCE THE PIPING SHALL BE BACKFILLED WITH CEMENTITIOUS FLOWABLE FILL PER SPECIFICATIONS. WHENEVER POSSIBLE, LOCATE PIPING OUTSIDE OF THE ZONE OF INFLUENCE. THE ZONE OF INFLUENCE IS THE AREA UNDER THE FOOTER WITHIN A 45 DEGREE ANGLE PROJECTING DOWN FROM THE BOTTOM EDGE OF THE FOOTER OF ALL SIDES OF THE FOOTER. ADDITIONALLY, GREASE TRAPS, MANHOLES, VAULTS AND OTHER UNDERGROUND STRUCTURES SHALL BE HELD AWAY FROM BUILDING WALLS FAR ENOUGH TO BE OUTSIDE OF THE ZONE OF INFLUENCE.
- THE DOCUMENTS COMPLY WITH 2006 IMC, 2007 KBC, AND ASHRAE 90.1-2007.
- WORK IN CONFINED AREAS SHALL BE IN ACCORDANCE WITH THE OWNER'S SAFETY POLICY REQUIREMENTS.
- CONTRACTOR SHALL PROVIDE EQUIPMENT SHOP DRAWINGS WITH BID PROPOSALS.

MECHANICAL DEMOLITION NOTES

- ALL OUTAGES SHALL BE SCHEDULED THROUGH THE NKU PROJECT REPRESENTATIVE FOR PROPER COORDINATION. A REQUEST FOR AN OUTAGE SHALL BE SUBMITTED IN WRITING A MINIMUM OF TWO WEEKS IN ADVANCE.
- ALL WALLS AND FLOOR SLABS SHALL BE REPAIRED TO MATCH EXISTING AND TO A LIKE NEW CONDITION. ALL RATED WALLS AND FLOOR SLABS SHALL BE PATCHED AND REPAIRED TO MAINTAIN RATING.
- ALL EXISTING BUILDING FINISHES SHALL BE PROTECTED DURING THE DEMOLITION PHASE.
- HEAVY DASHED LINES INDICATE ITEMS FOR REMOVAL (U.O.N) AND LIGHT SOLID LINES INDICATE EXISTING ITEMS TO REMAIN.
- COORDINATE DISPOSAL OF ALL FIXTURES, DEVICES, ETC. (INDICATED FOR DEMOLITION) WITH THE OWNER.

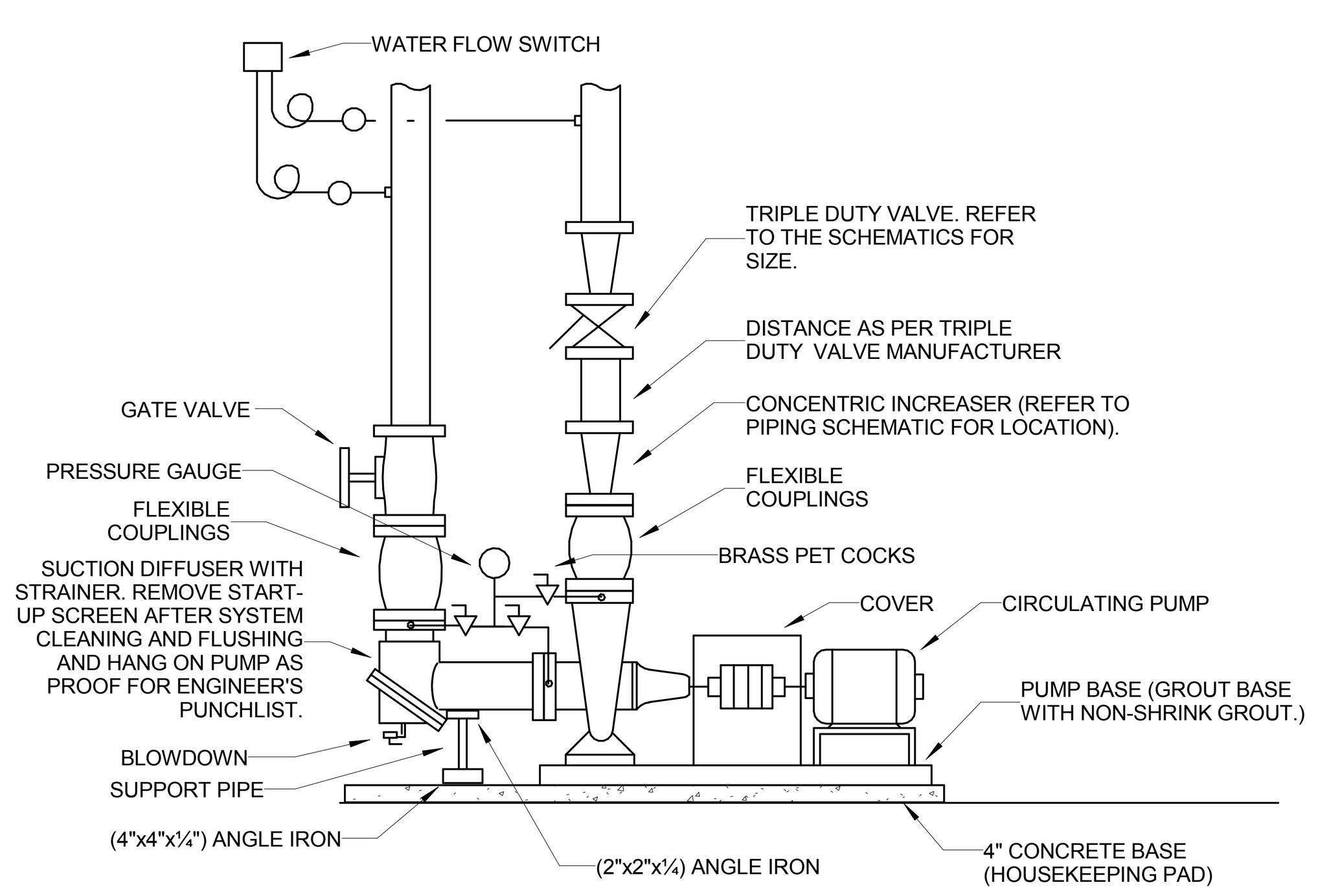
PHASING NOTES

- EXISTING CHILLED WATER SYSTEM SHALL REMAIN OPERATIONAL UNTIL MAY 8, 2017. THE CHILLED WATER SYSTEM SHALL BE FULLY OPERATIONAL AND TURNED ON BY MAY 22, 2017.
- THIS PROJECT INTERFACES EXTENSIVELY WITH EXISTING BUILDING SERVICES. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO COORDINATE AND PHASE ALL TIE-INS AND INTERRUPTIONS OF EXISTING SERVICES TO MINIMIZE OR ELIMINATE DOWNTIME. AS AN EXAMPLE, MAIN GAS SERVICE, WATER SERVICE, ELECTRICAL SERVICE, HVAC SERVICES, STEAM GENERATION, ETC., WILL BE AFFECTED AND REPLACED OR MOVED DURING THIS PROJECT. THE CONTRACTOR SHALL INSTALL ALL NEW SERVICES AND EQUIPMENT AND HAVE THEM TESTED AND FULLY AND RELIABLY FUNCTIONAL PRIOR TO INTERRUPTING, RELOCATING OR REMOVING ANY EXISTING SERVICES. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO BARE ANY AND ALL COSTS ASSOCIATED WITH THIS PHASING, INCLUDING TEMPORARY SERVICES, TEMPORARY RELOCATION, PREMIUM TIME WORK, ETC. CONTRACTOR SHALL COORDINATE ALL SAID WORK WITH THE OWNER AND APPLICABLE UTILITIES PER THE CONTRACT DOCUMENTS.

SYMBOLS & ABBREVIATIONS

AFF	ABOVE FINISHED FLOOR
AFR	ABOVE FINISHED ROOF
CD	CONDENSATE DRAIN
C.I.	CAST IRON
DN	DOWN
ID	INSIDE DIMENSION
NC	NORMALLY CLOSED
NO	NORMALLY OPEN
NIC	NOT IN CONTRACT
NO	NORMALLY OPEN
NTS	NOT TO SCALE
OD	OUTSIDE DIMENSION
CFCI	CONTRACTOR FURNISHED, CONTRACTOR INSTALLED
OFCI	OWNER FURNISHED, CONTRACTOR INSTALLED
OFOI	OWNER FURNISHED, OWNER INSTALLED
OR	OPEN RECEPTACLE
PRV	PRESSURE REDUCING VALVE (STEAM, WATER, GAS)
PSI	POUNDS PER SQUARE INCH
TB	THRUST BLOCK
TE	TOP ELEVATION
TYP	TYPICAL
UON	UNLESS OTHERWISE NOTED
VFD	VARIABLE FREQUENCY DRIVE
XXX / X	EQUIPMENT TAG DESIGNATOR
B	BOILER
HX	HEAT EXCHANGER

	POINT OF CONNECTION
	LIMIT OF DEMOLITION
	PIPE ELBOW TURNING UP/TURNING DOWN
	PIPE TEE TURNING UP/TURNING DOWN
CHWS/R	CHILLED WATER SUPPLY/RETURN
PC	PUMPED CONDENSATE
CWS/R	CONDENSER WATER SUPPLY/RETURN
HWS/R	HEATING WATER SUPPLY/RETURN
E(NAME)	EXISTING PIPING (THIN LINE)
ABAN(NAME)	ABANDONED EXISTING PIPING (THIN LINE)
	EXISTING DUCT OR PIPING TO BE REMOVED
	TWO-WAY CONTROL VALVE
	THREE-WAY CONTROL VALVE
	AUTOMATIC AIR VENT
	MANUAL AIR VENT
	BALANCING VALVE
	BALL VALVE
	BUTTERFLY VALVE
	TRIPLE DUTY VALVE
	STRAINER
	MANUAL ISOLATION VALVE
	PRESSURE REDUCING VALVE (WATER, ETC.)
	AUTO-FLOW CONTROL VALVE
	CHECK VALVE
	DOUBLE CHECK VALVE ASSEMBLY
	FLEXIBLE PIPE CONNECTION
	PIPING UNION
FS	FLOW SWITCH
PS	PRESSURE SWTICH
	THERMOMETER
	PETE'S PLUG
X	TAGGED NOTE DESIGNATOR
X	REVISION DESIGNATOR
VT	SAFETY RELIEF VENT PIPE



BASE MOUNTED PUMP DETAIL
NTS

CONDENSER PUMP SCHEDULE - ALT. #1

MARK	MANUFACTURER	MODEL	TYPE	SERVICE	GPM	PRESSURE (FEET HEAD)	VFD	MINIMUM EFFICIENCY (%)	RPM	ELECTRICAL DATA HZ	HP	BRAKE HP	VOLTAGE	PHASE	REMARKS
P-1	BELL AND GOSSETT	5A	e-1510	CONDENSER LOOP	750 GPM	35	Yes	84.9	1750	60	10	7.95	460 V	3	1,2,3,4,5

REMARKS:

1. FLOW PERFORMANCE BASED ON WATER AS WORKING FLUID.
2. PUMP SHALL BE NON-OVERLOADING.
3. FURNISH WITH STARTER AND NEC DISCONNECT.
4. ACCEPTABLE MANUFACTURERS INCLUDE ARMSTRONG, TACO, AND BELL & GOSSETT.
5. PROVIDE CONDENSER PUMP ONLY IF ALTERNATE IS ACCEPTED.

COOLING TOWER SCHEDULE

MARK	MANUFACTURER	MODEL #	DIMENSIONS LENGTH	WIDTH	HEIGHT	WEIGHT	FLOW RATE	EWT	LWT	AMBIENT WB TEMP	ELECTRICAL DATA FAN HP	FAN VOLTAGE	FAN PHASE	HEATER KW	SOUND POWER 63 HZ	125 HZ	250 HZ	500 HZ	1000 HZ	2000 HZ	4000 HZ	8000 HZ	REMARKS
CT-1	MARLEY	NC840PAN1	14'-2"	8'-5"	13'-5"	10815 lb	750 GPM	95 °F	85 °F	78 °F	15	460 V	3	9 kW	98	95	92	91	87	83	79	70	1,2,3,4,5

REMARKS:

1. PROVIDE 316 STAINLESS STEEL BASIN.
2. PROVIDE SINGLE POINT CONNECTION.
3. PROVIDE ALUMINUM SLOPED SERVICE LADDER.
4. PROVIDE SIDE ENCLOSURE LOUVERS.
5. ACCEPTABLE MANUFACTURERS SHALL BE EVAPCO, MARLEY, BAC, OR APPROVED EQUAL.

CHILLER SCHEDULE

MARK	TYPE	MANUFACTURER	MODEL	SERVICE	DIMENSIONS LENGTH	WIDTH	HEIGHT	WEIGHT (LBS)	FLUID TYPE	COMPRESSOR COOLING CAPACITY (TONS)	VOLTAGE	PHASE	MCA	MOCP	STARTER	NPLV (KW/TON)	EVAPORATOR EWT	LWT	GPM	FLUID PD	FOULING FACTOR	CONDENSER EWT	LWT	GPM	FLUID PD	FOULING FACTOR	REMARKS
CH-1	CENTRIFUGAL SHORT SHELL	TRANE	CVHE	NORSE COMMONS	11'-3"	5'-5"	7'-10"	15350 lb	WATER	250	460 V	3	233 A	300	Yes	0.3354	55 °F	45 °F	598	18.96 ftH2O	0.0001	85 °F	95 °F	750 GPM	19.45 ftH2O	0.00025	1,2,3,4,5

REMARKS:

1. PROVIDE SHORT SHELLS OPTION TO MAINTAIN UNIT CLEARANCES WITHIN EXISTING MECHANICAL ROOM CONSTRAINTS.
2. PROVIDE SINGLE POINT CONNECTION.
3. ACCEPTABLE MANUFACTURERS SHALL BE CARRIER, TRANE, OR APPROVED EQUAL.
4. UNIT SHALL BE HERMETIC.
5. AHRI CERTIFICATION TO MEET AHRI STANDARDS 550/590 AND 551/591.

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NORSE COMMONS CHILLER REPLACEMENT
NORTHERN KENTUCKY UNIVERSITY
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MECHANICAL LEGEND

PROJECT #:	XNCR16
DATE:	JANUARY 2017
DRAWN:	CRK
CHECKED:	SAC

REVISIONS

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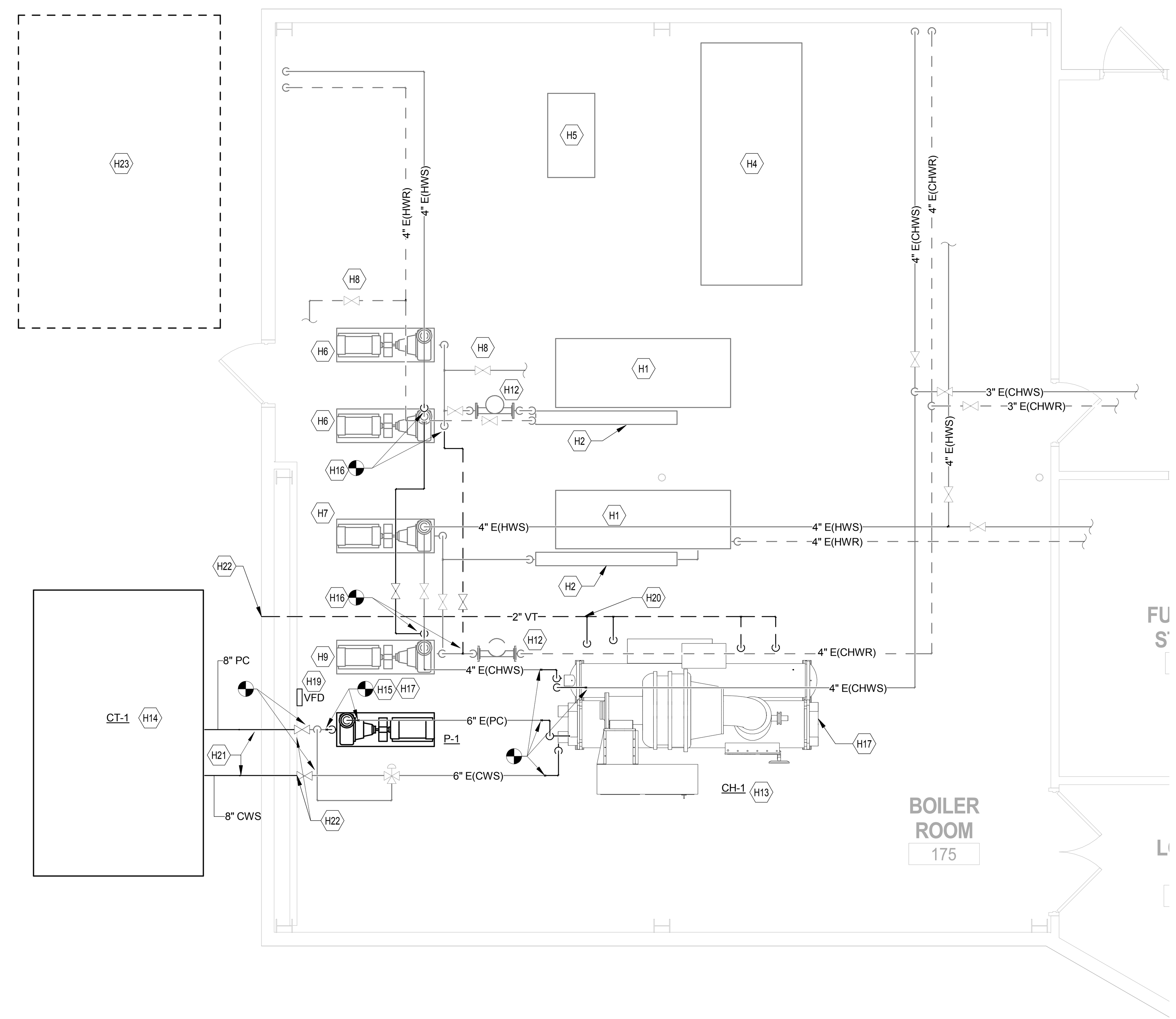
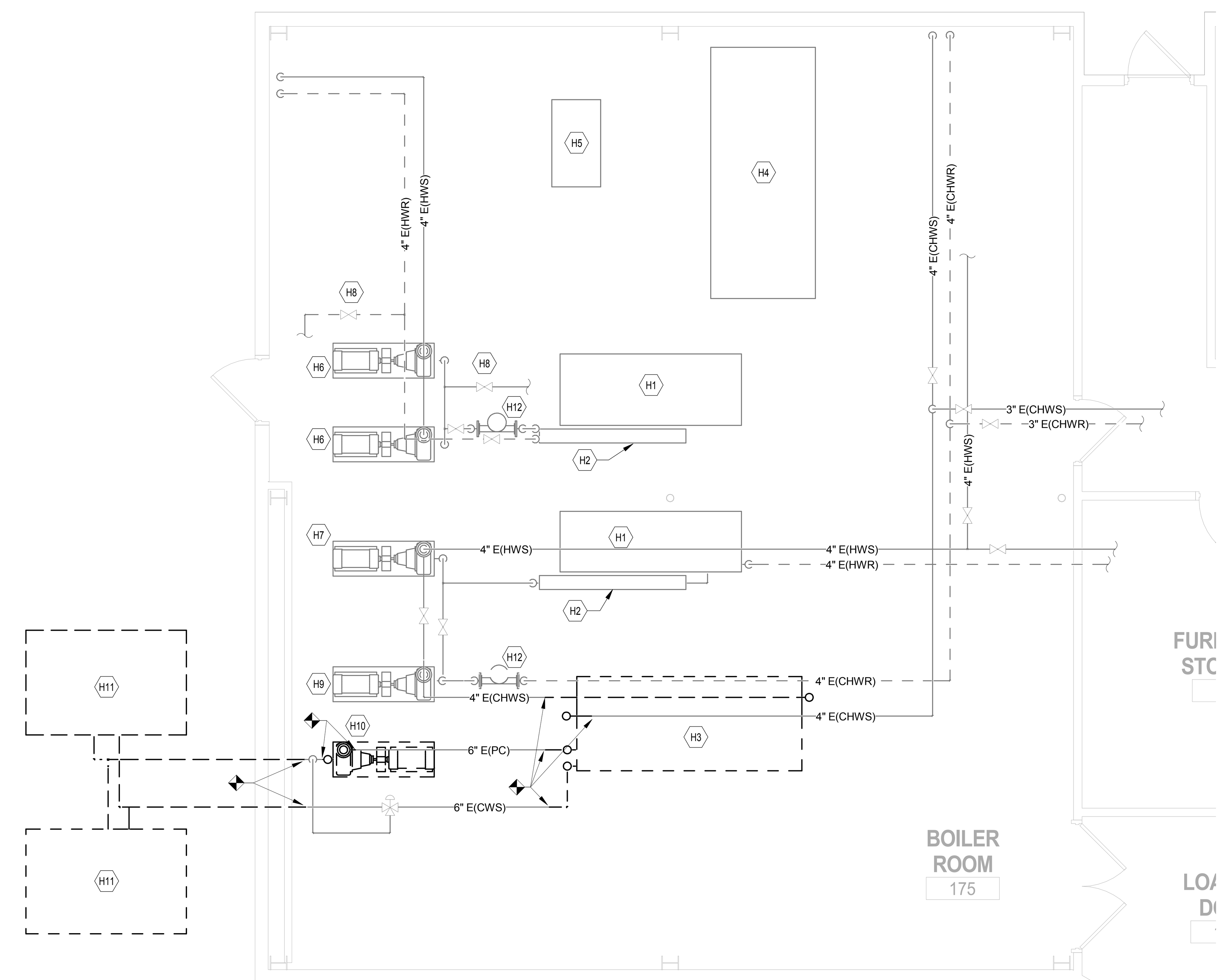


2 MECHANICAL NEW WORK PLAN
SCALE: 1/4" = 1'-0"



1 MECHANICAL DEMOLITION PLAN
SCALE: 1/4" = 1'-0"

TAGGED NOTES

H1 EXISTING STEAM BOILER TO REMAIN.
H2 EXISTING HEAT EXCHANGER TO REMAIN.
H3 REMOVE EXISTING 250 TON CHILLER AND ASSOCIATED PIPING TO POINT INDICATED ON THE DRAWING. CONTRACTOR SHALL RECOVER AND RECYCLE ALL REFRIGERANT.
H4 EXISTING HOT WATER STORAGE TANK TO REMAIN.
H5 EXISTING HOT WATER BOILER TO REMAIN.
H6 EXISTING HOT WATER SYSTEM PUMP SERVING KENTUCKY HALL TO REMAIN.
H7 EXISTING HOT WATER SYSTEM PUMP SERVING NORSE HALL TO REMAIN.
H8 EXISTING COLD WATER TIE-IN.
H9 EXISTING CHILLED WATER PUMP.
H10 EXISTING CONDENSER WATER PUMP SERVING EXISTING COOLING TOWER TO BE DEMOLISHED IF ALTERNATE #1 IS ACCEPTED. IF ALTERNATE BID IS ACCEPTED, REMOVE EXISTING CONDENSER WATER PUMP AND ASSOCIATED PIPING TO POINT INDICATED ON THE DRAWING.
H11 REMOVE EXISTING COOLING TOWER AND PIPING TO POINT INDICATED ON THE DRAWING.
H12 EXISTING AIR SEPARATOR TO REMAIN.
H13 CONTRACTOR SHALL PROVIDE AND INSTALL NEW 250 TON CHILLER. CONTRACTOR SHALL MAINTAIN MANUFACTURERS' CLEARANCES. CONTRACTOR SHALL PROVIDE PIPE CONNECTIONS AND PIPE FROM NEW UNIT TO EXISTING PIPING.
H14 CONTRACTOR SHALL PROVIDE AND INSTALL NEW COOLING TOWER. CONTRACTOR SHALL MAINTAIN MANUFACTURERS' CLEARANCES. CONTRACTOR SHALL PROVIDE PIPING CONNECTIONS AND PIPE FROM NEW UNIT TO EXISTING PIPING. REFER TO STRUCTURAL DRAWINGS FOR UNIT SUPPORT INFORMATION. BOTTOM OF NEW COOLING TOWER SHALL BE 70" ABOVE FINISHED GRADE.
H15 IF ALTERNATE BID #1 IS ACCEPTED, CONTRACTOR SHALL PROVIDE NEW CONDENSER PUMP. CONTRACTOR SHALL MAINTAIN MANUFACTURERS' CLEARANCES. CONTRACTOR SHALL PROVIDE PIPE CONNECTIONS FROM NEW UNIT TO EXISTING PIPING.
H16 IF ALTERNATE BID #3 IS ACCEPTED, CONTRACTOR SHALL PROVIDE CONNECTOR PIPE FROM CHILLED WATER SYSTEM PIPE TO HOT WATER SYSTEM PIPE SERVING KENTUCKY HALL.
H17 CONTRACTOR SHALL EXTEND EXISTING EQUIPMENT PAD 4" BEYOND UNIT BASE DIMENSION. REFER TO SPECIFICATIONS FOR CONCRETE REQUIREMENTS.
H19 CONTRACTOR SHALL PROVIDE VFD FOR COOLING TOWER. COOLING TOWER VFD SHALL BE LOCATED IN THE MECHANICAL ROOM IN THIS APPROXIMATE LOCATION. CONTRACTOR SHALL MAINTAIN MANUFACTURERS RECOMMENDED CLEARANCES.
H20 CONTRACTOR TO PROVIDE SAFETY RELIEF PIPE FROM CHILLER OUTPUTS TO THE BUILDING EXTERIOR. SAFETY RELIEF PIPE SHALL PENETRATE EXTERIOR WALL APPROXIMATELY 8'-0" ABOVE FINISHED FLOOR.
H21 CONTRACTOR TO PROVIDE HEAT TRACE ON EXTERIOR PIPING FROM MECHANICAL ROOM TO COOLING TOWER.
H22 SEAL EXTERIOR WALL PENETRATIONS AIR AND WATER TIGHT.
H23 AS AN OPTION, THE CONTRCTOR CAN LOCATE THE NEW COOLING TOWER IN THIS LOCATION. IF THIS OPTION IS PREFERRED, THE CONTRACTOR SHALL DEMOLISH THE EXISTING ABANDONED STRUCTURAL SUPPORTS, PROVIDE ADDITONAL PIPE PENETRATIONS, PROVIDE ADDITIONAL PIPE, AND SEAL THE EXISTING CHILLED WATER PIPE PENETRATIONS TO MATCH ADJACENT WALL AT NO ADDITIONAL COST.

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MECHANICAL PLAN

PROJECT #:	XNCR16
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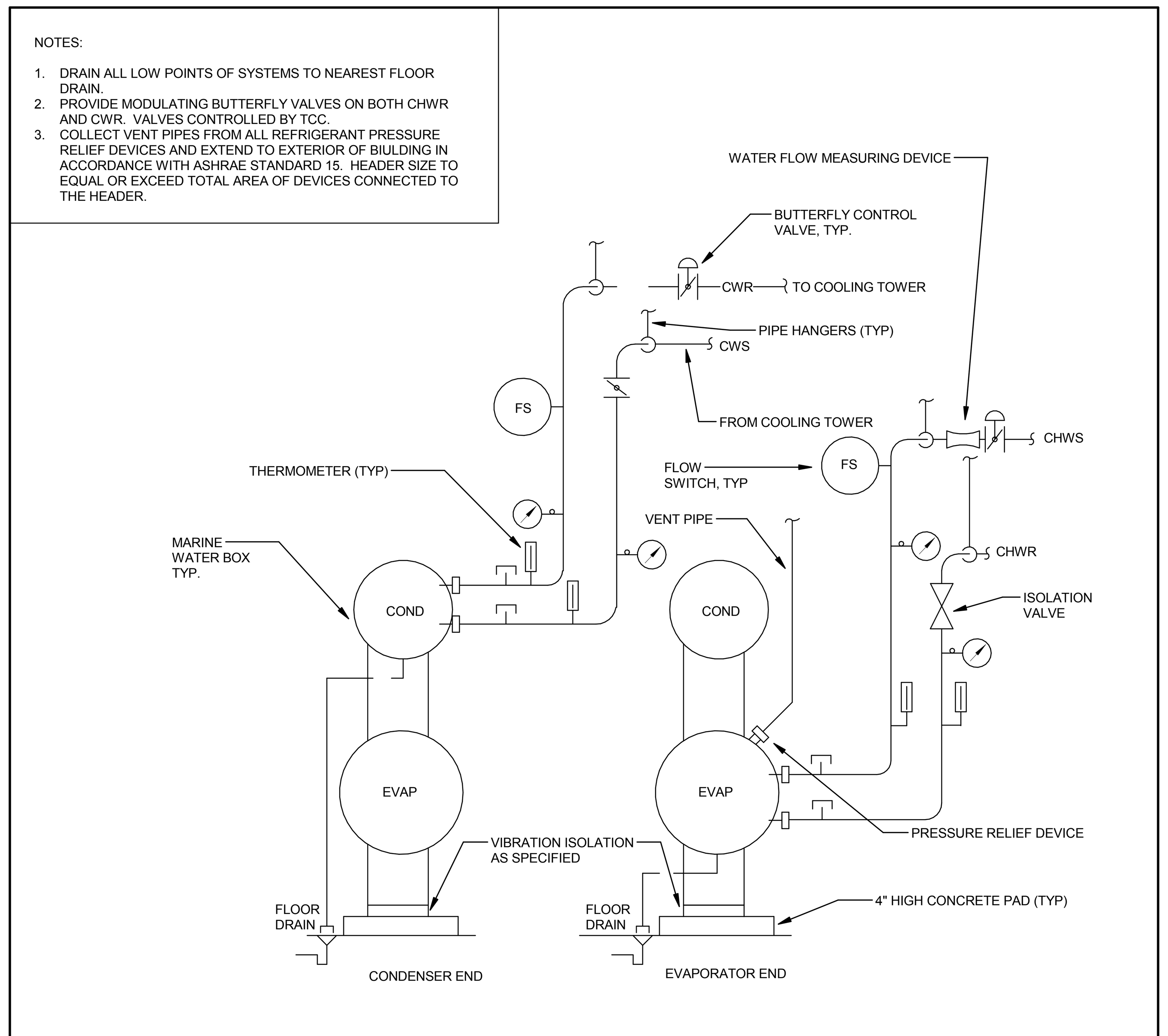
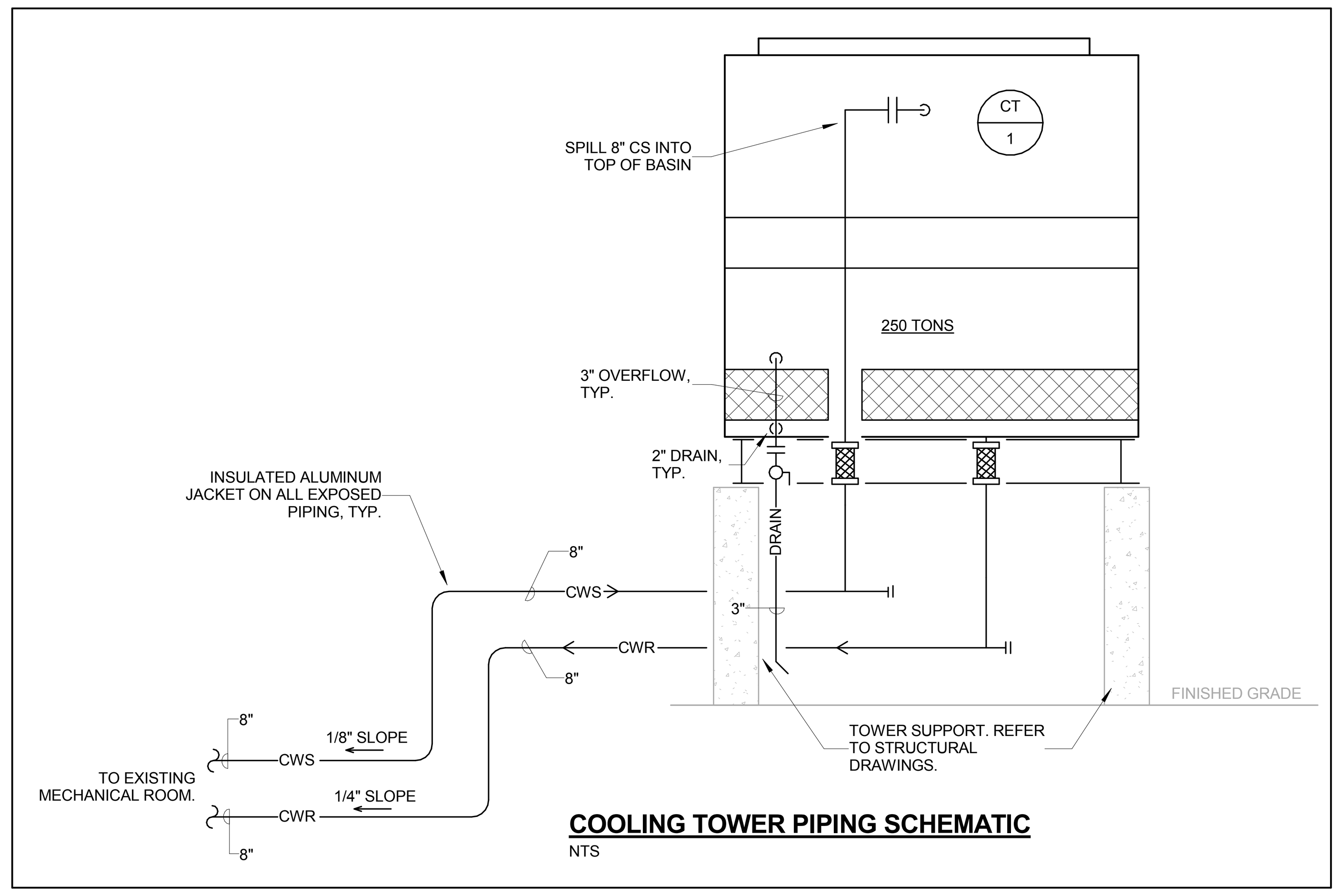


WATER COOLED CHILLER - PIPING CONNECTIONS

NTS



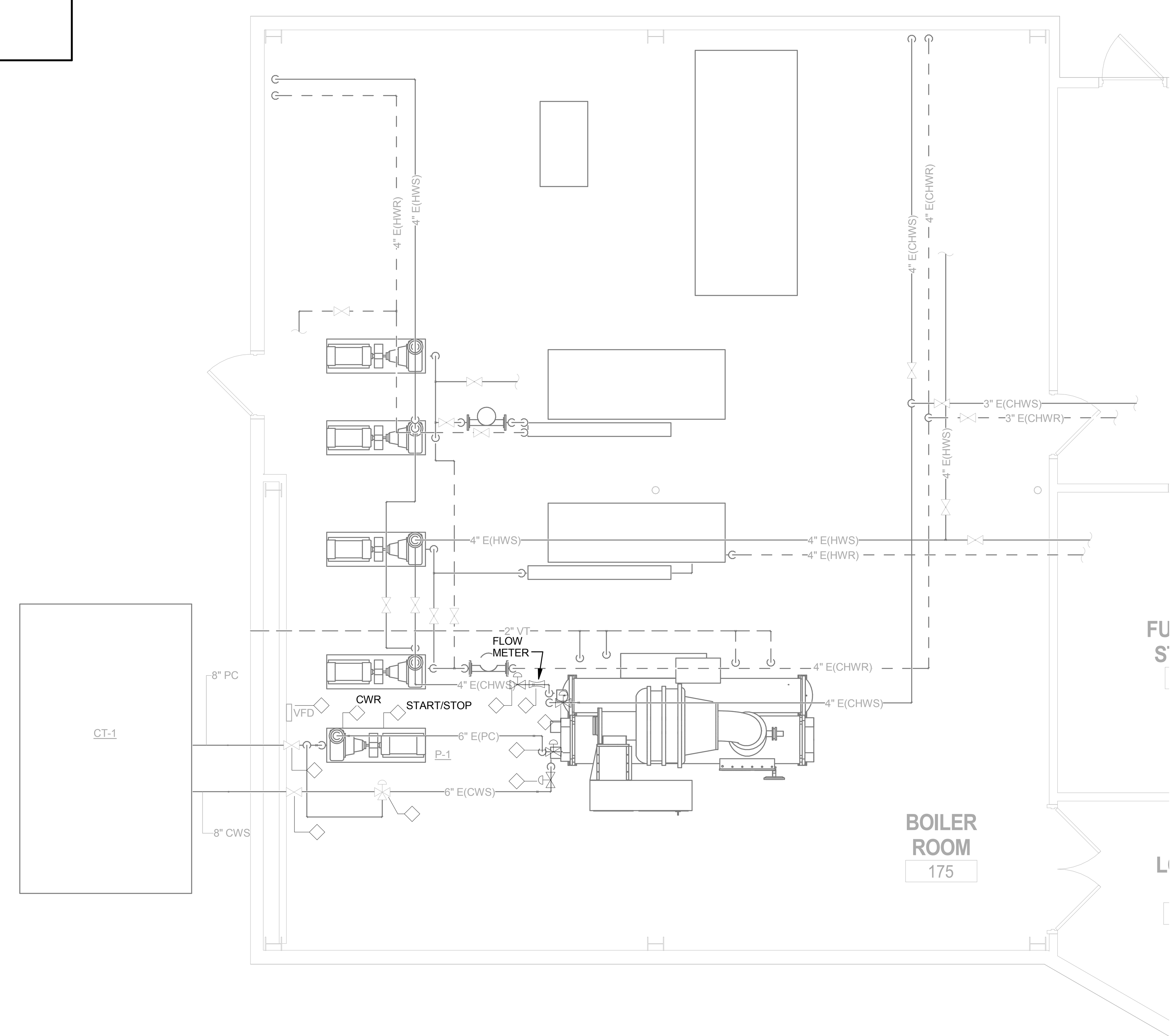
COOLING TOWER PIPING SCHEMATIC

NTS

CONDENSER PUMP POINTS LIST - ALTERNATE ONLY						
POINT DESCRIPTION	OBJECT NAME	DI	DO	AI	AO	OVERRIDE
P-1 START/STOP	CW_P_C		X			
P-1 STATUS	CW_P_S	X				

COOLING TOWER POINTS LIST						
POINT DESCRIPTION	OBJECT NAME	DI	DO	AI	AO	OVERRIDE
CT-1 COMMAND	CT_C		X			X
CT-1 STATUS	CT_S	X				
CT-1 VFD PERCENTAGE	CT_VFD_S				X	X
CT-1 VFD ALARM	CT_VFD_ALRM	X				
CT-1 CWR VALVE COMMAND	CT_CWR_VLV_CMD		X			X
CT-1 CWS VALVE COMMAND	CT_CWS_VLV_CMD		X			X
CT-1 CWS TEMPERATURE	CT_CWS_TEMP			X		
CT-1 CWS LOW TEMPERATURE ALARM	CT_CWS_TEMP_ALRM		X			
CT-1 CWS SETPOINT	CT_CWS_STPT				X	
CT-1 RUNTIME	CT_RUNTIME			X		
CT-1 RUNTIME SETPOINT	CT_RUNTIME_STPT				X	X
PURGE VALVE STATUS	PURGE_VLV_S	X				X
PURGE VALVE COMMAND	PURGE_VLV_C		X			
PURGE VALVE ALARM	PURGE_VLV_ALRM		X			

CHILLER POINTS LIST						
POINT DESCRIPTION	OBJECT NAME	DI	DO	AI	AO	OVERRIDE
CH-1 CONDENSER VALVE COMMAND	CHW_COND_VLV_C		X			
CH-1 CONDENSER VALVE POSITION	CHW_COND_VLV_S	X				
CH-1 EVAPORATOR VALVE COMMAND	CHW_EVAP_VLV_C		X			
CH-1 EVAPORATOR VALVE POSITION	CHW_EVAP_VLV_S	X				
CHW FLOW	CHW_FLOW				X	
CHWR TEMPERATURE	CHWR_T			X		
CHWS TEMPERATURE	CHWS_T			X		



CHILLED WATER SEQUENCE OF OPERATIONS:

CHILLER

THE CHILLER SHALL INTERNALLY CONTROL IT'S CAPACITY TO HANDLE THE CHILLED WATER LOAD OF THE CONNECTED BUILDINGS. IT SHALL DISCHARGE 45 ° F (ADJ.) CONSTANTLY. NUMBER OF COOLING TONS IS TO BE CALCULATED USING THE FOLLOWING EQUATION (GPM) X 500 X ((T-2)-(T-1)), WHERE THE MAIN FLOW (GPM) IS SENSED BY THE MAIN CHILLED WATER BTU METER (MAIN FLOW METER, F-1) AND MAIN SUPPLY (T-1) AND RETURN TEMPERATURES (T-2).

COOLING TOWER

THE COOLING TOWER SHALL BE OPERATIONAL WITH THE CHILLER. IF THE CHILLER IS ON THE COOLING TOWER MUST BE ACTIVATED. THE COOLING TOWER FAN SHALL BE STAGED TO MAINTAIN THE CONDENSER WATER SETPOINT. CONDENSER WATER SETPOINT SHALL MAINTAIN A 10 ° F OFFSET FROM THE WET BULB TEMPERATURE WITH A MAXIMUM SETPOINT OF 85 ° F (ADJ.) AND A MINIMUM SETPOINT OF 60 ° F (ADJ.). THE COOLING TOWER SHALL OPERATE IN THE FOLLOWING STAGES.

STAGE 1 IS TO FLOW WATER THROUGH THE TOWER WITH NO FAN OPERATION.
STAGE 2 IS TO START THE COOLING TOWER FAN VFD AT MINIMUM.
STAGE 3 IS TO GRADUALLY INCREASE SPEED OF THE COOLING TOWER FAN VFD UP TO 80%

ALARMS

ANY POINT THAT DOES NOT RESPOND WHEN COMMANDED OR IS OPERATING OUTSIDE ITS LIMITS OF OPERATION SHALL SEND AN ALARM TO THE BUILDING MANAGEMENT SYSTEM.

INTEGRATION

INTEGRATE CONTROLS OF THE NEW COOLING TOWER WITH THE EXISTING CONDENSER SYSTEM SEQUENCE OF OPERATION.

ALL NEW POINTS MUST BE TIED BACK INTO THE BUILDING MANAGEMENT SYSTEM.

VARIABLE FREQUENCEY DRIVES

ALL VFD'S SHALL BE INTEGRATED INTO THE BUILDING MANAGEMENT SYSTEM. THE BUILDING MANAGEMENT SYSTEM SHALL HAVE STATUS, HZ, ALARM, AND RUNTIME AT A MINIMUM.

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MECHANICAL CONTROLS

PROJECT #:	XNCR16
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ELECTRICAL DEMOLITION NOTES

- DOTTED LINES INDICATE ITEMS FOR REMOVAL (UON) AND THIN SOLID LINES INDICATE EXISTING ITEMS TO REMAIN.
- EXISTING CIRCUITS THAT CONTAIN DEVICES OR EQUIPMENT THAT ARE TO REMAIN. WHEN DEMOLITION OF AN ELECTRICAL DEVICE (OR CIRCUIT) IS INDICATED ON THE DRAWINGS: THE CONTRACTOR SHALL ENSURE THAT OTHER DEVICES OR EQUIPMENT "UPSTREAM" OR "DOWNSTREAM" ON THE CIRCUITS SHALL REMAIN IN "PRE- DEMOLITION" WORKING ORDER. "LEFT-OVER" CIRCUIT BREAKERS SHALL REMAIN, BE SWITCHED TO OFF POSITION, AND BE LABELED AS SPARES IN THEIR PANELS. PROVIDE NEW TYPEWRITTEN DIRECTORIES FOR ALL PANELS AFFECTED.
- LOCATIONS OF DEVICES, CONNECTIONS, ETC., INDICATED ON THIS DRAWING WERE TAKEN FROM VARIOUS SOURCES. THEY ARE DIAGRAMMATIC ONLY AND ARE SUBJECT TO VARIATION FROM EXISTING CONDITIONS. CERTAIN EXISTING ELEMENTS MAY NOT BE INDICATED AT ALL. THE CONTRACTOR PROPOSING TO DO ANY PART OF THE WORK INDICATED HEREON SHALL VISIT THIS SITE AND DETERMINE TO HIS SATISFACTION THAT THEY MAY COMPLETE ALL WORK REQUIRED FOR THE BID WHICH HE PROPOSES.
- REMOVE ALL ASSOCIATED BACKBOXES, CONDUIT AND CONDUCTORS FOR DEVICES / FIXTURES / ETC. BEING REMOVED (BACK TO SOURCE), WHETHER INDICATED OR NOT (UON). CONTRACTOR SHALL PATCH AND REPAIR ANY EXISTING WALLS, FLOORS OR CEILINGS WHERE DEVICES ARE SHOWN TO BE REMOVED (PATCH AND REPAIR TO RECEIVE NEW FINISHES - SEE ARCHITECTURAL PLANS).
- COORDINATE DISPOSAL OF ALL FIXTURES, DEVICES, ETC. (INDICATED FOR DEMOLITION) WITH OWNER. TURN OVER ITEMS REMOVED TO OWNER AT THEIR OPTION.
- COORDINATE WITH OTHER TRADES FOR THE REMOVAL AND/OR RELOCATION OF ELECTRICAL DEVICES AND CONNECTIONS ASSOCIATED WITH THEIR EQUIPMENT.
- PROVIDE TEMPORARY EMERGENCY EXIT LIGHTS AT CONSTRUCTION BARRIERS AS REQUIRED.
- CONTRACTOR SHALL PATCH AND REPAIR ALL EXISTING WALLS / CEILINGS AS REQUIRED WHERE DEVICES ARE BEING REMOVED OR INSTALLED.
- UNUSED/ABANDONED CONDUCTORS DISCOVERED ABOVE ACCESSIBLE CEILINGS SHALL BE REMOVED IN ACCORDANCE WITH NEC REQUIREMENTS.
- EXISTING ELECTRICAL SYSTEMS IN CONFLICT WITH CONSTRUCTION SHALL BE RELOCATED TO PERMIT INSTALLATION OF DEVICES AND EQUIPMENT SHOWN ON PLANS.
- CONTRACTOR SHALL SEAL ALL EXISTING AND NEW PENETRATIONS OF BUILDING ENVELOPE (EXTERIOR WALLS, ROOF, ETC.) WATER-TIGHT AND AS APPROVED BY ARCHITECT AND ENGINEER. ROOFING SHALL BE RESTORED BY A LICENSED ROOFING CONTRACTOR BASED ON WRITTEN INSTRUCTIONS AND DETAILS FROM ROOFING MANUFACTURER AS REQUIRED TO MAINTAIN ROOF WARRANTY. REFER TO ARCHITECTURAL AND ENGINEERING PLANS AND SPECIFICATIONS FOR FURTHER REQUIREMENTS.
- DEVICES INDICATED WITH AN "R" SHALL BE RELOCATED. REMOVE, PROTECT, AND REINSTALL IN NEW LOCATION INDICATED ON NEW WORK PLANS. INTERCEPT AND EXTEND ALL EXISTING CABLING TO NEW LOCATION. CLEAN AND RE-LAMP RELOCATED LUMINAIRES.
- ALL EXISTING PANELS AFFECTED BY THIS CONTRACTOR'S WORK SHALL BE PROVIDED WITH NEW TYPE-WRITTEN PANEL DIRECTORIES AND INSERT SLEEVES. PANEL DIRECTORIES SHALL NOT USE ROOM NAMES OR NUMBERS FROM THESE DRAWINGS. DIRECTORIES SHALL BE DETAILED AND COORDINATED WITH OWNER'S SUITE NUMBERS, FINAL ROOM NUMBERS, IT RACK NAMES, WORKSTATION DESIGNATIONS, ETC. UNUSED BREAKERS SHALL BE IN OFF POSITION.
- CONTRACTOR TO VERIFY THAT THERE ARE NO ELECTRICAL CIRCUITS IN CHASES BEING REMOVED UNDER DEMOLITION WHICH REMAIN IN SERVICE AND CANNOT BE REMOVED. SHOULD SUCH CIRCUITS BE ENCOUNTERED, THE CONTRACTOR IS TO REROUTE AND RECONNECT AS REQUIRED TO MAINTAIN SERVICE.

ELECTRICAL GENERAL NOTES

- EACH CONTRACTOR, PROPOSER, SUPPLIER AND/OR MANUFACTURER SHALL REFER TO ALL DOCUMENTS PERTAINING TO THIS PROJECT AND COORDINATE ACCORDINGLY SO AS TO ENSURE ADEQUACY OF FIT, COMPLIANCE WITH SPECIFICATIONS, PROPER VOLTAGE AND CURRENT CHARACTERISTICS TO AVOID CONFLICT WITH ANY OTHER BUILDINGS SYSTEMS. VERIFY SAME WITH SHOP DRAWINGS.
- ADDITIONAL ELECTRICAL REQUIREMENTS MAY BE SHOWN ON PLANS FROM OTHER DISCIPLINES IN THIS SET. IT IS THE CONTRACTOR'S RESPONSIBILITY TO REVIEW ALL PLANS AND SPECIFICATIONS FOR A COMPLETE UNDERSTANDING OF THE PROJECT REQUIREMENTS.
- WORK SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF ALL LOCAL, STATE, AND NATIONAL CODES. INCLUDING BUT NOT LIMITED TO NFPA 70 (NEC), NFPA 72, INTERNATIONAL BUILDING CODES, ETC.
- CONTRACTOR SHALL FOLLOW SEISMIC RESTRAINT AND DESIGN REQUIREMENTS CONTAINED IN LATEST ADOPTED STATE AND INTERNATIONAL BUILDING CODES, WITH ALL AMENDMENTS AS ADOPTED BY THE CURRENT LEGISLATION. REFER TO ELECTRICAL AND STRUCTURAL SPECIFICATIONS FOR ADDITIONAL INFORMATION.
- ALL OFFSETS, TURNS, FITTINGS, TRIM, DETAIL, ETC. MAY NOT BE INDICATED, BUT SHALL BE PROVIDED AS REQUIRED. ADDITIONAL ALLOWANCES SHALL BE INCLUDED FOR SAME AT EACH PROPOSER'S DISCRETION.
- INSTALL NO PIPING, CONDUIT, DUCTWORK, ETC. IN A LOCATION OR IN A MANNER WHICH WILL ALLOW FREEZING OR THE COLLECTION OF CONDENSATION THEREON. IF IN DOUBT, CONTACT THE ENGINEER.
- ADVISE THE ENGINEER OF ANY CONFLICTS, ERRORS, OMISSIONS, ETC. AT LEAST TEN DAYS PRIOR TO BID DATE, TO ALLOW CLARIFICATION BY WRITTEN ADDENDUM.
- WHERE CONFLICTS ARE FOUND BETWEEN DRAWINGS, DETAILS, OR SPECIFICATIONS, THE MORE STRINGENT REQUIREMENT SHALL APPLY. NOTIFY ARCHITECT OF DISCREPANCY IN WRITING.
- DEVIATION FROM SPECIFICATIONS OR PLANS REQUIRES PRIOR WRITTEN APPROVAL FROM THE ENGINEERS AND MUST BE SUBMITTED IN WRITING NO LATER THAN TEN DAYS PRIOR TO THE BID DATE.
- OBSERVE ALL APPLICABLE CODES, RULES AND REGULATIONS THAT MAY APPLY TO THE WORK UNDER THIS CONTRACT. (CITY, COUNTY, LOCAL, STATE, FEDERAL, MUNICIPALITY, UTILITY COMPANY, OSHA, ETC.).
- MOUNTING HEIGHTS FOR WALL MOUNTED DEVICES INDICATED ABOVE FINISHED FLOOR ARE TO CENTER OF DEVICE UNO. MOUNTING HEIGHTS TO CEILING SUSPENDED DEVICES ARE TO BOTTOM OF DEVICE UNO.
- INSTALL EQUIPMENT, MATERIALS, ETC. IN STRICT ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS AND DIRECTIONS. IF IN CONFLICT WITH THE DESIGN INDICATED IN CONTRACT DOCUMENTS, ADVISE THE ENGINEER PRIOR TO INSTALLATION FOR CLARIFICATION.
- DO NOT RECESS PANELBOARD TUBS OR OTHER FLUSH-MOUNTED EQUIPMENT IN WALLS THAT HAVE A FIRE RATING. NO INSTALLATION SHALL DIMINISH OR VOID FIRE RESISTIVE RATINGS IN ANYWAY.
- THE PURPOSE AND INTENT OF ALL OF THE DOCUMENTS PERTAINING TO THIS PROJECT IS TO PROVIDE A COMPLETE, FUNCTIONAL, SAFE, LIKE-NEW FACILITY. ANYTHING LESS SHALL BE UNACCEPTABLE.
- ALL SYSTEMS, EQUIPMENT AND MATERIALS ARE TO BE INSTALLED IN A NEAT AND WORKMANLIKE MANNER. WORK NOT MEETING THIS CRITERION SHALL BE REMOVED AND REINSTALLED SATISFACTORILY. FINAL DETERMINATION OF THE ACCEPTABILITY OF THE QUALITY OF WORK RESIDES WITH THE ENGINEER
- ALL WORK, MATERIALS, EQUIPMENT, ETC. SHALL BE FULLY GUARANTEED FOR ONE FULL CALENDAR YEAR FROM THE DATE OF SUBSTANTIAL COMPLETION AS DOCUMENTED BY THE ENGINEER, UNLESS LONGER WARRANTY PERIODS FOR EQUIPMENT ARE SPECIFIED.
- UNLESS OTHERWISE SPECIFIED OR INDICATED, ALL EQUIPMENT AND/OR MATERIALS WITHIN OCCUPIED SPACES OR EXPOSED TO VIEW ON THE BUILDING EXTERIOR SHALL BE PRIMED AND FINISHED SO AS TO COMPLEMENT ADJACENT SURFACE, UNLESS OTHERWISE NOTED. COORDINATE WORK AND COLORS WITH ARCHITECT.
- WHERE PENETRATING ROOFING MEMBRANE OR OTHER MATERIALS USED FOR WEATHERPROOFING THE BUILDING, MAKE SUCH PENETRATION IN A WAY THAT WILL NOT VOID OR DIMINISH THE ROOFING WARRANTY OR INTEGRITY IN ANYWAY. COORDINATE ALL SUCH PENETRATIONS WITH THE ROOFING MANUFACTURER AND ARCHITECT.
- THE CONTRACTOR IS RESPONSIBLE FOR ALL UTILITY COMPANY FEES, CASH CONTRIBUTIONS OR OTHER COSTS THAT THE UTILITY COMPANY MAY REQUIRE TO COMPLETE THEIR WORK. (ELECTRIC, TELEPHONE, TELEVISION, DATA, ETC.).
- COORDINATE WITH ARCHITECTURAL FLOOR PLANS, ELEVATIONS AND CASEWORK DETAILS FOR LOCATION OF ADDITIONAL RECEPTACLES, UTILITY OUTLETS, ELECTRICAL DEVICES, ETC.
- CEILING-MOUNTED ELECTRICAL DEVICES SHALL BE CENTERED IN 2'X2' CEILING TILE AND INSTALLED CENTERED ON 2' DIMENSION OF 2'X4' TILE AND ON CENTERLINE OR A QUARTER POINT ON 4' DIMENSION.
- ANY VIBRATING, OSCILLATING OR OTHER NOISE OR MOTION PRODUCING EQUIPMENT SHALL BE ISOLATED FROM SURROUNDING SYSTEMS IN AN APPROVED MANNER. NOISY OR STRUCTURALLY DAMAGING INSTALLATIONS SHALL BE SATISFACTORILY REPLACED OR REPAIRED AT THE INSTALLING CONTRACTORS' EXPENSE. THE FINAL DECISION ON THE SUITABILITY OF A PARTICULAR INSTALLATION'S ACCEPTABILITY SHALL BE THAT OF THE ENGINEER.
- CHECK ALL THREE PHASE MOTORS WITH A PHASE ROTATION METER, PRIOR TO PLACING IN SERVICE.
- PROVIDE DETAILED SHOP DRAWINGS TO ENGINEER PRIOR TO PURCHASING OR INSTALLING ANY EQUIPMENT
- DEVIATIONS IN SIZES, CAPACITIES, FIT, FINISH, ETC. FOR EQUIPMENT FROM THAT PRIME SPECIFIED SHALL BE THE RESPONSIBILITY OF THE PURCHASER OF THAT EQUIPMENT. ANY PROVISIONS REQUIRED TO ACCOMMODATE A DEVIATION, WHETHER APPROVED BY THE ENGINEER OR NOT, SHALL BE THE RESPONSIBILITY OF THE PURCHASER.
- THE CONSTRUCTION MANAGER, GENERAL CONTRACTOR, OR WHOMEVER HOLDS THE PRIME CONTRACT(S) FOR THIS CONSTRUCTION IS RESPONSIBLE FOR THE COORDINATION, APPEARANCE, SCHEDULING AND TIMELINESS OF THE WORK OF ALL TRADES, CONTRACTORS, SUPPLIERS, INSTALLERS, ETC. POOR OR UNTIMELY WORK ON THE PART OF ANY SUBCONTRACTOR SHALL BE RESOLVED BY THE PARTY WHO ENGAGED THEM ON THIS PROJECT.
- WHERE MOUNTING HEIGHTS ARE NOT INDICATED OR ARE IN CONFLICT WITH ANY OTHER BUILDING SYSTEM, CONTACT THE ENGINEER BEFORE AFFECTING INSTALLATION. REFER ALSO TO ARCHITECTURAL INTERIOR AND EXTERIOR ELEVATIONS, CEILING HEIGHTS AND OTHER DETAILS OF THESE DOCUMENTS, AS APPLICABLE.
- WHERE FIRE-RATED CEILING ASSEMBLIES ARE NOTED, PROVIDE UL-LISTED FIRE-RATED GYPSUM BOARD OR PRE-MANUFACTURED ENCLOSURES ABOVE LUMINAIRES, CEILING DEVICES, ETC. IN OR ON CEILING, AS REQUIRED TO MAINTAIN CEILING RATINGS.

ELECTRICAL GENERAL NOTES

- COORDINATE THE LOCATION OF DRAINS, ELECTRICAL OUTLETS, GAS OUTLETS, ETC. WITH ALL CASEWORK, KITCHEN EQUIPMENT, MECHANICAL ROOM EQUIPMENT, ETC. PRIOR TO COMMENCING INSTALLATION. WORK NOT SO COORDINATED SHALL BE REMOVED AND PROPERLY INSTALLED AT THE EXPENSE OF THE RESPONSIBLE CONTRACTOR(S).
- ALL ELECTRICAL COMPONENTS OR EQUIPMENT SHALL BE LISTED AND LABELED BY UNDERWRITER'S LABORATORIES OR OTHER APPROVED LISTING AGENCY. APPROVAL AND LABELING OF INDIVIDUAL COMPONENTS ON AN ASSEMBLY IS NOT ACCEPTABLE AS MEETING THIS REQUIREMENT, UNLESS WAIVED BY THE ENGINEER IN WRITING.
- ALL WIRING SYSTEMS SHALL BE INSTALLED WITH A MINIMUM OF SPLICES. CONDUCTORS, WHETHER SINGLE OR MULTI-PAIR, SHALL BE INSTALLED CONTINUOUS INSOFAR AS POSSIBLE FROM TERMINAL POINT TO TERMINAL POINT.
- NO CONDUIT, SUPPORTS, ETC. SHALL BE RUN THROUGH ACCESS CLEARANCES OF EQUIPMENT BY OTHER TRADES (I.E. VAV BOXES). COORDINATE WITH ALL TRADES PRIOR TO CONSTRUCTION.
- ALL CONTRACTORS SHALL EXERCISE EXTREME CARE IN THE COURSE OF THEIR WORK SO AS TO ENSURE THAT THEY DO NOT INTERRUPT ANY EXISTING SERVICE OR SUB-SERVICE FOR SAFETY PURPOSES. PAY PARTICULAR ATTENTION TO THIS PRECAUTION RELATIVE TO NATURAL GAS AND ELECTRICAL LINES. VERIFY THE LOCATION, SIZE, TYPE, ETC. OF EACH UNDERGROUND OR OVERHEAD UTILITY. ALL WORK SHALL BE PERFORMED IN ACCORDANCE WITH ALL FEDERAL, STATE AND/OR LOCAL RULES, REGULATIONS, STANDARD AND SAFETY REQUIREMENTS. UTILITIES SHALL BE INSTALLED IN ACCORDANCE WITH THE APPLICABLE MUNICIPALITY OR UTILITY COMPANY STANDARDS. IN ALL CASES, THE MOST STRINGENT REQUIREMENT SHALL APPLY.
- ALL SUPPORTS FOR EQUIPMENT, DEVICES OR FIXTURES SHALL BE UNIQUE, DIRECTLY FROM THE BUILDING STRUCTURE. DO NOT SUPPORT WORK FROM OTHER TRADES EQUIPMENT OR SUPPORTS WITHOUT WRITTEN PERMISSION FROM THE ENGINEER AND CONSENT OF THE OTHER TRADE, IN WRITING.
- WHERE INTERRUPTING AN EXISTING UTILITY OR SERVICE DELIBERATELY OR ACCIDENTALLY, THE RESPONSIBLE CONTRACTOR SHALL WORK CONTINUOUSLY AS NEEDED TO RESTORE SAME, PROVIDING PREMIUM TIME AS NEEDED.
- REFER TO ARCHITECTURAL WALL ELEVATIONS (WHERE GIVEN) FOR HEIGHTS AND MOUNTING RELATIONSHIP OF OUTLETS AND EQUIPMENT. IF IN DOUBT, CONTACT ENGINEER FOR DIRECTION PRIOR TO ROUGH IN.
- FLUSH OR PEDESTAL TYPE FLOOR OUTLETS/BOXES, AS INDICATED ON PLAN, SHALL BE LOCATED BY DIMENSIONS PROVIDED BY THE ARCHITECT, UNLESS OTHERWISE SHOWN ON PLANS. IF IN DOUBT, CONTACT THE ENGINEER PRIOR TO ROUGHING-IN ANY WORK.
- AS APPLICABLE, REFER TO ARCHITECTURAL PHASING PLANS AND PHASING BOUNDARIES ON THESE DRAWINGS FOR SEQUENCING OF WORK, FULL EXTENT OF AREAS INVOLVED, EXTENT OF CEILING WORK, ETC. PROVIDE TEMPORARY CONNECTIONS FOR CIRCUITS AND WORK AS REQUIRED TO MAINTAIN SEQUENCE OF THE WORK FROM PHASE TO PHASE.
- THIS CONTRACTOR SHALL BE RESPONSIBLE FOR ALL CUTTING AND PATCHING REQUIRED FOR HIS WORK. ALL CUTTING AND PATCHING SHALL BE IN ACCORDANCE WITH THE ARCHITECT'S STANDARDS FOR SUCH WORK.
- ALL WORK SHALL BE CONCEALED UNLESS SPECIFICALLY INDICATED TO BE EXPOSED, OR REQUIRED TO BE EXPOSED. IF IN DOUBT, CONTACT THE ENGINEER FOR CLARIFICATIONS PRIOR TO INSTALLING ANY SUCH WORK.
- INTERRUPTION OF ANY EXISTING SERVICES SHALL BE COORDINATED WITH THE OWNER, GENERAL CONTRACTOR, UTILITY COMPANY AS NECESSARY, AND THE ARCHITECT, AT LEAST TWO WEEKS IN ADVANCE OF ANTICIPATED INTERRUPTION. A SCHEDULE FOR THESE OUTAGES SHALL BE DEVELOPED AND AGREED UPON BETWEEN THE PARTIES MENTIONED TO AVOID UNNECESSARY INCONVENIENCE TO THE OWNER OR ANY AFFECTED PARTY. NOTIFY THE UTILITY COMPANY OF ANY ANTICIPATED SERVICES REQUIRED TWO WEEKS IN ADVANCE, IN WRITING. IF UTILITY COMPANY REQUIRES A LONGER NOTIFICATION PERIOD, SO PROVIDE.
- WHERE BACKBOXES ARE LOCATED IN THE SAME VERTICAL CHANNEL/STUD SPACE ON OPPOSITE SIDES OF THE SAME WALL, PROVIDE SOUND-INSULATING PUTTY AROUND BOXES AS REQUIRED TO ELIMINATE SOUND TRANSMISSION FROM ROOM TO ROOM.
- JUNCTION BOXES LOCATED ABOVE ACCESSIBLE CEILINGS SHALL BE LOCATED NO MORE THAN 36" ABOVE CEILING LEVEL. LABEL EACH BOX IN AREA OF WORK WITH A PERMANENT MARKER OR IN ACCORDANCE WITH SPECIFICATIONS, WHICHEVER IS MORE STRINGENT.
- ALL MATERIALS FURNISHED AND ALL WORK INSTALLED SHALL COMPLY WITH THE CURRENT EDITION OF THE NATIONAL ELECTRICAL CODES, NATIONAL FIRE CODES OF THE NATIONAL FIRE PROTECTION ASSOCIATION, THE REQUIREMENTS OF LOCAL UTILITY COMPANIES, AND WITH THE REQUIREMENTS OF ALL GOVERNMENTAL AGENCIES OR DEPARTMENTS HAVING JURISDICTION. IF ANY CONFLICTS OR DISCREPANCIES OCCUR THE MOST STRINGENT SHALL APPLY.
- DO NOT SCALE FROM DRAWINGS, AS PRINTING DISTORTS SCALE. WORK SHALL BE LAID OUT FROM DIMENSIONED DRAWINGS, OR DIMENSIONS SUPPLIED TO THE CONTRACTOR.
- NOISY WORK, WORK OUTSIDE CONSTRUCTION BARRIERS, WORK IN OCCUPIED AREAS, ETC. SHALL BE PERFORMED AFTER HOURS OR ON WEEKENDS. COORDINATE EXACT SCHEDULING WITH FACILITY PRIOR TO CONSTRUCTION.
- ALL ITEMS HAVING KEYED LOCKS/OPERATORS SHALL HAVE CORED LOCKS/OPERATORS. ALL KEYING SHALL MATCH THE OWNER'S EXISTING KEY-WAYS. COORDINATE EXACT REQUIREMENTS WITH OWNER PRIOR TO CONSTRUCTION.
- REFER TO ARCHITECTURAL PLANS FOR PHASING REQUIREMENTS. WORK SHALL BE COMPLETED IN PHASES PER THE PHASING PLAN AND AS COORDINATED WITH OWNER AND GENERAL CONTRACTOR. PROVIDE ALL REQUIRED INCREMENTAL INSPECTIONS, CERTIFICATIONS, ETC. AND ALL TEMPORARY SERVICES AS REQUIRED BY OWNER TO ACCOMPLISH THE PHASING PLAN.

TAGGED NOTES

E1 DEMO ELECTRICAL CONNECTION TO EXISTING EQUIPMENT.

E2 EXISTING ELECTRICAL GEAR IS GENERAL ELECTRIC 8000 LINE CONTROL CENTER - CAT NO 597X0702F01. 600A 480V/3PH 3 WIRE. ALL WORK ASSOCIATED OR MODIFICATIONS TO THIS GEAR TO SUPPORT NEW EQUIPMENT IS RESPONSIBILITY OF THE CONTRACTOR.

E3 PROVIDE NEW ELECTRICAL CONNECTION TO CHILLER CH-1. ROUTE CIRCUIT TO EXISTING MOTOR CONTROL CENTER, 3#350, 1#3G., IN 3" CONDUIT. PROVIDE NEW 300A RK FUSES IN EXISTING BUCKET.

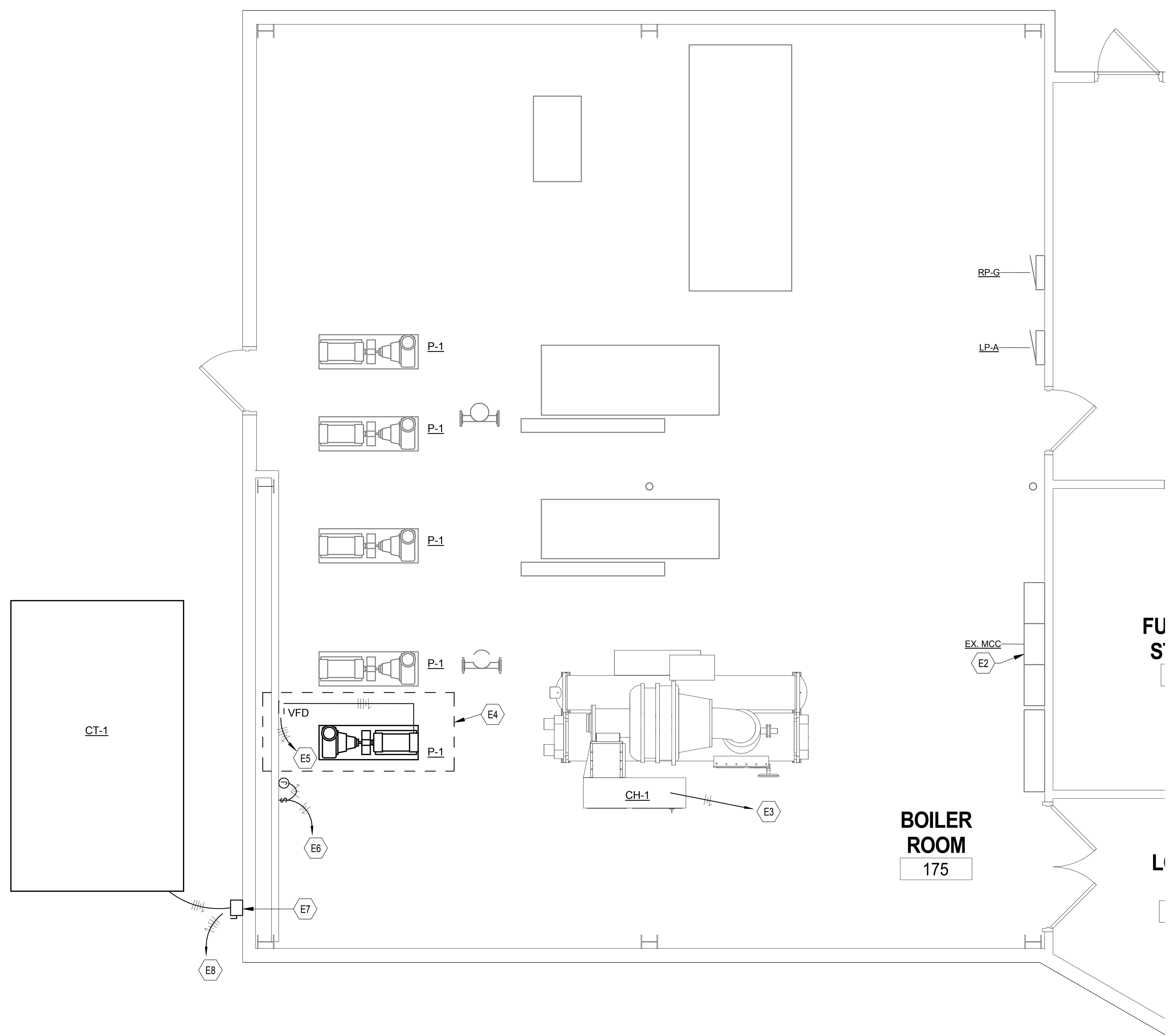
E4 ALL WORK ASSOCIATED WITH P-1 SHALL BE PRICED AS AN ALTERNATE. ALTERNATE 1.

E5 PROVIDE PUMP CONNECTION FROM EXISTING MCC. UTILIZE EXISTING BUCKET CURRENTLY SERVING PUMP, PROVIDE NEW 30A FUSES, 3#10, 1#10 GND, IN 3/4" CONDUIT.

E6 PROVIDE 30A MOTOR-RATED SNAP SWITCH, JUNCTION BOX AND CONNECTION TO HEAT TRACE SERVING COOLING TOWER PIPING. INCLUDE 2#10, 1#10 GND IN 3/4" CONDUIT TO PANEL RP-G, 20A/1P BREAKER.

E7 PROVIDE NEMA 3R 60A HEAVY-DUTY DISCONNECT MOUNTED TO BUILDING. ROUTE WIRE AND FLEXIBLE LIQUID-TIGHT CONDUIT TO UNIT.

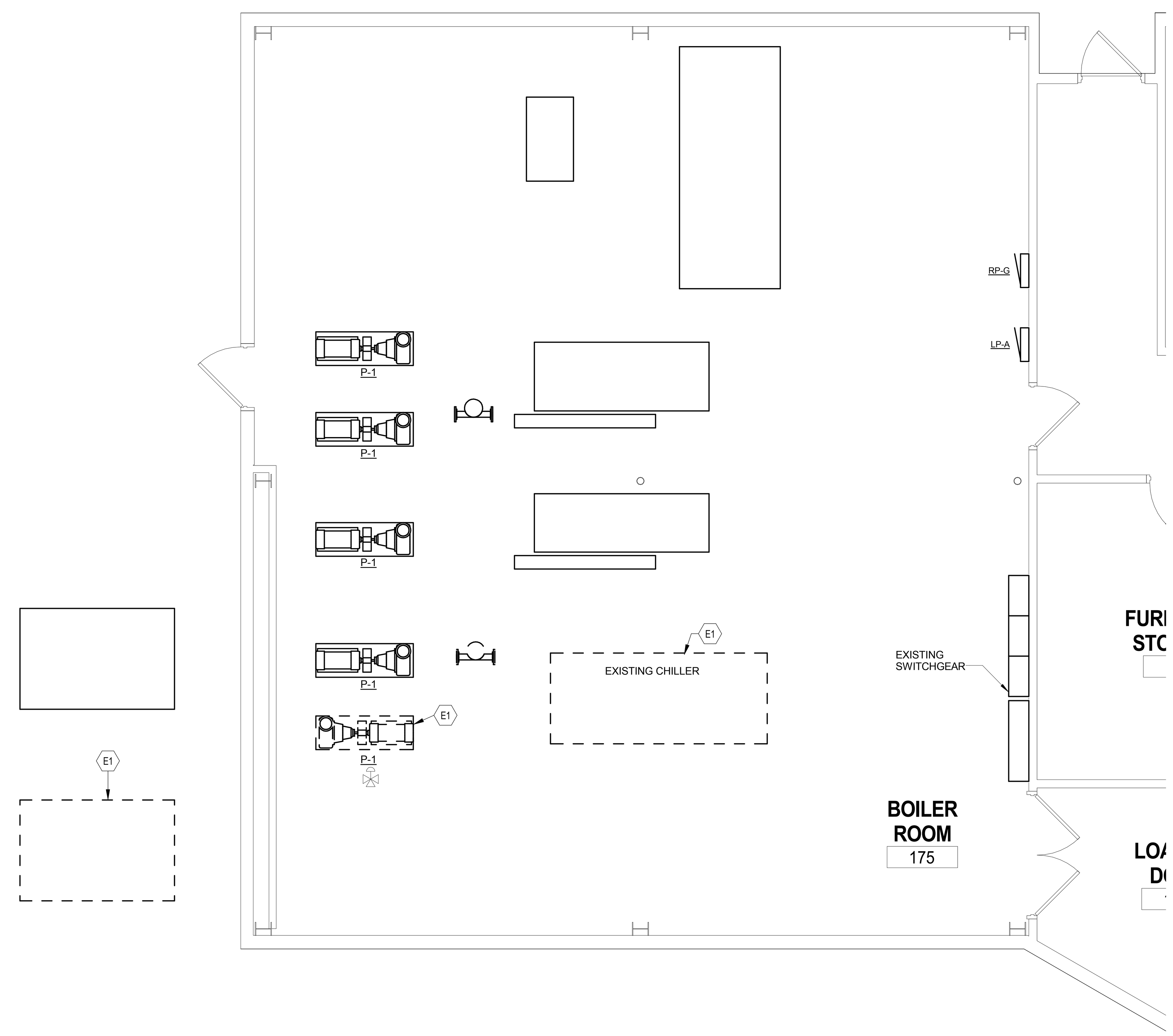
E8 PROVIDE COOLING TOWER CONNECTION FROM EXISTING MCC. UTILIZE EXISTING BUCKET CURRENTLY SERVING COOLING TOWER. PROVIDE NEW 45A FUSES, 3#6, 1#10 GND IN 1" CONDUIT.



2 POWER NEW WORK PLAN

SCALE: 1/4" = 1'-0"

0 1' 2' 4' 8' 12' 16'



1 POWER DEMOLITION PLAN

SCALE: 1/4" = 1'-0"

0 1' 2' 4' 8' 12' 16'

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ELECTRICAL PLANS

PROJECT #:	XNCR16
DATE:	JANUARY 2017
DRAWN:	MS
CHECKED:	BWR

REVISIONS

E1.0