ROGERS STATE UNIVERSITY
PHYSICAL PLANT

Request for Bids
Claremore Campus
Geothermal Upgrade Project

Rogers State University
Claremore, OK

RFB 2425-13

ROGERS STATE UNIVERSITY
PHYSICAL PLANT

REQUEST FOR BID No.: RFB 2425-13

NON -MANDATORY PRE-BID MEETING DATE / TIME: February 7, 202522 at 10:00 am
PRE-BID MEETING LOCATION: Claremore Campus – Physical Plant – Conference Room

BID DUE DATE:
March 5, 2025
BID OPENING TIME:
1:30 pm*
BID OPENING LOCATION: Claremore Campus – Physical Plant – Conference Room

*Bids received more than ninety-six (96) hours before the time set for receiving bids as well as bids received after the time set for receipt of bids will not be considered, and will be returned unopened.

SEALED BIDS ARE TO BE SENT TO:
1701 W. Will Rogers Blvd.
Claremore, OK 74017
Attention: Christie Lamberson – Procurement Coordinator
RE: RFB 2425-13– Geothermal Upgrade Project

Bid documents may be obtained by calling the purchasing contact listed below. Project documents can also be obtained online at http://www.rsu.edu/about/offices-services/purchasing/bids-proposals/. Sealed Bids are to be turned into the purchasing contact listed below before the due date and time. Late bids may be returned and not considered as a valid response. Contractors are encouraged to respond with a no-bid if they do not wish to be considered for this opportunity but do wish to remain on the active contact list. Electronic or unsealed bids are not acceptable.

UNIVERSITY CONTACTS:

Contractors are encouraged to contact the using Division's personnel to obtain clarification of the technical requirements of this "Request for bid". However, any modification to the requirements of this "Request for bid" must be enacted by the issuance of a written addendum from the Purchasing Department. Conflicting instructions given by personnel within the using Division, that are not substantiated by a written addendum issued by the Purchasing Department, will not be binding upon the University.

	For information regarding the general provisions of this 'Request for bid', contact:	For clarification of the technical requirements of this 'Request for bid', contact:
NAME:	**Christie Lamberson, Procurement Coordinator**	**Karl Reynolds Physical Plant Director or George Proctor Assistant Director**
TELEPHONE No.:	**918.343.7790**	**918-343-7818**
FAX No.:	**918.343.7817**	**918-343-7808**
E-MAIL ADDRESS:	**clamberson@rsu.edu**	**krevnolds@rsu.edu or gproctor@rsu.edu**

NON-MANDATORY PRE-BID MEETING:

1. Contractors are encouraged to attend a pre-bid meeting on Friday, February 7, 2025 at 1:30 pm at the Claremore Campus – Physical Plant – Conference Room.

2. After the initial pre-bid meeting, contractors will be provided a tour of each building represented in the project manual.

BID STATUS AND SUBMISSION INFORMATION:

1. Rogers State University shall have the right to reject any or all bids and solicit contractors again as herein provided if the best interests of the people of the State of Oklahoma would be best served by so doing. Further, the University reserves the right to award on an all or none basis, by item or groups of items in order to achieve the overall lowest cost.

2. Offers may be withdrawn at any time prior to the closing date, but no respondent may withdraw a bid after that date.

3. RFBs must demonstrate an understanding of the scope of service to be provided and the ability to accomplish the tasks set forth and must include information that will enable the University to determine the respondent's overall qualifications.

4. Any bid received by Rogers State University or an officer or employee thereof after the time set for the opening of bids may be returned unopened and not considered as a valid response to the RFB.

5. The University reserves the right to request additional information or clarification on any matter included in the bid.

6. All signatures must be affixed and notarized on the forms and attachments provided in this bid.

7. All bids shall be sealed and opened only at the time and place mentioned herein.

8. Submission of a bid will constitute an incontrovertible representation by the contractor; that (s) he has complied with every requirement of this bid.

9. The University reserves the right to waive minor informalities in bids and to split the award if in the best interest of the University.

CONDITIONS:

1. The University reserves the right to require the successful contractor to execute a written agreement for the provision of the product(s) and / or service(s) offered as a result of this bid solicitation. The resulting contract will incorporate this RFB solicitation, the response thereto, all additional agreements and stipulations, and the results of any final negotiations. All of these documents will constitute the final contract.
2. The contract shall contain all specifications, terms, and conditions in the bid and the bid form except as amended in the 'Award Notice'.
3. All changes to the contract must be mutually agreed to, in writing, prior to execution.
4. The parties hereby agree that no trade usage, prior course of dealing or course of performance under other contracts shall be a part of this agreement or shall be used in the interpretation or construction of this agreement.
5. Any exceptions taken by the contractor which are not included in the 'Award Notice' will not be part of the contract.
6. No delay or failure to enforce any provision of this agreement shall constitute a waiver or limitations of the University's rights under any resulting contract.
7. By submitting a bid to Rogers State University, the Contractor is required to adhere to and submit the following forms at the time of the bid submittal:
    a. The contractor agrees to comply with Equal Employment Opportunity and Affirmative Action requirements as stipulated in Executive Order 11246 and Executive Order 11375 (see attached).

b. Oklahoma laws require each contractor submitting a competitive offer to the State of Oklahoma for goods or services to furnish a notarized sworn 'Statement of Non-Collusion' (see attached).

c. Each contractor shall execute and forward a 'Business Relationship Affidavit' with the bid (see attached).

d. Oklahoma laws require each contractor submitting an offer to the State of Oklahoma for goods or services to furnish a notarized sworn "Sex Offender Affidavit" (see attached).

e. Oklahoma laws require each contractor submitting an offer to the State of Oklahoma for goods or services to furnish a Bid Bond. (see attached)

8. By submitting a bid to Rogers State University, the contractor is required to adhere to and submit the following forms at the time of contract:

a. Successful Suppliers shall, prior to beginning any work under any contract that may result under this RFP, as applicable, or as required by State or Federal law, acquire and have in effect minimum insurance coverage as set forth in the following table. The said minimum amounts are not intended to limit and do not or reduce any Supplier's liability:

Coverage Type:	***Minimum Amount:***
Workers' Compensation	Statutory
Commercial General Liability Insurance	$1,000,000
Property Damage	$1,000,000
Auto-Owned, Hired and Non-Owned	$1,000,000
Per-Occurrence for All Claimants and Coverage	$2,000,000

b. Successful Suppliers shall carry on their work in accordance with the requirements of the workers compensation law of the State of Oklahoma, and shall not reject the provisions thereof during the life of the contract. Successful Suppliers shall also protect themselves using liability coverage against any and all claims for damages to persons or property which may arise out of operations under the contract, whether such operations be by the contractor, subcontractor, or anyone directly employed by either of them.

c. Prior to commencement of work under any contract which may result from this RFP, Successful Suppliers shall purchase and maintain property insurance coverage for the full insurable value of the property at the site of such work. If the policy evidencing such insurance coverage stipulates a deductible amount, Successful Suppliers shall pay the difference attributable to such deductible in any payments made by the insurance carrier on claims paid by such carrier. The University will not purchase insurance relative to this RFP unless otherwise stated herein.

9. Successful Suppliers shall file certificates of such insurance with the University, and such related coverage shall be subject to the University's approval.

10. Rogers State University is exempt from State Sales Tax and Federal Excise Tax. The exemption authority is Oklahoma State Tax Code, Title 68, OS 1981, Article 13, Section 1356 and Federal Tax Exempt No. 736017987.

11. It is mutually agreed by and between the University and the contractor that the University's acceptance of the contractor's offer by the issuance of an 'Award Notice' shall create a contract between the parties thereto.

12. In the event of a conflict between the terms and conditions of the bid and information submitted by a contractor, the terms and conditions of this bid and resulting "contract" will govern.

13. **Termination for Cause** - The University may terminate the Contract for default or other just cause with a 30-day written request and upon written approval from the procuring agency. The University may terminate the Contract for default or any other just cause upon a 30-day written notification to the contractor.

The University may terminate the Contract, in whole not in part, without penalty or expense, at the end of any fiscal year of the University, if the legislature or other appropriate governmental entity fails to allocate sufficient funds to the University for the payments required or activities contemplated under the Contract.

The University may terminate the Contract immediately, without a 30-day written notice to the supplier, when violations are found to be an impediment to the function of an agency and detrimental to its cause, when conditions preclude the 30-day notice, or when the procuring agency determines that an administrative error occurred prior to

Contract performance.

If the Contract is terminated, the University shall be liable only for payment for products and/or services delivered and accepted.

14. **Termination for Convenience -** The University may terminate the Contract, in whole or in part, for convenience if the procuring agency determines that termination is in the University's best interest. The procuring agency shall terminate the Contract by delivering to the supplier a Notice of Termination for Convenience specifying the terms and effective date of Contract termination. The Contract termination date shall be a minimum of 60 days from the date the Notice of Termination for Convenience is issued by the procuring agency.

15. To the extent applicable by Okla. Stat. Ann. tit. 25, §1313, or Exec. Order No. 12989, 8 USCA §1324a (Feb. 13, 1996) as amended in 73 Fed. Reg. 33285 (June 6, 2008), Consultant or Contractor certifies that it is registered with and participates in the Status Verification System (SEVIS"). Further, in accordance with Okla. Stat. Ann. tit. 68, §2385.32, Consultant or Contractor verifies that it and its employees are authorized to work in the United States in accordance with the employment authorization found in 8 U.S.C. §1324(a)(4)."

16. Public Record

    After response acceptance and execution of all contracts and agreements resulting from this RFB, each Respondents bid will become public record and will be available by written request to RSU Purchasing Department. 1701 W Will Rogers Blvd, Claremore, OK 74017, FAX 918-343-7817.

GRATUITIES AND KICKBACKS.

1. A Rogers State University official or employee, or their immediate relatives, shall not accept anything of value whether in the form of a gift, service, loan, donation or promise from any person which may impair his or her independence of judgment or action in the performance of his or her official duties.

2. No donation or payment of a gratuity or kickback shall be made by or on behalf of any person and be accepted by any Rogers State University official or employee as an inducement or reward for the action in procuring the award of any contract or order.

INDEMNIFICATION REQUIREMENTS.

1. The following requirements are mandatory for protecting the interests of the University:

2. The successful contractor shall keep the University free and clear from all liens asserted by any person or firm for any reason arising out of the furnishing of services or materials by or to the contractor.

3. The successful contractor shall indemnify and hold the University harmless from all contractors' performance under the resulting contract.

4. The resulting contract shall be construed under the laws of the State of Oklahoma and venue in any action to enforce the contract shall be in a court of competent jurisdiction in Oklahoma.

5. The actions of the successful contractor with third parties are not binding upon the University. The contractor is not a division of the University.

6. The Contractor shall protect and indemnify the University, its officers, and agents against any claims of liability arising from or based on any violation thereof.

OBSERVING LAWS AND REGULATIONS.

1. The Contractor shall remain fully informed of, and shall faithfully observe, all laws, national and state, and all ordinances and regulations affecting the responsibility to the University, or affecting the rights of his / her employees.

2. Provider shall not discriminate because of race, color, religion, sex, age, national origin, sexual orientation, genetic information, disability or status as a Vietnam veteran, as defined and prohibited by applicable law, in any of its policies, practices or

   procedures. In addition, each party affirms that it is an equal opportunity and affirmative action employer and shall comply with all applicable federal, state and local laws and regulations including, but not limited to, Executive Order 11246 as amended by 11375 and 12086; 12138; 11625; 11758; 12073; the Rehabilitation act of 1973, as amended; the Vietnam Era Veterans Readjustment Assistance Act of 1975; Civil Rights Act of 1967; Immigration Reform and Control Act of 1986; Public Law 95-507; the Americans With Disabilities Act and any additions or amendments thereto.

3. Provider shall participate in the E-Verify program as required by Oklahoma statutes to enforce the provision of Oklahoma's immigration law to prove the legal status of the provider's employees. The E-Verify website is: http://www.uscis.gov/portal/site/uscis/menuitem.eb1d4c2a3e5b9ac89243c6a7543f6d1a/?vgnextoid=75bce2e261405110VgnVC M1000007718190aRCRD&vgnextchannel=75bce2e261405110VgnVCM1000007718190aRCRD.The E-Verify program, formerly known as the Department of Homeland Security's Basic Pilot Program or the Employment Eligibility Verification System, is jointly administered by the Department of Homeland Security through the United States Citizenship and Immigration Services and the Social Security Administration. This Program allows participating employers to verify whether newly hired employees are authorized to work in the United States by checking the information provided by the employees on their Form I-9 against the Department of Homeland Security through the United States Citizenship and Immigration Services, and the Social Security Administration databases.

QUALIFICATIONS OF CONTRACTORS.

1. Rogers State University may make such investigations as deemed necessary to determine the ability of the contractor to perform the work or provide a product, and the contractor shall furnish to Rogers State University all such information and data for this purpose.

2. Rogers State University reserves the right to reject any bid if the evidence submitted by, or investigation of, such contractor fails to satisfy that they are qualified to carry out the obligations of the contract and to complete the work or provide the product contemplated therein.

3. Each contractor must complete and submit with bid an AIA A305 Contractors Qualification Statement. A sworn statement providing evidence such as financial data, previous experience and evidence of authority to conduct business in the jurisdiction where the project is located.

RECOMMENDED PREPARATION:

Before submitting a bid, it is recommended that each interested party perform the following actions:

1. Visit the site to familiarize himself / herself with local conditions that may in any manner affect cost, progress, or performance of the work.

2. Familiarize himself / herself with federal, state and local laws, ordinances, rules and regulations that may in any manner affect cost, progress, or performance of the work.

3. Make any investigations and tests the contractor may deem necessary to determine his/her bid for performance of the work in accordance with the time, price, and other terms and conditions of the contract documents.

4. Determine the bid documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance of the work.

5. Ensure all information required herein be submitted with the bid response. Failure to provide the information may result in rejection of the offer.

BID SUBMISSION FORMAT:

1. Each contractor shall include all requirements, terms or conditions they may have and shall not assume that an opportunity will exist to add such matters after the bid has been submitted. Unacceptable terms and conditions added by the contractor may cause the University to award to another contractor, despite other factors of the evaluation.
2. A bidder on public construction contract exceeding fifty thousand dollars ($50,000.00) shall accompany the bid with: A certified check, cashier's check or bid bond equal to five percent (5%) of the bid, which shall be d eposited with Rogers State University As a guaranty.

ASSURANCE OF COMPLETION

1. Unless otherwise provided in State law, the successful bidder shall furnish an assurance of completion prior to the execution of any contract under this solicitation in the form of a performance, payment, and defect bond in a penal sum of 100 percent of the contract price; or, as may be required or permitted by State law;

2. Bonds must be obtained from guarantee or surety companies acceptable to the U.S. Government and authorized to do business in the State of Oklahoma where the work is to be performed.

BID FORM

RFB 2425-13– GEOTHERMAL HYDRONIC ACCESSORIES PROJECT

TO: ROGERS
STATE University
Claremore, Rogers
County, Oklahoma

To Whom It May Concern,

Having Carefully Examined the Specifications and Having Visited the Site & Examined all Conditions Affecting the Work, the Undersigned Proposes to Furnish All Labor, Materials, and Incidentals Called for by Said Documents for Complete Services Described Herein:

TOTAL BASE PRICE FOR GEOTHERMAL UPGRADE PROJECT

The Undersigned Agrees to Perform all Work Required by the Request for bid for the sum of:

($_____)

(_____Dollars)
(Amount shall be shown in both words and figures; in case of discrepancy, the amount in writing shall govern.)

ADD ALTERNATE NO. 1 –PAD AT PREPARATORY HALL

The Undersigned Agrees to Perform all Work Required by the Request for bid for the sum of:

($_____)

(_____Dollars)
(Amount shall be shown in both words and figures; in case of discrepancy, the amount in writing shall govern.)

ACKNOWLEDGMENT OF ADDENDA (if applicable):

Addendum No. 1 Date_____ Addendum No. 2 Date_____ Addendum No. 3 Date_____

I hereby certify that I have the authority to submit an offer of pricing on behalf of my company and that I have read and understand the terms and conditions of the bid.

_____ _____
(Typed or Printed Name) (Signature)

_____ _____
(Title) (Date)

_____ _____
(Company Name) (Federal Identification #)

_____ _____
(Company Address) (Company Telephone Number)

_____ _____
(Company City, State & Zip Code) (Company Fax Number

Subscribed and sworn to before me this__day of_____, 20___.

_____ _____
(Notary Public (or Clerk or Judge) My Commission Expires):

Check-list of Items required at the time of bid submittal:

- ☐ Bid Bond
- ☐ Signed and notarized copy of the entire bid request
- ☐ Addendum (if any)
- ☐ Business-relationship affidavit
- ☐ Non-collusion affidavit
- ☐ Equal Employment Opportunity and Affirmative Action Affidavit
- ☐ Sex Offenders Affidavit

Failure to provide necessary documents and/or bonds will invalidate your bid submittal.

Non Collusion Affidavit

State Of: _____

County Of: _____

_____, _____, of lawful age being
first duly sworn, on (Name) (title)

oath says that:

1 (s)he is the duly authorized agent of_____, the contractor and/or Contractor submitting the bid and/or procuring the contract which is attached to this statement, for the purpose of certifying the facts pertaining to the existence of collusion among contractors and between contractors and state officials or employees, as well as, facts pertaining to the giving or offering of things of value to the government personnel in return for special consideration in the letting of any contract to which this statement is attached;

2 (s)he is the fully aware of the facts and circumstances surrounding the making of the bid and/or the procurement of the contract to which this statement is attached and has been personally and directly involved in the proceedings leading to the submission of such bids; and

3 Neither the contractor nor anyone subject to the contractor's direction or control has been a party:

a) to any collusion among contractors in restraint of freedom of competition by agreement to bid at a fixed price or to refrain from submitting a bid;
b) to any collusion with any state official or employee as to quantity, quality or price in the prospective contract, or as to any other terms of such prospective contract, or as to any other terms of such prospective contract, nor
c) in any discussions between contractors and any state official concerning exchange of money or other thing of value for special consideration in letting of a contract,
d) to paying giving or donating or agreeing to pay, give or donate to any officer or employee of the State of Oklahoma, any money to other thing of value, either directly or indirectly, in procuring the contract to which this statement is attached.

Subscribed and sworn before me this_____day of_____, 2_____.

_____
NOTARY PUBLIC (or CLERK or JUDGE)

(My commission expires)

Business Relationship
Affidavit

BUSINESS RELATIONSHIPS AFFIDAVIT

STATE OF_____)
_____) SS. COUNTY OF___)

_____, Lawful age, being first duly sworn, on oath says that (s)he is the agent authorized by the vendor to submit the attached bid. Affiant further states that the nature of any partnership, joint venture, or other business relationship presently in effect or which existed within one (1) year prior to the date of this statement with the architect, engineer, or other party to the project is as follows:

_____
_____
_____

Affiant further states that any such business relationship presently in effect or which existed within one (1) year prior to the date of this statement between any officer or director of the preparing company and any officer or director of the architectural or engineering firm or other party to the project is as follows:

_____
_____
_____

Affiant further states that the names of all persons having any such business relationships and the positions they hold with their respective companies or firms are as follows:

_____
_____
_____

(If none of the business relationships herein above mentioned exist, affiant should so state.)

_____

Subscribed and sworn to before me this _____ day of _____, 20___.

_____ _____
Notary Public (or Clerk or Judge) (My Commission Expires):

Executive Order 11246

IMPORTANT: THIS MUST BE READ, SIGNED, AND RETURNED WITH BID

Certificate of Compliance with Executive Order 11246 (as amended) for Contracts in Excess of $10,000.

In entering into any resulting contract over $10,000, the Contractor agrees to comply with the Equal Employment Opportunity requirements stipulated in Executive Order 11246 as amended by Executive Order 11375. These specific requirements state:

1. "Equal Opportunity Clause"

During the performance of this/these contract(s) the contractor agrees as follows:

A. The contractor will not discriminate against any employee or applicant for employment because of race, creed, color, or national origin. The contractor will take affirmative action to ensure that applicants are employed, and employees are treated during employment, without regard to their race, creed, color, or national origin. Such action shall include, but not be limited to the following:

Employment, upgrading, demotion or transfer; recruitment or recruitment advertising; lay-off or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of this nondiscrimination clause.

B. The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.

C. The contractor will send to each labor union or representative or workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided by the agency contracting officer, advising the labor union or workers' representative of the contractor's commitments under Section 202 of Executive Order 11246 of September 24, 1965, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

D. The contractor will comply with all provisions of Executive Order 11246 of September 24, 1965 and the rules, regulations and relevant orders of the Secretary of Labor.

E. The contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the contracting agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations and orders.

F. In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of such rules, regulations, or orders, this contract may be cancelled, terminated or suspended in whole or part and the contractor may be declared ineligible for further government contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

G. The contractor will include the provisions of Paragraphs A through G in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to Section 207 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor.

The contractor will take such action with respect to any subcontract or purchase order as the contracting agency may direct as a means of enforcing such provisions including sanctions for noncompliance: Provided, however, that in the event the contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the contracting agency, the contractor may request the United States to enter such litigation to protect the interests of the United States.

2. Certification of Non-segregated Facilities

By the submission of this bid and/or acceptance of purchase order(s) during the above period, the contractor, offerer, applicant, or subcontractor certifies that he does not maintain or provide for his employees any segregated facilities at any of his establishments, and that he does not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained.

He certifies further that he will not maintain or provide for his employees any segregated facilities at any of his establishments, and that he will not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. The contractor, offerer, applicant, or subcontractor agrees that a breach of this certification is a violation of the equal opportunity clause in this contract. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, creed, color or national origin, because of habit, local custom, or otherwise. He further agrees that (except where he has obtained identical certifications from proposed subcontractors for specific time periods) he will obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding $10,000 which are not exempt from the provisions of the equal opportunity clause; that he will retain such certifications in his files; and that he will forward the following notice to such proposed subcontractors (except where the proposed subcontractors have submitted identical certifications for specific time periods).

3. Disabled Veteran and Vietnam Era Veteran Affirmative Action Program Requirements

In entering into any contract which exceeds $10,000, the contractor agrees to comply with Disabled Veteran and Vietnam Era Veteran Affirmative Action Program Requirements as stipulated in Public Law 93-508 and all amendments thereto. Failure to comply with the requirements of Public Law 93-508, Title 41, CFR60-250 and Title 41, CFR60-741 and all amendments thereto shall be deemed a material breach of this agreement and shall subject this contract to cancellation and rescission at the option of the University of Oklahoma. Copies of the applicable portions of this law are available from the University of Oklahoma Purchasing Office if required.

CERTIFICATION

If awarded this contract

_____

(Company)

agrees to comply with the provisions in Clauses I, II and III above.

_____

(Signature)

_____

(Date)

_____

(Title)

SEX OFFENDERS AFFIDAVIT

IMPORTANT: THIS MUST BE READ, SIGNED, AND COMPLETED AT THE TIME OF CONTRACT

Sex Offenders Affidavit

State of _____

SS.

County of _____

The undersigned (Architect, Supplier, Engineer or Supervisory Official), of lawful age, being duly Sworn, on oath says that no employee allowed to be working on School Premises under the Authority of the undersigned, has been convicted in this state, the United States or another state of:

Any sex offense subject to the Sex Offenders Registration Act in this state or subject to another state/s or the federal sex offender registration; or

Any felony offense except as provided in Subsection C of Section 4, 70 O.S 1991, Section 6-101.48 or when ten (10) years has elapsed since the date of the original conviction or the employee has received a Presidential or Gubernatorial pardon for the criminal offense.

(Contractor or Supplier) (Signature)

Subscribed and Sworn to Before Me this

_____Day of_____, _____

Notary Public_____

My Commission Number:_____

My Commission Expires:_____

SECTION 01010
SUMMARY OF WORK

1.1 WORK INCLUDED

At the Dr. Carolyn Taylor Center, Preparatory Hall, and UVB Clubhouse.:

1. Construction of enclosure at UVC to house chiller.
2. Installation of Chillers at UVC and associated piping electrical, and het exchanger plans and specifications.
3. Installation oof chillers onto DCTC roof top.
4. Installation of associated piping electrical, and heat exchanger. at DCTC.
5. Contractor responsible for all necessary demolition and construction required to facilitate installation of new equipment.
6. Contractor is responsible to repair damage to existing property damage by contractor or subcontractors.
7. Contractor to provide all labor, material equipment as required to complete project.
8. Contractor will dispose of all debris.
9. Contractor will test perform all test required to ensure new accessories perform as required.

1.2 ALTERNATE WORK

ADD ALTERNATE NO. 1

1. Construction of enclosure at Preparatory Hall to house chiller.
2. Installation of Chillers at Preparatory Hall and associated piping electrical, and heat exchanger per plans and specifications.

A. QUALITY ASSURANCE

Prior to start of work, contractor will provide "shop drawings" and a copy of manufacturer's installation recommendations for all products or systems that require a submittal, as indicated in the project manual.

B. EXAMINATION OF SITE

Failure to Visit Site will not relieve Contractor from necessity of furnishing materials or performing work that may be required to complete work in accordance with the project manual without additional cost to RSU.

C. CONTRACTOR USE OF PREMISES

i. Contractor's may utilize University provided utilities.

ii. Restrict access to extent required, allowing for ongoing activities at site.

iii. Operations of Contractor are limited to areas where work is indicated.

1. Take precautions to allow for continued operations including public access and other outside activities on the occupied portions of the site.
2. Schedule and coordinate such operations with RSU Physical Plant Director.

END OF SECTION

SECTION 01015
EXISTING CONDITIONS

1.1 EXISTING CONDITIONS

A. Dimensions: Contractor shall verify dimensions at site for built-in work, and for work adjoining that of other trades and for dimensions shown to existing structures or installations.

B. Possession, use, and responsibility for site: Keep the building site free of rubbish at all times. Remove all waste and site debris promptly.

C. Existing conditions: In submitting a bid, Contractor acknowledges that he has visited the site and reviewed existing conditions. While every attempt has been made to identify locations of work items, the Contractor is to remedy as specified all problems discovered that are of the same nature as Work Items listed in the Specifications.

D. Demolition:

1. Contractor shall use extreme care in the demolition, removal, repair or relocation of existing items in order to protect remaining items from damage. Replace any items or areas so damaged with matching, new items of equal quality.

2. Where operations involve the demolition, removal or repair of existing items in the exterior envelope of existing structures, the Contractor shall provide temporary protection as required to maintain the structure in a weather tight, structurally sound, environmentally stable condition at the end of each day and/or end of activity that is associated with these operations.

END OF SECTION

1.1 QUALITY ASSURANCE

A. Reference Standards: For products or workmanship specified or indicated by association, trade or Federal Standards comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.

B. No provision of any referenced standard specification, manual or code (whether or not specifically incorporated by reference in the Contract Documents) shall be effective to change duties and responsibilities of RSU or Contractor or any of their consultants, agents or employees from those set forth in Contract Documents, nor shall it be effective to assign to Physical Plant Director any duty or authority to supervise or direct furnishing or performance of Work or any duty or authority to undertake responsibilities contrary to provisions of General Conditions.

C. Where wording of referenced standard is permissive, or where requirements of more than one reference standard apply, provide under more restrictive and higher requirement.

D. Comply with recommendations of reference standards even though they are not mandatory in standard.

E. Notify Physical Plant Director of any conflicts between referenced standards and requirements specified in Specifications or indicated on Drawings before proceeding with work.

F. Detailed Requirements: Be familiar with and verify detailed requirements of referenced standards to verify that items and their installation provided under Work of this Contract meet or exceed standard's requirements.

G. Tolerances: Tolerances may vary from standards of different sections. Make adjustments necessary to assure proper fitting of different elements. Tolerances may be plus or minus as indicated but in sum shall be compensating, not cumulative.

H. Effective Date: Date of standard is that in effect as of documents date except when specific date is specified or when standard is part of applicable code which includes edition date.

I. Copies: When required by individual sections obtain copy of standard. Maintain copy at job site during work.

J. Certificates: When required by Contract Documents, or when requested in writing by Physical Plant Director, submit Certificate of Compliance or Manufacturer's Certificate that materials or workmanship, or both comply with requirements of referenced standard.

SECTION 01200
PROJECT MEETINGS

PART 1 GENERAL

1.1 REQUIREMENTS INCLUDED

A. Participation IS NOT required in pre-bid conference

B. Participation IS required at preconstruction conference.

C. Contractor administration of progress meetings and pre-installation conferences required.

1.2 RELATED REQUIREMENTS

A. Section 01010 – Summary of Work
B. Section 01015 – Existing Conditions
C. Section 01091 – Reference Standards
D. Section 01340 – Submittals
E. Section 01600 - Material and Equipment
F. Section 01700 - Contract Close Out

1.3 PREBID AND PRECONSTRUCTION CONFERENCES

A. RSU Physical Plant Director will administer pre-bid conference at RSU offices for clarification of RSU and Contractor responsibilities in use of site and for review of administrative procedures. The bidders will then be taken to the site to review the buildings.

B. RSU Contract Administrator will administer the preconstruction conference at RSU offices. Project start and completion date will be determined and other administrative procedural responsibilities will be reviewed.

1.4 PROJECT MEETINGS

Schedule and administer Project meetings through progress of the Work as deemed necessary by the RSU Physical Plant Director.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 00 1300

SUBMITTALS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work included: Make submittals required by the Contract Documents, and revise and resubmit as necessary to establish compliance with the specified requirements.

B. Relate work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.2 QUALITY ASSURANCE

A. Coordination of submittals:

1. Prior to each submittal, contractor shall carefully review and coordinate all aspects of each items being submitted.
2. Verify that each item and the submittal for it conform in all respects with the specified requirements.
3. By affixing the Contractor's signature to each submittal, certify that this coordination has been performed.
4. Unapproved submittals shall be returned to contractor.

B. "Or equal":

1. Where the phrase "or equal" or "or equal as approved by the Engineer," occurs in the Contract Documents, do not assume that the materials, equipment, or methods will be approved as equal unless the item has been specifically so approved by the Engineer.
2. All substitution approvals must be made PRIOR TO BIDDING as addressed in Instructions to Bidders.
3. The decision of the Engineer shall be final.

1.3 SUBMITTALS

A. Make submittals of Shop Drawings, samples, substitution requests, and other items in accordance with the provisions of this Section.

PART 2 - PRODUCTS

2.1 SHOP DRAWINGS

A. Scale and measurements: Make Shop Drawings accurately to a scale sufficiently large to show all pertinent aspects of the item and its method of connection to the Work.

B. Types of prints required:

1. Submit shop drawings in the form of electronic PDF documents.
2. Hard copies will not be acceptable.

C. Review comments of the Engineer will be shown on the prints when returned to the Contractor. The contractor may make and distribute such copies as are required for his purposes.

D. One set of approved shop drawings shall be maintained at the site at all times. Shop drawings without approved stamp shall not be used in the field.

2.2 MANUFACTURERS' LITERATURE

A. Where contents of submitted literature from manufacturers includes data not pertinent to the submittal, clearly show which portions of the contents is being submitted for review.

PART 3 - EXECUTION

3.1 IDENTIFICATION OF SUBMITTALS

A. Consecutively number all submittals.

1. When material is resubmitted for any reason, transmit under a new letter of transmittal and with a new transmittal number.

B. Accompany each submittal with a letter of transmittal showing all information required for identification and checking.

C. Transmittal Form: Provide locations on form for the following information:

1. Project name.
2. Date.
3. Destination (To:).
4. Source (From:).
5. Name and address of Engineer.
6. Name of Contractor.
7. Name of firm or entity that prepared submittal.
8. Names of subcontractor, manufacturer, and supplier.
9. Category and type of submittal.
10. Submittal purpose and description.
11. Specification Section number and title.
12. Specification paragraph number or drawing designation and generic name for each of multiple items.
13. Drawing number and detail references, as appropriate.
14. Indication of full or partial submittal.
15. Transmittal number, numbered consecutively.
16. Submittal and transmittal distribution record.
17. Remarks.
18. Signature of transmitter.

D. Maintain an accurate submittal log for the duration of the Work, showing current status of all submittals at all times. Make the submittal log available to the Engineer for his review upon request.

3.2 TIMING OF SUBMITTALS

A. Make submittals far enough in advance of scheduled dates for installation to provide time required for reviews, for securing necessary approvals, for possible revisions and resubmittals, and for placing orders and securing delivery.

B. In scheduling, allow at least ten working days for review by the Engineer following his receipt of the submittal.

3.3 ENGINEER'S REVIEW

A. Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Review by the Engineer does not relieve the Contractor from responsibility for errors which may exist in the submitted data.

C. Engineer will review each submittal, make marks to indicate corrections or revisions required, and return it. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.

D. Revisions:

1. Make revision required by the Engineer.
2. If the Contractor considers any required revision to be a change, he shall so notify the Engineer as provided for in Paragraph 4.3.7 of the General Conditions.
3. Make only those revisions directed or approved by the Engineer.

E. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

F. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

3.4 VERIFICATION OF SPECIFIED ITEMS

A. When items are provided exactly as specified, samples or literature submittal requirements may be waived by Engineer. However, if submittals of samples or literature are waived, a letter must be provided by the contractor indicating that the items have been provided exactly as specified in the contract documents. Items should be called out by Section number, product name and a brief description.

END OF SECTION 00 1300

SECTION 00 1500 EXECUTION

REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Installation of the Work.
3. Coordination of Utility service changes.
4. Cutting and patching.
5. Coordination of Owner-installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.
9. Correction of the Work.

1.2 QUALIFICATIONS

A. NOT USED

1.3 QUALITY OF CUTTING & PATCHING

A. Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, notify Engineer of locations and details of cutting and await directions from Engineer before proceeding. Shore, brace, and support structural element during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or results in increased maintenance or decreased operational life or safety.
3. Other Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that would result in reducing their capacity to perform as intended, or that would result in increased maintenance or decreased operational life or safety.
4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Engineer's opinion, reduce the building's aesthetic qualities. Remove and replace construction that, in Engineer’s opinion, has been cut and patched in a visually unsatisfactory manner.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

2.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and

verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

2.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

1. Confirm relevant property corners and easements corners in the area of construction. Where steel pins are not set at these locations, have new pins ½" x 24" minimum installed into the ground at such locations. Flag and paint pin tops with hot pink fluorescent paint.
2. Determine and confirm Benchmark location from survey.
3. Have staked/marked relevant building setback lines. Maintain through course of foundation work.
4. Contractor to contact local utility location service and related sources of information as required to flag locations of utilities. Clearly stake/mark utility lines and advise all subcontractors of same. Confirm depths and sizes against information on Survey. Advise Engineer of any discrepancy.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Engineer according to requirements in Division 1 Section "Project Management and Coordination."

2.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Engineer promptly.

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Engineer when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

D. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Engineer.

2.4 FIELD ENGINEERING

A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

2.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results.

Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Engineer.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

2.6 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

2.7 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Division 1 Section "Quality Requirements."

2.8 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for maintenance of temperature and relative humidity.

END OF SECTION 00 1500

1.1 REQUIREMENTS INCLUDED

A. Products
B. Transportation and Handling
C. Storage and Protection
D. Product Option
E. Substitutions

1.2 RELATED REQUIREMENTS

A. Section 01010 – Summary of Work
B. Section 01015 – Existing Conditions
C. Section 01090 – Reference Standards
D. Section 01340 – Submittals
E. Section 01700 - Contract Close Out

1.4 PRODUCTS

A. Products include material, equipment, and systems.
B. Comply with Specifications and referenced standards as minimum requirements.

1.5 TRANSPORTATION AND HANDLING

A. Transport products by methods to avoid product damage; deliver in undamaged condition in manufacturer's unopened containers or packaging, dry.
B. Provide equipment and personnel to handle products by methods to prevent soiling or damage.
C. Contractor shall be aware of vandalism and theft and is advised not to leave tools or materials unattended at the job site.

1.6 STORAGE AND PROTECTION

Store products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight enclosures; maintain within temperature and humidity ranges required by manufacturer's instructions.

1.7 PRODUCT OPTIONS

A. Products specified by naming one or more manufacturers with a provision for substitution: Submit a request for substitution for any manufacturer not specifically named.

1.8 SUBSTITUTIONS

A. All products proposed for use, including those specified by required attributes and performance shall require approval of RSU before being incorporated into the work. Do not substitute materials, equipment, or methods unless substitution has been specifically approved by RSU.

B. Submit to RSU, according to the requirements of this section, all substitution requests ten (10) days prior to bid opening date. Substitutions are reviewed for general compliance with specifications. The Contractor is responsible for conforming quantities, dimensions, site conditions, coordinating with other trades and complying with applicable building codes and local ordinances.

C. RSU will determine acceptability of proposed substitution, and will notify Contractors of acceptable or rejection in writing within a reasonable time.

END OF SECTION

SECTION 01700
CONTRACT CLOSE-OUT

1.1 REQUIREMENTS INCLUDED

A. Close-Out Procedures.

B. Project Record Documents.

1.2 CLOSE-OUT PROCEDURES

When Contractor considers work has reached final completion, submit written certification that Contract Documents have been reviewed, Work has been inspected, and that work is complete in accordance with Contract Documents and is ready for RSU to inspect.

1.3 FINAL CLEANING

A. Execute final cleaning prior to final project assessment.

B. Remove waste and surplus materials, rubbish, and construction facilities from the Project and from the site. Contractor shall not use waste containers at the site.

C. Clean exterior surfaces exposed to view of all foreign substances.

D. Clean interior surfaces exposed to view; remove temporary labels, stains and foreign substances.

1.4 PROJECT RECORD DOCUMENTS

A. Store documents separate from those used for construction. Keep documents current; do not permanently conceal work until required information has been recorded.

B. At Contract Close-Out:

1. Submit documents with transmittal letter containing date, Project title, Contractor's name and address, list of documents, and signature of Contractor.
2. Submit set of drawings reflecting changes as indicated on Project Record Drawings.
3. Warranty – Contractor shall provide a Two (2) year warranty for all materials and labor associated with the content of the contract.
4. Contractor to provide Manufacturer's warranties for all roofing systems of the contract.

END OF SECTION

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following items which apply to all Division 23 sections:

1. Submittals.
2. Coordination drawings.
3. Record documents.
4. Maintenance manuals.
5. Piping materials and installation instructions common to most piping systems.
6. Transition fittings.
7. Dielectric fittings.
8. Mechanical sleeve seals.
9. Sleeves.
10. Through penetration firestop assemblies.
11. HVAC demolition.
12. Equipment installation requirements common to equipment sections.
13. Painting and finishing.
14. Supports and anchorages.

B. Related Documents:

1. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and the other sections of this Division.
2. Other sections of this Division, and of other Divisions, may contain requirements that relate to this section.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, and spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

H. Firestopping (Through-Penetration Protection System): Sealing of stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.3 SUBMITTALS

A. Product Data for each kind of product indicated.

B. Submittal of shop drawings, product data, and samples will be accepted only when signed and submitted by this Contractor and the General Contractor. Data submitted from subcontractors and material suppliers directly to the Architect/Engineer will not be processed.

1.4 GENERAL WORK REQUIREMENTS

A. Permits:

1. Obtain and pay for all licenses and permits, fees, inspection and certificates required for the execution of this work.
2. Pay fees and charges for connection to outside services and use of property.
3. Deliver permits and certificates to the Architect to be transmitted to the Owner.

B. Utility Services:

1. This Contractor shall pay for all expenses, deposits, reimbursements, etc., required by the local rules and codes for the service to the buildings, complete and ready for use. See plot plan.
2. Consult gas, water and sewer utility for their requirements and for coordinating with their installation. Contractor shall provide any work thus required beyond that indicated by the drawings and specifications. He shall bear all expense involved for the complete installation of the gas service (both temporary and permanent) to the building ready for operation, including utility service charges, except as specifically excluded on the plans.
3. This Contractor shall consult all local departments to verify requirements and bid installation for service in accordance with local codes and Utility company rules and regulations.

1.5 RESPONSIBILITY

A. This Contractor will be held responsible for any and all damage to any part of the building or to the work of other contractors, as may be caused through his operation.

B. The operation and maintenance of the Mechanical Plant during construction shall be the responsibility of this contractor until the acceptance of the building by the Owner.

C. The General Contractor shall pay for all fuel cost for operation of the plant until the acceptance of the building by the Owner.

D. This contractor shall make all provisions for entry of equipment, installed under this contract, to the installed location. This contractor shall provide openings in existing construction if necessary. This contractor shall do all repair necessary to restore the building to the original condition. During the period of entry of equipment and removal of trash, no disruption of the Owner's normal business shall occur.

E. This Contractor shall fully coordinate equipment installation requirements with other trades. Any revisions or adjustments required to be made by other trades due to deviations from the basis of design equipment shall be the financial responsibility of this Contractor.

1.6 QUALITY ASSURANCE

A. Execute work in compliance with all applicable Federal. State and Municipal laws, codes, ordinances, and local customs regarding the trade to perform the work. The Contractor is required to verify that all installations comply with applicable codes. The codes applicable to this specific project may be listed on the Architect's code compliance sheet. If not, it is the Contractor's responsibility to determine which codes apply to the installations. Where code requirements conflict with those shown on the drawings and specifications, the code requirements shall take precedence. The Contractor shall notify the Architect immediately of any discrepancies between the applicable code requirements and the documents. Changes made to comply with the applicable requirements shall not justify an additional cost.

B. Inspect the existing site and conditions and check the drawings and specifications to be fully informed of the requirements for completion of the work. Lack of such information shall not justify an extra to the contract price.

C. The HVAC Work shall include labor, materials, and equipment to install systems and place in proper working order, as shown on plans and hereinafter specified. The installation shall include all labor, materials, tools, transportation, equipment, services and facilities, required for the complete, proper and substantial installation of all mechanical work shown on the plans, and/or outlined in these specifications. The installation shall include all materials, appliances, and apparatus not specifically mentioned herein or noted on the drawings but which are necessary to make a complete working installation of all mechanical systems.

D. Material and equipment shall be new, of best quality and design and free from defects. A manufacturer's nameplate affixed in a conspicuous place will be required on each major component of equipment stating manufacturer's name, address and catalog number.

E. Furnish testing equipment and test all piping systems under methods and conditions as specified.

F. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

G. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

H. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

I. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 and ASTM E814 with 0.10 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.

1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.

a. Floor Penetrations within Wall Cavities: T-Rating is not required.

J. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.

1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.

K. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.

L. Fire Resistant Joints between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.

M. Surface Burning Characteristics: 25/50 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.8 WORKMANSHIP AND COORDINATION

A. Make installation substantially as shown on plans.

B. Pipe and duct routing and equipment location shown on the drawings are schematic in nature. Make alterations in location of apparatus or piping as may be required to conform to building construction without extra charge.

C. Equipment service clearances, per equipment manufacturer's specifications, shall be maintained from general construction. No pipe shall be installed within these clearances. No piping shall be installed above electrical panels, starters or switchgear, or in elevator equipment rooms.

D. Cooperate with other contractors in their installation of work.

E. The ductwork shall take precedence over all pipe work except where it is necessary to maintain an even grade on the piping.

F. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

G. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

H. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces.

I. Use only experienced mechanics.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not apply sealants, caulking, or mastic materials outside the range of the manufacturer's installation instructions.

B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.

C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.

D. Provide ventilation in areas to receive solvent cured materials.

1.10 ELECTRONIC DOCUMENT REQUESTS

A. The Contractor may request the use of the bidding documents in electronic format (CAD, BIM, PDF etc.) for use in preparation of shop drawings and coordination drawings.

B. Professional Engineering Consultants, P.A. (PEC) reserves the right to refuse requests for electronic files at its sole discretion. The format of the files will be at PEC's sole discretion.

C. All electronic documents provided are provided on an as-is basis, and are utilized by the Contractor at his own risk. All files provided by the Engineer are subject to PEC's standard "CADD/Electronic File Disclaimer". This disclaimer can be provided upon request.

D. At PEC's sole discretion, per sheet fee of up to $50 may be required to cover the costs of preparing the electronic files for transmission.

E. By obtaining the bid document CAD or BIM files, the Contractor is not relieved from his duty to create construction, shop and coordination drawings.

1.11 RECORD DOCUMENTS

A. Prepare record documents in accordance with Division 1. These drawings shall reflect the actual "As-Built" condition including any change orders, of the mechanical systems and installation. In addition to the requirements specified in Division 1, indicate the following installed conditions:

1. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Refer to Identification Section. Indicate actual inverts and horizontal locations of underground piping.
2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
3. Approved substitutions, contract modifications, and actual equipment and materials installed.

1.12 MAINTENANCE MANUALS

A. Prepare Maintenance Manuals in accordance with Division 1 Sections. In addition to the requirements specified in Division 1, include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control stopping, shutdown, and emergency instructions.
3. Maintenance procedures for routing preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Approved shop drawing submittals.
5. Servicing instructions and lubrication charts and schedules.
6. Copy of valve tag chart.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified or pre-approved equals.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials.

2.4 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

D. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.5 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.

c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.6 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. Molded PE: Reusable, PE, tapered-cup shaped and smooth-outer surface with nailing flange for attaching to wooden forms.

2.7 FIRESTOPPING

A. Manufacturers:

1. Hilti Corp.
2. 3M fire Protection Products

B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.

1. Silicone Firestopping Elastomeric Firestopping: Single or multiple component silicone elastomeric compound and compatible silicone sealant.
2. Foam Firestopping Compounds: Single or multiple component foam compound.
3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
4. Fiber Stuffing and Sealant Firestopping: Composite of mineral or ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.

5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
7. Firestop Pillows: Formed mineral fiber pillows.

C. Color: As selected from manufacturer's full range of colors.

D. Coordinate the above requirements with Division 7.

2.8 FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

C. General:

1. Furnish UL listed products.
2. Select products with rating not less than rating of wall or floor being penetrated.

D. Non-Rated Surfaces:

1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

2.9 ACCESS DOORS

A. If specified in Division 7 that section shall apply. Where not specified in Division 7 provide access doors as follows.

B. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.

C. Frames: 16-gage steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.

1. For installation in masonry, concrete, ceramic tile, or wood paneling: 1 inch-wide-exposed perimeter flange and adjustable metal masonry anchors.
2. For gypsum wallboard or plaster: perforated flanges with wallboard bead.
3. For full-bed plaster applications: galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.

D. Flush Panel Doors: 14-gage sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.

1. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.

E. Locking Devices: Where indicated, provide 5-pin or 5-disc type cylinder locks individually keyed; provide 2 keys.

F. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bar-Co., Inc.
2. J.L. Industries.
3. Karp Associates, Inc.
4. Milcor Div. Inryco, Inc.
5. Nystrom, Inc.

2.10 DRIP PANS

A. Provide drip pans fabricated from corrosion-resistant sheet metal with watertight joints, and with edges turned up 2-1/2". Reinforce top, either by structural angles or by rolling top over 1/4" steel rod. Provide hole, gasket, and flange at low point for watertight joint and 1" drainline connections.

PART 3 - EXECUTION

3.1 HVAC DEMOLITION REQUIREMENTS

A. The existing areas surrounding the remodel area are fully occupied and shall remain operational throughout the duration of this project.

B. This contractor shall closely coordinate with the Owner and/or his representative the timing and schedule for any temporary cutoffs of any mechanical systems. The valve location and scheduled shutdown shall be closely coordinated with the Owner. It is recognized that temporary shutdown of systems will be required. These shall be scheduled in advance with Owner’s representatives and restored to full service at the end of the work period.

C. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
3. Equipment to Be Removed: Disconnect and cap services and remove equipment.

D. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

E. Contractor shall provide protective plastic drop cloths to protect the existing occupied areas and equipment from dust and debris during the construction work, and shall clean the areas of all construction dirt daily, and upon completion of the work.

F. Connection to existing piping for HVAC, medical gas, fire sprinkler or domestic water will require temporary shutdown of those mains to accomplish the new tie-ins. Closely coordinate and schedule this work with the Owner. Perform such work on weekends or nights as required by Owner's use and schedule.

G. All drained piping risers and mains shall be refilled with fluid and properly vented by this Contractor.

H. Coordinate with General Contractor the removal and replacement of all existing ceilings, walls, etc. as required for mechanical demolition work.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are specially noted and approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

    a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or stamped steel type with polished chrome-plated finish.
    e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type or stamped steel with polished chrome-plated finish.
    f. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw.
    g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw.
    h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

2. Existing Piping: Use the following:

    a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
    b. Insulated Piping: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and spring clips.
    c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass or stamped steel type with chrome-plated finish.
    d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass or stamped steel type with chrome-plated finish.
    e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
    f. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
    g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

    a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane water-proofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 for flashing.

1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Sections for materials and installation.

O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

P. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.3 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected. The Contractor shall field verify all existing conditions and dimensions. The Contractor shall make field adjustments as required to accommodate the new work.

B. Verify final equipment locations for roughing-in.

C. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.4 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Nonpressure Piping: Join according to ASTM D 2855.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657 using manufacturer certified mechanics and tools.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.5 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric nipples and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.6 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.7 MECHANICAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate mechanical systems, equipment, and materials installation with other building components, including the structure, fire sprinklers, and the electrical lights and equipment.
2. Verify all dimensions by field measurements.
3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
7. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations,

franchised service companies, and controlling agencies. Provide required connection for each service.

8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
10. Install access panel or doors where units are concealed behind finished surfaces.
11. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope, or systems requiring a fixed access clearance.
12. The Mechanical Contractor shall locate and mark the location of all holes and openings which require blocking out, cutting or core drilling.
13. All square openings through precast concrete shall be blocked out by precast manufacturer. All openings 6" dia. or larger shall be blocked out by precast manufacturer. All holes less than 6" dia. may be core drilled.
14. Contractor shall review with Owner location, accessibility, and method of operating all HVAC shut-off valves located in plumbing chases, ceiling cavity and mechanical rooms.
15. This Contractor shall assist with and provide supervised start-up of the steam, condensate return, hot water and chilled water systems, involving air venting, drainage, etc. Monitor the air venting until all air has been eliminated from the building system and the lines within the buildings are completely filled with fluid, or steam as applicable.
16. The ceiling cavity space is limited. Therefore the ductwork and piping locations shall be closely coordinated with each other as well as the lights, ceiling height, electrical conduit and fire sprinkler piping.
17. It is the intent, where possible, to locate the domestic water piping, medical gas piping, fire sprinkler piping, and HVAC piping above the ductwork and tight to the existing steel and concrete structure. The steam condensate return piping shall, in most cases, be located to run below the ductwork.
18. Selected pipe and duct elevations are shown on the plans as an aid to the contractor in their installation. Where necessary, due to conflicts, these items may be changed as long as conflict with other items does not occur.
19. Ductwork and piping shall rise into the joist or beam space and run between joists or beams where shown on the drawings and as may be required, whether specifically shown or not, to avoid conflict with other trades.
20. This Contractor shall be responsible for coordination with the fire sprinkler subcontractor, plumbing contractor, and the Electrical Contractor as required to avoid and or resolve conflicts. Conflicts between piping, ducts, electrical, sprinklers, etc. shall be resolved with no additional cost or change to the contract amount.
21. Where new work conflicts with existing ductwork or piping (plumbing, HVAC, fire protection, medical gas etc.) this contractor shall relocate those items as required to make way for new work without additional charges.

3.8 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with Division 1. In addition to the requirements specified in Division 1, the following requirements apply:

1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

B. Perform cutting, fitting, and patching of mechanical equipment and materials required to:

1. Uncover work to provide for installation of ill-timed work.
2. Remove and replace defective work.
3. Remove and replace work not conforming to requirements of the Contract Documents.
4. Remove samples of installed work as specified for testing.
5. Install equipment and materials in existing structures.
6. Upon written instructions from the Architect, uncover and restore work to provide for Architect/Engineer observation of concealed work.

3.9 PAINTING

A. Painting of HVAC systems, equipment, and components is specified in other divisions.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.10 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

B. Field Welding: Comply with AWS D1.1.

3.11 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.12 INSTALLATION - FIRESTOPPING

A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping and other items, requiring firestopping.

B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating. Install per manufacturer's instructions to comply with appropriate listing.

D. Fire Rated Surface:

1. Seal openings as follows:

a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
c. Pack void with backing material.
d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

E. Non-Rated Surfaces:

1. Seal openings, where required by code, through non-fire rated openings as follows:

a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
c. Install type of firestopping material recommended by manufacturer.

2. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
3. Interior partitions: Seal pipe penetrations at clean rooms, laboratories, hospital spaces, computer rooms, telecommunication rooms, and data rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and pipe.

F. Inspect installed firestopping for compliance with specifications and submitted schedule.

G. Clean adjacent surfaces of firestopping materials.

3.13 INSTALLATION OF ACCESS DOORS

A. Provide access doors in construction wherever access is required for valves, dampers, equipment, etc.

B. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.

C. Adjust hardware and panels after installation for proper operation.

3.14 INSTALLATION OF DRIP PANS

A. Locate drip pans under piping passing within 3' horizontally of electrical equipment, and elsewhere as indicated. Hang from structure with rods and building attachments, weld rods

to sides of drip pan. Brace to prevent sagging or swaying. Connect 1" drain line to drain connection, and run to nearest drain or elsewhere as indicated.

3.15 CLEANING

A. Refer to Division 1 for general requirements for final cleaning.

B. Contractor shall clean work area of all construction dirt and debris at the end of each work day.

3.16 WARRANTIES

A. Refer to Division 1 for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements.

B. Compile and assemble the warranties as specified into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference.

C. Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

D. This Contractor shall warrant all material and equipment installed by him for a period of one year after completion of the project.

END OF SECTION 230500

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes single- and three-phase motors for application on equipment provided under other sections and for motors furnished loose to Project.

B. Related Documents:

1. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and the other sections of this Division.
2. Other sections of this Division, and of other Divisions, may contain requirements that relate to this section.
3. Refer to Division 26 for starters, disconnects, fuses, and variable speed drives.

1.2 REFERENCES

A. American Bearing Manufacturers Association:

1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. National Electrical Manufacturers Association:

1. NEMA MG 1 - Motors and Generators.

C. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

A. Product Data: Submit catalog data for each motor furnished loose. Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

B. Testing Agency: Company member of International Electrical Testing Association and specializing in testing products specified in this section with minimum three years experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.

B. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.

C. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Separate winding for each speed.

E. Rotor: Random-wound, squirrel cage.

F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Class B.

H. Insulation: Class F.

I. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features shall be coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. All motors driven by a variable frequency PWM drive shall include a factory installed maintenance free, circumferential, conductive micro fiber or carbon brush shaft grounding ring to discharge shaft currents to ground. The conductive microfibers shall redirect shaft currents and provide a reliable, very low impedance path from shaft to motor frame by-passing motor bearings entirely. For vertical turbine pump motors, the upper shaft shall be provided with a coating to isolate the shaft from the bearings and the shaft grounding ring shall be installed within the motor casing. This information shall be provided with the shop drawing submittal for verification of method of installation and to ensure they are to be supplied.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Electronically Commutated Motor

1. Motor Enclosure: Open Type.
2. Motor shall be an electronically commutated, permanent magnet, brushless DC type motor (ECM) specifically designed for HVAC applications.
3. Motors shall be permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase.
4. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor.
5. Motor shall be speed controllable down to 20% of full speed (minimum 80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.

6. Motor shall be a minimum of 85% efficient at all speeds.

D. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

E. Motors 1/20 HP and Smaller: Shaded-pole type.

F. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.6 MOTOR CONNECTIONS

A. Flexible conduit, except where plug-in electrical cords are specifically indicated.

2.7 POWER FACTOR CORRECTION

A. Each motor, 10 horsepower and larger, except for motors with variable frequency drives, supplied for use within this project shall be supplied with capacitors as required to correct the power - factor of the individual motor to 95% lagging $\pm$ 3%. The Mechanical Contractor shall secure performance data on each individual motor and condenser. Provide operating current values on the condenser, and on the motor, and total line current for the combination. Provide voltage reading at time of disconnecting motor.

B. In no event shall the capacitor current exceed the "no-load" values of the motor current. Heating element ratings shall be adjusted if, and as necessary, to provide thermal protection to the motor. In the event the voltage reading at the time of disconnecting the unit exceeds a safe value, the capacitor rating shall be changed to provide safe voltages, as well as providing a power factor within the specified limit. All capacitor shall be rated for operation on the system voltage specified and furnished by the equipment manufacturer.

C. Each capacitor shall be suitable for energizing at temperatures as low as -10°F. and for continuous operation in ambient temperatures not exceeding 115°F. when installed and unrestricted ventilation and energized up to 100 percent of rated voltage.

D. Power factor correction capacitors shall be of the unit cell type. Individual capacitor cells shall be factory assembled and wired in a metallic, moisture-resistant enclosure. All power factor correction capacitors shall be UL listed. Capacitors shall be switched on and off with the motor and shall be installed and wired by the Electrical Contractor.

E. Individual capacitor cells shall utilize polypropylene film as the dielectric with vacuum deposited aluminum layers as the electrodes. Each capacitor cell shall be furnished with replaceable fuses with a current limiting interrupting capacity of 100,000 Amps and filled with a completely biodegradable fluid.

F. Discharge resistors shall be provided to reduce the residual voltage to 50 volts or less within one minute after the capacitor has been removed from the line. Resistors shall be mounted external to the capacitor cells to minimize the dielectric operating temperature.

G. Enclosures shall be fabricated from sheet metal having a minimum thickness of 0.026", suitable for indoor or outdoor installations, designed to prevent accidental contact with live conducting parts, finished with gray enamel and provided with integral mounting brackets for wall or floor mounting.

H. Nameplate shall contain name of manufacturer, rated voltage, frequency, kilovar rating, number of poles and amount of combustible fluid in gallons. Nameplate shall be externally attached to the enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install securely on firm foundation. Properly align motor with driven machine.

B. Install engraved plastic nameplates.

C. Ground and bond motors.

D. Furnish capacitors to Electrical Contractor for installation.

END OF SECTION 230513

SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Filled-system thermometers.
2. Liquid-in-glass thermometers.
3. Thermowells.
4. Dial-type pressure gages.
5. Gage attachments.
6. Test-plug kits.
7. Sight flow indicators.
8. Orifice flow meters.

B. Related Documents:

1. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and the other sections of this Division.
2. Other sections of this Division, and of other Divisions, may contain requirements that relate to this section.

1.2 SUBMITTALS

A. Product Data: Not Required

PART 2 - PRODUCTS

2.1 FILLED-SYSTEM THERMOMETERS

A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Ashcroft Inc.
   b. Marsh Bellofram.
   c. Miljoco Corporation.
   d. Palmer Wahl Instrumentation Group.
   e. Trerice, H. O. Co.
   f. Weiss Instruments, Inc.

2. Standard: ASME B40.200.
3. Case: Sealed type, cast aluminum or drawn; 4-1/2-inch nominal diameter.
4. Element: Bourdon tube or other type of pressure element.

5. Movement: Mechanical, dampening type, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
7. Pointer: Dark-colored metal.
8. Window: Glass.
9. Ring: Stainless steel.
10. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device; with ASME B1.1 screw threads.
11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.

    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.

12. Accuracy: Plus or minus 1 percent of scale range.

2.2 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Miljoco Corporation.
    b. Palmer Wahl Instrumentation Group.
    c. Trerice, H. O. Co.
    d. Weiss Instruments, Inc.

2. Standard: ASME B40.200.
3. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
7. Window: Glass.
8. Stem: Aluminum and of length to suit installation.

    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.

9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.3 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.

2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material: Brass or 304 stainless steel.
4. Type: Stepped shank unless straight or tapered shank is indicated.
5. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
6. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
7. Bore: Diameter required matching thermometer bulb or stemming.
8. Insertion Length: Length required matching thermometer bulb or stemming.
9. Lagging Extension: 2” minimum or longer as required for insulated piping and tubing.
10. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
11. Provide cap nut with chain fastened permanently to thermometer well.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.4 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AMETEK, Inc.; U.S. Gauge.
    b. Ashcroft Inc.
    c. Marsh Bellofram.
    d. Miljoco Corporation.
    e. Palmer Wahl Instrumentation Group.
    f. Trerice, H. O. Co.
    g. Weiss Instruments, Inc.
    h. WIKA Instrument Corporation - USA.

2. Standard: ASME B40.100.
3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective or coated aluminum with permanently etched scale markings graduated in psi and feet of water (for water use).
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Brass or stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.5 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping. Select disc material for fluid served and pressure rating.

B. Siphons: Loop-shaped section of steel pipe with NPS 1/4 or NPS 1/2 pipe threads.

C. Valves: Brass ball, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.6 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
2. Miljoco Corporation.
3. Peterson Equipment Co., Inc.
4. Sisco Manufacturing Company, Inc.
5. Trerice, H. O. Co.
6. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/2, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber suitable for inserting 1/8” O.D. probe assembly from dial type insertion pressure gage or temperature gage.

2.7 SIGHT FLOW INDICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Archon Industries, Inc.
2. Dwyer Instruments, Inc.
3. Emerson Process Management; Brooks Instrument.
4. Ernst Co., John C., Inc.
5. Ernst Flow Industries.
6. OPW Engineered Systems; a Dover company.
7. Penberthy; A Brand of Tyco Valves & Controls - Prophetstown.

B. Description: Piping inline-installation device for visual verification of flow.

C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.

D. Minimum Pressure Rating: 125 psig.

E. Minimum Temperature Rating: 200 deg F.

F. End Connections for NPS 2 and Smaller: Threaded.

G. End Connections for NPS 2-1/2 and Larger: Flanged.

2.8 FLOWMETERS

A. Orifice Flow meters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Griswold
b. Bell & Gossett; ITT Industries.
c. Flow Design
d. S. A. Armstrong Limited; Armstrong Pumps Inc.

2. Description: Flow meter with sensor, hoses or tubing, fittings, valves, indicator, and conversion chart.
3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
4. Sensor: Wafer-orifice-type, calibrated, flow-measuring element; for installation between pipe flanges.

a. Design: Differential-pressure-type measurement for water.
b. Construction: Cast-iron body, brass valves with integral check valves and caps, and calibrated stainless steel nameplate. Nameplate shall be installed with a stainless steel chain to allow for insulation.
c. Minimum Pressure Rating: 300 psig.
d. Minimum Temperature Rating: 250 deg F.

5. Operating Instructions: Include complete instructions and flow rate data with each flow meter.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.

H. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

I. Install remote-mounted pressure gages on panel.

J. Install valve and snubber in piping for each pressure gage for fluids (except steam).

K. Install valve and syphon fitting in piping for each pressure gage for steam.

L. Install flow indicators in piping systems in accessible positions for easy viewing.

M. Assemble and install connections, tubing, and accessories between flow-measuring elements and flow meters according to manufacturer's written instructions.

N. Install flow meter elements in accessible positions in piping systems.

O. Install wafer-orifice flow meter elements between pipe flanges. Chain mounted stainless steel nameplate shall be secured to the valve outside of the insulation.

P. Install differential-pressure-type flow meter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.

Q. Install connection fittings in accessible locations for attachment to portable indicators.

R. Install thermometers in the following locations:

1. Inlet and outlet of each chiller.
2. Inlet and outlet of each hydronic heat exchanger.
3. Elsewhere as indicated on the drawings.

S. Install pressure gages in the following locations:

1. Discharge of each pressure-reducing valve.
2. Inlet and outlet of each chiller chilled-water and condenser-water connection.
3. Suction and discharge of each pump.
4. Elsewhere as indicated on the drawings.

T. Install test plugs in the following locations:

1. Inlet and outlet of each hydronic zone.
2. Inlet and outlet of each chiller.
3. Inlet and outlet of each hydronic coil.
4. Inlet and outlet of each hydronic heat exchanger.
5. Elsewhere as indicated on drawings.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gages to proper angle for best visibility.

C. Thermometer stems shall be of length to match thermowell insertion length.

3.4 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 0 to 100 deg F and minus 20 to plus 50 deg C.

B. Scale Range for Condenser-Water Piping: 0 to 150 deg F and minus 20 to plus 70 deg C.

C. Scale Range for Heating, Hot-Water Piping: 40 to 240 deg F and 0 to 150 deg C.

D. Scale Range for Steam and Steam-Condensate Piping: 50 to 400 deg F and 0 to 200 deg C.

E. Scale Range for Air Ducts: Minus 40 to plus 160 deg F and minus 40 to plus 100 deg C.

3.5 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 0 to 100 psi and 0 to 600 kPa.

B. Scale Range for Condenser-Water Piping: 0 to 100 psi and 0 to 600 kPa.

C. Scale Range for Heating, Hot-Water Piping: 0 to 100 psi and 0 to 600 kPa.

D. Scale Range for Low Pressure Steam Piping: 0 to 30 psi and 0 to 240 kPa.

E. Scale Range for High Pressure Steam Piping0 to 200 psi and 0 to 1400 kPa.

END OF SECTION 230519

SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Iron ball valves.
3. Iron butterfly valves.
4. Iron, grooved-end butterfly valves.
5. Brass, grooved-end butterfly valves.
6. High-performance butterfly valves.
7. Bronze lift check valves.
8. Bronze swing check valves.
9. Iron swing check valves.
10. Iron swing check valves with closure control.
11. Iron, grooved-end spring-assisted check valves.
12. Bronze gate valves.
13. Iron gate valves.
14. Bronze globe valves.
15. Iron globe valves.
16. Lubricated plug valves.

B. Related Sections:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section and the other sections of this Division.
2. Other sections of this Division, and of other Divisions, may contain requirements that relate to this section.

1.2 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.3 SUBMITTALS

A. Product Data: Not Required.

1.4 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooved ends, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to HVAC valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.
5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch stem extensions to match specified insulation thickness and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Threaded: With threads according to ASME B1.20.1.
3. Grooved: With grooved ends according (or similar) to AWWA C606.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.

j. Port: Full.

B. Two-Piece, Regular-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Hammond Valve.
d. Milwaukee Valve Company.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Regular.

2.3 IRON BALL VALVES

A. Class 150, Iron Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Kitz Corporation.
d. Sure Flow Equipment Inc.
e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-72.
b. CWP Rating: 200 psig.
c. Body Design: Split body.
d. Body Material: ASTM A 126, gray iron.
e. Ends: Flanged.
f. Seats: PTFE or TFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel.
i. Port: Full.

2.4 IRON, BUTTERFLY VALVES

A. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Cooper Cameron Valves; a division of Cooper Cameron Corp.
c. Crane Co.; Crane Valve Group.
d. Hammond Valve.
e. Kitz Corporation.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 150 psig.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Stainless steel.

B. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Cooper Cameron Valves; a division of Cooper Cameron Corp.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Hammond Valve.
e. Kitz Corporation.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Stainless steel.

2.5 IRON, GROOVED-END BUTTERFLY VALVES

A. 150 CWP, Iron, Grooved-End Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Victaulic Company
   b. Kennedy Valve; a division of McWane, Inc.
   c. Tyco Fire Products LP; Grinnell Mechanical Products
   d. Or approved substitution.

2. Description:
   a. Standard: MSS SP-67, Type I.
   b. CWP Rating: 150 psig.
   c. Body Material: Coated, ductile iron.
   d. Stem: Two-piece stainless steel, offset from the disc centerline to provide complete 360-degree circumferential seating.
   e. Disc: Aluminum-bronze.
   f. Seat: EPDM, pressure responsive in sizes through NPS 12.

2.6 BRASS, GROOVED-END BUTTERFLY VALVES

A. 150 CWP, Brass, Grooved-End Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following

   a. Victaulic Company
   b. Kennedy Valve; a division of McWane, Inc.
   c. Tyco Fire Products LP; Grinnell Mechanical Products
   d. Or approved substitution.

2. Description:
   a. CWP Rating: 150 psig.
   b. Body Material: Cast brass to UNS C87850.
   c. Stem: Stainless steel, offset from the disc centerline to provide complete 360-degree circumferential seating.
   d. Disc: Aluminum-bronze.
   e. Seat: Fluoroelastomer.

2.7 HIGH-PERFORMANCE BUTTERFLY VALVES

A. Class 150, Single-Flange, High-Performance Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by Zwick, no substitutions permitted.
2. Description:

   a. Standard: ANSI B16.10.
   b. CWP Rating: 720 psig at 100 deg F.
   c. Body Design: Flange type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
   d. Body Material: Carbon steel.

e. Seat: Reinforced stainless steel.
f. Stem: One piece stainless steel; offset from seat plane.
g. Disc: Carbon steel.
h. Service: Bidirectional.
i. Packing: Graphite.

2.8 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.
b. Jenkins Valves.
c. Stockham.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Design: Vertical flow.
d. Body Material: ASTM B 61 or ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

2.9 BRONZE SWING CHECK VALVES

A. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group.
c. Jenkins Valves.
d. Stockham.
e. Kitz Corporation.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Red-White Valve Corporation.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 300 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

2.10 IRON SWING CHECK VALVES

A. Class 250, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Jenkins Valves.
c. Stockham.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-71, Type I.
b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
c. NPS 14 to NPS 24, CWP Rating: 300 psig.
d. Body Design: Clear or full waterway.
e. Body Material: ASTM A 126, gray iron with bolted bonnet.
f. Ends: Flanged.
g. Trim: Bronze.
h. Gasket: Asbestos free.

2.11 IRON, GROOVED-END SPRING-ASSISTED CHECK VALVES

A. Ductile Iron Spring-Assisted Check Valve for Vertical or Horizontal Installation.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Victaulic Company.
b. Kennedy Valve; a division of McWane, Inc.
c. Tyco Fire Products LP; Grinnell Mechanical Products
d. Or approved substitution.

2. Description:

a. NPS 2-1/2 to NPS 12, CWP Rating: 300 psig.
b. NPS 14 to NPS 24, CWP Rating: 230 psig.
c. Body Material: ASTM A 536, ductile iron.
d. Ends: Grooved.
e. Trim: Stainless steel.
f. Disc / Seat / Seal:

1) Stainless steel disc with elastomer seat.
2) Elastomer coated ductile iron disc with welded-in nickel seat.

g. Installation: Vertical or horizontal.

2.12 BRONZE GATE VALVES

A. Class 150, RS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Stockham.
c. Hammond Valve.
d. Kitz Corporation.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Powell Valves.
h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 300 psig.
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron.

2.13 IRON GATE VALVES

A. Class 300, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Stockham Division.
c. NIBCO INC.
d. Vogt

2. Description:

a. Standard: MSS SP-70, Type I.
b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig at 300 degrees F.
c. NPS 14 to NPS 24, CWP Rating: 300 psig at 300 degrees F.
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.
f. Trim: Bronze.
g. Disc: Solid wedge.
h. Packing and Gasket: Asbestos free, graphite.

B. Class 300, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Powell Valves.
g. Vogt.

2. Description:

a. Standard: MSS SP-70, Type I.
b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig at 300 degrees F.
c. NPS 14 to NPS 24, CWP Rating: 300 psig at 300 degrees F.
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.
f. Trim: Bronze.
g. Disc: Solid wedge.
h. Packing and Gasket: Asbestos free, graphite.

C. Class 800, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with the requirements, provide products by one of the following:

a. Milwaukee
b. Vogt

2. Description:

a. Standard: MSS SP-70, Type 1.
b. CWP Rating: 1745 PSIG at 300 degrees F.
c. Body Material: ASTM A 105 carbon steel with bolted bonnet.
d. Ends: Threaded or flanged.
e. Disc: Solid wedge.
f. Seat: Hard faced.
g. Packing and Gasket: Asbestos free, spiral wound gasket, graphite packing.

2.14 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Stockham Division.

c. Hammond Valve.
d. Kitz Corporation.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Powell Valves.
h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem and Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron.

2.15 IRON GLOBE VALVES

A. Class 300, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Jenkins Valves.
c. Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Vogt.

2. Description:

a. Standard: MSS SP-85, Type I.
b. CWP Rating: 500 psig at 300 degrees F.
c. Body Material: ASTM A 126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Packing and Gasket: Asbestos free, graphite.

B. Class 800, Iron Globe Valve:

1. Manufacturers: Subject to compliance with the requirements, provide products of one of the following:

a. Milwaukee.
b. Vogt.

2. Description:

a. Standard: MSS SP-70, Type 1.
b. CWP Rating: 1745 psig at 300 degrees F.
c. Body material: ASTM A 105 carbon steel with bolted bonnet.
d. Ends: Threaded or flanged.
e. Disc: Solid wedge.
f. Seat: Hard faced.
g. Packing and Gasket: Asbestos free, spiral wound gaskets, graphite packing.

2.16 LUBRICATED PLUG VALVES

A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Nordstrom Valves, Inc.

2. Description:

a. Standard: MSS SP-78, Type II.
b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
c. NPS 14 to NPS 24, CWP Rating: 150 psig.
d. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
e. Pattern: Venturi.
f. Plug: Cast iron or bronze with sealant groove.

B. Class 125, Regular-Gland, Lubricated Plug Valves with Flanged Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Nordstrom Valves, Inc.

2. Description:

a. Standard: MSS SP-78, Type II.
b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
c. NPS 14 to NPS 24, CWP Rating: 150 psig.
d. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
e. Pattern: Venturi.
f. Plug: Cast iron or bronze with sealant groove.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine grooved ends for form and cleanliness. Ends shall be clean and free from indentations and projections in the area from valve end to (and including) the groove.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown. Unions or flanges for servicing and disconnect are not required in installations using grooved joint couplings.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install gear operators on all non-quarter turn valves over 6” size.

F. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly, or gate valves.
2. Throttling Service except Steam: Globe valves.
3. Pump-Discharge Check Valves:

a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.

b. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal or resilient-seat check valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.
7. Grooved end valves may be used in lieu of flanged valves on applicable piping systems.

3.5 CHILLED-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, regular port, bronze with stainless-steel trim.
3. Bronze Swing Check Valves: Class 150, bronze disc.
4. Bronze Gate Valves: Class 150, NRS, bronze.
5. Bronze Globe Valves: Class 150, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron, Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, stainless-steel disc.
2. Iron, Single-Flange Butterfly Valves, NPS 14 to NPS 24: 150 CWP, EPDM seat, stainless-steel disc.
3. Iron, Grooved-End Butterfly Valves, NPS 2 to NPS 24: 150 psi CWP, EPDM seat / seal.
4. High-Performance Butterfly Valves: Class 150, single flange.
5. Iron Swing Check Valves: Class 125, metal seats.
6. Grooved-End, Spring-Assisted Iron Check Valves: 150-psi CWP.
7. Iron Gate Valves: Class 125, NRS.
8. Iron Globe Valves: Class 125.
9. Lubricated Plug Valves: Class 125, regular gland, flanged.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fiberglass pipe hangers.
4. Metal framing systems.
5. Fiberglass strut systems.
6. Thermal-hanger shield inserts.
7. Building attachments.
8. Pipe stands.
9. Pipe positioning systems.
10. Equipment supports.
11. Miscellaneous equipment.

B. Related Documents:

1. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and the other sections of this Division.
2. Other sections of this Division, and of other Divisions, may contain requirements that relate to this section.

1.2 DEFINITIONS

A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment where required.

1.4 SUBMITTALS

A. Product Data: Not Required.

1.5 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel or stainless steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 FIBERGLASS PIPE HANGERS

A. Clevis-Type, Fiberglass Pipe Hangers

1. Description: Similar to MSS SP-58, Type 1, steel pipe hanger except hanger is made of fiberglass or fiberglass-reinforced resin.
2. Hanger Rods: Continuous-thread rod, washer, and nuts made of stainless steel.

B. Strap-Type, Fiberglass Pipe Hangers:

1. Description: Similar to MSS SP-58, Type 9 or Type 10, steel pipe hanger except hanger is made of fiberglass-reinforced resin.
2. Hanger Rod and Fittings: Continuous thread rod, washer, and nuts made of stainless steel.

2.4 METAL FRAMING SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Tube & Conduit.
2. Cooper B-Line, Inc.
3. Unistrut Corporation; Tyco International, Ltd.

B. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.

C. Standard: MFMA-4.

D. Channels: Continuous slotted steel channel with inturned lips.

E. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

F. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.

G. Metallic Coating: Hot-dipped galvanized.

H. Paint Coating: Epoxy.

I. Plastic Coating: Polyurethane.

2.5 FIBERGLASS STRUT SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Tube & Conduit
2. Champion Fiberglass, Inc.
3. Cooper B-Line, Inc.
4. SEASAFE, INC.; a Gibraltar Industries Company.

B. Description: Shop- or field-fabricated pipe-support assembly similar to MFMA-4 for supporting multiple parallel pipes.

1. Channels: Continuous slotted fiberglass channel with inturned lips.
2. Channel Nuts: Fiberglass nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.6 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.
9. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig or ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.7 BUILDING ATTACHMENTS

A. General: Except as otherwise indicated, provide factory- fabricated building attachments comply with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Attachment materials to building structure shall be approved by the Structural Engineer.

B. Where concrete structure occurs hang piping using 1/2" diameter Phillips red head wedge anchors or equal by Hilti.

1. Concrete Inserts: MSS Type 18.
2. Top Beam C-Clamps: MSS Type 19.
3. Side Beam or Channel Clamps: MSS Type 20.
4. Center Beam Clamps: MSS Type 21.
5. Welded Beam Attachments: MSS Type 22.
6. C-Clamps: MSS Type 23.
7. Top Beam Clamps: MSS Type 25.
8. Side Beam Clamps: MSS Type 27.
9. Steel Beam Clamps with Eye Nut: MSS Type 28.

10. Linked Steel Clamps with Eye Nut: MSS Type 29.
11. Malleable Beam Clamps: MSS Type 30.
12. Steel Brackets: One of the following for indicated loading:

    a. Light Duty: MSS Type 31.
    b. Medium Duty: MSS Type 32.
    c. Heavy Duty: MSS Type 33.

13. Side Beam Brackets: MSS Type 34.
14. Plate Lugs: MSS Type 57.
15. Horizontal Travelers: MSS Type 58.

2.8 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece plastic or stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:

1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Plastic or stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.9 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for HVAC fixtures in commercial applications.

2.10 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.11 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly supporting piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.

F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

G. Installation of Building Attachments:

1. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.

2. Use power driven anchors or expansion anchors at concrete structure.
3. Install supplementary steel angles, fastened or welded to building structure as required to support pipe and accessories. Use 3” x 3” x 1/4” steel angle with long leg vertical, or heavier if required.

H. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Sections for how system interfaces with roofing system.

I. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each HVAC fixture. See Division 23 HVAC fixture Sections for requirements for pipe positioning systems for HVAC fixtures.

J. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

K. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

L. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

M. Install lateral bracing with pipe hangers and supports to prevent swaying.

N. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

P. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.
    c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 INSTALLATION - PIPE HANGER AND SUPPORT

A. Install in accordance with ASME B31.9, MSS SP 58, MSS SP69, and MSS SP 89.

B. Support horizontal and vertical piping as scheduled.

C. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.

D. Provide clearance in hangers and from structure and other equipment for installation of insulation.

E. Use hangers with 1-1/2 inch minimum vertical adjustment.

F. Design hangers for pipe movement without disengagement of supported pipe

G. Comply with MSS SP-69 for pipe-hanger selections and applications that are not otherwise specified.

H. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.

I. Use stainless-steel pipe hangers, fiberglass pipe hangers, fiberglass strut systems and stainless-steel or corrosion-resistant attachments for outdoors and/or hostile environment applications.

J. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing. Use vinyl-coated hangers and attachments for PEX, PVC, and CPVC piping. Use stainless steel hangers and stainless steel attachments on stainless steel pipes.

K. Use padded hangers for piping that is subject to scratching, including plastic pressure piping and all glass piping.

L. Use thermal-hanger shield inserts for insulated piping and tubing.

M. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified elsewhere, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.

3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

N. Vertical-Piping Clamps: Unless otherwise indicated and except as specified elsewhere, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.

2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

O. Hanger-Rod Attachments: Unless otherwise indicated and except as specified elsewhere, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

P. Building Attachments: Unless otherwise indicated and except as specified elsewhere, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

Q. Saddles and Shields: Unless otherwise indicated and except as specified elsewhere, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

R. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions: (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

S. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not otherwise specified.

T. Comply with MFMA-103 for metal framing system selections and applications that are not otherwise specified.

U. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.7 PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by material installation.

3.8 SCHEDULES

HORIZONTAL PIPE HANGER SPACING		
PIPE MATERIAL	MAXIMUM HANGER SPACING Feet	HANGER ROD DIAMETER Inches
Copper Tube, 1-1/4 inch and smaller	5	3/8
Copper Tube, 1-1/2 inch to 5 inches	8	1/2
Copper Tube 6 inch	10	5/8
Copper Tube 8 inch	10	3/4
Polypropylene/Polyethylene 3 inches and smaller	3	1/2
Polypropylene/Polyethylene 4 inches to 8 inches	4	7/8
Stainless Steel or Steel, 3 inches and smaller	12	1/2
Stainless Steel or Steel, 4 inches to 6 inch	12	3/4
Stainless Steel or Steel, 8 inches and larger	12	7/8

NOTE: 1. Where code requirements for hangers are more stringent than above, code requirements shall apply.
2. Place hangers within 12 inches of each horizontal elbow, fitting, valve and coupling.
3. Support horizontal cast iron pipe adjacent to each hub.
4. Rod diameters may be reduced one size for double-rod hangers, with 3/8 inch minimum rods.

VERTICAL PIPE SUPPORT SPACING	
PIPE MATERIAL	MAXIMUM SUPPORT SPACING Feet
Copper Tube	10
Fiberglass	12
Polypropylene/Polyethylene	5
Steel or Stainless Steel	15

NOTE: 1. Where not otherwise indicated, support vertical piping at each floor.
2. Support cast iron at hubs.
3. Support riser piping independently of connected horizontal piping.

END OF SECTION 230529

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Valve tags.
6. Warning tags.
7. Plastic underground pipe markers.

B. Related Documents:

1. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and the other sections of this Division.
2. Other sections of this Division, and of other Divisions, may contain requirements that relate to this section.

1.2 SUBMITTALS

A. Product Data: Not Required

1.3 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch; Stainless steel, 0.025-inch; Aluminum, 0.032-inch; or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
5. Fasteners: Stainless-steel rivets or self-tapping screws.
6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

D. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

E. Fasteners: Stainless-steel rivets or self-tapping screws.

F. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

G. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover or cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Multilayer, multicolored plastic, 0.0625 inch; Brass, 0.032-inch; Stainless steel, 0.025-inch; Aluminum, 0.032-inch; or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

2.6 PLASTIC UNDERGROUND PIPE MARKERS

A. Brightly colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten plastic or metal labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; mechanical rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings.
8. There shall be a minimum of one label for each system per room.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.6 UNDERGROUND PIPE MARKERS

A. Install underground plastic pipe markers 6 to 8 inches below finish grade, directly above buried pipe.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Balancing Hydronic Piping Systems:

    a. Constant-flow hydronic systems.

2. Testing, Adjusting, and Balancing Equipment:

    a. Heat exchangers.
    b. Motors.
    c. Chillers.

3. Testing, adjusting, and balancing existing systems and equipment.
4. Control system verification.

1.3 DEFINITIONS

A. BAS: Building automation systems.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

E. TDH: Total dynamic head.

1.4 PREINSTALLATION MEETINGS

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. TAB Plan:submit TAB strategies and step-by-step procedures as specified in "TAB Plan" Article.

D. System Readiness Checklists: Prior to beginning work, submit system readiness checklists as specified in "Preparation" Article.

E. Construction Document Examination Report: Prior to beginning work submit a report of the examination review required in "Examination" Article.

F. Installation Examination Report: During construction phases submit a report of the installation examination review required in “Examination” Article.

G. Certified TAB reports: After work is complete, submit TAB report as described in “Final Report” Article.

H. Sample report forms.

I. Controls Verification Report: Submit a report of the controls verification Article.

1.6 QUALITY ASSURANCE

A. The Mechanical Contractor shall procure the services of or an engineer pre-approved independent test and balance agency to test water moving equipment to supervise the balance and adjustment of these systems.

B. TAB Specialists Qualifications: Certified by NEBB:

1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB.
2. TAB Technician: Employee of the TAB specialist and certified by NEBB as a 3. TAB technician.

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

1.7 FIELD CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Construction Document Examination: Report: Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment:

1. Identify systems that contain diversity.
2. Verify floor plans and details that contain all balance devices necessary to execute entire specification.
3. Identify measurements that cannot be made or may not be accurate due to pipe or duct geometry.
4. Review equipment schedules and specifications as well as electrical connections to verify. Require speed control devices have been specified.
5. Identify balance devices that are difficult to reach during or after construction and make recommendations to overcome issue.
6. Bring any unmarked air inlet or outlets to the attention of the engineer immediately.
7. Review how TAB scope affects existing hydronic systems.

B. Installation Examination Report: Examine installed systems for deficiencies, which may reflect TAB activities. Prepare report bi-weekly and submit to engineer for review:

1. Examine systems for balancing devices such as test ports, gage locks, thermowells, flow-control devices, balancing valves and fittings and manual volume dampers.Verify that locations of these balance devices are applicable for intended purpose and are accessible.
2. Examine ceiling plenums and underfloor air plenum. Verify that penetrations in plenum walls are sealed and fire stopped if required.
3. Examine system and equipment installation and verify that field quality-control testing such as factory startups or pump alignment have occurred. Verify equipment and systems are clean and are being protected from construction process and verify that adjusting specified in individual sections have been performed.
4. Examine test reports specified in individual systems and equipment sections.
5. Examine HVAC equipment and verify that bearings are greased, bolts are aligned, and functioning controls is ready for operation.
6. Examine a sample of strainers to verify they are clean. A minimum of two strainers per system shall be inspected. Verify startup strainers have been removed. Provide photo documentation of findings.
7. Examine control valves for proper orientation, that operator(s) are securely attached.
8. Examining system pumps to verify gage ports are installed as detailed.
9. Examine expansion tank to determine if system is filled correctly and that air side is charged properly. Report water and air-filled pressures as well as corresponding system temperatures and fluid composition.
10. Examine the system for the presence of air.

C. Examine the approved submittals for HVAC systems and equipment to verify accessories required for compliance with TAB specifications are being provided.

3.2 PREPARATION

A. TAB Plan: Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. System Readiness Checklist: Prepare and execute system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Hydronics:

a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
b. Piping is complete with terminals installed.
c. Water treatment is complete, and that antifreeze is installed.
d. Systems are flushed, filled, and air purged.
e. Strainers are pulled and cleaned.
f. Control valves are functioning per the sequence of operation.
g. Shutoff and balance valves have been verified to be 100 percent open.
h. Pumps are started and proper rotation is verified.
i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
j. Variable-frequency controllers' startup is complete, and safeties are verified.
k. Suitable access to balancing devices and equipment is provided.
l. Base mounted pumps have been aligned.

2. Controls:

a. Verify controllers are communicating to user interface.
b. Verify software and cable requirements to communicate with control system.
c. Verify integrations to packaged controls and VFD’s are complete.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

B. Cut insulation, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230700 “HVAC INSULATION."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:

1. Check system pressure at expansion tank location and verify pressure exceeds the height of the system plus five psig.
2. Check flow-control valves for proper position.
3. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
4. Check that air has been purged from the system.
5. Check pump strainer to verify it is clean.
6. Verify glycol mixture of HVAC fluid. Correct flow and balance device measurements per device manufactures requirements.

3.5 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Adjust pumps to deliver total design gpm.

1. Measure total water flow.

a. Position valves for full flow through coils.
b. Measure flow by main flow meter, if installed.
c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

2. Measure pump TDH as follows:

a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
c. Convert pressure to head and correct for differences in gage heights.
d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
e. With valves open, read pump TDH. Initially, adjust pump discharge valve until design water flow is achieved, plus 15%.

3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

B. Adjust flow-measuring devices installed in mains and branches (if available) to design water flows:

1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

C. Adjust flow-measuring devices installed at terminals for each space to design water flows:

1. Measure flow at terminals.
2. Adjust each terminal to design flow.
3. Re-measure each terminal after it is adjusted.
4. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
5. Perform temperature tests after flows have been balanced.

D. For systems with pressure-independent valves at terminals:

1. Measure differential pressure and verify that it is within manufacturer's specified range.
2. Record all measurements. “Pass” and “Fail” are not acceptable.
3. Perform temperature tests after flows have been verified.

E. Verify final system conditions as follows:

1. Re-measure and confirm that total water flow is within design.
2. Re-measure final pumps' operating data, TDH, volts, and amps.
3. Mark final settings.
4. Plot RPM, head and brake horsepower on pump curve.

F. Verify that memory stops have been set and marked with permanent paint or marker.

3.6 PROCEDURES FOR HEAT EXCHANGERS

A. Adjust water flow to within specified tolerances.

B. Measure inlet and outlet water temperatures.

C. Measure inlet steam pressure.

D. Measure water pressure in and out of heat exchanger.

3.7 PROCEDURES FOR MOTORS

A. Record:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.8 PROCEDURES FOR CHILLERS

A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:

1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
6. Capacity: Calculate in tons of cooling.
7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving condenser air temperatures.
8. Coincident outdoor dry bulb and wet bulb temps.

3.9 CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Measure water flow rate at all flow monitor locations. Report both measurement and coincident control system readings.

B. Controls Verification Report: Also see Article “Final Report”:

1. Include summary of measurements performed, remaining deficiencies, and verifications from indicated conditions.
2. Include graphic or schematic showing location of duct static transmitters, air flow stations and water flow meters.
3. Measurement records shall include coincident value in control system.

3.10 TOLERANCES

A. Set HVAC system's water flow rates within the following tolerances:

1. Cooling-Water Flow Rate: Plus or minus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above. Obtain approval from Engineer prior to deviating from design values.

3.11 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems:

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves with annotated data.
2. Field startup reports prepared by system and equipment installers.
3. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Summary of TAB procedures.
    b. Complete list of issues encountered, including status, when issue was encountered and resolved.
    c. Conditions under which measurements were taken.

12. Nomenclature sheets for each item of equipment.
13. Notes to explain why certain final data in the body of reports vary from indicated values.
14. Test conditions for pump performance forms including the following:

    a. Other system operating conditions that affect performance.

15. Each page must include unique page number corresponding to table of contents.

D. System Diagrams: Include annotated floor plans of hydronic distribution systems. Present each system include the following:

1. Position of balancing devices If different than drawings).

E. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Service.
    d. Make and size.
    e. Model number and serial number.
    f. Water flow rate in gpm.
    g. Water pressure differential in feet of head or psig.
    h. Pump rpm.
    i. Impeller diameter in inches.
    j. Motor make and frame size.
    k. Motor horsepower and rpm.
    l. Voltage at each connection.
    m. Amperage for each phase.
    n. Full-load amperage and service factor.

2. Test Data (Indicated and Actual Values):

    a. Static head in feet of head or psig.
    b. Pump shutoff pressure in feet of head or psig.
    c. Actual impeller size in inches.
    d. Full-open flow rate in gpm.
    e. Full-open pressure in feet of head or psig.
    f. Final discharge pressure in feet of head or psig
    g. Final suction pressure in feet of head or psig.
    h. Final total pressure in feet of head or psig.
    i. Final water flow rate in gpm.
    j. Voltage at each connection.
    k. Amperage for each phase.

F. Controls Verification Report:

1. Test Data:

    a. Actual and control system values for each control input.
    b. Air flow stations. Actual and system values, configuration settings.
    c. Water flow meters. Actual and system values.
    d. Safety high static shutdown switches setting.
    e. Dirty filter pressure switches setting.
    f. Room pressure monitors. Actual and system values.
    g. Record flow coefficients for all terminal equipment.

3.12 VERIFICATION OF TAB REPORT

A. Engineer shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

B. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

C. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

D. If TAB work fails, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.

3.13 ADDITIONAL TESTS

A. Seasonal Periods: With approval from the Engineer, certain measurements may be deferred until weather conditions are near-peak summer or winter conditions. Such request must be submitted in writing to the engineer for approval. Request must be accompanied with a plan to conduct the deferred work. TAB specialist shall return to the project site to conduct remaining work.

3.14 COMMISSIONING ASSISTANCE

1. Refer to Section 238000 “Systems Commissioning” for requirements of that section.

END OF SECTION 230593

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. HVAC piping insulation, jackets, and accessories.
2. HVAC equipment insulation, jackets, and accessories.
3. HVAC ductwork insulation, jackets, and accessories.

B. Related Documents:

1. Drawings and general provisions of the contract, including General and Supplementary conditions and Division 01 specification sections, apply to this section and the other sections of this Division.
2. Other sections of this Division, and of other Division, may contain requirements that relate to this section.

1.2 REFERENCES

A. Sheet Metal and Air Conditioning Contractors':

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

B. National Fire Protection Association:

1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

C. UL Solutions:

1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
2. UL 1978 - Standard for Safety for Grease Ducts.

1.3 QUALITY ASSURANCE

A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84, UL 723, and NFPA 255. All items exposed in return air plenums must not exceed 25/50 for flame and smoke.

B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.

C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.

D. Perform Work in accordance with applicable local and state codes.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Applicator: Company specializing in performing Work of this section with minimum three years experience.

1.5 PRE-INSTALLATION MEETINGS

A. Convene minimum one week prior to commencing work of this section.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.

B. Maintain temperature before, during, and after installation for minimum period recommended by manufacturer.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Manufacturers for Glass Fiber and Mineral Fiber Insulation Products:

1. CertainTeed.
2. Knauf.
3. Johns Manville.
4. Owens-Corning.

B. Manufacturers for Closed Cell Elastomeric Insulation Products:

1. Aeroflex. Aerocell.
2. Armacell, LLC. Armaflex.
3. Nomaco. K-flex.

C. Manufacturers for Polyisocyanurate Foam Insulation Products:

1. Dow Chemical Company.

D. Manufacturers for Extruded Polystyrene Insulation Products:

1. Dow Chemical Company.

2.2 PIPE INSULATION

A. TYPE P-1: ASTM C547, molded glass fiber pipe insulation. Conform to ASTM C795 for application on Austenitic stainless steel.

1. Thermal Conductivity: 0.23 at 75 degrees F.
2. Operating Temperature Range: 0 to 850 degrees F.
3. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied reinforced foil kraft with self-sealing adhesive joints.
4. Jacket Temperature Limit: minus 20 to 150 degrees F.

B. TYPE P-2: ASTM C534, Type I, flexible, closed cell elastomeric insulation, tubular.

1. Thermal Conductivity: 0.27 at 75 degrees F.
2. Operating Temperature Range: Range: Minus 70 to 180 degrees F.

C. TYPE P-3: ASTM C547, Type I or II, mineral fiber preformed pipe insulation, noncombustible.

1. Thermal Conductivity: 0.23 at 75 degrees F.
2. Maximum Service Temperature: 1200 degrees F.
3. Canvas Jacket: UL listed, 6 oz/sq yd, plain weave cotton fabric treated with fire retardant lagging adhesive.

D. TYPE P-4: ASTM C591, Type IV, polyisocyanurate foam insulation, formed into shapes for use as pipe insulation.

1. Density: 2.0 pounds per cubic foot.
2. Thermal Conductivity: 180-day aged value of 0.19 at 75 degrees F.
3. Operating Temperature Range: Range: Minus 297 to 300 degrees F.
4. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied film of 4 mils thickness and water vapor permeance of 0.02 perms.

E. TYPE P-5: ASTM C578, Type XIII, extruded polystyrene insulation, formed into shapes for use as pipe insulation.

1. Thermal Conductivity: 180-day aged value of 0.259 at 75 degrees F.
2. Operating Temperature Range: Range: Minus 297 to 165 degrees F.
3. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied film of 4 mils thickness and water vapor permeance of 0.02 perms.

F. TYPE P-6: ASTM C533; Type I, hydrous calcium silicate pipe insulation, rigid molded white; asbestos free.

1. Thermal Conductivity: 0.45 at 200 degrees F.
2. Operating Temperature Range: 140 to 1200 degrees F.

2.3 PIPE INSULATION JACKETS

A. PVC Plastic Pipe Jacket:

1. Product Description: ASTM D1784, one piece molded type fitting covers and sheet material, off-white color.
2. Thickness: 30 mil.
3. Connections: Brush on welding adhesive.

B. ABS Plastic Pipe Jacket:

1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
2. Minimum service temperature: -40 degrees F.
3. Maximum service temperature of 180 degrees F.
4. Moisture vapor transmission: ASTM E96; 0.012 perm-inches.
5. Thickness: 30 mil.
6. Connections: Brush on welding adhesive.

C. Aluminum Pipe Jacket:

1. ASTM B209.
2. Thickness: 0.032 inch thick sheet.
3. Finish: Embossed.
4. Joining: Longitudinal slip joints and 2-inch laps.
5. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
6. Metal Jacket Bands: 3/8 inch wide; 0.020 inch thick stainless steel.

2.4 PIPE INSULATION ACCESSORIES

A. Vapor Retarder Lap Adhesive: Compatible with insulation.

B. Covering Adhesive Mastic: Compatible with insulation.

C. Piping 1-1/2 inches diameter and smaller: Galvanized steel insulation protection shield. MSS SP-69, Type 40. Length: Based on pipe size and insulation thickness.

D. Piping 2 inches diameter and larger: Wood insulation saddle, hard maple. Insert length: not less than 6 inches long, matching thickness and contour of adjoining insulation.

E. Closed Cell Elastomeric Insulation Pipe Hanger: Polyurethane insert with [aluminum] [stainless steel jacket] single piece construction with self-adhesive closure. Thickness to match pipe insulation.

F. Tie Wire: 0.048-inch stainless steel with twisted ends on maximum 12-inch centers.

G. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449.

H. Insulating Cement: ASTM C195; hydraulic setting on mineral wool.

I. Adhesives: Compatible with insulation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify piping, equipment and ductwork has been tested before applying insulation materials.

B. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION - PIPING SYSTEMS

A. Piping Exposed to View in Finished Spaces: Locate insulation and cover seams in least visible locations.

B. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Division 07 for penetration of assemblies with fire resistance rating greater than one hour.

C. Piping Systems Conveying Fluids Below Ambient Temperature:

1. Insulate the entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
2. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
3. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.

D. Glass Fiber Board Insulation:

1. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
2. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
3. Cover wire mesh or bands with cement to a thickness to remove surface irregularities.

E. Polyisocyanurate Foam Insulation and Extruded Polystyrene Insulation:

1. Wrap elbows and fitting with vapor retarder tape.
2. Seal butt joints with vapor retarder tape.

F. Hot Piping Systems less than 140 degrees F:

1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
3. Do not insulate unions and flanges at equipment, but bevel and seal ends of insulation at such locations.

G. Hot Piping Systems greater than 140 degrees F:

1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
3. Insulate flanges and unions at equipment.

H. Inserts and Shields:

1. Piping 1-1/2 inches Diameter and Smaller: Install galvanized steel shield between pipe hanger and insulation.
2. Piping 2 inches Diameter and Larger: Install insert between support shield and piping and under finish jacket.

    a. Insert Configuration: Minimum 6 inches long, of thickness and contour matching adjoining insulation; may be factory fabricated.
    b. Insert Material: Compression resistant insulating material suitable for planned temperature range and service.

3. Piping Supported by Roller Type Pipe Hangers: Install galvanized steel shield between roller and inserts.

I. Insulation Terminating Points:

1. Coil Branch Piping 1 inch and Smaller: Terminate hot water piping at union upstream of the coil control valve. On VAV, CV, and FTU terminal units, insulate heating water piping and components up to coil connections.
2. Chilled Water Coil Branch Piping: Insulate chilled water piping and associated components up to coil connection.
3. Cooling Coil Condensate Piping: Insulate entire piping system and components to prevent condensation.

J. Closed Cell Elastomeric Insulation:

1. Push insulation on to piping.
2. Miter joints at elbows.
3. Seal seams and butt joints with manufacturer’s recommended adhesive.
4. When application requires multiple layers, apply with joints staggered.

5. Insulate fittings and valves with insulation of like material and thickness as adjacent pipe.

K. High Temperature Pipe Insulation:

1. Install in multiple layers to meet thickness scheduled.
2. Attach each layer with bands. Secure first layer with bands before installing next layer.
3. Stagger joints between layers.
4. Finish with canvas jacket sized for finish painting.

L. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.

M. Piping Exterior to Building: Provide vapor retarder jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor retarder cement. Cover with aluminum jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water or on bottom side of horizontal piping.

N. Heat Traced Piping Interior to Building: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer.

O. Heat Traced Piping Exterior to Building: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size insulation large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water.

P. Prepare pipe insulation for finish painting. Refer to Division 09.

3.3 SCHEDULES

A. Cooling Services Piping Insulation Schedule:

PIPING SYSTEM	INSULATION TYPES	PIPE SIZE	INSULATION THICKNESS inches
Chilled Water Supply and Return [40 to 60 degrees F]	P-1[b]	1-1/4 inches and smaller 1-1/2 inches inch and larger	0.5 1.0
Chilled Water Supply and Return [less than 40 degrees F]	P-1[b]	3/4 inch and smaller 1 inch to 6 inches 8 inches and larger	0.5 1.0 1.5

Notes:

a. Not all insulation types listed are allowed in return air plenums. Insulation in air plenums must have a flame and smoke rating of 25/50 or less per ASTM E84.

b. Insulation type P-2, P-4, or P-5 may be used for piping installed outdoors. Install longitudinal seams on the bottom of the pipe to allow moisture to drain.

END OF SECTION 230700

SECTION 230800 - COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. HVAC commissioning description.
2. HVAC commissioning responsibilities.

B. Related Sections:

1. Drawings and general provisions of the contract, including General and Supplementary conditions and Division 01 specification sections, apply to this section and the other sections of this Division.
2. Other sections of this Division, and of other Division, may contain requirements that relate to this section.

1.2 REFERENCES

A. Associated Air Balance Council:

1. AABC - AABC Commissioning Guideline.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE Guideline 1 - The HVAC Commissioning Process.

C. National Environmental Balancing Bureau:

1. NEBB - Procedural Standards for Building Systems Commissioning.

1.3 COMMISSIONING DESCRIPTION

A. HVAC commissioning process includes the following tasks:

1. Testing and startup of HVAC equipment and systems.
2. Equipment and system verification checks.
3. Assistance in functional performance testing to verify testing and balancing, and equipment and system performance.
4. Provide qualified personnel to assist in commissioning tests, including seasonal testing.
5. Complete and endorse functional performance test checklists provided by Commissioning Authority to assure equipment and systems are fully operational and ready for functional performance testing.
6. Provide equipment, materials, and labor necessary to correct deficiencies found during commissioning process to fulfill contract and warranty requirements.

7. Provide operation and maintenance information and record drawings to Commissioning Authority for review verification and organization, prior to distribution.
8. Provide assistance to Commissioning Authority to develop, edit, and document system operation descriptions.
9. Provide training for systems specified in this Section with coordination by Commissioning Authority.

B. Equipment and Systems to Be Commissioned:

1. Chillers.
2. Pumps.
3. Piping systems.
4. Variable frequency drives.
5. Heat exchangers.
6. Testing, Adjusting and Balancing work.

C. Perform seasonal function performance tests for the following equipment and systems:

1. Chillers.
2. Pumps.
3. Heat Exchangers.

1.4 COMMISSIONING SUBMITTALS

A. Test Reports: Indicate data on system verification form for each piece of equipment and system as specified.

B. Field Reports: Indicate deficiencies preventing completion of equipment or system verification checks equipment or system to achieve specified performance.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record revisions to equipment and system documentation necessitated by commissioning.

B. Operation and Maintenance Data: Submit revisions to operation and maintenance manuals when necessary revisions are discovered during commissioning.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with AABC.

1.7 COMMISSIONING RESPONSIBILITIES

A. Equipment or System Installer Commissioning Responsibilities:

1. Attend commissioning meetings.
2. Ensure temperature controls installer performs assigned commissioning responsibilities as specified below.

3. Ensure testing, adjusting, and balancing agency performs assigned commissioning responsibilities as specified.
4. Provide instructions and demonstrations for Owner's personnel.
5. Ensure subcontractors perform assigned commissioning responsibilities.
6. Ensure participation of equipment manufacturers in appropriate startup, testing, and training activities when required by individual equipment specifications.
7. Develop startup and initial checkout plan using manufacturer’s startup procedures and functional performance checklists for equipment and systems to be commissioned.
8. During verification check and startup process, execute HVAC related portions of checklists for equipment and systems to be commissioned.
9. Perform and document completed startup and system operational checkout procedures, providing copy to Commissioning Authority.
10. Provide manufacturer’s representatives to execute starting of equipment. Ensure representatives are available and present during agreed upon schedules and are in attendance for duration to complete tests, adjustments and problem-solving.
11. Coordinate with equipment manufacturers to determine specific requirements to maintain validity of warranties.
12. Provide personnel to assist Commissioning Authority during equipment or system verification checks and functional performance tests.
13. Prior to functional performance tests, review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during tests.
14. Prior to startup, inspect, check, and verify correct and complete installation of equipment and system components for verification checks included in commissioning plan. When deficient or incomplete work is discovered, ensure corrective action is taken and re-check until equipment or system is ready for startup.
15. Perform verification checks and startup on equipment and systems as specified.
16. Assist Commissioning Authority in performing functional performance tests on equipment and systems as specified.
17. Perform operation and maintenance training sessions scheduled by Commissioning Authority.
18. Conduct HVAC system orientation and inspection.

B. Temperature Controls Installer Commissioning Responsibilities:

1. Attend commissioning meetings.
2. Review design for ability of systems to be controlled including the following:

    a. Confirm proper hardware requirements exists to perform functional performance testing.
    b. Confirm proper safeties and interlocks are included in design.
    c. Confirm proper sizing of system control valves and actuators and control valve operation will result capacity control identified in Contract Documents.
    d. Confirm proper sizing of system control dampers and actuators and damper operation will result in proper damper positioning.
    e. Confirm sensors selected are within device ranges.
    f. Review sequences of operation and obtain clarification from Architect/Engineer.

g. Indicate delineation of control between packaged controls and building automation system, listing BAS monitor points and BAS adjustable control points.
h. Provide written sequences of operation for packaged controlled equipment. Equipment manufacturers' stock sequences may be included, when accompanied by additional narrative to reflect Project conditions.

3. Inspect, check, and confirm proper operation and performance of control hardware and software provided in other HVAC sections.
4. Submit proposed procedures for performing automatic temperature control system point-to-point checks to Commissioning Authority and Architect/Engineer.
5. Inspect check and confirm correct installation and operation of automatic temperature control system input and output device operation through point-to-point checks.
6. Perform training sessions to instruct Owner's personnel in hardware operation, software operation, programming, and application in accordance with commissioning plan.
7. Demonstrate system performance and operation to Commissioning Authority during functional performance tests including each mode of operation.
8. Provide control system technician to assist during Commissioning Authority verification check and functional performance testing.
9. Provide control system technician to assist testing, adjusting, and balancing agency during performance of testing, adjusting, and balancing work.
10. Assist in performing operation and maintenance training sessions scheduled by Commissioning Authority.

C. Testing, Adjusting, and Balancing Agency Commissioning Responsibilities:

1. Attend commissioning meetings.
2. Participate in verification of testing, adjusting, and balancing report for verification or diagnostic purposes.
3. Assist in performing operation and maintenance training sessions scheduled by Commissioning Authority.

1.8 COMMISSIONING MEETINGS

A. Attend initial commissioning meeting and progress commissioning meetings as required by Commissioning Authority.

1.9 SCHEDULING

A. Prepare schedule indicating anticipated start dates for the following:

1. Piping system pressure testing.
2. Piping system flushing and cleaning.
3. Ductwork cleaning.
4. Ductwork pressure testing.
5. Equipment and system startups.
6. Automatic temperature control system checkout.
7. Testing, adjusting, and balancing.
8. HVAC system orientation and inspections.

9. Operation and maintenance manual submittals.
10. Training sessions.

B. Schedule seasonal tests of equipment and systems during peak weather conditions to observe full-load performance.

C. Schedule occupancy sensitive tests of equipment and systems during conditions of both minimum and maximum occupancy or use.

1.10 COORDINATION

A. Notify Commissioning Authority minimum of four weeks in advance of the following:

1. Scheduled equipment and system startups.
2. Scheduled automatic temperature control system checkout.
3. Scheduled start of testing, adjusting, and balancing work.

B. Coordinate programming of automatic temperature control system with construction and commissioning schedules.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install additional balancing dampers, balancing valves, access doors, test ports, and pressure and temperature taps required by Commissioning Authority.

B. Place HVAC systems and equipment into full operation and continue operation during each working day of commissioning.

C. Install replacement sheaves and belts to obtain system performance, as requested by Commissioning Authority.

D. Install test holes in ductwork and plenums as requested by Commissioning Authority for taking air measurements.

E. Prior to start of functional performance test, install replacement filters in equipment.

3.2 COMMISSIONING

A. Seasonal Sensitive Functional Performance Tests:

1. Test heating equipment at winter design temperatures.
2. Test cooling equipment at summer design temperatures [with fully occupied building].

3. Participate in testing delayed beyond Final Completion to test performance at peak seasonal conditions.

B. Be responsible to participate in initial and alternate peak season test of systems required to demonstrate performance.

C. Occupancy Sensitive Functional Performance Tests:

1. Test equipment and systems affected by occupancy variations at minimum and peak loads to observe system performance.
2. Participate in testing delayed beyond Final Completion to test performance with actual occupancy conditions.

END OF SECTION 230800

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Chilled water piping, above grade.

B. Related Documents:

1. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and the other sections of this Division.
2. Other sections of this Division, and of other Divisions, may contain requirements that relate to this section.

1.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Hydronic piping and support and installation shall withstand effects of earthquake motions determined according to ASCE/SEI 7.

1.3 SUBMITTALS

A. Product Data:

1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves, equipment and accessories.

B. Operation and Maintenance Data: Submit instructions for installation and changing components, spare parts lists, exploded assembly views.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

B. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.

C. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

D. All castings used for couplings housings, fittings, or valve and specialty bodies shall be date stamped for quality assurance and traceability.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

B. Fabricator or Installer: Company specializing in performing Work of this section with minimum three years experience.

1.7 PRE-INSTALLATION MEETINGS

A. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in “Piping Schedule” article for applications of pipe, tube, fitting materials and joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL TUBE AND FITTINGS, ABOVE GROUND

A. Steel Pipe: ASTM A53, Schedule 40 (0.375 inch wall for sizes 12 inch and larger), black.

1. Fittings: ASME B16.3, malleable iron or ASTM A234, forged steel welding type.
2. Joints: Threaded for pipe 2 inch and smaller; welded for pipe 2-1/2 inches and larger.

B. Steel Pipe: ASTM A53, Schedule 40 (0.375 inch wall for sizes 12 inch and larger), black, cut grooved ends.

1. Fittings: ASTM A395 and ASTM A536 ductile iron, or ASTM A234 carbon steel, grooved ends.
2. Joints: Grooved mechanical couplings meeting ASTM F1476.

a. Housing Clamps: ASTM A395 and ASTM A536 ductile iron, enamel coated compatible with steel piping sizes.
b. Gasket: Elastomer composition for operating temperature range suitable for service.
c. Accessories: Zinc electroplated steel bolts, nuts, and washers, comply with ASTM A449.
d. Rigid: Coupling housings with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support and hanging in accordance with ANSI B31.1 and B31.9. Installation-Ready, for direct stab installation without field disassembly.
e. Flexible: Use in locations where vibration attenuation and stress relief are required.

3. Fittings: Cold press mechanical joint fitting shall conform to material requirements of ASTM A420 or ASME B16.3 and performance criteria of IAPMO PS117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer.

2.3 COPPER TUBE AND FITTINGS, ABOVE GROUND

A. Copper Tubing: ASTM B88, Type L, hard drawn.

1. Fittings: ASME B16.22 solder wrought copper.
2. Tee Connections: At contractor's option, mechanically extracted collars with notched and dimpled branch tube may be used.
3. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F. Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.
4. Copper Pressure-Seal-Joint Fittings: ASME B16.18 or ASME B16.23.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Viega, Plumbing and Heating Systems.
2) Preapproved equal.

b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
c. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

B. Copper Tubing: ASTM B88, Type L, hard drawn, rolled grooved ends.

1. Fittings: ASME B16.22 wrought copper and bronze, or ASME B16.18 and ASTM B584 bronze sand castings, with copper-tube dimensioned grooved ends.
2. Joints: Grooved mechanical couplings meeting ASTM F1476.

a. Housing Clamps: ASTM A395 and ASTM A536 ductile iron with offsetting angle-pattern bolt pads, enamel coated, compatible with copper tubing sizes, to engage and lock.

b. Gasket: Elastomer composition for operating temperature range suitable for service.
c. Accessories: ASTM A449 compliant Zinc electroplated steel bolts, nuts, and washers.

C. Copper Tubing: ASTM B88, Type M, hard drawn.

1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
2. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.

2.4 UNIONS AND FLANGES

A. Unions for Pipe 2 inches and Smaller:

1. Ferrous Piping: Class 150, malleable iron, threaded.
2. Copper Piping: Class 150, bronze unions with soldered joints.
3. Dielectric Connections: Nipple with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
4. PVC Piping: PVC.

B. Flanges for Pipe 2-1/2 inches and Larger:

1. Ferrous Piping: Class 150, forged steel, slip-on flanges.
2. Copper Piping: Class 150, slip-on bronze flanges.
3. PVC Piping: PVC flanges.
4. Gaskets: 1/16 inch thick preformed neoprene gaskets.

C. Unions or flanges for servicing and disconnect are not required in installations using grooved joint couplings.

D. PVC Pipe Materials: For connections to equipment and valves with threaded connections, furnish solvent-weld socket to screwed joint adapters and unions, or ASTM D2464, Schedule 80, threaded, PVC pipe.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel or groove plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges, grooved joint couplings, or unions.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

E. After completion, fill, clean, and treat systems.

F. The installing contractor shall insure that internal components of the cold press mechanical joint press fitting are properly in place and free from damage. This is to include sealing elements, grip ring, and separator rings.

3.2 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install in accordance with Division 23 Section “Hangers and Supports for HVAC Piping and Equipment”.

B. Support horizontal piping as scheduled.

C. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

D. Place hangers within 12 inches of each horizontal elbow.

E. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

F. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.

G. Where installing several pipes in parallel and at same elevation, provide multiple pipe hangers or trapeze hangers.

H. Provide copper plated hangers and supports for copper piping.

I. Prime coat exposed steel hangers and supports. Refer also to Division 09. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

J. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

K. Comply with requirements in Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment” for seismic restraint devices.

3.3 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

A. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Locations and arrangements of piping take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.

B. Use fittings for all changes in direction and all branch connections.

C. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

D. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1" clearance outside

the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

E. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4" ball valve, and short 3/4" threaded nipple and cap.

F. Install piping at a uniform grade of 1 inch in 40 feet upward in the direction of flow.

G. Make reductions in pipe sizes using eccentric reducer fitting installed with the level side up.

H. Install branch connections to mains using Tee fittings in main with take-off out the bottom of the main, except for up-feed risers which shall have take-off out the top of the main line.

I. Install unions in pipes 2 inch and smaller, adjacent to each valve, at final connections to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.

J. Install dielectric nipples or waterway fittings to join dissimilar metals, including copper coil connections with steel pipe.

K. Install flanges or grooved joint couplings on valves, apparatus, and equipment having 2-1/2 inch and larger connections.

L. Install flexible connectors at inlet and discharge connections to pumps (except inline pumps) and other vibration producing equipment.

1. Three flexible type grooved joint couplings may be used in lieu of flexible connectors at equipment connections in applicable piping systems. The couplings shall be placed in close proximity to the vibration source.

M. Install strainers on the supply side of each control valve, pressure reducing valve, pressure regulating valve, solenoid valve, inline pump, and elsewhere as indicated. Install nipple and ball valve in blow down connection of strainers 2 inch and larger.

N. Press Connections: Copper press fittings shall be made in accordance with manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer.

O. Install piping in accordance with ASME B31.9.

P. Route piping parallel to building structure and maintain gradient. Diagonal runs are not permitted, unless expressly indicated.

Q. Install piping to conserve building space, and not interfere with use of space.

R. Group piping whenever practical at common elevations, spaced to permit applying insulation and servicing of valves.

S. Sleeve pipe passing through partitions, walls and floors.

T. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping.

U. Install pipe identification.

V. Install and anchor piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

W. Provide access where valves and fittings are not exposed.

X. Slope hydronic piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe aligned.

Y. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

Z. Prepare exposed unfinished pipe, fittings, supports, and accessories, ready for finish painting.

AA. Install valves with stems upright or horizontal, not inverted.

BB. Insulate piping and equipment.

3.4 PIPE JOINT CONSTRUCTION

A. Soldered Joints: Comply with the procedures contained in the AWS "Soldering Manual."

B. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."

1. CAUTION: Remove stems, seats, and packing of valves and accessible internal parts at piping specialties before brazing.
2. Fill the pipe and fittings during brazing, with an inert gas (i.e., nitrogen or carbon dioxide) to prevent formation of scale.
3. Heat joints using oxy-acetylene torch. Heat to proper and uniform temperature.

C. Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads. Join pipe fittings and valves as follows:

1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
2. Align threads at point of assembly.
3. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).
4. Assemble joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

a. Damaged Threads: Do not use pipe with threads which are corroded or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

D. Grooved Joints: Install in accordance with the manufacturer's latest published installation instructions. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to (and including) groove. Gasket shall be manufacturer by the coupling manufacturer and verified as suitable for the intended service. Grooved coupling manufacturer's factory trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools, application of groove, and installation of grooved piping products. Factory trained representative shall periodically visit the jobsite to ensure best practices in grooved product installation are being followed. Contractor shall remove and replace any improperly installed products.

E. Flanged Joints: Align flanges surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.

3.5 VALVE APPLICATIONS:

A. General Duty Valve Applications: The Drawings indicate valve types to be used. Where specific valve types are not indicated the following requirements apply:

1. Shut-off duty: Use ball, valves for line size 2" and smaller, use butterfly valves above 2" size.
2. Install shut-off duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, and elsewhere as indicated.

B. Install drain valves at low points in mains, risers, branch lines, and elsewhere as required for system drainage.

3.6 FIELD QUALITY CONTROL

A. Preparation for Testing - Prepare hydronic piping in accordance with ASME B 31.9 and as follows:

1. Leave joints including welds uninsulated and exposed for examination during the test.
2. Provide temporary restraints for expansion joints which cannot sustain the reactions due to test pressure. If temporary restraints are not practical, isolate expansion joints from testing.
3. Flush system with clean water. Clean strainers.
4. Isolate equipment that is not to be subjected to the test pressure from the piping. If a valve is used to isolate the equipment, its closure shall be capable of sealing against the test pressure without damage to the valve. Flanged joints at which blinds are inserted to isolate equipment need not be tested.

B. Testing - Test hydronic piping as follows:

1. Use clean ambient temperature water as the testing medium, except where there is a risk of damage due to freezing. Another liquid may be used if it is safe for workmen and compatible with the piping system components.
2. Use vents installed at high points in the system to release trapped air while filling the system. Use drains installed at low points for complete removal of the liquid.

3. Examine system to see that equipment and parts that cannot withstand test pressures are properly isolated. Examine test equipment to ensure that it is tight and that low pressure filling lines are disconnected.
4. Subject piping system to a hydrostatic test pressure which at every point in the system is not less than 125 PSIG. The test pressure shall not exceed the maximum pressure for any vessel, pump, valve, or other component in the system under test. Make a check to verify that the stress due to pressure at the bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength, or 1.7 times the "SE" value in appendix A of ASME B31.9, Code for Pressure Piping, Building Services Piping.
5. After the hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components as appropriate, and repeat hydrostatic test until there are no leaks. Continue test for 6 hours minimum and re-examine for leaks.

3.7 ADJUSTING AND CLEANING

A. Clean and flush hydronic piping systems. Remove, clean, and replace strainer screens. After cleaning and flushing hydronic piping system, but before balancing, remove disposable fine mesh strainers in pump suction diffusers.

B. During flushing use cleaning compounds specified in Division 23 Section "HVAC Water Treatment."

C. The following procedure shall be used for cleaning and flushing of hydronic water piping.

1. Mix cleaning compound with clean water per chemical manufacturer's instructions and distribute into the chilled water lines.
2. Completely fill system with water and chemical and bleed air.
3. Circulate system for 48 hours. Verify that all valves are open.
4. Clean strainers a minimum of every 2 hours for the first 4 hours; then clean every 4 hours minimum.
5. Drain water and chemical from piping system. Drain all low points. Allow the drain to bleed while system is circulating and verify proper operation of automatic make-up water valve.
6. Refill with clean water and circulate for 4 hours using the automatic make-up.
7. Completely drain water from piping system. Drain all low points.
8. Refill with clean water and corrosion inhibitor in quantity as recommended by the chemical manufacturer, based on water samples taken at the site.
9. Test water sample; if test pH exceeds make-up pH continue flushing operation.

3.8 TESTING

A. 125 Pound Systems: Test hydronic piping subject to main system pressure at not less than 150 pounds per square inch gauge or 1-1/2 times the maximum working pressure devices connected to the piping system, whichever is greater, measured at the low point of the system.

B. Test Result: After cleaning and filling the mechanical system, operate the system for a period of not less than 48 hours continuously during which time water treatment samples shall be taken at 4 hour intervals and the results plotted on a graph. Testing and sampling

shall continue until the graph indicates that the water treatment is maintaining the specified levels of chemical within plus or minus 10 percent under all conditions of load.

3.9 COMMISSIONING

A. Fill system with clean water, both new and existing systems which must be drained in order to make connections for new systems.

B. Check expansion tanks to determine that they are not air bound and that the system is completely full of water.

C. Before operating the system perform these steps:

1. Open valves to full open position. Close coil bypass valves.
2. Remove and clean strainers.
3. Check pump for proper direction of rotation and correct improper wiring.
4. Check air vents at high points of systems and determine if all are installed and bleed all air completely from the system.
5. Set temperature controls so all coils are calling for full flow.
6. Check operation of automatic bypass valves.
7. Lubricate motors and bearings.
8. After air is eliminated, circulate hydronic water systems for a minimum of 72 hours prior to water balancing.

3.10 PIPING SCHEDULE

Application	Piping	Fittings
Chilled Water, Heating Water and Glycol Piping 2-1/2” and Larger (Above Grade)	ASTM A53 Steel Pipe	Forged Steel, Welded
		Grooved-Joint
	Hard Copper Tube, Type L	Grooved-Joint Wrought Copper Soldered Joints
		Copper Pressure Seal Joints

Table Notes:
a. Allowed only where specifically indicated on the drawings.
b. Confirm suitability for penetrations of fire rated assemblies or through fire separations.
c. May not be installed in a return-air plenum.

END OF SECTION 232113

SECTION 232116 - HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Flexible connectors.
2. Expansion tanks.
3. Air vents.
4. Air separators.
5. Strainers.
6. Pump suction fittings.
7. Combination pump discharge valves.
8. Manual calibrated balance valves.
9. Automatic balance valves.
10. Relief valves.

B. Related Documents:

1. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and the other sections of this Division.
2. Other sections of this Division, and of other Divisions, may contain requirements that relate to this section.

1.2 SUBMITTALS

A. Product Data: Submit for manufactured products and assemblies used in this Project.

1. Manufacturer’s data and list indicating use, operating range, total range, accuracy, and location for manufactured components.
2. Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.
3. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each piping specialty.
4. Submit electrical characteristics and connection requirements.

1.3 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of actual locations of components and equipment.

B. Operation and Maintenance Data: Submit instructions for calibrating instruments, installation instructions, assembly views, servicing requirements, lubrication instruction, and replacement parts list.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept piping specialties on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Protect systems from entry of foreign materials by temporary covers, caps and closures, completing sections of the work, and isolating parts of completed system until installation.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not install instruments when areas are under construction, except rough in, taps, supports and test plugs.

1.7 FIELD MEASUREMENTS

A. Verify field measurements before fabrication.

PART 2 - PRODUCTS

2.1 FLEXIBLE CONNECTORS

A. Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure 300 psig.

2.2 EXPANSION TANKS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:

1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. Bell & Gossett/ITT Industries
4. Taco, Inc.

B. Construction: Welded steel, rated for 125-psig working pressure. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

C. Accessories: Pressure gage, stainless steel Schrader valve air-charge fitting with EPDM seats, tank drain; pre-charge to 12 psig unless otherwise noted.

D. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure double check back flow prevention device, test cocks, strainer, vacuum breaker, and by-pass valves.

2.3 AIR VENTS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:

1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. Bell & Gossett/ITT Industries
4. Taco, Inc.

B. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.

C. Automatic Float Type:

1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

2.4 AIR SEPARATORS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:

1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. Bell & Gossett/ITT Industries
4. Spirotherm
5. Taco, Inc.

B. Tangential-Type Air Separators:

1. Tank: Welded steel; ASME constructed and labeled for 125-psig minimum working pressure and 375 deg F maximum operating temperature.
2. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
3. Tangential Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.
4. Blowdown Connection: Threaded.
5. Size: Match system flow capacity.

2.5 STRAINERS

A. Size 2 inch and Smaller:

1. Screwed brass (ASTM B 62, Grade C) or iron body (ASTM A 126, Class B) for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

B. Size 2-1/2 inch to 4 inch:

1. Flanged iron body (ASTM A 126, Class B) for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

2. Grooved end ductile iron body (ASTM A 536, Grade 65-45-12) for 175 psig working pressure, Y pattern with 1/16 inch or 1/8 inch stainless steel perforated screen.

C. Size 5 inch and Larger:

1. Flanged iron body for 175 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.
2. Grooved end ductile iron body (ASTM A 536, Grade 65-45-12) for 175 psig working pressure, Y pattern with 1/8 inch or 5/32 inch stainless steel perforated screen.

2.6 PUMP SUCTION FITTINGS

A. Manufacturer same as pump manufacturer.

B. Fitting: Angle pattern, cast iron body. Threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger. Rated for 175 psig working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings, disposable fine mesh strainer to fit over cylinder strainer, and permanent magnet located in flow stream and removable for cleaning.

C. Accessories: Adjustable foot support, blow-down tapping in bottom, gage tapping in side.

2.7 COMBINATION PUMP DISCHARGE VALVES

A. Manufacturer same as pump manufacturer.

B. Valves: Straight or angle pattern, flanged cast-iron valve body with bolt-on bonnet for 175 psig operating pressure, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation.

2.8 MANUAL CALIBRATED BALANCE VALVES (MANUAL BALANCE VALVES)

A. Manufacturer: Subject to compliance with requirements, provide calibrated balance valves by one of the following:

1. Armstrong Model CBV-VS/CBV-VT (1/2” through 2”)
2. Armstrong Model CBV-A/CBV-A (2 ½” through 12”)
3. IMI Hydronic Engineering Flow-set Model AS-S WT/AS-FPT (1/2” through 2”)
4. IMI Hydronic Engineering Flow-set Model AG/AF (2 ½” through 14”)
5. MEPCO Model MBVS/MBVT (1/2” through 2”)
6. MEPCO Model MBVF (2 ½” through 12”)

7. TACO Model ACUF-AC/ACUF-AT (1/2" through 2")
8. TACO Model ACUF-F (2 ½" through 4")
9. Victaulic / Tour & Anderson Model STAS/STAD (1/2" through 2")
10. Victaulic / Tour & Anderson Model STAG/STAF (2 ½" through 12")

B. General: Provide as indicated, calibrated balance valves equipped with readout test ports to facilitate connecting of a differential pressure meter to balance valves. Equip each readout test port with integral EPT check valve designed to minimize system fluid loss during balancing process. Provide calibrated nameplate to indicate degree of closure of precision machined orifice with tamper resistant memory step. Valves shall be capable of positive shut-off with no leakage.

C. Features: Balancing Valves in sizes ½" through 2" shall be of bronze body construction with solder or NPT connections to match piping systems. Balancing valves in sizes 2 ½" through 12" shall be of cast iron body design conforming to ASME/ANSI B16.5 with brass interior parts and flanged or grooved connections to match piping systems. Construct each valve for 250 psig working pressure at a temperature of 230°F and supplied with a preformed insulated housing suitable for use on heating and cooling systems. Insulation shall have a flame spread not to exceed 25, fuel contributed not to exceed 50 and smoke developed rating not to exceed 50.

1. Provide each valve with an engraved valve tag attached permanently to valve with brass chain or wire link manufactured specifically for that purpose. A valve schedule suitable for framing shall be provided referring each valve by sequenced number and indicating a minimum of valve size, model, manufacturer, piping system and unit served if applicable. A copy of the valve schedule shall be provided with balancing valve shop drawings submittals.

2.9 AUTOMATIC BALANCE VALVE

A. Manufacturer: Subject to compliance with requirements, provide automatic balance valves by one of the following:

1. Griswold
2. IMI Hydronic Engineering
3. Jomar Valve
4. Pre-approved equal

B. Capacity: Flow rate to match equipment served, regardless of system pressure fluctuation, within $\pm$ 5%. Control range shall be 1 to 14 PSI, 2 to 32 PSI, 4 to 57 PSI or 8 to 128 PSI depending on location within the piping system.

C. Submittal shall include a schedule which delineates the control range for each specific flow controller at every unit along with the valve size.

D. Features: All internal working parts shall be of passivated stainless steel or nickel plated brass. The valve shall be tamperproof when installed. Body pressure tappings suitable for pressure gauge and thermometer installation and verification of pressure differential across valve orifice shall be provided - Brass body - 150 PSI and 250°F rating - Units 1 1/2" and smaller located at coils shall have female threaded ball valve with lever handle on system side of controller for isolation with female sweat connection on unit side. A metal

identification tag on chain will be provided for each valve. The tag will give valve model number, rated flow GPM, and pressure range. Units 3" and above shall be gray iron body Class 150 for flanged installation.

2.10 RELIEF VALVES

A. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated capacities ASME certified and labeled.

PART 3 - EXECUTION

3.1 INSTALLATION - HYDRONIC PIPING SPECIALTIES

A. Locate test plugs as indicated on Drawings.

B. Where large air quantities accumulate, provide enlarged air collection standpipes.

C. Install manual air vents at system high points at heat transfer coils, and elsewhere as required for system air venting.

D. For automatic air vents in ceiling spaces or other concealed locations, install vent tubing to nearest drain.

E. Provide air separator on suction side of system circulation pump and connect to expansion tank.

F. Provide drain and hose connection with valve on strainer blow down connection.

G. Provide pump suction fitting on suction side of base mounted centrifugal pumps and vertical inline pumps. Remove temporary strainers after cleaning systems.

H. Provide combination pump discharge valve on discharge side of base mounted and vertical inline centrifugal pumps.

I. Support pump fittings with floor mounted pipe and flange supports.

J. Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.

K. Select system relief valve capacity greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

L. Pipe relief valve outlet to nearest floor drain, or to glycol mixing drum.

M. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

N. Feed glycol solution to system through make-up line with pressure regulator, venting system high points. Set to fill to pressure indicated on drawings.

END OF SECTION 232116

SECTION 232117 - UNDERGROUND HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary conditions and Division 01 specification sections, apply to this section and the other sections of this Division.

B. Other sections of this Division, and of other Division, may contain requirements that relate to this section.

1.2 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. Steel pipes and fittings.
3. Ductile-iron pipe and fittings.
4. Transition fittings.
5. Conduit piping system.

1.3 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing hydronic piping systems with the following minimum working-pressure ratings:

1. Chilled-Water Piping: **150 psig** at **200 deg F**.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Conduit piping.
2. Cased piping.

B. Shop Drawings: For underground hydronic piping. Signed and sealed by a professional engineer.

1. Calculate requirements for expansion compensation for underground piping.
2. Show expansion compensators, offsets, and loops with appropriate materials to allow piping movement in the required locations. Show anchors and guides that restrain piping movement with calculated loads, and show concrete thrust block dimensions.
3. Show pipe sizes, locations, and elevations. Show piping in trench, conduit, and cased pipe with details showing clearances between piping, and show insulation thickness.

1.5 QUALITY ASSURANCE

A. Fiberglass Pipe and Fitting Installers: Installers of RTRF and RTRP shall be certified by manufacturer of pipes and fittings as having been trained and qualified to join fiberglass piping with manufacturer-recommended adhesive.

B. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: [**ASTM B 88, Type L**] [**ASTM B 88, Type M**].

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

2.2 STEEL PIPES AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black with plain ends; type, grade, and wall thickness as indicated in "Piping Application" Article.

B. Cast-Iron, Threaded Fittings: ASME B16.4; [**Class 125**] [**and**] [**Class 250**].

C. Malleable-Iron, Threaded Fittings: ASME B16.3, [**Class 150**] [**and**] [**Class 300**].

D. Malleable-Iron Unions: ASME B16.39; [**Class 150**] [**Class 250**] [**and**] [**Class 300**].

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, [**Class 125**] [**and**] [**Class 250**]; raised ground face, and bolt holes spot faced.

F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

H. Steel Welding Fittings: [**ASME B16.9**] [**and**] [**ASTM A 234/A 234M**], seamless or welded.

1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

I. Grooved-End-Pipe Couplings for Galvanized-Steel Piping: AWWA C606 for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.

J. Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

K. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and -bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

L. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151/A21.51, with mechanical-joint bell and plain spigot end.

1. Standard-Pattern, Mechanical-Joint Fittings: AWWA C110/A21.10, ductile or gray iron.
2. Compact-Pattern, Mechanical-Joint Fittings: AWWA C153/A21.53, ductile iron.

a. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.4 CONDUIT PIPING SYSTEM

A. Description: Factory-fabricated and -assembled, airtight and watertight, drainable, pressure-tested piping with conduit, inner pipe supports, and insulated carrier piping. Fabricate so insulation can be dried in place by forcing dry air through conduit.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Perma-Pipe, Inc.
b. Rovanco Piping Systems, Inc.
c. Thermacor Process, L.P.

B. Carrier Pipe: Copper tube and fittings Standard-weight, steel pipe and fittings Schedule 40, steel pipe and fittings Schedule 80, steel pipe and fittings Ductile-iron pipe and fittings].

C. Carrier Pipe Insulation:

1. Mineral-Wool Pipe Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, 850 deg F, Grade A.

    a. Bands: ASTM A 666, Type 304, stainless steel, 3/4 inch wide, 0.020 inch thick.

2. Calcium Silicate Pipe Insulation: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.

    a. Bands: ASTM A 666, Type 304, stainless steel, 3/4 inch wide, 0.020 inch thick.

3. Polyisocyanurate Foam Pipe Insulation: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.

    a. Comply with ASTMC 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F at 75 deg F after 180 days of aging.
    b. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1-1/2 inches as tested by ASTM E 84.
    c. Fabricate shapes according to ASTM C 450 and ASTM C 585.

4. Polyurethane Foam Pipe Insulation: Unfaced, preformed, rigid cellular polyurethane material intended for use as thermal insulation.

    a. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F at 75 deg F after 180 days of aging.
    b. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1-1/2 inches as tested by ASTM E 84.
    c. Fabricate shapes according to ASTM C 450 and ASTM C 585.

D. Minimum Clearance:

1. Between Carrier Pipe Insulation and Conduit: 1 inch.
2. Between Insulation of Multiple Carrier Pipes: 3/16 inch.
3. Between Bottom of Carrier Pipe Insulation and Conduit: 1 inch.
4. Between Bottom of Bare, Carrier Pipe and Casing: 1-3/8 inches.

E. Conduit: Spiral wound, steel.

1. Finish: With two coats of fusion-bonded epoxy, minimum 20 mils thick.
2. Cover: With polyurethane foam insulation with an HDPE jacket; thickness indicated in "Piping Application" Article.
3. Piping Supports within Conduit: Corrugated galvanized steel with a maximum spacing of 10 feet.
4. Fittings: Factory-fabricated and -insulated elbows and tees. Elbows may be bent pipe equal to carrier pipe. Tees shall be factory fabricated and insulated, and shall be compatible with the carrier pipe.
5. Expansion Offsets and Loops: Size casing to contain piping expansion.

6. Accessories include the following:

    a. Water Shed: Terminal end protector for carrier pipes entering building through floor, 3 inches deep and 2 inches larger than casing; terminate casing 20 inches above the floor level.
    b. Guides and Anchors: Steel plate welded to carrier pipes and to casing, complete with vent and drainage openings inside casing.
    c. End Seals: Steel plate welded to carrier pipes and to casing, complete with drain and vent openings on vertical centerline.
    d. Gland Seals: Packed stuffing box and gland follower mounted on steel plate, welded to end of casing, permitting axial movement of carrier piping, with drain and vent connections on vertical centerline.
    e. Joint Kit: Half-shell, pourable or split insulation and shrink-wrap sleeve.

F. Manholes: Black steel with lifting eyes.

1. Finish: Spray-applied urethane, minimum 30 mils thick.
2. Access: 30-inch-diameter waterproof cover with gasket, ladder, and two 6-inch vents, one high and one low, extending above grade with rain caps.
3. Conduit Stub-Outs and Seals: Welded steel with drain and vent openings.
4. Sump: 12 inches in diameter, 12 inches deep.
5. Floatation Anchor: Oversized bottom keyed into concrete base.

G. Source Quality Control: Factory test conduit to 15 psig for a minimum of two minutes with no change in pressure. Factory test carrier pipe to 150 percent of the operating pressure of system. Furnish test certificates.

PART 3 - EXECUTION

3.1 EARTHWORK

A. See Division 31 for excavating, trenching, and backfilling.

3.2 PIPING APPLICATION

A. Chilled-Water Piping:

1. NPS 2 and smaller shall be any of the following:

    a. Schedule 40 steel pipe; **Class 250, cast-iron** fittings; cast-iron flanges and flange fittings; and threaded joints.

2. NPS 2-1/2 and larger shall be any of the following:

    a. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
    b. Mechanical-joint, ductile-iron pipe; standard pattern mechanical-joint fittings; and mechanical joints.
    c. RTRP and RTRF with adhesive or flanged joints.

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Remove standing water in the bottom of trench.

C. Do not backfill piping trench until field quality-control testing has been completed and results approved.

D. Install piping at uniform grade of 0.2 percent. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points and elsewhere as required for system drainage. Install manual air vents at high points.

E. In conduits, install drain valves at low points and manual air vents at high points.

F. Install components with pressure rating equal to or greater than system operating pressure.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. See Division 23 Section "Common Work Results for HVAC" for sleeves and mechanical sleeve seals through exterior building walls.

J. Secure anchors with concrete thrust blocks. Concrete is specified in Division 03 Section.

K. See Division 26 Section for cathodic devices and connections to piping and conduit systems.

3.4 JOINT CONSTRUCTION

A. See Division 33 Section "Common Work Results for Utilities" for basic utility piping joint construction.

B. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

C. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

D. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

E. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

F. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Ch. 35, "Pipe and Tubing," using copper-phosphorus brazing filler metal complying with AWS A5.8.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

H. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

J. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.

3.5 IDENTIFICATION

A. Install continuous plastic underground warning tapes during back filling of trenches for underground hydronic piping. Locate tapes 6 to 8 inches below finished grade, directly over piping. See Division 31 for warning-tape materials and devices and their installation.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: **Owner will engage** a qualified testing agency to perform tests and inspections.

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

C. Perform tests and inspections.

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

D. Tests and Inspections:

1. Prepare hydronic piping for testing according to ASME B31.9 and as follows:

a. Leave joints, including welds, uninsulated and exposed for examination during test.
b. Fill system with water. Where there is risk of freezing, air or a safe, compatible liquid may be used.

c. Use vents installed at high points to release trapped air while filling system.

2. Test hydronic piping as follows:

a. Subject hydronic piping to hydrostatic test pressure that is not less than 1.5 times the design pressure.
b. After hydrostatic test pressure has been applied for 10 minutes, examine joints for leakage. Remake leaking joints using new materials and repeat hydrostatic test until no leaks exist.

E. Prepare test and inspection reports.

END OF SECTION 232117

SECTION 232123 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and the other sections of this Division.

B. Other sections of this Division, and of other Divisions, may contain requirements that relate to this section.

1.2 SUMMARY

A. This Section includes the following:

1. Close-coupled, vertical in-line centrifugal pumps.

1.3 DEFINITIONS

A. Buna-N: Nitrile rubber.

B. EPT: Ethylene propylene terpolymer.

1.4 SUBMITTALS

A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.

B. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.

1. Wiring Diagrams: Power, signal, and control wiring.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of hydronic pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

B. Store pumps in dry location.

C. Retain protective covers for flanges and protective coatings during storage.

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with pump manufacturer's written rigging instructions.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CLOSE-COUPLED, VERTICAL IN-LINE CENTRIFUGAL PUMPS

A. Manufacturers:

1. Armstrong Pumps Inc.
2. Bell & Gossett; Div. of ITT Industries.
3. Grundfos Pumps Corporation.
4. Taco, Inc.

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically. Rate pump for 175-psig (1204-kPa) minimum working pressure and a continuous water temperature of 225 deg F (107 deg C).

C. Pump Construction:

1. Casing: Radially split, cast iron, with replaceable bronze wear rings, threaded gage tappings at inlet and outlet, and threaded companion-flange connections.

2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
3. Pump Shaft: Carbon steel.
4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.
5. Pump Bearings: Oil lubricated; bronze-journal or thrust type.

D. Motor: Single speed, unless otherwise indicated; and rigidly mounted to pump casing. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

2.3 PUMP SPECIALTY FITTINGS

A. Suction Diffuser: Angle pattern, 175-psig (1204-kPa) pressure rating, cast-iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and factory-fabricated support.

B. Triple-Duty Valve: Angle or straight pattern, 175-psig (1204-kPa) pressure rating, cast-iron body, pump-discharge fitting; with drain plug and bronze-fitted shutoff, balancing, and check valve features. Brass gage ports with integral check valve, and orifice for flow measurement.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONCRETE BASES

A. Install concrete bases of dimensions required for pumps and controllers. Refer to Division 23 Section "Common Work Results for HVAC."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

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

B. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.3 PUMP INSTALLATION

A. Comply with HI 1.4 for centrifugal pumps.

B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Install continuous-thread hanger rods and vibration isolation hangers of sufficient size to support pump weight. Vibration isolation devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment." Fabricate brackets or supports as required. Hanger and support materials are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

E. Suspend vertically mounted, in-line centrifugal pumps independent of piping. Install pumps with motor and pump shafts vertical. Use continuous-thread hanger rods and vibration isolation hangers of sufficient size to support pump weight. Vibration isolation devices are specified in Division 21 Section "Vibration and Seismic Controls for HVAC Piping and Equipment." Hanger and support materials are specified in Division 22 Section "Hangers and Supports for HVAC Piping and Equipment/Hangers and Supports for HVAC Piping and Equipment."

F. Set base-mounted pumps on concrete foundation. Disconnect coupling before setting. Do not reconnect couplings until alignment procedure is complete.

1. Support pump baseplate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches (19 to 38 mm) between pump base and foundation for grouting.
2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.

3.4 ALIGNMENT

A. Align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.

B. Comply with pump and coupling manufacturers' written instructions.

C. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation" for centrifugal pumps.

D. After alignment is correct, completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.5 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install check valve, venturi balance valve, and shut-off valve on discharge side of pumps, unless shown otherwise. Observe manufacturer-required distance straight pipe run into and out of venturi balance valve.

F. Install section diffuser and shutoff valve on suction side of pumps, unless shown otherwise.

G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

H. Install pressure gages on pump suction and discharge, at integral pressure-gage tapping, or install single gage with multiple input selector valve.

I. Install electrical connections for power, controls, and devices.

J. Ground equipment according to Division 26

K. Connect wiring according to Division 26.

3.6 STARTUP SERVICE

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

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Perform the following startup checks for each pump before starting:

    a. Verify bearing lubrication.
    b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    c. Verify that pump is rotating in the correct direction.

5. Prime pump by opening suction valves and closing drains and prepare pump for operation.

6. Start motor.
7. Open discharge valve slowly.

END OF SECTION 232123

SECTION 23 5700 - HEAT EXCHANGERS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and the other sections of this Division.

B. Other sections of this Division, and of other Divisions, may contain requirements that relate to this section.

1.2 SUMMARY

A. Section includes plate heat exchangers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

C. Delegated-Design Submittal: Details and design calculations for seismic restraints for heat exchangers.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For heat exchanger, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Heat Exchanger: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of heat exchanger anchorage devices on which certification is based and their installation requirements.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For heat exchangers to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GASKETED-PLATE HEAT EXCHANGERS

A. Manufacturers:

1. Alfa Laval
2. Armstrong
3. Mueller
4. Bell & Gossett, ITT Corporation
5. Polaris
6. Taco
7. Tranter

B. Configuration: Freestanding assembly consisting of frame support, top and bottom carrying and guide bars, fixed and movable end plates, tie rods, individually removable plates, and one-piece gaskets.

C. Construction: Fabricate and label heat exchangers to comply with ASME Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels," Division 1.

D. Frame:

1. Capacity to accommodate 15 percent additional plates.
2. Painted carbon steel with provisions for anchoring to support.

E. Top and Bottom Carrying and Guide Bars: Painted carbon steel, aluminum, or stainless steel.

1. Fabricate attachment of heat-exchanger carrying and guide bars with reinforcement strong enough to resist heat-exchanger movement during seismic event when heat-exchanger carrying and guide bars are anchored to building structure.

F. End-Plate Material: Painted carbon steel.

G. Tie Rods and Nuts: Steel or stainless steel.

H. Plate Material: 0.02 thick before stamping; Type 316 stainless steel.

I. Gasket Materials: Nitrile or EPDM rubber.

J. Piping Connections: Factory fabricated of materials compatible with heat-exchanger shell. Attach tappings to shell before testing and labeling.

1. NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
2. NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.

K. Enclose plates in solid aluminum removable shroud.

L. Capacities and Characteristics: Refer to schedule on drawings.

2.2 ACCESSORIES

A. Shroud: Aluminum sheet.

B. Miscellaneous Components for Steam Unit: Strainers, valves, pressure gage, thermometer, and piping.

C. Pressure Relief Valves: ASME rated and stamped.

1. Pressure relief valve setting: 125 PSI.

2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect heat exchangers according to ASME Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels," Division 1. Affix ASME label.

B. Hydrostatically test heat exchangers to minimum of one and one-half times pressure rating before shipment.

C. Heat exchangers will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas for compliance with requirements for installation tolerances and for structural rigidity, strength, anchors, and other conditions affecting performance of heat exchangers.

B. Examine roughing-in for heat-exchanger piping to verify actual locations of piping connections before equipment installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GASKETED-PLATE HEAT-EXCHANGER INSTALLATION

A. Install gasketed-plate heat exchanger anchored to structure as indicated on Drawings.

B. Install metal shroud over installed gasketed-plate heat exchanger according to manufacturer's written instructions.

3.3 CONNECTIONS

A. Comply with requirements for piping as specified. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to heat exchangers to allow space for service and maintenance of heat exchangers. Arrange piping for easy removal of heat exchangers.

C. Install shutoff valves at heat-exchanger inlet and outlet connections.

D. Install relief valves on heat-exchanger heated-fluid connection and install pipe relief valves, full size of valve connection, to floor drain.

E. Install thermometer on heat-exchanger and inlet and outlet piping, and install thermometer on heating-fluid inlet and outlet piping. Comply with requirements for thermometers specified in Section 230519 "Meters and Gages for HVAC Piping."

F. Install pressure gages on heat-exchanger and heating-fluid piping. Comply with requirements for pressure gages specified in Section 230519 "Meters and Gages for HVAC Piping."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Heat exchanger will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 CLEANING

A. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

END OF SECTION 23 5700

SECTION 236423.13 - AIR-COOLED, SCROLL WATER CHILLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes packaged, air-cooled, electric-motor-driven, scroll water chillers.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. COP: Coefficient of performance. The ratio of the rate of heat removal to the rate of energy input using consistent units for any given set of rating conditions.

C. DDC: Direct digital control.

D. EER: Energy-efficiency ratio. The ratio of the cooling capacity given in Btu/h to the total power input given in watts at any given set of rating conditions.

E. GFI: Ground fault interrupt.

F. IPLV: Integrated part-load value. A single-number part-load efficiency figure of merit for a single chiller calculated per the method defined by AHRI 550/590 and referenced to AHRI standard rating conditions.

G. I/O: Input/output.

H. kW/Ton: The ratio of total power input of the chiller in kilowatts to the net refrigerating capacity in tons at any given set of rating conditions.

I. NPLV: Nonstandard part-load value. A single number part-load efficiency figure of merit for a single chiller calculated per the method defined by AHRI 550/590 and intended for operating conditions other than the AHRI standard rating conditions.

J. SCCR: Short-circuit current rating.

K. TEAO: Totally enclosed air over.

L. TENV: Totally enclosed nonventilating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include refrigerant, rated capacities, operating characteristics, and furnished specialties and accessories.
2. Performance at AHRI standard conditions and at conditions indicated.
3. Performance at AHRI standard unloading conditions.
4. Minimum evaporator flow rate.
5. Refrigerant capacity of water chiller.
6. Oil capacity of water chiller.
7. Fluid capacity of evaporator.
8. Characteristics of safety relief valves.
9. Force and moment capacity of each piping connection.

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

1. Assembled unit dimensions.
2. Weight and load distribution.
3. Required clearances for maintenance and operation.
4. Size and location of piping and wiring connections.
5. Diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings:

1. Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

a. Structural supports.
b. Piping roughing-in requirements.
c. Wiring roughing-in requirements, including spaces reserved for electrical equipment.
d. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.

2. Each view to show screened background with the following:

a. Column grids, beams, columns, and concrete housekeeping pads.
b. Layout with walls, floors, and roofs, including each room name and number.
c. Equipment and products of other trades that are located in vicinity of chillers and part of final installation, such as plumbing systems.

B. Certificates: For certification required in "Quality Assurance" Article.

C. Seismic Qualification Data: Certificates, for water chillers, accessories, and components, from manufacturers.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Installation instructions.

E. Source quality-control reports.

F. Startup service reports.

G. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each water chiller to include in emergency, operation, and maintenance manuals.

B. Spare Parts List: Recommended spare parts list with quantity for each.

C. Touchup Paint Description: Detailed description of paint used in application of finish coat to allow for procurement of a matching paint.

D. Instructional Videos: Including those that are prerecorded and those that are recorded during training.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Tool kit to include the following:

1. A tool kit specially designed by chiller manufacturer for use in servicing chiller(s) furnished.
2. Special tools required to service chiller components not readily available to Owner service personnel in performing routine maintenance.
3. Lockable case with hinged cover, marked with large and permanent text to indicate the special purpose of tool kit, such as "Chiller Tool Kit." Text size shall be at least 1 inch high.
4. A list of each tool furnished. Permanently attach the list to underside of case cover. Text size shall be at least 1/2 inch high.

B. Touchup Paint: **32 oz.** container of paint used for finish coat. Label outside of container with detailed description of paint to allow for procurement of a matching paint in the future.

1.8 QUALITY ASSURANCE

A. AHRI Certification: Certify chiller according to AHRI 590 certification program.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Ship water chillers from the factory fully charged with refrigerant and filled with oil.

B. Package water chiller for export shipping.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of water chillers that fail in materials or workmanship within specified warranty period.

1. Extended warranties include, but are not limited to, the following:

a. Complete chiller including refrigerant and oil charge.
b. Complete compressor and drive assembly including refrigerant and oil charge.
c. Refrigerant and oil charge.
d. Parts and Labor

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Scroll water chillers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Component Importance Factor: 1.5.

B. Site Altitude: Chiller shall be suitable for altitude at which installed without affecting performance indicated. Make adjustments to affected chiller components to account for site altitude.

C. AHRI Rating: Rate water chiller performance according to requirements in AHRI 550/590.

D. ASHRAE Compliance: ASHRAE 15 for safety code for mechanical refrigeration.

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

F. ASME Compliance: Fabricate and stamp water chiller heat exchangers to comply with ASME Boiler and Pressure Vessel Code.

G. Comply with NFPA 70.

H. Comply with requirements of UL 1995, "Heating and Cooling Equipment," and include label by a qualified testing agency showing compliance.

I. Operation Following Loss of Normal Power:

1. Equipment, associated factory- and field-installed controls, and associated electrical equipment and power supply connected to backup power system shall automatically return equipment and associated controls to the operating state occurring immediately before loss of normal power without need for manual intervention by an operator when power is restored either through a backup power source, or through normal power if restored before backup power is brought on-line.
2. See drawings for equipment served by backup power systems.
3. Provide means and methods required to satisfy requirement even if not explicitly indicated.

J. Outdoor Installations:

1. Chiller shall be suitable for outdoor installation indicated. Provide adequate weather protection to ensure reliable service life over a 25-year period with minimal degradation due to exposure to outdoor ambient conditions.
2. Chillers equipped to provide safe and stable operation while achieving performance indicated when operating at extreme outdoor temperatures encountered by the installation. Review historical weather database and provide equipment that can operate at extreme outdoor temperatures recorded over past 30-year period.

2.2 MANUFACTURERS

A. Acceptable manufacturers include:

1. LG
2. York
3. Trane
4. Daikin Applied
5. Carrier

2.3 MANUFACTURED UNITS

A. Description: Factory-assembled and run-tested water chiller complete with compressor(s), compressor motors and motor controllers, evaporator, condenser with fans, electrical power, controls, and indicated accessories.

B. Fabricate water chiller mounting base with reinforcement strong enough to resist water chiller movement during a seismic event when water chiller is anchored to field support structure.

C. Sound-reduction package shall have the following:

1. Acoustic enclosure around compressors.
2. Reduced-speed fans with acoustic treatment.
3. Designed to reduce sound level without affecting performance.

D. Security Package: Security grilles with fasteners for additional protection of compressors, evaporator, and condenser coils. Grilles shall be coated for corrosion resistance and shall be removable for service access.

2.4 CABINET

A. Base: Galvanized-steel base extending the perimeter of water chiller. Secure frame, compressors, and evaporator to base to provide a single-piece unit.

B. Frame: Rigid galvanized-steel frame secured to base and designed to support cabinet, condenser, control panel, and other chiller components not directly supported from base.

C. Casing: Galvanized steel.

D. Finish: Coat base, frame, and casing with a corrosion-resistant coating capable of withstanding a 500-hour salt-spray test according to ASTM B117.

2.5 COMPRESSOR-DRIVE ASSEMBLIES

A. Compressors:

1. Description: Positive-displacement direct drive with hermetically sealed casing.
2. Each compressor provided with suction and discharge service valves, crankcase oil heater, and suction strainer.

    a. For multiple compressor assemblies, it is acceptable to isolate each compressor assembly in lieu of each compressor.

3. Operating Speed: Nominal 3600 rpm for 60-Hz applications.
4. Capacity Control: On-off compressor cycling, plus hot-gas bypass.

    a. Digital compressor unloading is an acceptable alternative to achieve capacity control.

5. Oil Lubrication System: Automatic pump with strainer, sight glass, filling connection, filter with magnetic plug or removable magnet in sump, and initial oil charge.

    a. Manufacturer's other standard methods of providing positive lubrication are acceptable in lieu of an automatic pump.

6. Vibration Isolation: Mount individual compressors on vibration isolators.

    a. For multiple compressor assemblies, it is acceptable to isolate each compressor assembly in lieu of each compressor.

B. Compressor Motors:

1. Hermetically sealed and cooled by refrigerant suction gas.
2. High-torque, two-pole induction type with inherent thermal-overload protection on each phase.

C. Compressor Motor Controllers:

1. Across the Line: NEMA ICS 2, Class A, full voltage, nonreversing.

2.6 REFRIGERATION

A. Refrigerant: R-410A. Classified as Safety Group A1 according to ASHRAE 34.

B. Refrigerant Compatibility: Parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.

C. Refrigerant Circuit: Each circuit shall include an expansion valve, refrigerant charging connections, a hot-gas muffler, compressor suction and discharge shutoff valves, a liquid-line shutoff valve, a replaceable-core filter-dryer, a sight glass with moisture indicator, a liquid-line solenoid valve, and an insulated suction line.

D. Refrigerant Isolation: Factory install positive shutoff isolation valves in the compressor discharge line and the refrigerant liquid-line to allow the isolation and storage of the refrigerant charge in the chiller condenser.

1. For multiple compressor assemblies, it is acceptable to isolate each compressor assembly in each circuit in lieu of each compressor.

E. Pressure Relief Device:

1. Comply with requirements in ASHRAE 15, ASHRAE 147, and applicable portions of ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Select and configure pressure relief devices to protect against corrosion and inadvertent release of refrigerant.
3. ASME-rated, spring-loaded, pressure relief valve; single- or multiple-reseating type. Pressure relief valve(s) shall be provided for each heat exchanger.

2.7 EVAPORATOR

A. Brazed-plate or shell-and-tube design, as indicated.

B. Brazed Plate:

1. Direct-expansion, single-pass, brazed-plate design.
2. Type 304 or 316 stainless-steel construction.
3. Code Compliance: Tested according to ASME Boiler and Pressure Vessel Code.
4. Fluid Nozzles: Terminate with mechanical-coupling end connections for connection to field piping. Furnish flange adapters to mate to flanged piping.
5. Inlet Strainer: Factory-furnished 20-mesh strainer for field installation in supply piping to evaporator. Manufacturer has option to factory install strainer.

C. Flow Switch: Factory-furnished flow switch wired to chiller operating controls.

D. Heater: Factory-installed and -wired electric heater with integral controls designed to protect the evaporator to minus 20 deg F.

E. Remote-Mounting Kit: Designed for remote field mounting where indicated. Provide kit for field installation.

2.8 AIR-COOLED CONDENSER

A. Coil(s) with integral subcooling on each circuit.

B. Copper Tube with Plate Fin Coils:

1. Construct coils of copper tubes mechanically bonded to aluminum fins.

C. Aluminum Microchannel Coils:

1. Series of flat tubes containing a series of multiple, parallel-flow microchannels layered between refrigerant header manifolds.
2. Single- or multiple-pass arrangement.
3. Construct fins, tubes, and header manifolds of aluminum alloy treated with a corrosion-resistant coating.

D. Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.

E. Fans: Direct-drive propeller type with statically and dynamically balanced fan blades, arranged for vertical air discharge.

F. Fan Motors: TENV or TEAO enclosure, with sealed and permanently lubricated bearings, and having built-in overcurrent- and thermal-overload protection.

1. Overcurrent- and thermal-overload protection not integral to motor is acceptable if provided with chiller electrical power package.

G. Fan Guards: Removable steel safety guards with corrosion-resistant coating.

2.9 INSULATION

A. Closed-cell, flexible, elastomeric thermal insulation complying with ASTM C534/C534M, Type I for tubular materials and Type II for sheet materials.

1. Thickness: 2 inches.

B. Adhesive: As recommended by insulation manufacturer.

C. Factory-applied insulation over all cold surfaces of chiller capable of forming condensation. Components shall include, but not be limited to, evaporator, evaporator water boxes including nozzles, refrigerant suction pipe from evaporator to compressor, cold surfaces of compressor, refrigerant-cooled motor, and auxiliary piping.

1. Apply adhesive to 100 percent of insulation contact surface.
2. Before insulating steel surfaces, prepare surfaces for paint, and prime and paint as indicated for other painted components. Do not insulate unpainted steel surfaces.
3. Seal seams and joints to provide a vapor barrier.
4. After adhesive has fully cured, paint exposed surfaces of insulation to match other painted parts.
5. Manufacturer has option to factory or field insulate chiller components to reduce potential for damage during installation.
6. Field-Applied Insulation:

a. Components that are not factory insulated shall be field insulated to comply with requirements indicated.
b. Manufacturer shall be responsible for chiller insulation whether factory or field installed to ensure that manufacturer is the single point of responsibility for chillers.
c. Manufacturer's factory-authorized service representative shall instruct and supervise installation of field-applied insulation.
d. After field-applied insulation is complete, paint insulation to match factory-applied finish.

2.10 ELECTRICAL

A. Factory installed and wired, and functionally tested at factory before shipment.

B. Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to water chiller.

C. House in a unit-mounted, NEMA 250, Type 3 enclosure with hinged access door with lock and key or padlock and key.

D. Wiring shall be numbered and color-coded to match wiring diagram.

E. Factory wiring shall be located outside of an enclosure in a raceway. Terminal connections shall be made with not more than a 24-inch length of conduit.

F. Minimum SCCR according to UL 508 shall be as required by electrical power distribution system, but not less than 42,000 A.

G. Each motor shall have overcurrent protection.

H. Overload relay sized according to UL 1995, or an integral component of water chiller control microprocessor.

I. Phase-Failure and Undervoltage: Solid-state sensing with adjustable settings.

J. Power Factor Correction: Capacitors to correct power factor to **0.90**at full load.

K. Controls Transformer: Unit-mounted transformer with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.

L. Control Relays: Auxiliary and adjustable time-delay relays, or an integral to water chiller microprocessor.

M. Indicate the following for water chiller electrical power supply:

1. Current, phase to phase, for all three phases.
2. Voltage, phase to phase and phase to neutral for all three phases.
3. Three-phase real power (kilowatts).
4. Three-phase reactive power (kilovolt amperes reactive).
5. Power factor.
6. Running log of total power versus time (kilowatt hours).

7. Fault log, with time and date of each.

2.11 CONTROLS

A. Factory installed and wired, and functionally tested at factory before shipment.

B. Standalone, microprocessor based, with all memory stored in nonvolatile memory so that reprogramming is not required on loss of electrical power.

C. Enclosure: Share enclosure with electrical power devices or provide a separate enclosure of matching construction.

D. Operator Interface: Keypad or pressure-sensitive touch screen. Multiple-character, digital display. Display the following:

1. Date and time.
2. Operating or alarm status.
3. Operating hours.
4. Outside-air temperature if required for chilled-water reset.
5. Temperature and pressure of operating set points.
6. Chilled-water entering and leaving temperatures.
7. Refrigerant pressures in evaporator and condenser.
8. Saturation temperature in evaporator and condenser.
9. No cooling load condition.
10. Elapsed time meter (compressor run status).
11. Pump status.
12. Antirecycling timer status.
13. Percent of maximum motor amperage.
14. Current-limit set point.
15. Number of compressor starts.
16. Alarm history with retention of operational data before unit shutdown.

E. Superheat.Control Functions:

1. Manual or automatic startup and shutdown time schedule.
2. Capacity control based on evaporator leaving-fluid temperature.
3. Capacity control compensated by rate of change of evaporator entering-fluid temperature.
4. Chilled-water entering and leaving temperatures, control set points, and motor load limit.
5. Current limit and demand limit.
6. External water chiller emergency stop.
7. Antirecycling timer.
8. Automatic lead-lag switching.

F. Ice-building mode.Manual-Reset Safety Controls: The following conditions shall shut down water chiller and require manual reset:

1. Low evaporator pressure or high condenser pressure.
2. Low chilled-water temperature.

3. Refrigerant high pressure.
4. High or low oil pressure.
5. High oil temperature.
6. Loss of chilled-water flow.
7. Control device failure.

G. BAS System Interface: Factory-install hardware and software to enable system to monitor, control, and display chiller status and alarms, and as necessary to execute the sequences of operations shown on the drawings.

1. Communication Interface: BBACnet communication interface shall enable control system operator to remotely control and monitor the water chiller from an operator workstation. Control features and monitoring points displayed locally at water chiller control panel shall be available through DDC system for HVAC.

H. Factory-installed wiring outside of enclosures shall be in NFPA 70-complaint raceway. Make terminal connections with liquidtight or flexible metallic conduit.

2.12 ACCESSORIES

A. Factory-furnished neoprene isolators with seismic restraints for field installation, minimum deflection of 0.25”.

2.13 CAPACITIES AND CHARACTERISTICS

A. Refer to drawings for capacities and characteristics.

2.14 SOURCE QUALITY CONTROL

A. Perform functional test of water chillers before shipping.

B. Factory performance test water chillers, before shipping, according to AHRI 550/590.

1. Test the following conditions:

a. Design conditions indicated.
b. AHRI 550/590 part-load points.

C. Factory test and inspect evaporator according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1. Stamp with ASME label.

D. For water chillers located outdoors, rate sound power level according to AHRI 370 procedure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before water chiller installation, examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, controls, and electrical connections to verify actual locations,

sizes, and other conditions affecting water chiller performance, maintenance, and operations.

1. Water chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping, controls, and electrical connections.

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

3.2 WATER CHILLER INSTALLATION

A. Coordinate sizes and locations of bases with actual equipment provided. Cast anchor-bolt inserts into concrete bases.

B. Coordinate sizes, locations, and anchoring attachments of structural-steel support structures with actual equipment provided.

C. Install water chillers on support structure indicated.

D. Equipment Mounting:

1. Install water chillers on cast-in-place concrete equipment bases.
2. Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

E. Maintain manufacturer's recommended clearances for service and maintenance.

F. Maintain clearances required by governing code.

G. Chiller manufacturer's factory-trained service personnel shall charge water chiller with refrigerant if not factory charged and fill with oil if not factory installed.

H. Install separate devices furnished by manufacturer and not factory installed.

1. Chillers shipped in multiple major assemblies shall be field assembled by chiller manufacturer's factory-trained service personnel.

3.3 PIPING CONNECTIONS

A. Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements in Section 232300 "Refrigerant Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

C. Where installing piping adjacent to chillers, allow space for service and maintenance.

D. Evaporator Fluid Connections: Refer to Detail.

E. Connect each drain connection with a drain valve, full size of drain connection.

3.4 ELECTRICAL POWER CONNECTIONS

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Provide nameplate for each electrical connection indicating electrical equipment designation and circuit number feeding connection. Nameplate shall be laminated phenolic layers of black with engraved white letters at least 1/2 inch high. Locate nameplate where easily visible.

3.5 STARTUP SERVICE

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

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

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

1. Verify that refrigerant charge is sufficient and water chiller has been leak tested.
2. Verify that pumps are installed and functional.
3. Verify that thermometers and gages are installed.
4. Operate water chiller for run-in period.
5. Check bearing lubrication and oil levels.
6. Verify that refrigerant pressure relief device for chillers installed indoors is vented outside.
7. Verify proper motor rotation.
8. Verify static deflection of vibration isolators, including deflection during water chiller startup and shutdown.
9. Verify and record performance of chilled-water flow and low-temperature interlocks.
10. Verify and record performance of water chiller protection devices.
11. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

D. Visually inspect chiller for damage before starting. Repair or replace damaged components, including insulation. Do not start chiller until damage that is detrimental to operation has been corrected.

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

3.6 DEMONSTRATION

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

1. Instructor shall be factory trained and certified.

2. Provide not less than 8 hours of training.
3. Train personnel in operation and maintenance and to obtain maximum efficiency in plant operation.
4. Provide instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
5. Obtain Owner sign-off that training is complete.
6. Owner training shall be held at Project site.

END OF SECTION 23 6423.13

Division 23 - Heating, Ventilation, and Air Conditioning (HVAC)

SECTION 260500 –COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 GENERAL CONDITIONS:

A. The General Conditions, Supplementary General Conditions, General Requirements, and Special Conditions shall be and are hereby made a part of this Section of the specifications.

B. In case of conflicts between the electrical drawings and Division 26 of these specifications, the more stringent requirements shall govern. In all cases, notify the Engineer for direction.

C. The requirements of COMMON WORK RESULTS FOR ELECTRICAL establish minimum requirements, apply to, and are hereby made a part of all sections of Division 26, 27, and 28 of this specification.

D. The Contractor shall be responsible for excavation of all earth, soil, and rock conditions at the site. Review the elevations and soil boring logs and include all associated costs.

1.2 DESCRIPTION:

A. The electrical work shall include all labor, materials, tools, transportation, equipment, services and facilities, required for the complete, proper and substantial installation of all electrical work shown on the plans, and/or outlined in these specifications. The installation shall include all materials, appliances, and apparatus not specifically mentioned herein or noted on the drawings, but which are necessary to make a complete working installation of all electrical systems.

B. All of the electrical related work required for this project (unless specified otherwise) is a part of the Electrical Contract price but is not necessarily specified under this division of the specifications or shown on the electrical drawings. Therefore, all divisions of the specifications and all drawings shall be consulted.

C. The plan drawings are schematic only and are not intended to show the exact routing of raceway systems unless dimensions are noted on the drawings. Final routing will be governed by field conditions (structural members, mechanical equipment, ductwork, underground piping, duct banks, etc.) and shall be determined by the Contractor and approved by the Architect. Any changes in routing shall not change the design of the raceway system.

D. The plan drawings showing device and equipment locations are schematic only and are not intended to show exact locations unless dimensions are noted on the drawings. The Contractor shall review all contract drawings that may affect the location of devices and equipment to avoid possible interference and permit full coordination of all work. The right to make any reasonable change in location within 6'-0", is reserved by the Architect up until the time of rough-in at no extra cost.

E. Furnish and install electrical wiring, systems, equipment and accessories in accordance with the specifications and drawings. Capacities and ratings of transformers, cable,

switchgear, panelboards, motor control, and other items, arrangement for specified items in general are shown on drawings.

F. Electrical service entrance equipment (arrangements for temporary and permanent connections to the power company's system) shall conform to the power company's requirements. Coordinate fuses, circuit breakers and relays with the power company's system, and obtain power company approval. Provide all required temporary building power and lighting. Remove when finished. Installation of temporary power and lighting shall comply with N.E.C. and OSHA requirements.

G. Ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways accordingly sized.

1.3 MINIMUM REQUIREMENTS:

A. Codes Rules and Regulations: Execute all work under ADA, the latest rules and regulations of the National Electrical Code (NEC), the National Fire Protection Association, and with all laws, regulations and ordinances of the County, State, City, and the Utility Company.

B. Codes shall govern in case of any direct conflict between codes, plans and specifications; except when plans and specifications require higher standards than those required by code. Variance from the plan and specifications made to comply with code must be approved by the Architect. If approved they shall be made with no increased cost to the Owner.

1.4 STANDARDS:

A. All material and equipment shall be listed, labeled or certified by UL LLC, where such standards have been established. Equipment and material which are not covered by UL Standards will be accepted provided equipment and material is listed, labeled, certified or otherwise determined to meet safety requirements of a nationally recognized testing laboratory. Equipment of a class which no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as NEMA, or ANSI. Evidence of compliance shall include certified test reports and definitive shop drawings.

B. Definitions:

1. Certified: Equipment is "certified" if:

a. Equipment has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards, or to be safe for use in a specified manner.
b. Production is periodically inspected by a nationally recognized testing laboratory.
c. It bears a label, tag, or other record of certification.

2. Nationally recognized testing laboratory: A testing laboratory which is approved, in accordance with OSHA regulations, by the Secretary of Labor.

1.5 QUALIFICATIONS (PRODUCTS AND SERVICES):

A. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.

B. Product Qualification:

1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
2. The Engineer reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.

1.6 MANUFACTURED PRODUCTS:

A. Materials and equipment furnished shall be new, of best quality and design, free from defects, of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts should be available. All items used on this project shall be free of asbestos, PCB, and mercury material.

B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.

C. Equipment Assemblies and Components:

1. Components of an assembled unit need not be products of the same manufacturer unless indicated otherwise.
2. Manufacturers of equipment assemblies, which include components made by others, shall be completely responsible for the final assembled unit.
3. Components shall be compatible with each other and with the total assembly for the intended service.
4. Constituent parts which are similar shall be the product of a single manufacturer.

D. Factory and Field wiring shall be identified on the equipment being furnished and on all wiring diagrams.

E. When Factory Testing is Specified:

1. The Engineer shall have the option of witnessing factory tests. The Contractor shall notify the Engineer a minimum of 15 working days prior to the manufacturer making the factory tests.
2. Four copies of certified test reports containing all test data shall be furnished to the Engineer prior to final inspection and not more than 90 days after completion of the tests.
3. When equipment fails to meet factory test and reinspection is required, the Contractor shall be liable for all additional expenses, including expenses of the Engineer.

1.7 EQUIPMENT PROTECTION:

A. Equipment and material shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain.

B. During installation, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of foreign matter and be vacuum cleaned both inside and outside before testing, operating and painting.

C. Damaged equipment shall be, as determined by the Engineer, placed in satisfactory operating condition or be returned to the source of supply for repair or replacement.

D. Painted surfaces shall be protected with factory installed removable heavy Kraft paper, sheet vinyl or equal.

E. Damaged paint on equipment and materials shall be restored to the original quality of paint and workmanship as used by the manufacturer so repaired area is not obvious.

1.8 GENERAL WORK REQUIREMENTS:

A. Arrange, phase and perform work to assure electrical service both temporary and permanent for buildings at all times.

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

C. Examination of Site:

1. Visit the site, inspect the existing conditions and check the drawings and specifications so as to be fully informed of the requirements for completion of the work.
2. Lack of such information shall not justify an extra to the contract price.

D. Permits:

1. Obtain and pay for all licenses and permits, fees, inspection and certificates required for the execution of this work.
2. Pay fees and charges for connection to outside services and use of property.
3. Deliver permits and certificates to the Architect to be transmitted to the Owner.

E. Services:

1. This Contractor shall pay for all expenses, deposits, reimbursements, etc., required by the local rules and codes for the service to the buildings, complete and ready for use. See plot plan.
2. Consult Power Company for their requirements and for coordinating with their installation. Contractor shall provide any work thus required beyond that indicated by the drawings and specifications. He shall bear all expense involved for the complete installation of the electrical service (both temporary and permanent) to the building ready for operation, including utility service charges, except as specifically excluded on the plans.
3. This Contractor shall consult all local departments to verify requirements and bid installation of service in accordance with local codes and Utility company rules and regulations.
4. This Contractor shall bear all expense involved for the complete telephone and internet service conduit installation and pull wire ready for cable installation.

Verify complete installation with the local telephone company and internet service provider and bid installation to comply with their requirements.

F. Responsibility:

1. This Contractor will be held responsible for any and all damage to any part of the building or to the work of other contractors, as may be caused through this contractor's operation.
2. Any mutilation of building finishes or equipment initiated by electrical construction shall be properly corrected by the respective finishing contractor and paid for by the Electrical Contractor.
3. The operation of the temporary power and the permanent electrical system shall be the responsibility of this Contractor until acceptance of the building by the Owner.

G. Work to be done by General Contractor:

1. Build in all openings, sleeves, chases, etc., for conduit and equipment as established, furnished and set by this Contractor. The General Contractor shall seal or grout all openings after this Contractor has installed the conduits.
2. Build in bolts, brackets, hangers etc., for work established, furnished and set by this Contractor.
3. All concrete work required for equipment furnished and set by this Contractor including clean up pads under electrical gear, fixture bases, transformer bases, etc.
4. Painting: All painting of electrical equipment installed in finished areas shall be done by the General Contractor. Painting will not be required on receptacles, switches, circuit breakers etc. All fixtures and exterior poles specified to be factory-primed shall be painted by General Contractor. Paint all wiremold, exposed conduit and equipment, etc., to match final wall colors.
5. Provide fireproofing above fixtures located in fire rated ceilings per U.L. requirements.
6. Pay all utility costs for operation of electrical system during construction until acceptance of building by the Owner.

H. Work done by the Mechanical Contractor:

1. The Mechanical Contractor shall furnish wiring diagrams and temperature control drawings of all equipment furnished to the Electrical Contractor. (Catalog information is unacceptable, provide point to point drawings.)
2. The Mechanical Contractor shall furnish and install all control equipment requiring connections to air, water, steam, etc., such as pneumatic electric relays, remote bulb temperature controls, solenoid valves, aquastats and pressure controls.
3. The Mechanical Contractor shall reimburse the Electrical Contractor for any changes in system design i.e.; control or equipment which affects the Electrical Contractor. Also refer to equipment connections, controls and instrumentation in 260500.

I. Workmanship and Coordination:

1. Make installation substantially as shown on the plans.

2. Make alterations in location of apparatus or conduit as may be required to conform to building construction without extra charge.
3. Mechanical equipment service clearances and electrical apparatus service clearances as specified in their respective manufacturer's product data shall be maintained free from conduit.
4. Cooperate with other trades in their installation of work.
5. Complete the installation in a workmanlike manner, completely connected and ready to give proper and continuous service.
6. Use only experienced licensed electricians.

J. Cutting and Patching:

1. Notify the General Contractor in ample time, of the location of all chases, sleeves, and other openings required in connection with the work of this contract.
2. Cutting and patching made necessary because of failure to comply with the above shall be done by the General Contractor at the expense of the Electrical Contractor.
3. When it is necessary for the Electrical Contractor to cut building materials, it shall be done in a neat and workmanlike manner meeting with the approval of the Architect.
4. Holes through concrete shall be carefully drilled with a "Concrete Termite" drill. A Star Drill or Air Hammer will not be permitted. Structural members shall not be cut without approval from the Architect.
5. Any penetrations thru the roof shall be made with "Stoneman" 900 Series flashing connections as manufactured by Elmdor/Stoneman, City of Industry, California, or as approved by the Architect.
6. Any penetrations made in exterior or basement foundation walls shall be sealed with Thunderline "Link-Seal" connections, as manufactured by Thunderline Corporation, Wayne, Michigan.

K. Manufacturer’s Instructions:

1. Apply, install, connect, erect, use, clean, and condition articles, materials and equipment as directed by the manufacturer.

L. Provide separate support for all devices mounted in or to lay-in ceiling tile. Ceiling tile shall not be used to support any device.

1.9 EQUIPMENT INSTALLATION AND REQUIREMENTS:

A. Equipment location shall be as close as practical to locations shown on the drawings.

B. Working spaces shall not be less than specified in the National Electrical Code for all voltages specified.

C. Inaccessible Equipment:

1. Where the Engineer determines that the Contractor has installed equipment without proper clearances or not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled as directed at no additional cost to the Owner.

a. Install access panels as approved by the Architect to provide access to all equipment, J-boxes and outlets located in non-accessible spaces. Panels shall be flush locking type with a fire rating equal to the ceiling system.

2. "Conveniently accessible" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, pumps, belt guards, transformers, piping, and ductwork. Outlet and box covers shall be removable by using regular length (8") screw drivers.

D. Distribution Equipment:

1. All items of Electrical Distribution Equipment (switchboards - panelboards - disconnects) shall be of one manufacturer, unless specifically noted on the drawings, in the specifications, or approved by the Engineer. Intermixing of distribution equipment by different manufacturers will not be permitted.

2. Equipment layouts on the drawings are based on one manufacturer. Verify all actual equipment sizes with equipment manufacturer prior to bidding.
3. If layout changes are required due to differing electrical manufacturer's equipment size, they must be submitted to and approved by the Engineer. National Electric Code working clearances must be maintained at all times. Extra remuneration will not be allowed for layout changes that differ from those shown.
4. Provide and install all steel supports as required for mounting of electrical equipment.
5. Anchor all free standing electrical equipment including switchboards, switchgear, substations, motor control centers, paralleling gear, transfer switches, transformers, etc. to the floor with plated, 1/2" diameter minimum, anchor bolts or as recommended by the manufacturer.

1.10 EQUIPMENT CONNECTIONS, CONTROLS AND INSTRUMENTATION:

A. General: The following applies to all electrical power and control connections for all equipment requiring electrical installation work provided by others.

B. Electrical Contractor shall install and connect the following items for equipment requiring electrical power that is either furnished or specified by other Contractors and/or the Owner. Where these required items are not furnished with the equipment being connected, it shall be the Electrical Contractors responsibility to provide the necessary items including conduit, boxes and wiring.

1. Starters
2. Variable Frequency Drives
3. Disconnecting Devices
4. Thermal Overload Devices
5. Overcurrent Devices
6. Control Devices (Local and Remote)
7. Equipment Mounting Structures
8. Additional Miscellaneous Devices

C. In general, all major equipment will be specified to be factory prewired with only service and interconnecting wiring required at the site by the electrical contractor; however, the Electrical Contractor shall check all divisions of the specification to verify if the equipment is specified factory prewired and if not, then it shall be the responsibility of the Electrical Contractor to provide the complete wiring of the equipment in accordance with wiring diagrams provided by other contractors and/or Owner to the Electrical Contractor. All interconnecting of equipment shall be by the Electrical Contractor.

A. All line and low voltage wiring/connections required to control equipment shall be provided as indicated below. Where the Mechanical Contractor (MC) is indicated, this also includes the Temperature Controls Contractor (TCC) if utilized on the project.

1. Line voltage conduit by EC
2. Line voltage wiring and connections by EC
3. Controls provided by MC
4. Low voltage control wiring and terminations shall be provided and installed by the
5. Conduit and rough-ins for low voltage control wiring shall be provided by **EC.** Conduit shall be provided for low voltage control wiring as required by Mechanical drawings/specifications.

B. The Electrical Contractor shall provide 120 volt control power supply; #12 Ga. CU. THHN/THWN in 1/2"C. minimum at all points required by controls, instrumentation and sprinkler risers. Circuit as shown on the plans or to the nearest 120 volt panel if no circuiting is indicated. Use spare 20 Amp. breakers. Each control panel shall be on a separate circuit unless otherwise indicated. If the controlled equipment is fed from the emergency system, then the control power supply must feed from the emergency system.

C. The Contractor shall become familiar with the equipment to be furnished by the other Contractors and/or the Owner in connection with this work and include provisions for such connections and work in the Contractor's price. Extra remuneration will not be allowed for such work.

D. Connections to all equipment have been designed from units as specified on the drawings or in the specifications. In the event equipment or control differs on approved shop drawings it shall be the responsibility of the Supplying Contractor to coordinate electrical connections to the units and reimburse Electrical Contractor for any changes in system design. These changes shall not involve additional cost to the Owner.

E. Review all plans and specifications to verify all equipment connections that are required by mechanical and/or other contractors. Although the electrical drawings will show equipment connection requirements, it is the Electrical Contractor's responsibility to connect all equipment furnished by other Contractor's at no extra cost to the Owner, even if this equipment connection is not shown on the electrical drawings. Coordinate all required connections not shown on the electrical drawings with the Engineer.

1.11 NAMEPLATES:

A. General: The following items shall be equipped with nameplates:

1. Disconnect switches (fused or nonfused), transformers, switchgear and switchboards (including branch circuit breakers/switches), panelboards, separately

mounted circuit breakers, starters, contactors, relays, junction boxes and pull boxes.

B. Inscription: Nameplates shall adequately describe the function or use of the particular equipment involved. Nameplates for panelboards and switchboards shall include the panel designation, voltage, and phase, A.I.C. rating of the supply (see schedules, one-line diagram, and color coding). For example, "Panel A" 120/208 V, 3-Phase, 4-Wire, 10,000 A.I.C. or “50,000 AIC with 22 KA Breakers, Series with class ‘J’ Fuses”:

1. Phase A - Black
2. Phase B - Red
3. Phase C - Blue
4. Neutral - White
5. Ground - Green

C. The name used for a machine nameplate shall be the same as the one used on the machine's motor starter, disconnect and P.B. station nameplates. Nameplates for fused switches and panels shall also indicate fuse type and size.

1. In addition to the instructions listed above:

a. All panelboards and transfer switches fed from the emergency system shall be labeled “Emergency System”.
b. All panelboards and transfer switches fed from the standby system shall be labeled “Standby System”.

D. Construction:

1. Nameplates shall be as follows:

a. Normal power - laminated phenolic plastic white front and back with black core.

b. Emergency System - laminated phenolic plastic red front and back with white core.
c. Standby System - laminated phenolic plastic blue front and back with white core.

1. Lettering shall be engraved through front layer to form 1/4" characters. Nameplates shall be securely fastened to the equipment to be identified, with No. 4 Phillips, round head, cadmium plated, steel self tapping screws or nickel plated brass bolts. Motor nameplate may be nonferrous metal not less than 0.03 inches thick, die stamped. In lieu of separate plastic nameplates, engraving directly on device plates is acceptable. Letters engraved thus, shall be filled with contrasting enamel. All nameplates and their installation are part of this work. Free hand lettering or dymo label marker will not be acceptable.

1.12 MATERIALS OF APPROVED EQUAL:

A. Where items of equipment and/or materials are specifically identified herein by a manufacturer's name, model or catalog number, and only such specific items may be used in the base bid, except as hereinafter provided.

B. Unless requests for changes in base bid specifications are received, approved and noted by written addendum prior to the opening of bids, the successful contractor will be held to furnish specified items.

C. After contract is awarded, changes in specifications shall be made only as defined under "Substitution of Equipment".

1.13 SUBSTITUTION OF EQUIPMENT:

A. After execution of the contract, substitution of equipment of makes other than those specifically named in the contract documents, may be approved by the Engineer, only if the equipment named in the specifications cannot be delivered to the job in time to complete the work in proper sequence and due to conditions beyond control of the Contractor. Provide documentary proof in writing from the manufacturer that the specified equipment will not be available in time. If the Contractor is responsible for the delay, the substitution will not be approved.

B. Requests for substitutions must be accompanied by documentary proof of equality or difference in price and delivery, if any, in form of certified quotations from suppliers of both specified and proposed equipment.

1.14 SUBMITTALS: IN ACCORDANCE WITH SECTION SAMPLES AND SHOP DRAWINGS, FURNISH THE FOLLOWING:

A. The Engineer's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site.

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

C. Submittals shall be complete and submitted together for each section. Individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assemble as a whole. Partial submittals will not be considered for approval.

1. Mark the submittals, "SUBMITTED UNDER SECTION_____". Mark out all statements on sheets that do not apply otherwise. The Engineer may select options and equipment not originally specified. All options that are not marked out will be assumed that the Contractor will furnish the same.
2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
3. Submit each section separately.

4. Mark catalog cuts to indicate equipment, capacities, finishes, sizes, etc. Each individual item shall have its own sheet provided for approval. (Example: Separate sheets for each panelboard.)

D. The submittals shall include the following:

1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
2. Elementary and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
3. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.
4. Quantities of materials will not be verified by the Architect or Engineer. Approval stamp on shop drawings does not constitute approval of quantities listed on shop drawings.
5. Shop drawings:

    a. All shop drawings shall be checked and signed by this contractor and general contractor prior to submittal to the Architect/Engineer.
    b. Shop drawings submitted without Contractor’s signatures or approval and verification will not be approved.

    c. Shop drawings shall be submitted on wire, cables, devices, lighting fixtures (including distribution curves), motor starters, panelboards, disconnects, substations, transformers, switchgear, switchboards, motor control centers, conduit, raceway systems, low-voltage systems, etc.

6. Each sheet shall be either 8 1/2" x 11"; 8 1/2" x 13"; or 11" x 17" bond with a 5" x 3" clear area for engineer’s stamp. (This area shall not be used by this contractor or the general contractor’s stamp.) Larger drawings shall be able to be blue printed.
7. Submittals for low-voltage systems (fire alarm, security, PA, controls, sound, clock, nurses’ call, intercom, etc.) shall include complete riser diagrams showing all conductors and conduit sizes.

E. Engineer’s acceptance of Compliance Submittals will not relieve the Contractor from his responsibility for any deviations from the requirements of the contract documents, unless Contractor has in writing called Engineer's attention to such deviation at the time of submission and the Engineer has given written approval to the specific deviation; nor shall any acceptance by Engineer relieve Contractor from responsibility for errors or omissions in Compliance Submittals.

F. Quantity of Submittals: See the general specification sections.

1.15 ELECTRICAL WORK COMPLETION:

A. Before requesting final inspection the following work must be completed.

B. Operating Instructions:

1. The Contractor shall submit along with the shop drawings of the equipment, three (3) copies of operating instructions for all items. Instructions shall be prepared by the manufacturer of the equipment.
2. After the operating instructions have been approved by the Engineer, the Contractor shall include the three (3) copies in maintenance instructions brochures.
3. The Contractor shall also obtain all manufacturers' instructions, manuals, and one complete set of drawings and turn these over to the Architect at the completion of the project.
4. The Contractor shall keep in a safe place; all keys and special wrenches furnished with equipment under this contract and shall give same to the Architect at the completion of the project.
5. The Contractor shall prepare a complete brochure, in triplicate, covering all systems and equipment furnished and installed under his contract. Brochures shall be submitted to the Architect-Engineer for approval and delivery to the Owner. The cost of this brochure shall be included in the contract cost. Brochures shall contain the following:

    a. Certified equipment drawings and/or catalog data clearly marked for equipment furnished as required for approval submission under detailed section of the specifications.
    b. Complete operating and maintenance instructions for each item of equipment.
    c. Complete part list for each equipment item.
    d. Any special emergency operating instructions or a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to the various parts of the system.

6. Brochures shall be bound in hard backed three ring binders with an index, sub dividers and reinforced sheets.

    a. Project name and address.
    b. Section of work covered by brochure, i.e., "Electrical Work".
    c. Name and address of Architect.
    d. Name and address of Engineer.
    e. Name and address of Contractor.
    f. Telephone number of Contractor, including night or emergency number.

7. In addition to these written instructions, each respective Contractor shall fully and carefully instruct the Owner, or Owner's selected representatives, as to the proper operation, care and maintenance of each system and its equipment.

1.16 TESTING AND ADJUSTMENT:

A. Record loads on each phase of all panelboards, distribution panels, switchboards, transformers and submit final readings to the Architect for records. This Contractor shall adjust equipment, instruments, gages, meters etc., as required to test and adjust these systems.

B. Check, test, and adjust the mechanisms of all electrical equipment and adjustable parts of lighting fixtures as required for optimum performance.

C. Perform tests for insulation resistance in accordance with the requirements of the National Electrical Code and insure that all circuits are free from short circuits.

D. Keep a calibrated voltmeter and ammeter available at all times and provides service for test readings when and as required, up until the project is accepted by the Owner.

E. Electrical Testing and Verification: Refer to the following specification sections (as applicable) for required tests and verifications:

1.
2. 260519 – Low Voltage Electrical Power Conductors and Cables
3. 260526 – Grounding and Bonding for Electrical Systems
4.
5. 262416 – Panelboards
6. 262726 – Wiring Devices

1.17 AS-BUILT DRAWINGS:

A. Show on black or blue line prints in red ink all changes from original plans made during the installation. Return two (2) sets of red marked drawings, specifications and addenda, as set forth in the General Conditions, to the Architect upon completion of the project.

1.18 FINAL INSPECTION:

A. Final inspection will be made upon written request from the General contractor after the project is completed; in accordance with the Supplementary General Conditions.

B. Furnish a workman familiar with this project to accompany the Engineer on final inspection and have available ladders, drop cords, and other equipment as required to gain access to any portion of this system.

C. This Contractor and his principal subcontractors shall be represented at the inspection by a person of authority responsible to demonstrate to the engineer that his work conforms to the intent of the plans and specifications.

D. Extra inspections made necessary by the Electrical Contractor's failure to comply with the conditions as set forth above shall be charged to the Contractor for the Inspector's time both on the job and spent in travel between the office and the project site.

1.19 GUARANTEE:

A. Guarantee all work, material and equipment for a period of one year after date of substantial completion.

B. During the one year guarantee period the Electrical Contractor shall be responsible for any defects which develop in the electrical systems. Upon notification of a defect by the General Contractor the Electrical Contractor shall make immediate effort to correct it and shall notify the Architect when this work is completed. This guarantee does not include ordinary lamp failure.

C. Repairs and/or replacements shall be made with no cost to Owner.

D. Provide as part of the work of this contract, in addition to the first year's guarantee on equipment and materials, the following routine maintenance and inspection. (The one year time period will not start until each item is completed in accordance with plans and specifications and accepted by the Owner). Correct and adjust all emergency systems, controls, fire alarm, transformer, etc. This service to be provided throughout the guarantee period.

1.20 SINGULAR NUMBER:

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

1.21 LOW VOLTAGE SYSTEMS:

A. Power wiring for low voltage systems shall be furnished and installed by the contractor as shown on the drawings and as required by the equipment manufacturer.

B. Rough-in for low voltage outlets shall be installed as shown on the drawings or as required by the application or by the equipment manufacturer. Where no specific requirement is noted the rough-in shall match that specified for a typical telecom outlet.

C. Nurse call, code blue, medical gas, and fire alarm systems shall be completely installed in separate conduit systems. All cable for these systems shall be in conduit and shall not be combined with any other system cable. Conduits systems shall be furnished and installed by the Electrical Contractor.

D. Conduit for low-voltage systems other than nurse call, code blue, medical gas, and fire alarm shall be limited to the following and shall be furnished and installed by the Electrical Contractor.

1. Conduit in walls, from outlets to accessible ceilings, terminated with open end bushing above ceiling.
2. Conduits between floors, terminated with open end bushings.
3. Conduits across fire and/or smoke walls, terminated with open end bushings, and sealed with approved fire rated material.
4. Other conduits as shown on drawings.

E. Conduits shall be sized as required by the number and type of conductors applied and/or as noted on plans (minimum 1") and shall be not smaller than sizes recommended by the equipment manufacturer. All conduits shall be labeled to identify which system it is to be used for i.e.: Fire Alarm, Nurse Call, Code Blue, P.A. etc.

F. When ceiling voids are used as air return plenums, only U.L. Listed plenum cable shall be used or cables shall be completely routed in conduit.

G. All low voltage wiring installed in ceiling voids shall be bundled, neatly routed, suspended above the grid system or located in cable tray and labeled with appropriate tags as to service.

H. Low voltage wire and cable shall be specifically designed to function with equipment supplied. Cable shall be color coded for ease of installation and service, twisted, shielded, and grounded for control of voice circuits and covered with wear-resistant moisture proof protective insulation. Wire shall bear manufacturer's trademark either embossed or printed on cable.

I. Low-voltage systems shall be provided with a minimum of 20% spare capacity upon completion of the project unless otherwise noted.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 260500

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

A. Section includes:

1. Building wires and cables rated 600 VAC and less.
2. Connectors, splices, and terminations rated 600 VAC and less.
3. Wire lubricating compound.
4. Control wiring.

1.3 SUBMITTALS

A. Product Data (Where indicated in Section “Common Work Results for Electrical”, provide the following information): For each type of product indicated.

1.4 QUALITY ASSURANCE

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

B. Comply with NFPA 70.

C. Comply with NEMA WC 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES (POWER AND LIGHTING):

A. Conductors and Cables: NEMA WC 70, except as hereinafter specified.

1. All conductors shown on plans are sized for copper.
2. UL label required.

B. Single Conductor:

1. Soft annealed copper.
2. Stranded for sizes No. 8 and larger. Solid or stranded for sizes No. 10 and smaller, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise.
3. Minimum size No. 12, except where larger sizes are shown. (Size No. 14 minimum for controls).

C. Stranding:

1. Conductors between stationary and moving devices, such as hinged doors or panels, shall have Class H or Class K stranding. All other conductors shall have Class B or Class C stranding.

D. Insulation:

1. THHN-THWN, XHHW - Sizes No. 12 and larger.

2.2 SPLICES AND JOINTS:

A. In accordance with UL 486 A, B, D and NEC.

B. Split-bolt type connectors are not allowed.

C. Branch circuits (No. 10 and smaller):

1. Connectors: Solderless, screw-on, reusable pressure cable type, 600 volt, 105 degree C. with integral insulation, approved for copper and aluminum conductors.
2. The integral insulator shall have a skirt to completely cover the stripped wires.
3. The number, size, and combination of conductors, as listed on the manufacturer's packaging shall be strictly complied with.

D. Branch Circuits (No. 8 and No. 6):

1. Connectors: Pre-insulated, mechanical, reusable cable type, 600 volt, 90 degree C. with integral insulation, approved for copper and aluminum conductors, cold temperature rated to -45 degree C. Connectors shall be equal to those manufactured by Polaris Connectors.
2. Provide connectors rated for the location where installed.
3. The number, size, and combination of conductors, as listed on the manufacturer's packaging shall be strictly complied with.

E. Feeder Circuits:

1. All feeder conductors shall be the same size and type and be continuous from the overcurrent device to the panel or equipment the feeder terminates at.
2. Connectors shall be indent type, UL listed for use with the size and type of wire installed of high conductivity and corrosion-resistant material. Do not install more than one conductor per connector unless the connector is UL listed for use with the number of conductors installed.
3. Power distribution blocks shall be provided for splices or where quantity or size of conductors exceeds the terminal rating of the device to be connected. Power distribution blocks shall be equal to Square D by Schneider Electric Class 9080 Type LB or Mersen Electrical Power MPDB series. Provide with covers. Power distribution blocks shall be securely mounted in a code sized enclosure.
4. Field installed compression connectors for cable sizes 250 kcmil and larger shall have not less than two clamping elements or compression indents per wire.
5. Insulate splices and joints with materials approved for the particular use, location, voltage, and temperature. Insulation rating shall be not less than that of the conductor that is being joined.

6. Plastic electrical insulating tape: Flame retardant, cold and weather resistant.

2.3 CONTROL WIRING:

A. Unless otherwise specified in other sections of these specifications, size control wiring as specified for power and lighting wiring, except the minimum size shall be not less than No. 14, 90 degrees C. insulation. Where stranded conductors are used, provide with spade type insulated copper terminals.

B. Size wire large enough so that the voltage drop under inrush conditions does not adversely affect operation of the controls.

2.4 WIRE LUBRICATING COMPOUND:

A. The cable pulling lubricant shall be compatible with all cable jackets. The lubricant shall be UL (or CSA) listed. The lubricant shall contain no waxes, greases, silicones, or polyalkylene glycol oils or waxes.

B. A 200-gram sample of the lubricant, when placed in an one-foot, split metal conduit and fully dried for 24 hours at 105 degrees C, shall not spread a flame more than three-inches beyond a point of ignition at a continued heat flux of 40 kW/m^2. Total time of test shall be one-half hour.

C. Approved Lubricant is:

1. Polywater J from American Polywater Corporation

PART 3 - EXECUTION

3.1 INSTALLATION, GENERALLY:

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

B. Install all wiring in raceway systems.

C. Where No. 10 or No. 12 stranded conductors terminate at receptacles, toggle switches, or other devices with a screw-type connection, provide a solid conductor pigtail or spade-type connector listed for use with the appropriate class of stranded wire.

D. Install a ground wire sized per NEC 250.122 in each conduit containing phase conductors.

E. Color Code:

1. All conductors shall be identified by circuit number and color coding at all termination points and splices. All conductors shall be identified in all pull and junction boxes by the following method of color coding. Means of identification shall be permanently posted at each branch circuit panel with a nameplate identifying color coding system used in that panelboard.

Phase	208Y/120V	480Y/277V	240V.	120/240V	240/120V
A	Black	Brown	Black	Black	Black
B	Red	Orange	Red	Red	Orange
C	Blue	Yellow	Blue		Blue
Neutral	White	Gray		White	White
Ground	Green	Green	Green	Green	Green
Iso. Grd	Green w/Yellow	Green w/Yellow	Green w/Yellow	Green w/Yellow	Green w/Yellow

2. Use solid color compound or solid color coating for No. 6 and smaller branch circuit conductors and neutral sizes.
3. Phase conductors No. 4 and larger color code using one of the following:

    a. Solid color compound or solid color coating.
    b. Colored as specified using 3/4-inch wide tape. Apply tape in half overlapping turns for a minimum of three-inches for terminal points, and in junction boxes, pull boxes, troughs, manholes, and handholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable stating size and insulation type.
    c. Yellow stripe on isolated ground may be 1/4-inch wide yellow tape on top of green.

4. Where neutrals are located in the same raceway, junction box or enclosure, neutrals shall be marked or labeled to indicate which circuit conductor (phase conductor) they are associated with. Neutrals (with stripes matching the associated phase conductor color) meeting the requirements of NEC Section 200.6 are acceptable for this purpose.
5. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
6. Provide plastic engraved color code legend on each panelboard and switchboard per NEC Section 210.5 (C).
7. All improperly color coded conductors will be completely replaced at no additional cost to Owner.

F. All cable and wiring shall be continuous between electrical equipment. Splices shall not be added except as required for taps in branch circuits or as approved by the engineer.

G. Splice cables and wires only in outlet boxes, junction boxes, pull boxes, manholes, or handholes. Do not splice cables in panelboards, switchboards, disconnects, etc.

H. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.

I. For panelboards, cabinets, wireways, switches, and equipment assemblies, neatly form, and tie all cables.

J. Seal cable and wire entering a building from underground between the wire and conduit, where the cable exits the conduit, with a non-hardening approved compound.

K. Wire Pulling:

1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
2. Use ropes made of nonmetallic material for pulling feeders.
3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the Engineer.
4. Pull multiple cables into a single conduit with a single continuous pull.
5. Use wire lubricant per this specification when recommended by the cable manufacturer or as required to prevent damage to cables during installation.

3.2 INSTALLATION IN MANHOLES:

A. Install and support cables in manholes on the steel racks with porcelain or equal insulators. Train the cables around the manhole walls, but do not bend to a radius less than six times the overall cable diameter.

3.3 SPLICE INSTALLATION:

A. Splices and terminations shall be mechanically and electrically secure.

B. Where the Engineer determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices at no additional cost to the Owner.

3.4 CONTROL, COMMUNICATION, AND SIGNAL WIRING INSTALLATION:

A. Unless otherwise specified in other sections of these specifications, install wiring as described below. Wiring shall be connected to perform the functions shown and specified in other sections of this specification.

B. Except where otherwise required, install a separate power supply circuit for each system, or control equipment, or control power. Circuit to nearest 120 volt panel or nearest emergency panel if equipment controlled is connected to emergency system. Use spare 20 Amp breakers in panels where none are designated. Verify all requirements with actual equipment supplied in field.

C. Install a breaker lock-on clip on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems. Lock-on clips for circuit breakers serving fire alarm systems shall be painted red.

D. System voltages shall not exceed 120 volts and shall be lower voltages where shown on the drawings or required by the NEC.

E. Wire and cable identification:

1. Install a permanent wire marker on each wire at each termination, outlet box, junction box, panel, and device. Markers shall be typed or handwritten and shall be clearly legible.
2. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
3. Wire markers shall retain their markings after cleaning.
4. In each manhole and handhole, install permanent, waterproof tags to identify the cable type/system and the building or area served.

3.5 FEEDER IDENTIFICATION:

A. In each, interior pullbox and junction box, identify each phase, neutral and/or ground conductor by conductor color coding or tape based on system voltage.

B. In manholes and handholes, install permanent, waterproof tags to identify the cable type. Identify each phase, neutral, and/or ground conductor by conductor color coding or tape based on system voltage.

3.6 FIELD TESTING:

A. Feeders and branch circuits shall have their insulation tested after installation and before connection to utilization devices such as fixtures, motors, or appliances.

B. Test shall be performed by megger and conductors shall test free from short-circuits and grounds.

C. Test conductors' phase-to-phase and phase-to-ground.

D. Megger motors after installation but before start-up and test free from grounds.

E. The Contractor shall furnish the instruments, materials, and labor for these tests.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

A. This section includes grounding and bonding systems and equipment.

B. This section includes grounding and bonding systems and equipment, plus the following special applications:

1. Foundation steel electrodes.
2. Ground bonding common with lightning protection system.
3. Underground distribution grounding.

1.3 SUBMITTALS:

A. Product Data (Where indicated in Section “Common Work Results for Electrical”, provide the following information): For each type of product indicated.

B. As-Built Data: Plans showing dimensioned as-built locations of grounding features, including the following:

1. Ground rods.
2. Grounding arrangements and connections for separately derived systems.
3. Test wells.
4. Ground rings.

C. Test Records: Submit the following test records to the Engineer for review and approval, and include in the operational and maintenance manuals:

1. Grounding system tests per paragraph FIELD QUALITY CONTROL in Part 3 of this Section.

1.4 QUALITY ASSURANCE:

A. 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.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS:

A. Insulated General Purpose: UL and NFPA 70 approved types, copper, with THW, XHHW or dual rated THHN-THWN insulation color identified green.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B3.
2. Stranded Conductors: ASTM B8.

C. Size conductors not less than what is shown on the drawings and not less than required by the NFPA 70.

2.2 GROUND BUS:

A. Pre-drilled rectangular bars of annealed copper, 1/4 by 4 inches in cross-section with 9/32 inch holes spaced 1-1/8 inches apart. Stand-off insulators shall comply with UL 891 for use in switchboards, 600V and shall be Lexan or PVC, impulse tested at 5000V.

2.3 GROUND RODS:

A. Copper-clad steel, sectional type, 3/4-inch diameter by 20 feet long.

2.4 CONNECTORS:

A. Listed and labeled by a NRTL acceptable to the authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.

C. Welded Connections:

1. Exothermic welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
2. For structural steel, steel grounding stud for compression connector.

D. Compression Connectors: Hydraulic crimped, irreversible compression type kits. Connectors shall be factory filled with oxide inhibitor. All crimps shall be made with a hydraulic tool that embosses the index number on the outside of the connector.

E. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long barrel, two-bolt connection to ground bus bar.

F. All splices and grounding electrode connections shall be made with exothermic welds or with hydraulic compression fittings.

2.5 INTERSYSTEM GROUND BAR:

A. Complies with UL 467.

B. Base and cover shall be impact resistant and UV rated.

C. Shall be rated for copper and aluminum conductors.

D. Shall have provisions for one main grounding electrode conductor and a minimum of four bonding conductors.

PART 3 - EXECUTION

3.1 APPLICATIONS:

A. Conductors: Install solid or stranded conductors for #10 AWG and smaller and stranded conductors for #8 AWG and larger unless otherwise indicated.

B. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.

C. Isolated Ground Conductors: Green colored insulation with continuous yellow stripe. On feeders with isolated ground, identify isolated grounding conductor with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors or hydraulic compression connectors except as otherwise indicated.
3. Connections to Structural Steel: Welded connectors.
4. Aboveground Connections to Ground Rods: Bolted connectors.

5. Connections to Ground Rods at Test Wells: Bolted connectors.

3.2 INSTALLATION, GENERALLY:

A. Ground in accordance with the NFPA 70 as shown, and as hereinafter specified. All equipment ground conductors shall be terminated on a ground bus or ground lug attached to equipment can.

B. Service Grounding:

1. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus.
2. Install a main bonding jumper between the neutral and ground buses.

C. System Grounding:

1. Secondary service neutrals shall be grounded at the supply side of the secondary disconnecting means and at the related transformers.
2. Separately derived systems (transformers downstream from the service entrance) ground the secondary neutral.

3. Individual Buildings: Bond Main Disconnect ground bus to building steel, 20 foot re-bar in foundation, water pipe, driven ground, and ground ring.

D. Equipment Grounding:

1. Metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be grounded for personnel safety and to provide a low impedance path for possible ground fault currents.

3.3 SECONDARY EQUIPMENT AND CIRCUITS:

A. Main Bonding Jumper: Connect the secondary service neutral to the ground bus in the service equipment.

B. Water Pipe and Supplemental Electrode:

1. Provide a ground conductor connection between the service equipment ground bus and the metallic water pipe system. Jumper insulating joints in the water pipe.
2. Provide a supplemental grounding electrode and bond to the water pipe ground, or connect to the service equipment ground bar.

C. Service Disconnect: Provide a ground bar bolted to the enclosure with lugs for connecting the various grounding conductors. Connect the neutral to the ground bus (main bonding jumper).

D. Switchgear, Switchboards, and Unit Substations:

1. Connect the various feeder green grounding conductors to the ground bus in the enclosure with suitable pressure connectors.
2. Connect the grounding electrode conductor to the ground bus.
3. Connect metallic conduits, which terminate without mechanical connection to the housing, by grounding bushings and ground wire to the ground bus.

E. Transformers:

1. Exterior: Exterior transformers supplying interior service equipment shall also have the neutral grounded at the transformer secondary. Provide a grounding electrode at the transformer.
2. Separately derived systems (transformers downstream from service equipment): Ground the secondary neutral at the transformer. Provide a grounding electrode conductor from the transformer to the nearest cold water pipe and the nearest structural steel that are effectively grounded. If neither of these are available, provide a driven ground rod or other code approved grounding electrode.

F. Conduit Systems:

1. Ground all metallic conduit systems.
2. Non-metallic conduit systems shall contain a grounding conductor.

3. Conduit provided for mechanical protection containing only a grounding conductor, bond to that conductor at the entrance and exit from the conduit via grounding bushings.

G. Feeders and Branch Circuits: Install green grounding conductors with feeders and branch circuits in all feeders and branch circuits and in any raceway containing a phase conductor.

H. Isolated Grounds: All isolated grounds must be insulated and must terminate on isolated ground buses in the equipment. No other equipment grounds shall be connected to isolated ground bus. Where isolated grounds are shown and PVC conduit is used, an equipment ground must be installed to ground metallic boxes and mounting straps.

I. Boxes, Cabinets, Enclosures, and Panelboards:

1. Bond the grounding wires to each pullbox, junction box, outlet box, cabinets, and other enclosures through which the ground wires pass (except for special grounding systems for intensive care units and other critical units shown.).
2. Make ground wire connections to ground bus in motor control centers, panelboards, etc.

J. Receptacles and toggle switches are not approved for grounding through their mounting screws. Ground with a ground wire from green ground terminal on the device to the outlet box ground screw.

K. Ground lighting fixtures to the green grounding conductor of the wiring system when the green ground is provided; otherwise, ground the fixtures through the conduit systems. Fixture connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.

L. Fixed electrical appliances and equipment shall have a ground lug installed for termination of the green ground conductor.

M. Telephone Terminal Boards: Provide a #3/0 AWG CU ground in 1" C. from each board to the main service disconnect ground bus.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS:

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set top of rod 4 inches above finished floor. Seal floor opening with waterproof, non-shrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, puling irons, ladders, and cable shields within each manhole to ground rod or grounding conductor. Make connections with #4 AWG minimum, stranded, hard drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and non-current carrying metal items to underground cable and grounding electrodes.

3.5 CONDUCTIVE PIPING:

A. Bond all conductive piping systems in the building to the electrical system ground. Bonding connections shall be made as close as practical to the water pipe ground or service equipment ground bus.

3.6 SPLICES:

A. All splices and grounding electrode connections shall be made with exothermic welds or with hydraulic compression fittings.

3.7 GROUNDING RESISTANCE:

A. Grounding system ground resistance must not exceed 5 ohms. Final tests shall assure that this requirement is met.

B. Where permanent ground connections are required, make the connections by the exothermic process or hydraulic compression method to form solid metal joints.

C. Where rock prevents the driving of vertical ground rods, install grounding electrodes in horizontal trenches to achieve the specified resistance.

D. Where more than one ground rod is required to meet the specified resistance, they shall be located at least 10 feet apart. Interconnect with grounding electrode conductor below grade and as otherwise indicated.

3.8 INSTALLATION:

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where subject to strain, impact, or damage.

B. Grounding electrode conductors shall be continuous.

C. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to the service entrance (where more than one ground rod has been installed). Set top of test well flush with finished grade or floor.

3.9 FIELD QUALITY CONTROL:

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation. Inspect compression type connections for proper die index number embossment.

B. Perform the following testing:

1. After installing grounding system, but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Test completed grounding system as each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at ground rods. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance no fewer than two full days after the last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81. Submit test results to the Engineer.
    c. Excessive Ground Resistance: If resistance to ground exceeds specified values, promptly notify Engineer, and include recommendations for reducing ground resistance.

END OF SECTION 260526

SECTION 260533 – RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Description:

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

B. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Non-metallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Non-metallic wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes and enclosures.
7. Handholes and boxes for exterior underground cabling.

C. Related Requirements:

1. Section 260543 “Underground Electrical Construction” for exterior ductbanks and manholes.

1.3 DEFINITIONS:

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid steel conduit.

C. IMC: Intermediate metal conduit.

D. RGS: Rigid galvanized steel.

1.4 ACTION SUBMITTALS:

A. Product Data (Where indicated in Section “Common Work Results for Electrical”, provide the following information): For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings (Where indicated in Section “Common Work Results for Electrical”, provide the following information): For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS:

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.

PART 2 - PRODUCTS

2.1 RACEWAYS:

A. Raceway Size: In accordance with the NFPA 70 but not less than 1/2-inch unless otherwise shown. Where permitted by the NFPA 70, 1/2-inch flexible conduit may be used for connections to recessed lighting fixtures.

B. Raceway Supports:

1. Parts and hardware: Zinc-coat or provide equivalent corrosion protection.
2. Pipe Straps: Fed. Spec. FF-S-760, Type I, Style A or B.
3. Individual Raceway Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
4. Multiple Raceway (trapeze) hangers: Not less than 1-1/2 by 1-1/2 inch, 12 gauge steel, cold formed, lipped channels or not less than 2-1/8 by 2-1/8 inch, 18 gauge B-Line “4Dimension Channel”; with not less than 3/8-inch diameter steel hanger rods.
5. Solid Masonry and Concrete Anchors: Fed. Spec. FF-S-325; Group III self-drilling expansion shields, or machine bolt expansion anchors Group II, Type 2 or 4, or Group VIII.

C. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.

2.2 CONDUIT:

A. Install raceway types as shown on drawings and as listed below.

B. Metal Conduit:

1. Rigid steel: UL 6 and ANSI C80.1.
2. Rigid aluminum: UL 6A and ANSI C80.5.
3. Rigid intermediate steel conduit (IMC): UL 1242 and ANSI C80.6.
4. Electrical metallic tubing (EMT): U.L. 797 and ANSI C80.3. Maximum size 5-inch. Permitted only with cable rated 600 volts or less.
5. Flexible steel conduit (commercial Greenfield): UL 1, zinc-coated steel.
6. Liquid-tight flexible metal conduit: UL 360 flexible galvanized steel tubing covered with extruded liquid-tight jacket of polyvinyl chloride (PVC). Provide conduit with a continuous copper bonding conductor spiral between the convolutions.
7. PVC Coated Rigid Steel: NEMA RN 1. Conduit and fittings shall be as manufactured by Robroy Industries; Plasti-Bond, Perma-Cote, and KorKap or Thomas & Betts; Ocal. Any deviation will require approval of the specifying Engineer or Owner.

    a. Shall be UL listed.
    b. All male threads on conduit, elbows and nipples shall be protected by application of a urethane coating.
    c. All female threads on fittings or conduit couplings shall be protected by application of a urethane coating.

C. Conduit Fittings for Metal Conduit:

1. Comply with NEMA FB 1 and UL 514B.
2. Rigid steel and IMC conduit fittings:

    a. Standard threaded couplings, locknuts, bushings, and elbows: Fed. Spec. W-F-408, except only material of steel or malleable iron is acceptable. Integral retractable type IMC couplings are acceptable also.
    b. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure
    c. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted. Bushings for conduit smaller than 1-1/4-inch shall have flared bottom with ribbed sides.
    d. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
    e. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank coverplates having the same finishes as that of other electrical plates in the room.

f. In trade sizes 2-1/2 inches to 4-inches for rigid steel raceway or intermediate metal raceway, contractor may use Allied 'Kwik-Couple' fittings in lieu of individual steel couplings. 'Kwik-Couple' fittings shall not be used in hazardous locations. Where 'Kwik-Couple' fittings are used exterior for vertical risers, install fitting with taper end up.

3. Rigid aluminum conduit fittings:

   a. Standard threaded couplings, locknuts, bushings, and elbows: Malleable iron, steel or aluminum alloy materials. Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.
   b. Locknuts and bushings: As specified for rigid steel and IMC raceways.
   c. Set screw fittings: Not permitted for use with aluminum raceway.

4. Electrical metallic tubing fittings:

   a. Fed. Spec. W-F-408, except only material of steel for compression type. Steel or die-cast is acceptable for set screw type. Die-cast compression is not acceptable.
   b. Couplings and connectors: Concrete tight and rain tight, with connectors having flared throats. Use gland and ring compression type or set screw type couplings and connectors. Set screw type couplings for conduit 2 inches and larger shall be four set screws each. Use set screws of case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
   c. Indenter type connectors or couplings are prohibited.
   d. In trade sizes 1-1/4 inches to 4 inches, contractor may use Allied “Kwik-Fit EMT” or “Kwik-Fit Compression EMT” fittings in lieu of individual steel couplings.

5. Flexible steel conduit (greenfield) fittings:

   a. Fed. Spec. W-F-406 and UL 5, except only steel or malleable iron material is acceptable.
   b. Clamp type, with insulated throat.

6. Liquid-tight flexible metal conduit fittings:

   a. Fed. Spec. W-F-406, except only steel or malleable iron material is acceptable.
   b. Type incorporating a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.

7. Expansion and deflection couplings:

   a. UL 467 and UL 514.
   b. Accommodate, 1.9 cm (0.75”) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.

c. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, NFPA 70 Section 250.98, and the NFPA 70 code tables for ground conductors.
d. Shall be watertight, seismically qualified, corrosion-resistant, threaded for and compatible with rigid or intermediate metal conduit.
e. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.
f. Expansion fittings shall accommodate a minimum of 4-inches of movement.

D. Nonmetallic Conduit:

1. PVC Conduit: NEMA TC 2 and UL 651 Schedule 40, conduit size is 3/4-inch minimum.

E. Conduit Fittings for Non-Metallic Conduits:

1. PVC Conduit: Comply with NEMA TC 3; match to conduit type and material.

2.3 CONDUIT SLEEVES

A. Conduit sleeves shall be one of the following:

1. Rigid steel or IMC conduit with threaded ends and non-metallic bushings on each end.
2. EMT conduit with U.L. Listed slide on non-metallic bushings on each end.

B. Fire rated conduit sleeves shall be:

1. Provided at fire rated walls or penetrations and as indicated on the drawings.
2. EZ-Path, ‘Hilti’ #CP 653 or approved equal.

2.4 CABLE SUPPORTS

A. Appropriate cable supports shall be used at all times to prevent unnecessary tension or slag in the cable bundles. Support spacing and size shall be as required to comply with applicable ANSI Standards and manufacturers recommendations.

B. Cable Tray: Cable tray shall be provided as shown on the drawings. Cable tray shall be sized to support all cable with a maximum fill of 40%. Refer to section “CABLE TRAYS FOR ELECTRICAL SYSTEMS”.

C. J-Hooks: J-Hooks shall be sized to support all cable with a maximum fill of 40%.

1. nVent Caddy #Cat HP Series or approved equal.

D. Cable Wraps: All cable wraps shall be plenum rated re-enterable hook and loop type, sized as required. The use of plastic ties, cable wraps, “zip ties” or compression ties of any kind are prohibited.

2.5 OUTLET BOXES:

A. UL-50, UL514A and NEMA OS 1.

B. Cast metal where required by NFPA 70 or shown, and equipped with rustproof boxes; NEMA FB 1.

C. Sheet metal boxes: 4-inch square, galvanized steel, except where otherwise shown.

D. Boxes installed in concrete or masonry and boxes larger than two gang shall be masonry type.

E. Box extensions used to accommodate building finishes shall be of the same material as the recessed box.

F. Boxes for use with IMC or RGS raceways shall be cast 'F' type or stainless steel unless noted otherwise on the drawings.

G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

H. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.

2.6 WIREWAYS AND AUXILIARY GUTTERS:

A. Sized according to NFPA 70.

B. Equip with hinged covers, except where removable covers are shown. Wireways shall only be permitted as indicated on the drawings or approved by the Engineer.

C. Fittings and accessories: Include covers, couplings, offsets, elbows expansion joints, adapters, hold down straps, end caps, and other fittings to match and mate with wireways as required for a complete system.

D. Metal Wireways:

1. Sheet metal complying with UL 870 and NEMA 250.
2. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70 and shall be marked for intended location and application.

2.7 PULL AND JUNCTION BOXES:

A. Small boxes shall comply with NEMA OS 1.

B. Larger boxes shall comply with UL 50 and NEMA 250.

C. Pull and junction boxes shall be code gauge steel boxes with hinged, bolted or screwed covers. Boxes shall be flush or surface mounted as shown or required.

D. Junction and pull box shall be installed where shown on drawings and additional boxes shall be installed if required for pulling of wire provided location and installation is

approved by the Architect. All boxes shall be code construction with screw type cover and shall be installed in accessible locations.

E. Pull and junction boxes for use with IMC or RGS raceways shall be cast 'FS' type or stainless steel unless noted otherwise on the drawings. Comply with NEMA FB 1 and UL 1773 with gasketed cover.

2.8 SURFACE METALLIC RACEWAY:

A. Raceways shall be Wiremold #500 minimum or #700 for small sizes and Wiremold Series 2000, 3000, and 4000 for larger capacities or equal by MonoSystems, Inc. In all cases, do not exceed the fill per the manufacturers published data.

B. Use outlets and fittings by the same manufacturer and approved for use with the raceway.

C. Provide multiple compartment raceways where power and low voltage wiring are located in the same raceway.

2.9 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.

B. Comply with SCTE 77.

C. Configuration: Designed for flush burial with open bottom unless otherwise indicated.

D. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.

E. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

F. Cover Legend: Molded lettering shall be "ELECTRIC" for power handholes and "COMMUNICATIONS" or "CONTROLS" as applicable for low voltage handholes.

G. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

H. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

I. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete.

PART 3 - EXECUTION

3.1 RACEWAY:

A. Minimum 1/2-inch for above grade or Access Control, 3/4-inch for below grade or Fire Alarm, and 1-inch on site or for Telecommunications, unless otherwise noted.

B. A ground wire, sized per NFPA 70 Section 250.122 shall be installed in all conduits containing phase conductor(s).

C. RGS or IMC must be used at all times when exposed to weather or physical abuse and in all NFPA 70 classified hazardous locations. EMT may not be used in direct contact with earth, or in concrete slabs on grade.

D. U.L. approved Schedule 40 P.V.C. conduit may be used where feeders or branch circuits are to be run in earth or slabs (3/4" minimum).

1. Use PVC coated RGS ells and risers approved for underground use. All conduit risers through concrete floors shall be RGS from below the top of the floor slab. Use conduit adapters when converting from PVC to steel conduit.
2. Use plastic spacers when more than one conduit is installed together. See Drawings for areas requiring concrete encasement.

E. All nonmetallic (PVC and fiberglass) conduits shall be provided with separate ground conductor sized per NFPA 70.

3.2 PENETRATIONS:

A. Cutting or Holes:

1. Locate holes in advance where they are proposed in the structural sections such as ribs or beams. Obtain the approval of the Structural Engineer prior to drilling through structural sections.
2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed, except where permitted by the Structural Engineer as required by limited working space.

B. Fire Stop:

1. Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases, and maintains specified fire rating. Fire stops shall be UL listed for the wall rating and construction method. Completely fill and seal clearances between raceways and openings with the fire stop material.
2. Fire stops shall be installed according to applicable codes.

3. Each firestopping location shall be labeled on each side of the penetrated fire barrier, within 300 mm (12 in.) of the firestopping material as specified in the latest edition of ANSI/TIA-606. Documentation of fire stops shall be in accordance with the latest edition of TIA-606.

C. Fire Barrier Penetration Seals:

1. Manufacturer: Subject to compliance with requirements, provide fire barrier penetration seals of one of the following:

a. Electro Products Div./3M
b. Nelson; Unit of General Signal.

2. Provide seals for any opening through fire-rated walls, floors, ceilings, or assemblies used as passage for components such as conduits or cables.
3. Cracks, voids or holes up to 4-inch diameter: Use putty or caulking, one-piece intumescent elastomer, non-corrosive to metal, compatible with synthetic cable jackets, and capable of expanding 10 times when exposed to flame or heat and UL-listed.
4. Openings greater than 4-inch diameter and raceway sleeves thru floors at telephone terminal boards: Use sealing system capable of passing 3-hour fire test in accordance with ASTM E-814, consisting of wall wrap or liner, partitions, and end caps capable of expanding when exposed to temperatures of 250 degrees to 350 degrees F (121 to 177·C), that is UL-listed. KBS "Sealbags" manufactured by P-W Industries will be acceptable.
5. Execution: Fill entire opening with sealing compound. Adhere to manufacturer's installation instructions. All fire barrier seals shall meet the rating of the wall.

D. Waterproofing:

1. Install sleeves and sleeve seals at exterior floor, exterior wall, and roof conduit penetrations and completely seal clearances around the conduit and sleeve and make watertight as specified in Section, SEALING AND CAULKING.

3.3 CONDUIT SYSTEMS INSTALLATION, GENERAL:

A. Installation: In accordance with UL, NFPA 70, as shown, and as hereinafter specified.

1. Where non-metallic (PVC or fiberglass) conduits are used, a ground wire sized per NFPA 70 Section 250.122 shall be provided if not already specified.

B. All branches of the emergency system shall be installed entirely independent of other raceway systems. Common supports and hangers may be used.

C. Raceway Burial Depths: (Underground work)

1. 18” minimum, 30” maximum cover to grade or bottom of floor slab.
2. 24” minimum under streets, highways, roads, alleys, driveways and parking lots.
3. 2” minimum below concrete slab inside a building.
4. Prior to any underground work, contractor shall verify and locate all existing underground utilities. All existing utilities may not be shown on the drawings. Verify in field with owner and with utility locating services. The contractor shall exercise extreme caution when trenching or boring, hand digging at all crossings and where in close proximity of existing utilities. Repair existing parking lots, streets, roads, alleys, driveways, etc. to its original condition in a timely manner prior to substantial completion. Contractor shall be responsible for any damage to underground utilities.
5. Underground conduits shall be installed in a sand bed and in an organized manner.

6. Conduit ductbanks of more than 3 conduits (2” and larger) shall be installed with spacers and encased with flowable fill.

D. Install raceways as follows:

1. Comply with NECA 1, comply with NECA 101 for metal conduit and NECA 102 for aluminum conduit except where requirements on drawings or this article are stricter.
2. In complete runs before pulling in cables or wires.
3. Flattened, dented, or deformed raceways are not permitted. Remove and replace the damaged raceways with new undamaged material.
4. Assure raceway installation does not encroach into the ceiling height head room, walkways, or doorways.
5. Cut square with a hacksaw, ream, remove burrs, and draw up tight.
6. Mechanically and electrically continuous.
7. Independently support raceway. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, mechanical piping, or mechanical ducts.). Group raceways with common supports where possible. Conduit shall be supported within 12-inches of connectors.
8. Close ends of empty raceway with plugs or caps at the rough-in stage to prevent entry of debris, until wires are pulled in.
9. Raceway installations under fume and vent hoods are prohibited.
10. Secure raceways to cabinets, junction boxes, pull boxes and outlet boxes with bonding type locknuts. For RGS and IMC raceway installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make raceway connections to junction box covers.
11. Flashing of penetrations of the roof membrane is specified in Section, FLASHING AND SHEET METAL.
12. Raceways shall not be used as a support.
13. Use thread compounds that are UL approved conductive type to insure low resistance ground continuity through the raceways.
14. Tightening set screws with pliers is prohibited.
15. Keep raceways a minimum of 6 inches away from parallel runs of flues and steam or hot-water pipes.

E. Raceway Bends:

1. Make bends with standard raceway bending machines.
2. Raceway hickey may be used for slight offsets, and for straightening stubbed out raceways.
3. Bending of raceways with a pipe tee or vise is prohibited.

F. Raceways Installed Under Metal - Corrugated Sheet Roof Decking

1. Where rigid metal conduit or intermediate metal conduit is not used, raceways shall be installed and supported so the nearest outside surface of the raceway is not less than 1.5 inches from the nearest surface of the roof decking.

G. PVC coated RGS:

1. Use only fittings listed for use with this type of conduit.
2. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduit and fittings. Use sealant recommended by conduit manufacturer and apply in thickness and number of coats recommended by manufacturer.

3. Right angle beam clamps and U bolts shall be specially formed and sized to snugly fit the outside diameter of the coated conduit.
4. All clamping, cutting, threading, bending, and assembly instructions listed in the manufacturer's installation guide should be vigorously followed. Installer certification, before installation, is required.

3.4 CONCEALED WORK INSTALLATION:

A. General:

1. Raceway and Outlet Boxes Installation: All raceway systems work and outlet boxes shall be installed concealed in walls, floor and roof construction or concealed within furred spaces or above ceilings. In equipment or mechanical rooms exposed work shall include feeders and connections to equipment unless noted otherwise.

B. In Concrete:

1. Raceway: RGS, IMC, PVC or EMT; except do not install EMT in concrete slabs that are in contact with soil, gravel or vapor barriers.
2. Align and run raceways in direct lines.
3. Install raceways through concrete beams only when the following occurs:

    a. Where shown on the structural drawings.
    b. As approved by the Structural Engineer prior to construction, and after submittal of drawing showing location, size, and position of each penetration.

4. Installation of raceways in concrete that is less than three inches thick is prohibited. All raceways installed in concrete shall be approved by the Structural Engineer.

    a. Raceway outside diameter larger than one-third of the slab thickness is prohibited.
    b. Space between raceways in slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.
    c. Install raceways approximately in the center of the slab so that there will be a minimum of 3/4-inch of concrete around the raceways.

5. Make couplings and connections watertight.

C. Above Furred or Suspended Ceilings and in Walls:

1. Raceways for conductors 600 volts and below:

    a. RGS, IMC, rigid aluminum, or EMT. Types mixed indiscriminately in the same system are prohibited.
    b. Do not use aluminum in wet locations or in contact with concrete.

2. Raceways for conductors above 600 volts:

a. RGS or rigid aluminum. Do not use aluminum in wet locations or in contact with concrete.
b. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.

3. Align and run raceways parallel or perpendicular to the building lines.
4. Connect recessed or lay-in lighting fixtures and all other devices installed in a lay-in ceiling to raceway runs with flexible metal conduit extending from a junction box to the fixture. Provide a ground wire in all flexible conduits.
5. Tightening set screws with pliers is prohibited.

3.5 EXPOSED WORK INSTALLATION:

A. Raceways for Conductors 600 volts and below:

1. RGS, IMC, rigid aluminum, or EMT. Types mixed indiscriminately in the system are prohibited.
2. Do not use aluminum in wet locations or in contact with concrete.
3. All raceways exposed to physical abuse and in all industrial pump, treatment plant locations shall be RGS, or IMC.

B. Raceways for conductors above 600 volts:

1. RGS or rigid aluminum. Do not use aluminum in wet locations.
2. Aluminum mixed indiscriminately with other types in the same system is prohibited.

C. Align and run raceways parallel or perpendicular to the building lines.

D. Install horizontal runs close to the ceiling or beams and secure with raceway straps.

E. Surface metallic raceways:

1. Surface metallic raceway shall only be used where shown on the drawings, and in remodels and modifications to existing where wall and ceiling voids do not permit concealed installation but shall not be used at any other location unless called for on the drawings.
2. All surface raceway and outlets must be painted to match the surface it is attached to.
3. Install a ground wire sized per NFPA 70 Section 250.122 for the largest circuit in the raceway if not already specified.

F. Painting:

1. Paint exposed raceways as specified in Section, PAINTING.
2. Paint raceways containing cables rated over 600 volts safety orange as specified in Section, PAINTING. In addition, paint legends, using 2-inch high black numerals and letters, showing the cable voltage rating. Provide legends where raceways pass through walls and floors and at maximum 20-foot intervals in between.

3.6 WET OR DAMP LOCATIONS:

A. Unless otherwise shown, use raceways of RGS or IMC above grade. Use PVC conduit below grade, except RGS ells and risers shall be used.

B. Provide sealing fittings, to prevent passage of water vapor, where raceways pass from warm to cold locations, i.e., (refrigerated spaces, constant temperature rooms, air conditioned spaces) or similar spaces.

C. When RGS ells and risers are used below grade or when RGS or IMC conduit or RGS ells and risers are used below concrete building slabs in contact with soil, gravel, or vapor barriers, conduit shall have a minimum 20 mil PVC tape or coated with bituminous asphaltum compound //be PVC coated RGS.

D. Rooftops:

1. Where raceways or cables are exposed to direct sunlight on or above rooftops, raceways or cables shall be installed a minimum of 7/8" above the roof to the bottom of the raceway or cable.
2. The ampacity of conductors or cables shall be de-rated in accordance with N.E.C. Section 310.15(B)(3)(c).
3. Raceways or cables shall be supported up off the surface of the roof with a polymeric rooftop support equal to Caddy Pyramid series. Supports shall be non-penetrating and shall be designed to prevent damage to the roofing materials. Wood supports are not allowed.

3.7 CORROSIVE LOCATIONS:

A. Conduit shall be PVC coated RGS.

3.8 MOTORS AND VIBRATING EQUIPMENT:

A. Use flexible metal conduit (Type FMC) for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission. Provide liquid-tight flexible metal conduit Type (LFMC) for installation in exterior locations, kitchens, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, treatment plants, pump stations, and locations subject to seepage or dripping of oil, grease or water. Provide a green ground wire with all flexible metal conduit.

3.9 EXPANSION JOINTS:

A. Expansion fittings shall be used wherever the change in length of PVC conduit due to temperature variation exceeds 0.25-inches per NEC Section 352.44.

B. All conduits routed outdoors or in non-conditioned spaces (i.e., attics, non-insulated plenums, etc.) shall have expansion fittings per the following:

1. Steel: One expansion fitting in runs longer than 40 feet. Provide additional expansion fittings every 200 feet.
2. Aluminum: One expansion fitting in runs longer than 20 feet. Provide additional expansion fittings every 100 feet.

3. PVC: One expansion fitting in runs longer than 20 feet. Provide additional expansion fittings every 50 feet.

C. Equip raceways 3-inches and larger, that are rigidly secured to the building structure on opposite sides of a building expansion joint, with expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.

D. Equip raceways smaller than 3-inches, that are rigidly secured to the building structure on opposite sides of a building expansion joint, with junction boxes located 12-inches either side of the expansion joint. Connect junction boxes with 24-inches of flexible conduit that is slack (to allow for movement). Flexible conduit shall have an insulated copper bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 3-inches and larger conduits are acceptable.

3.10 RACEWAY SUPPORTS, INSTALLATION:

A. All raceways shall have supports at maximum spacing of 10-feet and within 3-feet of a fitting, elbow, change of direction, box outlet or enclosure. Safe working load shall not exceed 1/4 of proof test load of fastening devices. This shall apply to both vertical and horizontal conduit runs.

B. Use pipe straps or individual raceway hangers for supporting individual conduits.

C. Support multiple raceway runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the raceways, wires, hanger itself, and 200 pounds. Attach each raceway with U-bolts or other approved fasteners.

D. Support raceways independently of junction boxes; pull boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.

E. Fasteners and Supports in Solid Masonry and Concrete:

1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
2. Existing Construction:

a. Steel expansion anchors not less than 1/4-inch bolt size and not less than 1-1/8 inch embedment.
b. Power set fasteners not less than 1/4-inch diameter with depth of penetration not less than 3-inches.
c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.

F. Hollow Masonry: Toggle bolts are permitted. Bolts supported only by plaster are not acceptable.

G. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.

H. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.

I. Chair, wire, or perforated strap shall not be used to support or fasten conduit.

J. Spring steel type supports "caddy clips" that are listed for the intended use are acceptable in appropriate locations.

K. Vertical Supports: Vertical raceway runs shall have riser clamps and supports in accordance with NFPA 70 and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

3.11 BOX INSTALLATION:

A. Boxes for Concealed Raceways:

1. Mount flush. Boxes protruding from the finished wall surface or with more than 1/8-inch gap between the wall or outlet mounted in the box will be changed out with all wall reconstruction expense paid by the Electrical Contractor.
2. Provide raised covers for boxes to suit the wall or ceiling, construction and finish.

B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling in operations.

C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.

D. Outlet boxes in the same wall mounted back-to-back are prohibited.

E. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is 4-inches square by 2-1/8 inches deep, with device covers for the wall material and thickness involved.

F. Where lighting fixtures and appliance outlets are to be mounted in concrete or in plaster finish on concrete, outlet boxes shall be installed in forms at exact dimensions from bench marks, columns, walls or floors.

G. Where lighting fixtures and appliances outlets are to be mounted on masonry walls and/or plastered furring or other finish, outlet boxes shall be roughed in to general location before installation of wall and furring and shall be reset to exact dimensions before walls and furring are constructed.

H. All outlet boxes shall be set true to horizontal and vertical lines parallel to walls, floors and ceilings and true to finish lines. All boxes shall be secured to ceilings or walls so all installations are solidly mounted.

I. Boxes mounted to wall studs shall be secured to a horizontal box mounting bracket equal to B-Line Series #BB2 or Caddy Series #SGB. B-Line Series #BB4, Caddy Series #H23 or equal one piece support brackets may be used for mounting light switch boxes only. However, metal stud clips with far side box supports are not acceptable.

J. Boxes for exterior exposed work (where approved by the engineer) shall be Appleton or Pyle National Type FS or FSC for shallow devices and Type FD or FDC for deep devices. Boxes for ceiling mounted light fixtures shall have approved no-bolt fixture studs. Boxes used as junction boxes shall have beveled edge flat steel blank cover.

K. Where outlet boxes are mounted exposed in unfinished areas, (where approved by the engineer) surface mounted boxes shall be 4-inches square, have rounded corners and 1/2-inch raised steel cover plates.

L. Location of outlets on small drawings is approximate and exact dimensions for locations of outlets shall be as taken from large scale plans and details on drawings or as directed by the Architect/Engineer.

1. Outlets shall be located generally from column centers and finished wall lines or to center of wall or joints between wall panels. Ceiling outlets shall be installed at elevation of suspended ceiling connected to outlets in ceiling or slab above. Where necessary to fit and center with panel or ceilings and wall spaces, the contractor must, at no expense the Owner, shift the lighting outlets or other outlets as required by the Architect.

M. Clock outlets shall be mounted 7-inches below ceiling height unless otherwise noted on the drawings. All other outlets shall be mounted at heights above floor as called for on drawings or as directed.

N. Bracket lights over mirrors shall be centered on mirrors with 2-inch fixture clearance above mirror.

O. Boxes for switches and receptacles installed in columns shall be located off center to allow for future partitions.

P. Boxes for switches at or near door shall be installed on the side opposite the hinge. Verify door swing direction prior to rough-in.

Q. To prevent sound from traveling through walls, electrical devices from different rooms shall not be mounted in the same stud place. Through-wall boxes shall not be used. In fire rated walls or partitions, outlet boxes on opposite sides of walls or partitions shall be separated by a horizontal distance of 24-inches. Outlet boxes larger than 4-inch square shall not be installed in fire rated walls or partitions. Verify location of fire rated walls or partitions with Architectural drawings prior to rough-in.

R. Mark all junction boxes and pull boxes and/or the conduit where it enters the box with panel designation and circuit number in permanent, black marker. Mark on the outside where located in unfinished spaces and mark on the inside in finished spaces.

S. Verify exact location of floor boxes and poke-throughs with Architect prior to rough-in.

3.12 DIVISION 27 AND DIVISION 28 SYSTEMS CONDUIT:

A. These specifications include the furnishing of all labor and materials necessary for the complete installation of a system of conduits, outlets, and boards for use by the system suppliers.

B. This installation must be done according to the requirements of the system suppliers and the general specifications covering "Light and Power" herewith.

C. Low Voltage Cable Pathways:

1. Pathways shall be designed and installed to meet applicable local and national building and electrical codes or regulations.
2. All pathway components shall be installed according to the manufacturer's specifications.
3. Grounding/Earthing and bonding of pathways shall comply with applicable codes and regulations.
4. Pathways shall not have exposed sharp edges that may come into contact with low voltage systems cables.
5. Pathways shall not be located in elevator shafts.
6. Vertically routed cables through chases must be supported per manufacturer's instructions and applicable ANSI Standards to prevent cable tension from occurring.
7. Cable Tray: All cabling should be installed in low voltage cable trays where possible. Power cable must never reside in the same cable tray as the low voltage system cabling. All cabling installation procedures shall also adhere to the recommended "Do's" and Don'ts" in TIA 568.
8. J-Hooks: J-Hooks shall be used in common areas where cable trays are not available and/or as indicated on the plans. J-Hooks shall be located with a maximum spacing of 3'-0" on center. Cables shall not contact the ceiling, piping, light fixtures, ducts, etc. All cables must be suspended independently from other supports.
9. Cable Wraps: Cable wraps shall be used at appropriate intervals to secure cable between j-hooks or cable trays, and to provide strain relief at termination points. These wraps shall not be over tightened to the point of deforming or crimping the cable sheath. Cable wraps should rotate 360 degrees when applied correctly. Spacing shall be a maximum of 3'-0". Placement shall not be over cable labels. Cable wraps (zip-tie type) shall not be used as a means of support.
10. Conduit Sleeves. Conduit sleeves shall be provided where cables are indicated to pass though walls and at other locations as indicated on the plans. Sleeves shall be 2-inch conduit minimum extending 6-inches on either side of walls. Where possible, sleeves shall be located 6-inches above ceiling.

D. Provide and install pull boxes at all locations as required by the system suppliers. Mark all pull boxes and/or the conduit where it enters the box with type of system in permanent, black marker. Mark on the outside where located in unfinished spaces and mark on the inside in finished spaces.

E. Provide and install conduit sleeves thru floors and walls as required by the system suppliers.

F. The systems shall be provided with main service conduit sized as indicated on drawings. Each phone, data or TV location requires 1-inch empty conduit with pull rope unless noted otherwise. Conduits shall be routed to nearest associated telephone or data terminal board or above lay-in ceiling. If ceiling is an air return plenum, cables shall be routed completely in conduit or must be rated for use in air return plenum. Verify conditions of job prior to rough-in.

G. Install the raceway system as shown on drawings.

H. All conduit ends shall be equipped with non-metallic insulated bushings.

I. All 2, 3 and 4-inch conduits within buildings shall include pull boxes after every two 90 degree bends. Size per the latest edition of TIA-569.

J. Vertical conduits/sleeves through closets floors shall terminate not less than 3-inches above the floor and not less than 3-inches below the ceiling of the floor below.

K. Terminate conduit runs to/from the associated telephone or data backboard in a closet or designated space at the top or bottom of the backboard. Conduits shall enter closets next to the wall and be flush with the backboard.

L. Where drilling is necessary for vertical conduits, locate holes so as not to affect structural sections such as ribs or beams.

M. All empty conduits located in equipment closets or on backboards shall be sealed with a standard non-hardening duct seal compound to prevent the entrance of moisture and gases and to meet fire resistance requirements.

N. Conduit runs shall contain no more than two quarter turns (90 degree bends) between pull boxes/backboards.

O. Furnish and install nylon pull rope in all empty conduits. (Sleeves through floor/wall are exceptions).

3.13 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES:

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from ½-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finish grade. Set covers of other enclosures 1 inch above finished grade.

D. Install handholes with bottom below frost line.

E. Where conduits enter side of enclosures, field-cut openings for conduits according to manufacturer’s written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

END OF SECTION 260533

SECTION 260543 - UNDERGROUND ELECTRICAL CONSTRUCTION

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section includes the furnishing, construction and installation of duct lines to form a complete underground raceway system.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Concrete: ACI-318. Concrete shall have 3000 psi minimum 28 day compressive strength. Steel reinforcement shall be provided.

B. Duct Lines:

1. Size: Except where otherwise shown on the drawings, ducts and conduits shall be not less than 4-inch trade size.
2. Ducts (direct burial):

a. Plastic duct:

1) NEMA TC2 and TC3, EPC-40-PVC, Type II and III.
2) UL 651, heavy wall PVC or PE.
3) Duct shall be suitable for use with 75 degree C rated cable.

b. Rigid metal conduit: UL 6 rigid galvanized steel.

1) Where metal conduit is shown on drawings, or hereinafter specified, conduit shall have a coating of 20 mil bonded PVC or shall be coated with bituminous asphaltic compound.

C. Ground Rods: Shall be copper clad steel, 3/4-inch diameter, and 20 feet long. Sectional ground rods (10'-0" min.) are permitted.

D. Ground Wire: Shall be stranded bare copper No. 6 AWG minimum.

E. Marker Tape: Shall be 6" wide, minimum, and equal to Thomas and Betts #NA0700 Series "Electric Line".

PART 3 - EXECUTION

3.1 TRENCHING:

A. General:

1. See Section, EARTHWORK for excavating, shoring, sheeting, bracing, and backfilling.

2. Work with extreme care near existing ducts, conduits, cables, and other utilities to avoid damaging them.
3. Cut the trenches neatly and uniformly.
4. Contractor shall include the removal of any rock encountered in the excavation. Verify with the soil borings. No additional cost will be paid by the Owner.

B. For Reinforced Concrete Encased Ducts:

1. After excavation of the trench, stakes shall be driven in the bottom of the trench at four-foot intervals to establish the grade and route of the duct bank.
2. Pitch the trenches uniformly towards manholes or both ways from high points between manholes for the required duct line drainage. Avoid pitching the ducts towards buildings wherever possible.
3. The walls of the trench may be used to form the side walls of the duct bank provided that the soil is self-supporting and that concrete envelope can be poured without soil inclusions. Forms are required where the soil is not self-supporting.
4. After the concrete encased duct has sufficiently cured, the trench shall be backfilled to grade with earth.

3.2 DUCT LINE INSTALLATION:

A. General:

1. Duct lines shall be in accordance with the NEC, as shown on the drawings, and as specified.
2. Duct shall be sloped to drain towards manholes and handholes, and away from building and equipment entrances. Pitch shall be not less than four inches in 100 feet. Curved sections in duct lines shall consist of long sweep bends with a minimum radius of 50 feet in the horizontal and vertical directions. The use of manufactured bends is limited to building entrances and stub-ups to equipment.
3. Upon completion of the duct bank installation, a standard flexible mandrel shall be pulled through each duct to loosen particles of earth, sand, or foreign material left in the line. The mandrel shall be not less than 12 inches long and shall have a diameter 1/2-inch less than the inside diameter of the duct. A brush with stiff bristles shall then be pulled through each duct to remove the loosened particles. The diameter of the brush shall be the same as, or slightly larger than, the diameter of the duct.
4. Seal the ducts and conduits at building entrances, and at outdoor terminations for equipment, with a suitable non-hardening compound to prevent the entrance of moisture and gases.
5. Raceway Burial Depths:

    a. 18" minimum, 30" maximum cover to grade or bottom of floor slab.
    b. 24" minimum under streets, highways, roads, alleys, driveways and parking lots.
    c. 2” minimum below concrete slab inside a building.

B. Reinforced Concrete Encased Ducts:

1. Install reinforced concrete encased ducts for both medium and low voltage systems when shown on the drawings.

2. Duct lines shall consist of single or multiple duct assemblies encased in reinforced concrete. Ducts shall be uniform in size and material throughout the installation, unless otherwise shown or specified.
3. Rigid, unplasticized, polyvinyl chloride spacers shall securely support and maintain uniform spacing of the duct assembly a minimum of three inches above bottom of trench during the concrete pour. Spacers shall be placed at intervals per NEC Table 352.30.
4. Clearances between individual ducts:

    a. For like services: Not less than three inches.
    b. For power and signal services: Not less than 12 inches.
    c. For medium voltage to signal/communication/control: Not less than 18".
    d. Provide plastic spacers to maintain clearances.
    e. Provide nonferrous tie wires to prevent displacement of the ducts during pouring of concrete. Tie wires shall not act as substitute for spacers.

5. Duct lines shall terminate at window openings in manhole walls as shown on the drawings. All ducts shall be fitted with end bells.
6. Couple the ducts with proper couplings. Couplings shall be staggered in rows and layers to insure maximum strength and rigidity of the duct bank.
7. The reinforced concrete envelope encasing the ducts shall extend not less than three inches beyond the outside walls of the outer ducts and conduits.
8. Ducts shall be kept clean of earth, sand, or gravel during construction, and sealed with tapered plugs upon completion of each portion of the work.
9. Where new ducts, conduits, and concrete envelopes are to be joined to existing manholes, handholes, ducts, conduits, and concrete envelopes, make the joints with the proper fittings and fabricate the concrete envelopes to insure smooth durable transitions.
10. Where ducts turn up above grade, elbows, risers and fittings shall be PVC coated RGS.

END OF SECTION 260543

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY:

A. Section includes:

1. Lighting and appliance branch-circuit panelboards.
2. Distribution panelboards.

1.3 SUBMITTALS:

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage surge suppressor, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment, include the following information:

1. Dimensional data.
2. Enclosure type, per NEMA 250.
3. Detailed bus configuration, including current and voltage ratings.
4. Short-circuit current rating of panelboard and overcurrent protective devices.

    a. Where series ratings are permitted and utilized, submit evidence of series ratings for each selected combination of fuses and/or circuit breakers.

5. Evidence of NRTL listing for series rating of installed devices.
6. Detailed features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Layout or elevation of each panelboard showing the relative locations of all specified breakers, lugs, accessories, and features.
8. Wiring diagrams for power, signal, and control wiring.

C. Operation and Maintenance Data: Include operation and maintenance data for all panelboards and components in the operation and maintenance manuals. Data shall include, but not be limited to:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Summary of final settings for all adjustable overcurrent protective devices.
3. Print or copy of all final panel schedules in 8.5" x 11" format.

D. Test Records: Submit the following test records to the Engineer for review and approval, and include in the operation and maintenance manuals:

1. Load Balancing: Submit records of load readings before and after load balancing, per paragraph ADJUSTING in Part 3 of this Section.

1.4 QUALITY ASSURANCE:

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.

B. Product Selection for Restricted Space: Drawings may indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with any indicated maximum dimensions.

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

D. Comply with NEMA PB 1 and NFPA 70.

1.5 COORDINATION:

A. Coordinate layout and installation of panelboards and components with other construction that penetrates wall or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and requires clearances for equipment access doors and panels.

B. Coordinate sizes and locations of any concrete bases with actual equipment provided.

1.6 PROJECT CONDITIONS:

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions:

1. Notify Owner in writing, not fewer than seven days in advance of proposed interruption of service.
2. Do not proceed with interruption of electric service without Owner’s written permission.
3. Comply with NFPA 70E.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS:

A. All panelboard components shall be the product and assembly of the same manufacturer. All similar units of all panelboards shall be of the same manufacturer.

B. All panelboards shall be completely factory assembled with molded case circuit breakers or switches.

C. Panelboards shall have main breaker, main switch, or main lugs, voltage, bus sizing, and flush or surface mounting as indicated on the Drawings.

D. Enclosures: Flush or surface mounted as indicated on the Drawings

1. Rated for environmental conditions at installed location:

   a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
   b. Outdoor Locations: NEMA 250, Type 3R.
   c. Kitchens and Wash-Down Areas: NEMA 250, Type 4X Stainless Steel.
   d. Other Wet or Damp Locations: NEMA 250, Type 4.
   e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Non-corrosive Liquids: NEMA 250, Type 12.

2. Cabinets:

   a. Finish shall be galvanized steel.
   b. Shall not have ventilation openings for panels with bus ratings of 225 amperes or less.
   c. Back and sides shall be fabricated from one piece of formed steel for lighting and appliance branch-circuit panelboards.
   d. Shall contain a minimum of four interior mounted studs and necessary hardware for “in” and “out” adjustment of panel interior.
   e. Gutter sizes for cabinets containing through-feeders shall be increased by the amount required for auxiliary gutters in the NEC.
   f. For multi-section flush-mounted panelboards, all cabinets shall be the same height.

3. Front Trim:

   a. Shall include frame and door with concealed hinges.
   b. Shall be secured to cabinet with screws. Trim clamps are not allowed.
   c. Shall be galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer’s standard two-coat, baked-on finish consisting of prime coat and thermosetting top coat.
   d. Shall be same width and height as cabinet for surface-mounted panels. Shall overlap cabinet by at least 0.75 inches for flush-mounted panels.
   e. Shall not have ventilation openings for panels with bus ratings of 225 amperes or less.
   f. Shall include a welded angle on the rear to support and align trim to cabinet.
   g. Shall be separate for each section of multi-section panelboards. For flush installations, trims and doors of all sections shall be the same height.

   h. All trims for circuit breaker panelboards with bus ratings of 600 amperes or less shall be hinged trim construction with a concealed piano hinge on the right side. Trim shall be able to be hinged open by operating a latch or removing no more than four (4) screws.

4. Doors:

a. Shall be galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting top coat.
b. Shall be provided with concealed butt hinges welded to the doors and trim.
c. In making switching devices accessible, doors shall not uncover any live parts.

d. Shall have directory card holder with transparent protective cover for card, permanently mounted to inside of door.

e. Shall have the manufacturer's standard flush lock. All panels shall use the same key.

E. Phase, Neutral, and Ground Buses:

1. Material shall be plated copper, with copper connection straps bolted together and rigidly supported on molded insulators.
2. Phase bus bars for panels with single pole branches shall be arranged for sequential phasing of branch circuit devices.
3. Phase bus bar connections for breakers with trip settings of 100 amperes and less shall be arranged so that a two-pole breaker may be substituted for two single-pole breakers, and a three-pole breaker may be substituted for three single-pole breakers, without any modifications to the bus bars or connecting straps.
4. Protective devices shall be able to be replaced without removing adjacent units or main bus connectors, and without drilling or tapping. Panel phase bus connections to protective devices shall be field removable by means of a screwdriver.
5. Neutral bus shall be full sized. Neutral bus shall be rated for 200 percent of phase bus ampacity for panels fed from K-Factor Rated transformers and as indicated on the Drawings.
6. Equipment ground bus shall be bonded to cabinet, and shall have adequate terminals and lugs for all branch circuit and feeder equipment grounding conductors.
7. Isolated ground bus shall be provided when indicated on the Drawings. It shall be insulated from the cabinet, and shall have adequate terminals and lugs for all branch circuit and feeder isolated grounding conductors.
8. In multi-section panelboards, the bussing in each section shall be full size. In all except the final section, provide sub-feed line-side lugs or feed-through load-side lugs for cable connections to the other sections. Sections with tapped bus or cross-over bus shall not be accepted.
9. Coordinate lug quantities and sizes with the feeders serving the panel, as scheduled on the Drawings.

F. Future Devices: Where designated on panel schedule or one-line diagram as "space" or "future", include all mounting brackets, bus connections, filler plates, and necessary appurtenances necessary for installation of devices.

G. Panelboard Short-Circuit Current Rating:

1. Refer to the Drawings for required A.I.C. ratings for each panelboard.
2. Panelboards shall bear a UL label indicating the integrated equipment rating.

3. Rating Options:

a. Fully rated panelboards and circuit breakers.

2.2 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS:

A. Shall comply with the GENERAL REQUIREMENTS FOR PANELBOARDS listed above.

B. 240 Volt Panelboards: Subject to compliance with requirements, provide product from one of the following list of manufacturers and types:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit: PRL1A
2. General Electric Company: AQ or RQ
3. Siemens Infrastructure and Cities (Siemens IC): P1
4. Square D by Schneider Electric: NQOD

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES:

A. Molded Case Circuit Breaker (MCCB):

1. Molded Case Circuit Breakers shall comply with the requirements specified in Section “Overcurrent Protective Devices”.
2. Circuit breakers shall be factory-installed in the panelboards in the same numbered positions indicated on the Drawings.
3. Thermal-Magnetic or Non-Adjustable Electronic Trip Molded Case Circuit Breakers shall be provided for all panelboard circuit breakers less than 400 amperes, unless noted otherwise.
4. Adjustable Electronic Trip Molded Case Circuit Breakers shall be provided for all panelboard circuit breakers 400 amperes and larger, unless noted otherwise.
5. Where indicated on the drawings breaker shall be provided with a handle blocking clip, allowing the breaker to be blocked in the “ON” position.

B. Fused Switch:

1. Fused switches shall comply with requirements specified in Section “Enclosed Switches and Circuit Breakers”.
2. Fuses shall comply with requirements specified in Section “Overcurrent Protective Devices”.

2.4 SURGE PROTECTIVE DEVICES:

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

B. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. Where indicated on the Drawings, install panelboards on concrete bases, in addition to attaching them to the vertical finished or structural surface behind the panelboard.

B. Install wall-mounted panelboards so that the maximum height of the highest circuit breaker or switch above the finished floor does not exceed 78 inches. The bottom of the cabinet shall not be less than 6 inches above the finished floor.

C. Mount panelboard cabinet plumb and rigid, without distortion of the box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

D. Arrange panelboard sections for easy removal without disturbing other sections. Locate sections so that present and future conduits can be conveniently connected. Coordinate sizes of cabinets with the designated installation space.

E. Where flush-mounted panelboards are specified, install one 3/4-inch empty conduit into an accessible ceiling space for every three single-pole spare breakers or breaker spaces, for future use.

F. Multi-section panelboards shall be coupled together by conduit nipples appropriately sized for all feeder wiring installed between the sections.

G. Where multi-section panelboards are flush-mounted, sections shall be arranged side by side and shall be 1.5 inches apart.

H. Arrange conductors in gutters into neat groups and bundle and wrap with nylon cable ties.

I. At the direction of the Architect or Engineer, where panelboards are installed in public areas, paint the exposed surfaces of the trims, doors, and cabinets to match surrounding wall finishes after the panelboards are installed.

3.3 IDENTIFICATION

A. Identify all field-installed conductors, interconnect wiring, and components.

B. Panelboard Nameplates: Label each panelboard with a nameplate as indicated on the Drawings and as specified elsewhere.

C. Create a type-written schedule of circuits in each panelboard, after approval of the Engineer, and install in the directory holder in each panelboard.

1. Circuit descriptions shall include final room numbers, room descriptions, and items or equipment served.
2. Spare breakers and breaker spaces shall be neatly marked in pencil, to allow for future updates of the schedule.

3. Schedules shall be typed on paper directory cards, or printed on card stock appropriately sized for the directory sleeves provided on the panel door.

3.4 ADJUSTING:

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Load Balancing: If the contractor modifies the circuiting arrangement from what is shown on the plans, the contractor shall be responsible for balancing the loads between phases. The maximum difference of load between phases shall not exceed 20%. Submit calculations to the engineer for review.

C. All adjustable trip circuit breakers shall be, as a default, set by the manufacturer to match as closely as possible the trip curve of a fuse of the same ampacity rating (Class J fuses for 600 amperes and less, Class L for over 600 amperes). Ground fault default settings shall be minimum time delay and low pickup, and shall be field adjusted up as necessary to avoid nuisance tripping.

1. Contractor may use reduced settings during construction if desired.

D. Set final values for all field-adjustable circuit breaker trip ranges as directed by the Engineer.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY:

A. This section includes the furnishing, installation, and connection of wiring devices.

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Weather-resistant receptacles.

1.3 DEFINITIONS:

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. SPD: Surge Protective Device.

1.4 ADMINISTRATIVE REQUIREMENTS:

A. Coordination:

1. Receptacles for Owner Furnished Equipment: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

1.5 ACTION SUBMITTALS:

A. Product Data (Where indicated in Section “Common Work Results for Electrical”, provide the following information): For each type of product.

B. Shop Drawings (Where indicated in Section “Common Work Results for Electrical”, provide the following information): List of legends and description of materials and process used for premarking wall plates.

1.6 CLOSEOUT SUBMITTALS:

A. Operational and Maintenance Data: For wiring devices to include all manufacturers’ packing label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 GENERAL WIRING DEVICE REQUIREMENTS:

A. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

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

C. Comply with NFPA 70.

2.2 RECEPTACLES:

A. Comply with NEMA WD 1, NEMA WD 6, and UL 498.

B. LIST OF ACCEPTABLE RECEPTACLE MANUFACTURERS

Manufacturer	**Volt**	**Hubbell / Kellems**	**Leviton**	**P&S**	**Bryant**	**Cooper Wiring Devices**
2. Industrial Specification Grade:						
Duplex:	20 A. 125 V.	HBL5362	5352	5362A	BRY5362	AH5352
Ground Fault:	20 A. 125 V.	GFR5362TR	G5362	---	---	VGF20
Weather Resistant:	20 A. 125 V.	HBL5362WR	---	---	BRY5362WR	---

C. Weatherproof duplex receptacles shall be weather resistant GFCI grounded duplex receptacles.

1. All receptacles shall be mounted with the same orientation (horizontal or vertical). When a different orientation is required or desired, obtain permission from the Architect/Engineer prior to rough-in.
2. Damp Locations: Provide with a single weatherproof coverplate.
3. Wet Locations: Provide “In-Use” extra-duty metallic weatherproof cover.
    a. Hubbell #WP26E (vertical) or #WP26EH (horizontal)
    b. Red Dot #CKMUV (vertical) or #CKMU (horizontal)
    c. Taymac #MX3200(vertical) or #MX3300 (horizontal
    d. Intermatic #WP1010MXD (vertical) or #WP1010HMXD (horizontal)

D. See plans for Special Outlet Schedule.

E. Receptacle body shall be formed of high-impact nylon faced thermoplastic or urea and receptacle contacts shall be Bronze. Hard use industrial specification grade receptacles shall have a one-piece brass bridge with integral ground contacts.

F. When only one receptacle is connected to a 20-amp circuit by itself, that receptacle must be rated 20 Amp.

G. All receptacles shall be self-grounding with ground lug.

H. Install receptacles to clear all cabinets, equipment, etc.

I. Color of receptacles: Ivory. Verify colors prior to ordering.

J. All 120V, 15 or 20A receptacles located, within kitchens, within 6 feet of a sink, exterior locations, elevator machine rooms, elevator pits, garages, per NFPA 70 and as located on the plans shall be ground fault circuit interrupters (GFCI) for personnel protection (Class A) with 5ma trip. Feed through GFCI receptacles or GFCI breakers may be used to protect other receptacles in the same room and on the same circuit if wired per the manufacturer's recommendations. Prior to final inspection, perform ground fault test on each protected receptacle and submit list of all receptacles tested with results to the Engineer. Label receptacles that are GFCI protected by another feed through GFCI receptacle or by GFCI breaker "GFCI protected".

K. Provide duplex receptacle on separate circuit beside each telephone terminal board location and other communications equipment requiring 120V, power.

L. All 15 and 20 amp, 125 or 250 volt non-locking receptacles in damp or wet locations should be listed as “weather resistant”.

2.3 PENDANT CORD-CONNECTOR DEVICES:

A. Description:

1. Matching plug and receptacle body connector.
2. Body: Nylon with screw-open, cable-gripping jaws and provisions for attaching external cable grip.
3. External Cable Grip: Woven wire mesh type made of high-strength, galvanized steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.4 CORD AND PLUG SETS:

A. Description:

1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket, with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
3. Plug: Nylon body and integral cable clamping jaws. Match cord and receptacle type for connection.

2.5 TOGGLE SWITCHES:

A. Wall Switches: Wall switches in general, used to control lighting shall be quiet operating.

B. Comply with NEMA WD 1, UL 20, and FS W-S-896.

C. Switches shall be single pole, two-pole, three-way, four-way, keyed, and with pilot light as called for on the drawings. Groups of switches shall be under one gangplate. Where switches are in fire rated walls groups of switches shall be maximum of two (2) gangs under one cover plate.

D. Switches shall be as follows unless specified otherwise.

Single Pole	20 A. 120 V. / 277 V.
Two Pole	20 A. 120 V. / 277 V.
Three-Way	20 A. 120 V. / 277 V.
Four-Way	20 A. 120 V. / 277 V.

Pilot Light	20 A. 120 V. / 277 V.
Key Switch	20 A. 120 V. / 277 V.

E. When only one switch is connected to a 20 amp circuit by itself, it must be rated 20A.

F. All switches shall be self grounding w/ground lugs.

G. LIST OF ACCEPTABLE SWITCH MANUFACTURERS

Manufacturer:	P&S	Hubbell / Kellems	Leviton	Bryant	Cooper Wiring Devices
Specification Grade Switches	PS 20AC Series	HBL 1220 Series	1220 Series	4901	AH 1220 Series
Key Switches:	PS 20AC-L Series	HBL 1220-L Series	1221-L Series	4901L	AH 1220 Series
Pilot Light Switches	PS 20AC-CPL Series	HBL 1220-PL Series	1221-PLR Series	4901PLR Series	AH 1220 PL Series

H. Pilot light switches shall be illuminated toggle switch lighted red in "on" position. Key switches shall be master keyed.

I. Color of switches: Ivory. Verify colors prior to ordering.

J. Provide barriers between 277V switches and between 277V and 120V switches installed in a common outlet box.

2.6 WALL PLATES:

A. Wall plates shall be flexible (non-breakable) nylon or polycarbonate.

B. Wall plates in industrial areas, gymnasiums, maintenance areas, warehouses and other high abuse areas shall be stainless steel.

C. Nylon plate color shall be Ivory unless otherwise specified. Nylon plate color for devices on the emergency system shall be Red unless otherwise specified. Verify colors prior to ordering. Nylon plate manufacturer shall be the same as the device manufacturer so that colors match.

D. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.

E. Provide plates for all telephone, cable TV, communication outlets.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Installation shall be in accordance with NFPA 70, and as shown on the drawings.

B. Comply with NECA 1.

C. Switches shall be located on the latch side of all doors. If switches must be located on the hinge side of a door, they shall be located so that they are not behind the door when it is open. All questionable locations shall be brought to the Engineers/Architects attention.

D. Verify all outlet locations on the job prior to rough-in. Locations may be altered up to 6'-0" in any direction without additional cost to the Owner.

E. When conductors larger than #12 AWG are used on 15A or 20A circuits, splice #12 AWG pigtails for device connections.

F. Install ground pin up on vertically mounted receptacles and install ground pin to the right on horizontally mounted receptacles.

G. Dimmers: Do not remove cooling fins from dimmers. Space boxes as required.

3.2 FIELD QUALITY CONTROL:

A. Convenience Receptacles:

1. Verify ground continuity.
2. Verify correct polarity of hot and neutral conductors.

B. Hospital Grade Receptacles:

1. In addition to above tests for convenience receptacles, test straight-blade receptacles in patient care rooms for the retention force of the grounding blade shall not be less than 4 oz. per NFPA 99.
2. Provide test reports per NFPA 99.
3. In addition, comply with testing requirements listed in Section “Overcurrent Protective Devices” under heading “Grounding Resistance Testing Patient Care Spaces”.

END OF SECTION 262726

SECTION 262810 - OVERCURRENT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

A. Section includes:

1. Cartridge fuses rated 600 VAC and less for use in control circuits, enclosed switches, panelboards, switchboards, enclosed controllers, and motor control centers.
2. Plug fuses rated 125 VAC and less for use in enclosed switches and fuseholders.
3. Spare fuse cabinets.
4. Molded Case Circuit Breakers (MCCBs)

1.3 DEFINITIONS:

A. MCCB: Molded Case Circuit Breaker

1.4 SUBMITTALS:

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, and descriptions of individual components.

1. Dimensions and manufacturer’s technical data on features, performance, and electrical characteristics.
2. Current and voltage ratings.
3. Short-circuit current ratings (both interrupting and withstand, as appropriate).
4. Evidence of UL listing for series rating of installed devices.

B. Operation and Maintenance Data:

1. Manufacturer’s written instructions for testing, operating, and adjusting overcurrent protective devices.
2. Summary of final settings for all adjustable overcurrent protective devices.

1.5 QUALITY ASSURANCE:

A. Source Limitations: Obtain overcurrent protective devices, components, and accessories, within same product category, through one source from a single manufacturer.

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

C. Comply with NFPA 70.

D. Comply with NEMA FU 1 for cartridge fuses.

E. Comply with UL 248-11 for plug fuses.

F. Comply with UL 489 for circuit breakers.

1.6 COORDINATION:

A. Coordinate overcurrent protective device ratings with utilization equipment nameplate limitations of maximum fuse and/or breaker size and with system short-circuit current levels.

B. Final fuse sizes for mechanical and other motor loads shall be selected by the fuse manufacturer to provide Type-2 “no damage” protection for equipment served. Contractor shall provide and install the selected fuses.

1.7 EXTRA MATERIALS:

A. Furnish extra materials that match products installed and that are packaged in protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity of installed fuses for each size and type but no fewer than three for each size and type.

PART 2 - PRODUCTS

2.1 FUSES:

A. Manufacturers: Subject to compliance with requirements, provide product from one of the following list of manufacturers:

1. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.
3. Mersen Electrical Power
4. Littelfuse, Inc.

B. Cartridge Fuses:

1. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2. Fuse Classes:

a. Class-CC: UL 248-4, time-delay, rejection type
b. Class-J: UL 248-8, dual-element, time-delay
c. Class-L: UL 248-10, dual-element, time-delay

C. Plug Fuses:

1. Characteristics: UL 248-11, dual-element, time-delay, Edison base.

2.2 SPARE FUSE CABINET:

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

B. Size: Adequate for storage of all spare fuses specified with 20 percent minimum extra spare capacity.

C. Finish: Gray, baked enamel.

D. Identification: Engraved nameplate to read “SPARE FUSES” in 1.5” high letters on exterior of door.

E. Fuse Pullers: Provide for each size and type of fuse, where applicable and available, from the fuse manufacturer.

2.3 MOLDED-CASE CIRCUIT BREAKERS:

A. Shall be provided as factory installed components of panelboards or switchboards, or as separately enclosed units, as specified in other Sections or on the Drawings.

B. Manufacturers: Subject to compliance with requirements, provide product from one of the following list of manufacturers:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit
2. General Electric Company
3. Siemens Infrastructure and Cities (Siemens IC)
4. Square D by Schneider Electric

C. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

D. Standard Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Line connections shall be bolt-on.
3. Lugs: Mechanical type, suitable for the trip rating, number and size of conductors, and conductor material.
4. Multi-pole units shall be enclosed in a single housing or be factory-assembled to operate as a single unit. They shall have a trip element for each pole, a common trip bar for all poles, and a single operator.
5. Operating handle shall indicate ON, TRIPPED, and OFF positions.

6. Shall be 80% rated, unless 100% rating is shown on the Drawings or is otherwise specified.
7. Application Listing: Appropriate for application:

a. Type SWD for switching fluorescent lighting loads.

b. Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
c. Type HACR for feeding heating, air conditioning, and refrigeration equipment.

E. Optional Features and Accessories: Provide where indicated on the Drawings or otherwise specified.

1. Ground-Fault Protection: Relay and trip unit with push-to-test feature.
2. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
3. Handle Padlocking Device: Fixed attachment, for padlocking circuit-breaker handle in off position.

F. Thermal-Magnetic (or Non-Adjustable Electronic Trip) Circuit Breakers:

1. Shall have inverse time element for low-level overloads.
2. Shall have instantaneous magnetic trip element for short circuits.
3. Shall have front-mounted, field-adjustable magnetic trip setting for circuit-breaker frame sizes 250 amperes and larger. Factory setting shall be LO, unless otherwise noted.

G. Adjustable Electronic Trip Circuit Breakers:

1. Shall have RMS sensing.
2. Shall have field replaceable rating plug and field replaceable electronic trip unit.
3. Shall have the following field-adjustable settings:

a. Instantaneous trip.
b. Long-time delay and pickup levels.
c. Short-time delay and pickup levels.

4. Shall have a digital current ammeter.
5. Shall have a trip test button to provide a means to manually trip the breaker.
6. Shall have permanently installed provisions for padlocking the breaker in the open position.
7. Field adjustable settings shall be protected by a transparent cover.

H. Current-Limiting Circuit Breakers: Frame sizes 400 amperes and smaller; shall have let-through ratings less than NEMA FU 1, RK-5.

I. Ground-Fault Circuit Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (5-mA trip) with self-test circuitry.

J. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).

K. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-Volt, single pole configuration.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine overcurrent protective devices before installation. Reject units that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install overcurrent protective devices of sizes and with characteristics appropriate for each piece of equipment.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS:

A. Cartridge Fuses:

1. Service Entrance: Class-J for up to 600 A; Class-L for over 600 A
2. Feeders: Class-J for up to 600 A; Class-L for over 600 A
3. Motor branch circuits: Class-J for up to 600 A; Class-L for over 600 A
4. Single-phase motor and other branch circuits where appropriate fuse holders are specified in other Sections: Class-CC

B. Plug Fuses:

1. Motor and other branch circuits: Edison-base type.

3.3 CIRCUIT BREAKER APPLICATIONS:

A. Refer to applicable Drawings and Specification Sections for information on types of circuit breakers to be installed in particular applications. Applicable Sections may include, but not be limited to, “Switchboards”, “Panelboards”, and “Enclosed Switches and Circuit Breakers”.

3.4 INSTALLATION:

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare fuse cabinet(s) .

3.5 IDENTIFICATION:

A. Install labels complying with requirements found on the Drawings and elsewhere in this Specification. Install labels at every fused switch and each fuse block, socket, or holder which indicate fuse replacement information

END OF SECTION 262810

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

A. Section includes:

1. Fusible Switches
2. Nonfusible Switches
3. Toggle Type Switches
4. Fustats
5. Enclosed Circuit Breakers
6. Enclosures

1.3 DEFINITIONS:

A. NC: Normally closed

B. NO: Normally open

1.4 SUBMITTALS:

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, factory setting, accessories, and finishes.

1. Enclosure types and details for types other that NEMA 250, Type 1.
2. Current and voltage ratings.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work. Include wiring diagrams for power, signal, and control wiring.

C. Operation and Maintenance Data: Include operation and maintenance data for all enclosed switches and circuit breakers in the operation and maintenance manuals. Data shall include, but not be limited to:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.5 QUALITY ASSURANCE:

A. Source Limitations: Obtain enclosed switches and circuit breakers, components, and accessories, within same product category, through one source from a single manufacturer.

B. Product Selection for Restricted Space: Drawings may indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures and adjacent surfaces and other items. Comply with indicated maximum dimensions.

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

D. Comply with NFPA 70.

1.6 COORDINATION:

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and requires clearances for equipment access doors and panels.

1.7 PROJECT CONDITIONS:

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions:

1. Notify Owner in writing, not fewer than seven days in advance of proposed interruption of service.
2. Do not proceed with interruption of electric service without Owner's written permission.
3. Comply with NFPA 70E.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES:

A. Manufacturers: Subject to compliance with requirements, provide product from one of the following list of manufacturers:

1. Allen-Bradley; Rockwell Automation
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit
3. Eaton Electrical Inc.; Pringle Business Unit
4. General Electric Company
5. Siemens Infrastructure and Cities (Siemens IC)
6. Square D by Schneider Electric

B. Type GD General Duty switches are not allowed, unless specifically noted otherwise.

C. Type HD, Heavy Duty, Single Throw, 1200A and smaller: UL 98 and NEMA KS 1.

1. Shall be horsepower rated for the load served.
2. Shall have clips or bolt pads to accommodate the specified fuses, with rejection features to reject fuses other than those specified.

a. Refer to Section "Overcurrent Protective Devices" for specified fuse types.

3. Shall have an external operating handle indicating ON and OFF positions, with provisions to padlock the switch in the OFF position.
4. Shall have a mechanical interlock to prevent the opening of the cover unless the handle is in the OFF position. This interlock shall be defeatable with a special tool to permit inspection.
5. Shall have an equipment ground kit. Equipment ground shall be internally mounted and labeled for copper and aluminum ground conductors.
6. Accessories: Provide where indicated on the Drawings or required to complete the intended design.

    a. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
    b. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
    c. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact arranged to activate before switch blades open.
    d. Hookstick Handle: Allows use of a hookstick to operate the handle.
    e. Service Entrance Rating: Labeled for use as service entrance equipment.

D. Other specialty switch types, such as Six Pole or Double Throw, shall be provided where indicated on the Drawings or as necessary for the equipment served, and shall meet the requirements for Type HD single throw switches above.

2.2 NONFUSIBLE SWITCHES:

A. Shall meet all requirements for FUSIBLE SWITCHES above, except that they shall not accept fuses.

1.

2.3 TOGGLE TYPE SWITCHES:

A. Shall be installed where indicated on the Drawings or elsewhere in the Specifications.

B. Shall be 20A, 30A, 40A, or 60A, one, two, or three poles, voltage and horsepower rated for the load served.

C. Shall be provided with matching steel coverplate, with provisions for padlocking the switch in the OFF position.

D. Shall be provided with an appropriately sized mounting box where other than a standard outlet box is necessary for switch installation.

2.4 FUSTATS:

A. 120V motor loads up to 0.5 horsepower: Shall be horsepower rated and include an Edison-base fuse holder and integral toggle switch. Where located in damp or wet locations, provide weatherproof unit equal to Bussman #SSN.

B. 120V motor loads, 0.75 horsepower: Shall consist of a horsepower rated Edison-base fuse holder, with a separate horsepower rated toggle switch mounted adjacent to fuse holder.

C. 120V motor loads, 1 horsepower, or 277V motor loads: Shall consist of a horsepower and voltage rated manual motor starter switch and a horsepower and voltage rated fuse holder designed to hold a time-delay Class CC rejection-type fuse.

1. Manual motor starter switch: NEMA ICS 2, general purpose, Class A, with quick-make, quick-break toggle action, marked to indicate ON, OFF, and TRIPPED. Shall include an ambient-compensated type overload relay with inverse-time characteristics and NEMA ICS 2, Class 10 tripping characteristics. Shall have heaters and sensors in each phase, matched to nameplate full-load current of specific motor it protects and appropriately adjusted for duty cycle.

D. 120V motor loads up to 1 horsepower: Shall be Siemens "LF111N" 30A, 120V disconnect switch with Edison-base fuse holder, NEMA1 rated.

2.5 ENCLOSED CIRCUIT BREAKERS:

A. Circuit breakers shall comply with Section "Overcurrent Protective Devices".

1. Shall be Thermal-Magnetic or Non-adjustable Electronic Trip Molded-Case for breakers less than 400 amperes, unless noted otherwise.
2. Shall be adjustable Electronic Trip Molded-Case for breakers 400 amperes and larger, unless noted otherwise.

2.6 ENCLOSURES:

A. Comply with NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50.

B. Enclosure Types: Shall be compatible with environmental conditions at installed locations, unless more stringent requirements are specified on the Drawings or elsewhere in the Specifications.

1. Indoor Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Kitchens, Wash-Down Areas, and Wet or Damp Non-Corrosive Locations: NEMA 250, Type 4X Stainless Steel.
4. Other Wet or Damp Corrosive Locations: NEMA 250, Type 4X Non-Metallic.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Non-corrosive Liquids: NEMA 250, Type 12.
6. Hazardous Areas: NEMA 250, Type 7, 8, or 9, as indicated by hazard classification and environmental conditions at the installed location.

C. Finished Spaces: In finished spaces, enclosures shall be flush mounted unless otherwise noted.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the work.

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

3.2 INSTALLATION:

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated. Maximum mounting height and required working clearances shall comply with NFPA 70.

B. Install fuses in fusible devices.

1. Where fuses serve utilization equipment or motors, coordinate final fuse sizes with equipment nameplates and comply with listed minimum and maximum sizes.
2. Plug fuses installed in fustats shall be sized for 125 percent of the nameplate full load amps or running load amps.

C. Comply with NECA 1.

3.3 IDENTIFICATION:

A. Identify field-installed conductors, interconnecting wiring, and components.

B. Label each enclosure with engraved nameplate.

3.4 ADJUSTING:

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit breaker trip ranges.

END OF SECTION 262816

SECTION 262900 – MOTORS

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section applies to all motors that are not directly specified or when referenced by other sections.

PART 2 - PRODUCTS

2.1 MOTORS:

A. For alternating current, fractional and integral horsepower motors. Fed. Spec. CC-M-1807, NEMA Publications MG1 and MG2 shall apply.

B. Voltage ratings shall be as follows:

1. Single phase:

a. Motors connected to 120 volt systems: 115 volts.
b. Motors connected to 208 volt systems: 200 volts.
c. Motors connected to 240 volt or 480 volt systems: 230/460 volts, dual connection.

2. Three phase:

a. Motors connected to 208 volt systems: 200 volts.
b. Motors, less than 100 HP, connected to 240 volt or 480 volt systems: 230/460 volts, dual connection.
c. Motors, 100 HP or larger, connected to 480 volt systems: 460 volts.

C. Number of phases shall be as follows:

1. Motors, 1/2 HP and less: Single phase, 120 volt.
2. Motors, larger than 1/2 HP: 3 phase, 480 volt (208 or 240 volt when 480 volt distribution not used).
3. Exceptions:

a. Hermetically sealed motors.
b. Motors for equipment assemblies, less than one HP, may be single phase provided the manufacturer of the proposed assemblies cannot supply the assemblies with three phase motors.

D. Horsepower ratings shall be adequate for operating the connected loads continuously in the prevailing ambient temperatures in areas where the motors are installed, without exceeding the NEMA standard temperature for the motor insulations.

E. Motor designs, as indicated by the NEMA code letters, shall be coordinated with the connected loads to assure adequate starting and running torques.

F. Motor Enclosures:

1. Shall be the NEMA types shown on the drawings for the motors.
2. Where the types of motor enclosures are not shown on the drawings, they shall be the NEMA types which are most suitable for the environmental conditions where the motors are being installed.
3. Thoroughly clean and paint the enclosures at the factory with manufacturer's prime coat and standard finish.

G. Additional requirements for specific motors, as indicated in other sections, shall also apply.

H. Energy-Efficient Motors: When higher than standard efficiency motors are specified or indicated, they shall be rated using the IEEE Standard No. 112, Method B, test procedures, as detailed in NEMA MG1, 12.53.a. The nameplate shall identify the NEMA Nominal Efficiency indicated on the drawings.

I. Motor Connected and Controlled by Variable Frequency Drives.

1. Motors shall be NEMA Design “B”, and U.L. Listed inverter duty rated motors for “PWM” drives with motor winding heater overloads.
2. Motors shall comply with NEMA MG1, Part 31 and can withstand the stress of 1600V peak with a 0.1 m second rise time.
3. Connect cooling fans as required via the variable frequency drive. Provide controls, contactors, and wiring as required.
4. Motors shall be provided with a shaft grounding ring, except for motors located in a hazardous environment.

    a. A maintenance free, circumferential, conductive micro fiber shaft grounding ring (SGR) to discharge shaft currents to ground. The conductive microfibers shall redirect shaft currents and provide a reliable, very low impedance path from shaft to motor frame by-passing motor bearings entirely.
    b. Vertical turbine pump motor, the upper shaft shall be provided with a coating to isolate the shaft from the bearings. The shaft grounding ring shall be installed within the motor casing. This information shall be provided with the shop drawings submittal for verification of method of installation and to ensure they are to be supplied.
    c. Each motor shall be provided with SGR by the motor manufacturer or equipment manufacturer and shall not be field installed.
    d. All motors sizes up to 100 h.p. (75kW) shall be guaranteed not to fail due to electrical bearing fluting damage, during the motor warranty period.
    e. Each motor equipped with this device shall be provided with an externally mounted tag stating that a SGR is installed.
    f. Method of installation shall be as recommended by manufacturer however, epoxy mounted SGR’s shall not be used.
    g. Device shall have the following features:

        1) Protect motor and attached equipment.
        2) Provide long term effectiveness.
        3) Easy to install.

4) Contamination proof.
5) Effective at any R.P.M.
6) Maintenance free operation.

h. After each motor is installed, the contractor shall have a 3rd party test the installation to ensure no VFD induced shaft voltages are present and provide written documentation of the successful test results. If the testing is not successful, the installation shall be corrected prior to putting the motor into service. The testing must be performed with a Fluke 199C Scope Meter and the appropriate accessories for testing while the motor is in operation.

J. E Frame Energy Efficient Motors: All equipment provided with E frame motors shall have a performance controller as manufactured by "Performance Control" provided and installed in addition to the across the line starter in all cases except when motor is controlled by a variable frequency drive.

2.2 POWER FACTOR:

A. Each motor as indicated in Section POWER FACTOR CORRECTION shall be supplied at 95% power factor by the equipment supplier or power factor correction, meeting the requirements of Section POWER FACTOR CORRECTION - shall be provided to correct the power factor to 95%. (Exception: this does not apply to motors controlled by frequency drives.)

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Installation shall be in accordance with the NEC, as shown on the drawings, and as required by other sections of these specifications.

END OF SECTION 262900

SECTION 264313 – SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

A. Section includes field-mounted and factory-mounted surge protective devices for low-voltage (120 to 600 V) power distribution and control equipment.

B. Related Sections:

1. Section “Wiring Devices” for devices with integral SPD.

1.3 DEFINITIONS:

A. ATS: Acceptance Testing Specifications.

B. SPD: Surge Protective Device.

C. TVSS: Transient voltage surge suppressor(s), both singular and plural; also, transient voltage surge suppression.

D. VPR: Voltage Protection Rating.

1.4 SUBMITTALS:

A. Product Data: For each type of product indicated. Include rated capacities; installed dimensions and operating weights; electrical characteristics, furnished specialties, and accessories.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Include wiring diagrams for power, signal, and control wiring.

C. Operation and Maintenance Data: Include operation and maintenance data for all surge protective devices in the operation and maintenance manuals.

1.5 QUALITY ASSURANCE:

A. Source Limitations: Obtain surge protective devices, components, and accessories, within same product category, through one source from a single manufacturer.

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

C. The unit shall be UL 1449 Listed (internally mounted units shall be UL recognized) as a Surge Protective Device and UL 1283 Listed as an Electromagnetic Interference Filter. Internally mounted units shall maintain the UL Listing of the equipment they are mounted in.

D. Comply with NFPA 70.

E. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.

1.6 COORDINATION:

A. Coordinate layout and installation of surge protective devices and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate surge protective devices with Division 26 Section "Electrical Power Monitoring and Control."

1.7 PROJECT CONDITIONS:

A. Service Conditions: Rate surge protective devices for continuous operation under the following conditions unless otherwise indicated:

1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage for 480/277Y and not less than 125 percent of nominal system operating voltage for 208/120Y.
2. Operating Temperature: 30 to 150 deg F (0 to 65 deg C).
3. Humidity: 0 to 95 percent, non-condensing.
4. Altitude: Less than 12,000 feet above sea level.

1.8 EXTRA MATERIALS:

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Replaceable Protection Modules: 1 of each size and type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide product from one of the following list of manufacturers:

1. Current Technologies
2. Cutler Hammer
3. General Electric Company
4. Liebert Corp.
5. Square D by Schneider Electric
6. Transtector
7. Leviton (For Retrofit and Add-On Devices Only)

8. Innovative Technology Inc. (For Retrofit and Add-On Devices Only)

2.2 GENERAL REQUIREMENTS:

A. UL 1449 Listed.

B. Internally mounted within the electrical equipment unless noted otherwise.

C. Modular design with field-replaceable modules, minimum of 1 module per phase.

D. MOV's shall be individually fused per mode, with a 200-kA minimum interrupting capacity and shall be classified by the NEC as an overcurrent protection device allowing tapped device conductors from a disconnect without an overcurrent device.

E. UL 1449 minimum nominal discharge current rating of 20kA per mode.

F. Bolted compression lugs for internal wiring.

G. Integral disconnecting means if direct bussed connected.

H. Redundant suppression circuits.

I. LED indicator lights for power and protection status.

J. On board diagnostic monitoring with audible alarm, and silencing switch, to indicate when protection has failed and when failure of even one MOV has occurred.

K. Surge-event operations counter.

L. EMI/RFI filtering of -50dB @ 100kHz.

M. One set of dry contacts rated at 5 A and 250 V ac, for remote monitoring of protection status. Coordinate with building power monitoring and control system.

N. Protection Modes and UL 1449 Maximum Voltage Protection Ratings shall be as follows:

Voltage	**Line-to-Neutral**	**Line-to-Ground**	**Neutral-to-Ground**	**Line-to-Line**
120/208Y, 3 Phase, 4 Wire	700V	700V	600V	1000V
277/480Y, 3 Phase, 4 Wire	1200V	1200V	1200V	1800V

2.3 SERVICE ENTRANCE SURGE PROTECTIVE DEVICES:

A. Devices shall be factory installed and built-in with direct bussed connections.

B. Include integral 60A disconnect switch.

C. Peak Single-Impulse Surge Current Rating: 150 kA per phase.

2.4 PANELBOARD SURGE PROTECTIVE DEVICES:

A. Devices shall be factory installed with direct bussed connections where possible.

B. If the manufacturer requires a disconnect, an integral disconnect switch or molded case breaker (60 amp min.) shall be provided. Submit testing to demonstrate that overcurrent devices do not open upon peak single impulse surge current test.

C. Arrangement with bussed or wire connections to phase buses, neutral bus, and ground bus. Ground and neutral buses should be relocated to minimize connection lengths. If cables are used, they shall be the lowest impedance possible. Wires shall be kept as short and straight as possible. Do not exceed manufacturer’s recommended lead lengths.

D. Modifications to the panelboard shall be UL labeled as a panelboard and as a SPD. For two and three section panelboards, the SPD module shall be installed in the first section where the line connections occur.

E. Peak Single-Impulse Surge Current Rating: 150 kA per phase.

2.5 CONTROL PANELS AND MISCELLANEOUS 120V. EQUIPMENT:

A. Peak Single-Impulse Surge Current Rating: 80 kA per phase.

2.6 ENCLOSURES:

A. Internally mounted unless otherwise specified. Add-on devices shall comply with NEMA 250, matching the enclosure or panel being protected.

PART 3 - EXECUTION

3.1 INSTALLATION OF SURGE PROTECTIVE DEVICES:

A. Install devices at service entrance on load side of main disconnect, with ground lead bonded to service entrance ground.

B. SPD equipment and devices. Upon completion the Representative shall submit a letter certifying the complete installation is per this specification and per all manufacturer's requirements and recommendations.

3.2 CONNECTIONS:

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL:

A. Testing: Perform the following field quality-control testing:

1. After installing surge protective devices, but before electrical circuitry has been energized, test for compliance with manufacturer's published field testing requirements.

2. Complete startup checks according to manufacturer's written instructions.
3. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.19. Certify compliance with test parameters.

B. Manufacturer shall repair or replace malfunctioning units. Retest after repairs or replacements are made.

C. Verify that electrical wiring installation complies with this specification and manufacturer's installation requirements.

D. Do not perform insulation resistance (megger) tests of the distribution wiring equipment with the surge protective devices installed. Disconnect all wires, including neutral, before conducting insulation resistance tests, and reconnect immediately after the testing is over.

3.4 START-UP SERVICE:

A. The manufacturer shall train the Owner's maintenance personnel to adjust, operate, and maintain surge protective devices (minimum one (1) hr of field training).

1. Train Owner's maintenance personnel on procedures and schedules for maintaining suppressors.
2. Review data in maintenance manuals.
3. Contractor shall schedule training with Owner, through Architect, with at least seven days advance notice.

END OF SECTION 264313

Division 26 - Electrical

DESIGN CRITERIA

1. BUILDING CODE: INTERNATIONAL BUILDING CODE (IBC), 2018 EDITION, INCLUDING LOCAL SUPPLEMENTS. THE STRUCTURE IS CLASSIFIED AS A RISK CATEGORY II FACILITY.

2. DEAD AND LIVE LOADS:

LOCATION	UNIFORM LIVE LOAD	CONCENTRATED LIVE LOAD	TOTAL DEAD LOAD*
ROOF	20 PSF	----------	20 PSF

ROOF LIVE LOADS ON SUPPORTING ELEMENTS SHALL NOT BE REDUCED
*TOTAL DEAD LOAD INCLUDES WEIGHT OF STRUCTURAL ELEMENTS.

3. WIND:

BASIC WIND SPEED, V:	108 MPH (3 SECOND GUST)
ALLOWABLE STRESS DESIGN WIND SPEED, V_{asd}:	84 MPH (3 SECOND GUST)
WIND EXPOSURE:	C

4. SEISMIC:

SITE CLASS:	D - DEFAULT
SEISMIC DESIGN CATEGORY:	B
SEISMIC IMPORTANCE FACTOR:	1.0
S_S:	0.123
S_1:	0.073
S_{DS}:	0.132
S_{D1}:	0.116
SEISMIC FORCE RESISTING SYSTEM:	ORDINARY REINFORCED MASONRY SHEAR WALLS
RESPONSE MODIFICATION COEF., R	2
METHOD OF ANALYSIS:	EQUIVALENT LATERAL FORCE
C_S:	0.066
BASE SHEAR:	21 KIPS

PLAN MARKS

GB# — GRADE BEAM MARK, REF. GRADE BEAM SCHEDULE

WF# — WALL FOOTING MARK, REF. WALL FOOTING SCHEDULE

F# — SPREAD FOOTING MARK, REF. SPREAD FOOTING SCHEDULE

HSS6X6X1/4 — COLUMN SIZE

BP-1, P-1 — PILASTER TYPE, REF. PILASTER DETAILS; BASE PLATE TYPE, REF. BASE PLATE DETAILS

BRACED FRAME ABOVE, REF. FRAMING ELEVATIONS & BRACED FRAME SCHEDULE

BRACED FRAME BELOW, REF. FRAMING ELEVATIONS & BRACE FRAME SCHEDULE

MOMENT CONN., REF. FRAMING ELEVATIONS & MOMENT CONN. SCHEDULE

W16X26 (20) <3/4"> — CAMBER; # OF HEADED SHEAR CONNECTORS (3/4" DIA. U.N.O.); BEAM SIZE

J# — JOIST MARK, REF. JOIST SCHEDULE

L# — LINTEL MARK AND SYMBOL, REF. LINTEL SCHEDULE

1 / 8' - 0" — SHEAR WALL MARK, REF. SHEAR WALL SCHEDULE (POINTS TO SHEATHED SIDE); SHEAR WALL LENGTH

H# — HEADER MARK, REF. HEADER SCHEDULE

STEP IN SURFACE ELEVATION

SLOPE IN SURFACE ELEVATION

MATERIAL LEGEND

	LOAD BEARING CMU (NON-LOAD BEARING CMU HALFTONED)
	EARTH
	EXISTING
	GROUT/SAND/GRANULAR FILL
	PRECAST CONCRETE
	CONCRETE
	NOT IN SCOPE (E.G. VENEER, PAVING, ETC.)
	STEEL (IN SECTION)
	GRATING

ABBREVIATIONS

#	NUMBER OR POUNDS	I.J.	ISOLATION JOINT
(E)	EXISTING	IN	INCH(ES)
@	AT	INT.	INTERIOR
ADD'L	ADDITIONAL	K	KIPS
ALT.	ALTERNATE	L(L)	LIVE (LOAD)
APPROX.	APPROXIMATE	LBS	POUNDS
ARCH.	ARCHITECTURAL	LLH	LONG LEG HORIZONTAL
B.O.	BOTTOM OF	LLV	LONG LEG VERTICAL
BLDG.	BUILDING	LOC.	LOCATION
BOT.	BOTTOM	MANUF.	MANUFACTURER
BRG.	BEARING	MAX.	MAXIMUM
C.J.	CONTROL JOINT	MECH.	MECHANICAL
CFS	COLD-FORMED STEEL	MIN.	MINIMUM
CL	CENTERLINE	MISC.	MISCELLANEOUS
CLR.	CLEAR	MTL.	METAL
CMU	CONCRETE MASONRY UNIT	N.A.	NOT APPLICABLE
COL.	COLUMN	N.S.	NEAR SIDE
COMP.	COMPOSITE	N.T.S.	NOT TO SCALE
CONC.	CONCRETE	O.C.	ON CENTER
CONN.	CONNECTION	O.D.	OUTSIDE DIAMETER
CONST.	CONSTRUCTION	O.H.	OVERHEAD
CONT.	CONTINUOUS	OPP.	OPPOSITE
COORD.	COORDINATE	P.A.F.	POWDER ACTUATED FASTENER
CTR.	CENTER	PCF	POUNDS PER CUBIC FOOT
D(L)	DEAD (LOAD)	PEMB	PRE-ENGINEERED METAL BUILDING
DBA	DEFORMED BAR ANCHOR	PERP.	PERPENDICULAR
DEMO.	DEMOLITION / DEMOLISH	PL.	PLATE
DIA.	DIAMETER	PLF	POUNDS PER LINEAR FOOT
DIM.	DIMENSION	PSF	POUNDS PER SQUARE FOOT
DWG.	DRAWING	PSI	POUNDS PER SQUARE INCH
DWL.	DOWEL	QTY.	QUANTITY
E(L)	EARTHQUAKE/SEISMIC (LOAD)	RAD.	RADIUS
E.G.	FOR EXAMPLE	REF.	REFERENCE
E.J.	EXPANSION JOINT	REINF.	REINFORCING
E.O.R.	ENGINEER OF RECORD	REQ'D	REQUIRED
EA.	EACH	REV.	REVISION/REVISED
EL.	ELEVATION	S.J.	SAWN JOINT
ELEC.	ELECTRICAL	S.S.	STAINLESS STEEL
ELEV.	ELEVATOR	SCHED.	SCHEDULE
EQ.	EQUAL	SF	SQUARE FEET/FOOT
EQUIP.	EQUIPMENT	SIM.	SIMILAR
ETC.	ET CETERA	SPA.	SPACE(S)
EXIST.	EXISTING	SQ.	SQUARE
EXP.	EXPANSION	SSE	SPECIALTY STRUCTURAL ENGINEER
EXT.	EXTERIOR	STD.	STANDARD
F.S.	FAR SIDE	STIFF.	STIFFENER
F.V.	FIELD VERIFY	STRUCT.	STRUCTURAL
FDN.	FOUNDATION	T.O.	TOP OF
FT	FEET / FOOT	T/C	TENSION/COMPRESSION
FTG.	FOOTING	TEMP.	TEMPORARY
G.C.	GENERAL CONTRACTOR	TYP.	TYPICAL
GA.	GAUGE	U.N.O.	UNLESS NOTED OTHERWISE
GALV.	GALVANIZED	VERT.	VERTICAL
GEN.	GENERAL	W(L)	WIND (LOAD
H.D.G.	HOT-DIP GALVANIZED	W/	WITH
HD. ST.	HEADED STUD	W/C	WATER / CEMENT RATIO
HORIZ.	HORIZONTAL	WP	WORKING POINT
I.D.	INSIDE DIAMETER	WT.	WEIGHT
I.E.	INVERT ELEVATION	WWF	WELDED WIRE FABRIC

STRUCTURAL SHEET INDEX

REQUIRED SPECIAL INSPECTIONS AND TESTS OF SOILS

TYPE	FREQUENCY
1. Verify materials below shallow foundations are adequate to achieve the design bearing capacity.	Periodic
2. Verify excavations are extended to proper depth and have reached proper material.	Periodic
3. Perform classification and testing of compacted fill materials.	Periodic
4. Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill.	Continuous
5. Prior to placement of compacted fill, inspect subgrade and verify that site has been prepared properly.	Periodic

Special Inspection Additional Requirements:

- Additional items that need special inspection, in the opinion of the building official, shall be inspected.
- Coordination of Special Inspections with construction of the inspected items shall be the responsibility of the contractor.
- If Special Inspection is waived by the Authority having Jurisdiction, the general contractor shall provide the designer of record with a copy of the written exemption for each item that has been waived.
- The building official may perform inspections in addition to and/or concurrently with the Special Inspection's outlined in the tables.
- The general contractor is responsible for implementing a quality control program. The quality control program is in addition to the Special Inspection requirements and must meet or exceed those responsibilities required as part of the contract drawings and specifications.

REQUIRED QUALITY ASSURANCE PROTOCOL FOR MASONRY CONSTRUCTION

MINIMUM VERIFICATION REQUIREMENTS

Minimum Verification	REQUIRED FOR QUALITY ASSURANCE[a]			REFERENCE FOR CRITERIA	
	Level 1	Level 2	Level 3		TMS 602
Prior to construction, verification of compliance of submittals.	R	R	R		Art. 1.5
Prior to construction verification of f'_m and f'_{AAC} except where specifically exempted by the Code.	NR	R	R		Art. 1.4 B
During construction, verification of Slump flow and Visual Stability Index (VSI) when self-consolidating grout is delivered to the project site.	NR	R	R		Art. 1.5 & 1.6.3
During construction, verification of f'_m and f'_{AAC} for every 5,000 sq. ft (465 sq. m).	NR	NR	R		Art. 1.4 B
During construction verification of proportions of materials as delivered to the project site for premixed or preblended mortar, prestressing grout, and grout other than self-consolidation grout.	NR	NR	R		Art. 1.4 B

MINIMUM SPECIAL INSPECTION

Inspection Task	FREQUENCY[b]			REFERENCE FOR CRITERIA	
	Level 1	Level 2	Level 3	TMS 402	TMS 602
1. As masonry construction begins, verify that the following are in compliance:					
a. Proportions of site-prepared mortar	NR	P	P		Art. 2.1, 2.6 A & 2.6 C
b. Grade and size of prestressing tendons and anchorages	NR	P	P		Art. 2.4B & 2.4 H
c. Grade, type and size of reinforcement, connectors, anchor bolts, and prestressing tendons and anchorages	NR	P	P		Art. 3.4 & 3.6 A
d. Prestressing technique	NR	P	P		Art. 3.6 B
e. Properties of thin-bed mortar for AAC masonry	NR	C[c]/P[d]	C		Art. 2.1 C.1
f. Sample panel construction	NR	P	C		Art. 1.6 D
2. Prior to grouting, verify that the following are in compliance:					
a. Grout space	NR	P	C		Art. 3.2 D & 3.2 F
b. Placement of prestressing tendons and anchorages	NR	P	P	Sec. 10.8 & 10.9	Art. 2.4 & 3.6
c. Placement of reinforcement, connectors, and anchor bolts	NR	P	C	Sec. 6.1, 6.3.1, 6.3.6 & 6.3.7	Art. 3.2 E & 3.4
d. Proportions of site-prepared grout and prestressing grout for bonded tendons	NR	P	P		Art. 2.6 B & 2.4 G.1.b
3. Verify compliance of the following during construction:					
a. Materials and procedures with the approved submittals	NR	P	P		Art. 1.5
b. Placement of masonry units and mortar joint construction	NR	P	P		Art. 3.3 B
c. Size and location of structural members	NR	P	P		Art. 3.3 F
d. Type, size and location of anchors, including other details of anchorage of masonry to structural members, frames, or other construction	NR	P	C	Sec. 1.2.1 (e), 6.2.1 & 6.3.1	
e. Welding reinforcement	NR	C	C	Sec. 6.1.6.1.2	
f. Preparation, construction, and protection of masonry during cold weather (temperature below 40°F(4.4°C)) or hot weather (temperature above 90°F (32.2°C))	NR	P	P		Art. 1.8 C & 1.8 D
g. Application and measurement of prestressing force	NR	C	C		Art. 3.6 B
h. Placement of grout and prestressing grout for bonded tendons is in compliance	NR	C	C		Art. 3.5 & 3.6 C
i. Placement of AAC masonry units and construction of thin-bed mortar joints	NR	C[c]/P[d]	C		Art. 3.3 B.9, & 3.3 F.1.b
4. Observe preparation of grout specimens, mortar specimens, and/or prisms	NR	P	C		Art. 1.4 B.2.a.3, 1.4 B.2.b.3, 1.4 B.2.c.3, 1.4 B.3 & 1.4 B.4

(a) R = Required, NR = Not Required
(b) Frequency refers to the frequency of inspection, which may be continuous during the task listed or periodically during the listed task, as defined in the table. NR = Not Required, P = Periodic, C = Continuous
(c) Required for the first 5000 square feet (465 square meters) of AAC masonry
(d) Required after the first 5000 square feet (465 square meters) of AAC masonry

REQUIRED SPECIAL INSPECTIONS AND TESTS OF CONCRETE CONSTRUCTION

TYPE	FREQUENCY	REFERENCED STANDARD	IBC REFERENCE
1. Inspect reinforcement, including prestressing tendons, and verify placement.	Periodic	ACI 318 Ch. 20, 25.2, 25.3, 26.6.1-26.6.3	1908.4
2. Reinforcing bar welding: a. Verify weldability of reinforcing bars other than ASTM A706 b. Inspect single-pass fillet welds, maximum 5/16"; and c. Inspect all other welds.	Periodic Periodic Continuous	AWS D1.4 ACI 318: 26.6.4	
3. Inspect anchors cast in concrete.	Periodic	ACI 318: 17.8.2	
4. Inspection of anchors post installed in hardened concrete members.[b] a. Adhesive anchors installed in horizontally or upwardly inclined orientations to resist sustained tension loads. b. Mechanical anchors and adhesive anchors not defined in 4.a.	Continuous Periodic	ACI 318: 17.8.2.4 ACI 318: 17.8.2	
5. Verify use of required design mix.	Periodic	ACI318: Ch.19, 26.4.3, 26.4.4	1904.1, 1904.2 1908.2, 1908.3
6. Prior to concrete placement, fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete.	Continuous	ASTM C172, ASTM C31, ACI 318: 26.5, 26.12	1908.10
7. Inspection of concrete and shotcrete placement for proper application techniques.	Continuous	ACI 318: 26.5	1908.6, 1908.7, 1908.8
8. Verify maintenance of specified curing temperature and techniques.	Periodic	ACI 318: 26.5.3-26.5.5	1908.9
9. Inspection of prestressed concrete for: a. Application of prestressing forces; and b. Grouting of bonded prestressing tendons.	Continuous Continuous	ACI 318: 26.10 ACI 318: 26.10	
10. Inspect erection of precast concrete members.	Periodic	ACI 318: Ch. 26.9	
11. Verify in-situ concrete strength, prior to stressing of tendons in post-tensioned concrete and prior to removal of shores and forms from beams and structural slabs.	Periodic	ACI 318: 26.11.2	
12. Inspect formwork for shape, location and dimensions of the concrete member being formed.	Periodic	ACI 318: 26.11.1.2(b)	

(a) Where applicable, see Section 1705.12, Special inspections for seismic resistance.
(b) Specific requirements for special inspection shall be included in the research report for the anchor issued by an approved source in accordance with 17.8.2 in ACI 318, or other qualification procedures. Where specific requirements are not provided, special inspection requirements shall be specified by the registered design professional and shall be approved by the building official prior to the commencement of the work.

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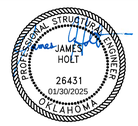
REVISIONS

No.	Date	Description



RSU Geothermal Chillers

1701 W. Will Rogers Blvd
Claremore, OK 74017

STRUCTURAL COVER SHEET

100% CD

PEC PROJECT NUMBER: 231211-000
DATE 01/22/2025
DRAWN BY KAC
CHECKED BY JGH

S000

RENOVATION (EXISTING CONDITIONS)

1. INFORMATION SHOWN FOR THE EXISTING STRUCTURE ON THESE DRAWINGS WAS TAKEN FROM A SITE INVESTIGATION. SOME LIMITED ARCHIVED DRAWINGS WERE LOCATED AND USED FOR INFORMATION AS APPROPRIATE.

2. WORK SHOWN ON THESE PLANS ASSUMES THAT THE ORIGINAL CONSTRUCTION WAS PERFORMED IN ACCORDANCE WITH THE ABOVE INDICATED ORIGINAL DRAWINGS INCLUDING (BUT NOT LIMITED TO) DIMENSIONS, ELEVATIONS, MEMBER SIZES, MATERIALS, DETAILS, ETC. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY THE CONDITIONS RELATING TO THE EXISTING STRUCTURE AND TO NOTIFY THE STRUCTURAL ENGINEER IMMEDIATELY OF ANY DISCREPANCIES OR CONFLICTS.

3. THE DRAWINGS LOCATED FOR THE ORIGINAL BUILDING(S) WERE WIDELY INCOMPLETE. DUE TO THE INCOMPLETE NATURE OF EXISTING DRAWINGS AND VARIOUS INACCESSIBILITIES IN THE BUILDING, ASSUMPTIONS WERE MADE TO PREPARE THESE DOCUMENTS. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY EXISTING CONDITIONS AND CONSTRUCTION RELATING TO THE STRUCTURE AND TO NOTIFY THE STRUCTURAL ENGINEER IMMEDIATELY OF ANY DISCREPANCIES OR CONFLICTS.

4. WHERE NEW WORK IS TO BE FITTED TO OLD WORK, THE CONTRACTOR SHALL CHECK ALL DIMENSIONS AND CONDITIONS IN THE FIELD, AND REPORT ANY ERRORS OR DISCREPANCIES TO THE STRUCTURAL ENGINEER PRIOR TO THE FABRICATION AND ERECTION OF ANY NEW MEMBERS.

5. EXISTING MATERIALS TO BE REMOVED AND REINSTALLED AS PART OF THE PROJECT, THAT BECOME DAMAGED, SHALL BE REPLACED WITH NEW MATERIAL OF EQUAL QUALITY AND APPEARANCE, AT THE CONTRACTOR'S EXPENSE.
6. ALL WORK SHALL BE PERFORMED WITHOUT DAMAGE TO ADJACENT RETAINED WORK. ADJACENT EXISTING CONSTRUCTION SHALL BE PROTECTED FROM DUST, DIRT, AND DEBRIS ACCUMULATION AT ALL TIMES.

CONCRETE

1. ALL CONCRETE HAS BEEN DESIGNED IN ACCORDANCE WITH ACI 318 AND THE BUILDING CODE, AND IN CONFORMANCE WITH THE CURRENT "ACI MANUAL OF CONCRETE PRACTICE."

2. THE CONCRETE REQUIREMENTS ARE:

   A. CEMENT SHALL BE TYPE I OR II CONFORMING TO ASTM C150 OR TYPE 1L CONFORMING TO ASTM C595. FLY ASH CONFORMING TO ASTM C618 TYPE C OR F MAY BE USED TO REPLACE A MAXIMUM OF 20% OF THE CEMENT BY WEIGHT.

   B. FINE AGGREGATE FOR NORMAL WEIGHT CONCRETE SHALL MEET ASTM C33.

   C. COARSE AGGREGATES FOR NORMAL WEIGHT CONCRETE SHALL CONFORM TO ASTM C33, GRADE 67 OR LARGER. COARSE AGGREGATES SHALL BE NO LESS THAN 50% OF THE TOTAL AGGREGATE BY WEIGHT, UNLESS APPROVED BY THE ENGINEER PRIOR TO MIX DESIGN SUBMITTAL.

   D. MIX REQUIREMENTS ARE:

LOCATION	MINIMUM F'_C (PSI)	MINIMUM CEM. (PCY)	MAX. W/C RATIO	AIR CONTENT	SLUMP INCHES§
FOUNDATIONS	4,000	470	0.45	5%±1%	2-5
SLAB ON GRADE	4,000	564	0.42	3%MAX.	2-5

   § PRIOR TO THE ADDITION OF WATER REDUCING ADMIXTURES. IF APPROVED BY ENGINEER, SLUMP MAY NOT EXCEED 8" WITH THE ADDITION OF WATER REDUCING ADMIXTURES

3. ADMIXTURES, HARDENERS, & CURING COMPOUNDS

   A. ALL CONCRETE ADMIXTURES SHALL, WHEN MIXED INTO CONCRETE, BE NON-CHLORIDE AND NON-CHLORIDE FORMING.

   B. ALL ADMIXTURES MUST CONFORM TO ASTM C-494 AND C-260.

   C. CONCRETE CURING COMPOUND AND SEALERS SHALL MEET ASTM C-309 TYPE 1 OR 1D.

4. MISCELLANEOUS CONCRETE DETAILS:

   A. ALL EXPOSED EDGES OF CONCRETE SHALL BE CHAMFERED 3/4" INSIDE THE FORMS OR TOOLED TO 3/4" RADIUS UNLESS NOTED OTHERWISE.

   B. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE DESIGN OF ALL FORMING AND SHORING.

   C. SAW CUTTING OF EXISTING STRUCTURAL CONCRETE.

      a. THE CONTRACTOR SHALL HAVE ALL STRUCTURAL CONCRETE INTENDED TO BE CORED OR CUT INVESTIGATED WITH GROUND PENETRATING RADAR (GPR) PRIOR TO CUTTING/CORING. LOCATION OF REINFORCING SHALL BE REPORTED TO THE ENGINEER OF RECORD (EOR). THE EOR MAY DIRECT THE CONTRACTOR TO ADJUST THE OPENING LOCATION TO REDUCE THE QUANTITY OF EXISTING REINFORCING THAT WILL BE CUT.

      b. ALL NEW CIRCULAR OPENINGS SHALL BE CORE DRILLED. ALL NEW RECTANGULAR OPENINGS SHALL BE CORE DRILLED IN EACH CORNER TO PREVENT OVERCUTTING BEYOND THE INTENDED CORNERS. THE CONTRACTOR SHALL APPLY APPROPRIATE PRESSURE TO THE EQUIPMENT TO PREVENT SPALLING OVER 1/2" ON THE BACK SIDE OF THE OPENING.

CONCRETE REINFORCING

1. MATERIALS

	ASTM	GRADE
REINFORCING STEEL:	A615	60

2. DETAILS:

   A. WELDING OF REINFORCING STEEL IS PROHIBITED UNLESS NOTED OTHERWISE. WHEN WELDING IS APPROVED, WELDING SHALL BE IN ACCORDANCE WITH AWS D1.4 "WELDING REINFORCING STEEL, ETC."

   B. SHOP DRAWINGS SHALL BE SUBMITTED WITH REINFORCING STEEL IN ACCORDANCE WITH ACI 315.

3. PLACEMENT:

   A. ALL REINFORCING AND EMBEDMENTS SHALL BE SUPPORTED ON CHAIRS/BOLSTERS TO THE DESIGN DIMENSIONS. SPACING SHALL BE SUFFICIENTLY CLOSE TO PREVENT DISPLACEMENT OR PERMANENT DEFORMATION DUE TO CONCRETE PLACEMENT, FOOT TRAFFIC, OR VIBRATION. "PUDDLING IN" OR "PULLING UP" REINFORCING IS NOT AN ACCEPTABLE METHOD FOR PLACING REINFORCING. CHAIRS/BOLSTERS SHALL HAVE PLASTIC COATED FEET OR BE MADE OF STAINLESS STEEL. CHAIRS/BOLSTERS IN CONTACT WITH EARTH SHALL HAVE BOTTOM PLATES AND BE COATED TO PREVENT CORROSION. ANCHOR RODS SHALL BE HELD IN PLACE WITH TEMPLATES SUFFICIENTLY STRONG TO PREVENT DISPLACEMENT OR TILTING.

   B. MAINTAIN ACI CLEAR COVER ON REINFORCING AS LISTED BELOW UNLESS NOTED OTHERWISE.

CAST AGAINST EARTH (BOTTOM OR SIDES):	3"
FORMED - EXPOSED TO SOIL, WEATHER OR LIQUIDS:	2"
SLABS ON GRADE (FROM TOP OF SLAB):	1.5"

   C. PROVIDE CORNER BARS OF THE SAME SIZE AND SPACING AS ADJACENT REINFORCING.

   D. REINFORCING STEEL SHALL BE LAPPED PER CONCRETE REINFORCEMENT LAP TABLE.

MASONRY

1. MASONRY HAS BEEN DESIGNED IN ACCORDANCE WITH THE TMS 402/602 AND THE BUILDING CODE USING THE ORDINARY REINFORCED METHOD.

2. MATERIALS:

   A. ALL CONCRETE MASONRY UNITS (CMU) SHALL BE TWO-CELL, LIGHTWEIGHT AGGREGATE UNITS WITH A SPECIFIED MINIMUM COMPRESSIVE STRENGTH OF 2000 PSI ON NET AREA AT 28 DAYS CONFORMING TO ASTM C90.

   B. ALL MORTAR SHALL BE TYPE "S" CONFORMING TO ASTM C270.

   C. THE MINIMUM COMPRESSIVE STRENGTH (f'm) OF A PRISM ASSEMBLED OF CMU AND FULL MORTAR BEDDING SHALL BE 2000 PSI AT 28 DAYS ON THE NET AREA.

   D. GROUT SHALL CONFORM TO ASTM C476 WITH 3/8" AGGREGATE WITH TYPE I CEMENT, A MAXIMUM WATER/CEMENT RATION OF 0.65, AND A SLUMP OF 5" TO 9". THE MINIMUM GROUT COMPRESSIVE STRENGTH (f'c) SHALL BE 2500 PSI.

   E. REINFORCING STEEL SHALL MEET THE REQUIREMENTS OF ASTM A615, GR. 60.

   F. CMU LOCATED BELOW GRADE SHALL BE NORMAL-WEIGHT AGGREGATE UNITS WITH ALL CELLS GROUTED SOLID.

3. HORIZONTAL WALL REINFORCING:

   A. PROVIDE CONTINUOUS HORIZONTAL REINFORCING AT THE TOP OF THE WALL AND AT A MAXIMUM OF 4'-0" ON CENTER IN KNOCK-OUT BOND BEAMS UNLESS NOTED OTHERWISE. REINFORCING STEEL SHALL LAP PER TABLE.

   B. PROVIDE HORIZONTAL REINFORCING AT THE HEAD OF ALL OPENINGS IN A "U" SHAPED SOLID BOTTOM LINTEL BLOCK. CUT OFF THE BOTTOM SHELL OF THE LINTEL BLOCKS AT VERTICAL REINFORCING LOCATION FOR JAMBS. PROVIDE HORIZONTAL REINFORCING AT THE SILL OF ALL OPENINGS IN A KNOCK-OUT BOND BEAM. REINFORCING STEEL SHALL EXTEND BEYOND OPENING PER DETAILS.

   C. MINIMUM HORIZONTAL REINFORCING IN ALL LINTELS AND BOND BEAMS SHALL BE AS FOLLOWS UNLESS NOTED OTHERWISE:

THICKNESS	REINFORCING
8"	(2) #5

4. VERTICAL REINFORCING:

   A. PROVIDE VERTICAL REINFORCING (NORMAL REINFORCING) IN FULLY GROUTED CELLS, CENTERED AND HELD IN PLACE BY REINFORCING STEEL GUIDES IN ALL WALLS AS FOLLOWS, UNLESS NOTED OTHERWISE:

THICKNESS	EXTERIOR WALLS
8"	#5 AT 48" O.C.

   B. PROVIDE VERTICAL FULLY GROUTED REINFORCED CELLS AT EACH SIDE OF AN ISOLATION JOINT, AT INTERSECTIONS OF WALLS, EACH SIDE OF A WALL OPENING, AT EACH BEAM BEARING, AND AT THE END OF A WALL.

   C. VERTICAL REINFORCING SHALL EXTEND CONTINUOUSLY FROM THE TOP OF THE SUPPORTING MEMBER TO THE TOP BOND BEAM. THERE SHALL BE A DOWEL, CAST INTEGRAL WITH THE SUPPORTING MEMBER, FOR EACH VERTICAL REINFORCING BAR EXCEPT AS NOTED. ALL VERTICAL REINFORCING STEEL SHALL BE HOOKED INTO TOP BOND BEAM. ALL HOOKS, STRAIGHT EMBEDMENTS AND LAPS SHALL BE PER TABLE.

5. LOCATION AND DETAILS OF CONTROL AND ISOLATION JOINTS IN MASONRY WALLS SHALL BE PER THE ARCHITECTURAL DRAWINGS. IF NOT SHOWN OR NOTED ON THE ARCHITECTURAL DRAWINGS, THE MAXIMUM SPACING OF CONTROL OR ISOLATION JOINTS SHALL BE AT A LENGTH TO HEIGHT RATIO OF 2:1 OR 30'-0" O.C., WHICHEVER IS LESS. REINFORCING IN ALL BOND BEAMS, INCLUDING THE TOP BOND BEAM, SHALL BE DISCONTINUOUS AT CONTROL AND ISOLATION JOINTS. CONTRACTOR SHALL SUBMIT A JOINT LAYOUT PLAN FOR APPROVAL PRIOR TO CONSTRUCTION.

6. CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING WALL ELEVATIONS AS PART OF THE SUBMITTAL. WALL ELEVATIONS SHALL INCLUDE HORIZONTAL AND VERTICAL REINFORCING, EMBEDS, CONTROL JOINTS, OPENINGS, ETC. IT IS THE CONTRACTOR'S RESPONSIBILITY TO COORDINATE WITH THE ARCHITECTURAL, MECHANICAL AND ELECTRICAL DRAWINGS FOR ALL OPENING LOCATION.

CONTRACT/CONSTRUCTION DOCUMENTS

1. THE CONTRACTOR SHALL BE RESPONSIBLE TO OBTAIN A FULL SET OF THE MOST RECENT REVISIONS OF EACH DOCUMENT INCLUDING ALL PLANS, SPECIFICATIONS, ADDENDA, AND SUPPLEMENTAL INSTRUCTIONS.

2. THE CONTRACTOR SHALL REVIEW THE DOCUMENTS PRIOR TO FABRICATION AND/OR INSTALLATION OF ANY MATERIALS FOR CONFLICTS. IF CONFLICTS OCCUR THE CONTRACTOR SHALL USE THE MOST STRINGENT REQUIREMENT OR REQUEST A CLARIFICATION THROUGH A REQUEST FOR INFORMATION (RFI).

3. THE DOCUMENTS MAY NOT BE REPRODUCED IN WHOLE OR IN PART FOR USE ON PROJECTS OTHER THAN IDENTIFIED IN THE TITLE BLOCK. SHOULD THE CONTRACTOR USE THE DOCUMENTS AS A PORTION OF A SHOP DRAWING SUBMITTAL, THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY CONSEQUENCES RESULTING FROM ERRORS IN THE REPRODUCED DOCUMENTS.

4. DETAILS LABELED TYPICAL ARE INTENDED TO REPRESENT A CONDITION THAT OCCURS AT SEVERAL LOCATIONS IN THE PLANS WHETHER OR NOT THE DETAIL IS REFERENCED.

5. DO NOT SCALE THE PLANS AND DETAILS FOR THE PURPOSE OF ESTABLISHING DIMENSIONS.

CONTRACTOR'S RESPONSIBILITY

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR REVIEWING ALL SUB-CONTRACTOR SUBMITTALS AND NOTING ALL DEVIATIONS FROM THE CONSTRUCTION DOCUMENTS PRIOR TO SUBMITTING TO THE ENGINEER FOR REVIEW.

2. SUBSTITUTION REQUESTS SHALL BE SUBMITTED IN WRITING WITH THE COST REDUCTION AMOUNT AND THE SCHEDULE IMPACT FOR THE OWNER (SUBMITTALS WITHOUT THE COST AND SCHEDULE IMPACT WILL NOT BE REVIEWED). A COMPARISON OF THE DATA WITH THE MATERIAL SPECIFIED INCLUDING CODE APPROVALS SHALL BE PROVIDED.

3. REQUESTS FOR INFORMATION (RFI) SHALL BE SUBMITTED IN WRITING WITH COST, SCHEDULE IMPACT, AND SUGGESTED SOLUTION INCLUDED. AN RFI THAT DOES NOT INCLUDE THE COST AND SCHEDULE IMPACT WILL NOT BE REVIEWED.

4. DEFECTIVE WORK REPORT (DWR) SHALL BE SUBMITTED TO THE ENGINEER. THE DWR SHALL REPORT THE DEFECT AND PROPOSE A REMEDIATION OF THE DEFECT. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL COSTS ASSOCIATED WITH THE REMEDIATION OF THE DEFECT INCLUDING ENGINEERING COSTS, IF ANY.

5. WHEN THE CONTRACTOR BECOMES AWARE OF WHAT MAY BE AN UNFORESEEN CONDITION THAT COULD AFFECT COST OR SCHEDULE, THE CONTRACTOR SHALL NOTIFY THE ENGINEER IN WRITING. AFTER REVIEW AND ENGINEER'S DETERMINATION THAT AN UNFORESEEN CONDITION EXISTS; THE CONTRACTOR SHALL SUBMIT A CHANGE ORDER REQUEST FOR APPROVAL WITH BOTH COST AND SCHEDULE IMPACT ATTACHED.

6. THE CONTRACTOR'S SCHEDULE MUST PROVIDE A REASONABLE TIME ALLOWANCE FOR THE ENGINEERING REVIEW AND APPROVAL.

7. THE CONTRACTOR WILL BE SOLELY RESPONSIBLE FOR SITE SAFETY. THE ENGINEER IS RESPONSIBLE FOR FOLLOWING THE CONTRACTOR'S CONSTRUCTION SITE SAFETY INSTRUCTIONS PROVIDED IN WRITING. ALTERNATELY, THE CONTRACTOR SHALL ASSIGN AN ESCORT TO ADVISE THE ENGINEER OF SITE SAFETY ISSUES DURING SITE VISITS. THE ENGINEER'S PURPOSE OF A SITE VISIT IS SOLELY TO BECOME FAMILIAR WITH THE GENERAL PROGRESS AND QUALITY OF THE PROJECT. THE ENGINEER'S SITE VISIT IS NOT A QUALITY CONTROL FUNCTION.

CONSTRUCTION MEANS AND METHODS ISSUES

1. SLAB ON GRADE AND ELEVATED SLABS ARE NOT DESIGNED TO SUPPORT CRANES, FORKLIFTS, TRUCKS, MANLIFTS, OR OTHER CONSTRUCTION RELATED EQUIPMENT UNLESS NOTED AS SUCH. IT IS THE CONTRACTOR'S RESPONSIBILITY TO DETERMINE IF CONSTRUCTION EQUIPMENT CAN BE SAFELY OPERATED ON THESE SLABS AND TO REPAIR ANY DAMAGE THE EQUIPMENT MAY CAUSE.

2. THE CONSTRUCTION DOCUMENTS REPRESENT A STABLE STRUCTURE IN THE COMPLETED FORM. THE CONTRACTOR SHALL PROVIDE ANY TEMPORARY BRACING AND/OR SHORES TO SAFELY CONSTRUCT THE BUILDING AND PREVENT DAMAGE DURING CONSTRUCTION.

3. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND ELEVATIONS OF EXISTING CONSTRUCTION THAT MAY AFFECT THE PROJECT AND REPORT DISCREPANCIES TO THE ENGINEER. ANY DIMENSIONS FOR ELEVATIONS THAT IMPACT NEW WORK SHALL BE VERIFIED PRIOR TO FABRICATION OF ANY MATERIAL. EXISTING BUILDING ELEMENTS THAT ARE TO BE ABANDONED THAT INTERFERE WITH NEW CONSTRUCTION SHALL BE REMOVED.

4. WHEN A PIECE OF EQUIPMENT (HVAC, ELECTRICAL, KITCHEN, ETC.) IS PROVIDED THAT IS DIFFERENT THAN THE EQUIPMENT THAT THE STRUCTURE WAS DESIGNED FOR EITHER BY SIZE, WEIGHT OR CONFIGURATION, THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL COSTS ASSOCIATED WITH THE REMEDY OF THE SITUATION. THOSE COSTS SHALL INCLUDE THE ENGINEERING COSTS TO REDESIGN PORTIONS OF THE STRUCTURE TO ACCOMMODATE THE SUBSTITUTED EQUIPMENT.

5. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE STRUCTURAL DESIGN AND MATERIALS FOR ATTACHING NON-STRUCTURAL ELEMENTS TO ANY PORTION OF THE STRUCTURE TO RESIST ALL LOADS, INCLUDING SEISMIC, IN A WAY THAT DOES NOT OVERSTRESS STRUCTURAL MEMBERS. NON-STRUCTURAL ELEMENTS CAN BE FOUND IN EACH OF THE OTHER DISCIPLINES (ARCHITECTURAL, MECHANICAL, ELECTRICAL, ETC.).

STRUCTURAL TESTS, INSPECTIONS, AND QUALITY ASSURANCE

1. ALL STRUCTURAL TESTS AND INSPECTIONS SHALL BE PERFORMED PER CHAPTER 17 OF THE BUILDING CODE WITH LOCAL SUPPLEMENTS, UNLESS MORE STRINGENT REQUIREMENTS ARE SPECIFIED.

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C.O.A. #1046 PE/LS EXPIRES:
JUNE 30, 2025

REVISIONS

No.	Date	Description

STATE OF OKLAHOMA — REGISTERED PROFESSIONAL ENGINEER — JAMES HOLT — 26431 — 01/30/2025

RSU Geothermal Chillers

1701 W. Will Rogers Blvd
Claremore, OK 74017

GENERAL NOTES

100% CD

PEC PROJECT NUMBER: 231211-000
DATE 01/22/2025
DRAWN BY KAC
CHECKED BY JGH

S001

N

1 SITE PLAN

0' 4' 8' 12' **1" = 100'-0"**

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REVISIONS

No.	Date	Description

STATE OF OKLAHOMA — STRUCTURAL ENGINEER — JAMES HOLT — 26431 — 01/30/2025

RSU Geothermal Chillers

1701 W. Will Rogers Blvd
Claremore, OK 74017

SITE PLAN

100% CD

PEC PROJECT NUMBER: 231211-000
DATE 01/22/2025
DRAWN BY KAC
CHECKED BY JGH

S100

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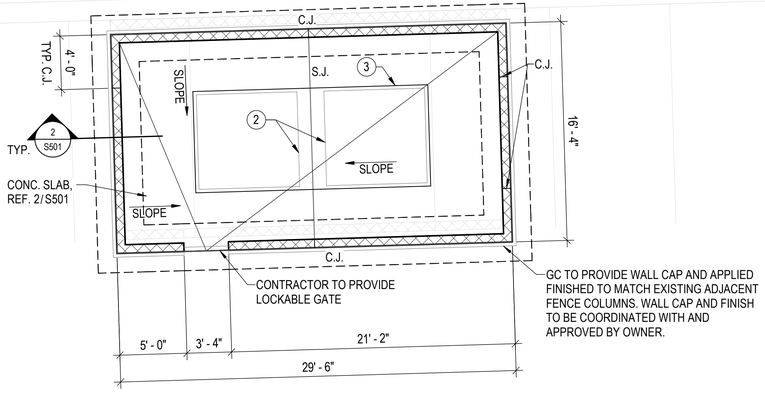

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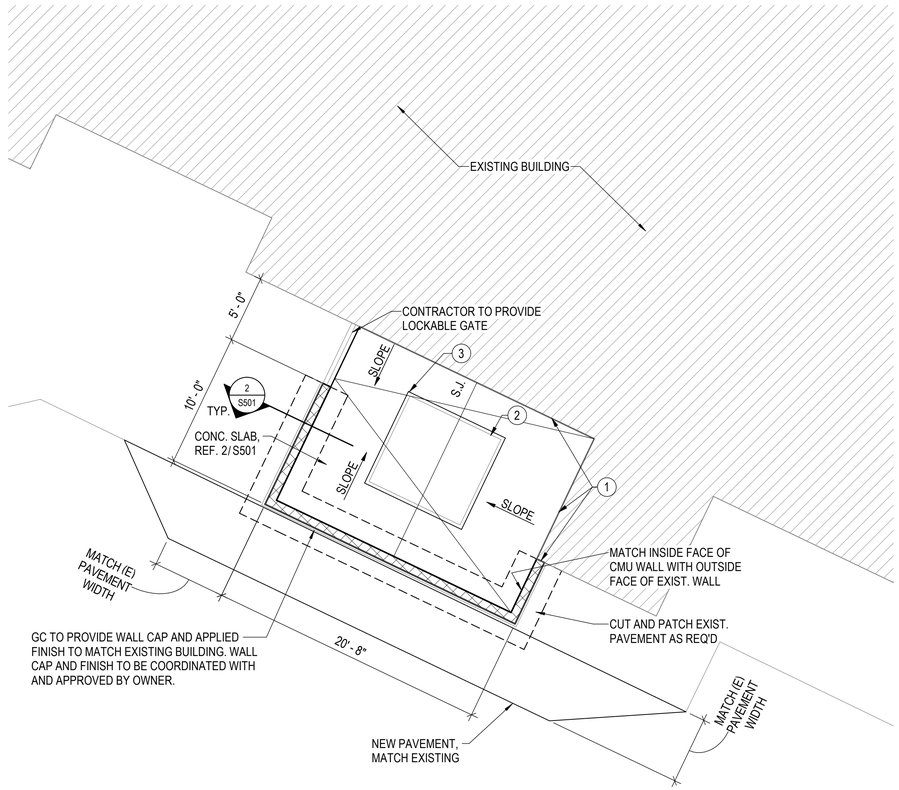
1 EQUIPMENT ENCLOSURE FOUNDATION PLAN

0' 4' 8' 12' 3/16" = 1'-0"



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2 ALTERNATE 1 - EQUIPMENT ENCLOSURE FOUNDATION PLAN

0' 4' 8' 12' 3/16" = 1'-0"

FOUNDATION PLAN NOTES:

1. TOP OF FOUNDATION 8" BELOW T.O. SLAB UNLESS NOTED OTHERWISE.
2. SEE SHEET S100 FOR OVERALL SITE PLAN.
3. SEE SHEET S001 FOR GENERAL STRUCTURAL NOTES AND SHEET S000 FOR SPECIAL INSPECTION REQUIREMENTS.
4. SEE SHEET S501 FOR FOUNDATION AND CMU DETAILS.
5. REFERENCE MECHANICAL DRAWINGS FOR LOCATIONS OF EXTERIOR EQUIPMENT.
6. DEMOLISH EXISTING PAVEMENT AS REQUIRED TO INSTALL NEW CONCRETE FOUNDATION AND SLAB.
7. SLOPE SLAB TOWARD GATE OPENING IN CMU WALL.

FOUNDATION MARKS:

1. 1/2" EXPANSION JOINT MATERIAL
2. CHILLER, REF. MECH FOR SIZE AND LOCATION
3. EQUIP. PAD, REF. 8/S501

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C.O.A. #1046 PE/LS EXPIRES:
JUNE 30, 2025

REVISIONS

No.	Date	Description

STATE OF OKLAHOMA REGISTERED PROFESSIONAL STRUCTURAL ENGINEER
JAMES HOLT
26431
01/30/2025

RSU Geothermal Chillers

1701 W. Will Rogers Blvd
Claremore, OK 74017

PARTIAL FOUNDATION PLANS

100% CD

PEC PROJECT NUMBER: 231211-000
DATE 01/22/2025
DRAWN BY KAC
CHECKED BY JGH

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CONCRETE REINFORCEMENT LAP, EMBEDMENT, AND HOOK LENGTHS

fy = 60,000 PSI **f'c = 4,000 PSI**

NOTES:

1. LENGTHS SHOWN CONFORM WITH NON-SEISMIC PROVISIONS OF ACI 318 FOR UNCOATED BARS.
2. BAR CLEAR SPACING IS THE CENTER TO CENTER BAR SPACING MINUS ONE BAR DIAMETER.
3. CLASS A LAP LENGTHS APPLY WHEN BAR LAPS ARE STAGGERED TO LAP HALF THE BARS AT THE SAME LOCATION. USE CLASS B LAP FOR ALL OTHER CASES.
4. TOP BARS ARE HORIZONTAL REINFORCEMENT PLACED SO THAT MORE THAN 12 INCHES OF CONCRETE IS CAST BELOW THE REINFORCEMENT.
5. MULTIPLY LENGTHS GIVEN BY 2.0 FOR BARS WITH CLEAR SPACING OF TWO BAR DIAMETERS OR LESS, OR CONCRETE COVER OF ONE BAR DIAMETER OR LESS.

BAR SIZE	CLEAR SPACING (S) (IN)			EMBEDMENT & CLASS A LAP (IN)						CLASS B LAP (IN)						HOOK EMBED (IN)
				TOP BAR			OTHER BARS			TOP BAR			OTHER BARS			
	2d	3d	5d	2d<s<3d	S>3d	S>5d	2d<s<3d	S>3d	S>5d	2d<s<3d	S>3d	S>5d	2d<s<3d	S>3d	S>5d	
3	3/4	1-1/8	1-7/8	28	18	12	21	14	12	36	24	14	28	18	12	8
4	1	1-1/2	2-1/2	37	25	15	28	19	12	48	32	19	37	25	15	10
5	1-1/4	1-7/8	3-1/8	46	31	18	36	24	14	60	40	24	46	31	18	12
6	1-1/2	2-1/4	3-3/4	55	37	22	43	28	17	72	48	29	55	37	22	15
7	1-3/4	2-5/8	4-3/8	81	54	32	62	42	25	105	70	42	81	54	32	18
8	2	3	5	92	62	37	71	47	28	120	80	48	92	62	37	20
9	2-1/4	3-3/8	5-5/8	104	70	42	80	54	32	136	90	54	104	70	42	22
10	2-1/2	3-3/4	6-3/8	117	78	47	90	60	36	153	102	61	117	78	47	25
11	2-7/8	4-1/4	7	130	87	52	100	67	40	170	113	68	130	87	52	27

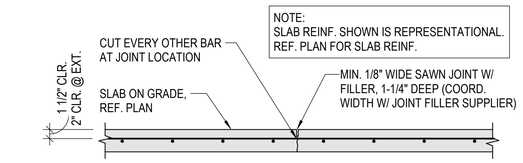
CMU REINFORCEMENT LAP LENGTHS

fy = 60,000 PSI **f'm = 2,000 PSI**

NOTES:

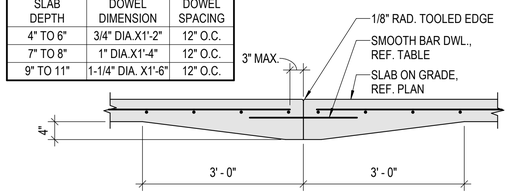
1. THE LAP LENGTH LISTED IS THE SAME FOR HORIZ. & VERT. BARS.
2. MULTIPLY LAP LENGTHS GIVEN BY 1.5 FOR EPOXY COATED BARS.
3. FOR CMU W/ (2) BARS PER CELL, d' ASSUMED AS 2-1/2".

BAR SIZE (d)	8" CMU W/ (1) BAR PER CELL (IN)	8" CMU W/ (2) BAR PER CELL (IN)	12" CMU W/ (2) BAR PER CELL (IN)	CMU HOOK (IN)
3	12	12	12	5
4	13	18	13	7
5	20	28	20	9
6	38	52	37	10
7	52	70	50	12
8	79	105	75	13
9	102	133	95	15



REINFORCING SAWN JOINT (S.J.) DETAIL

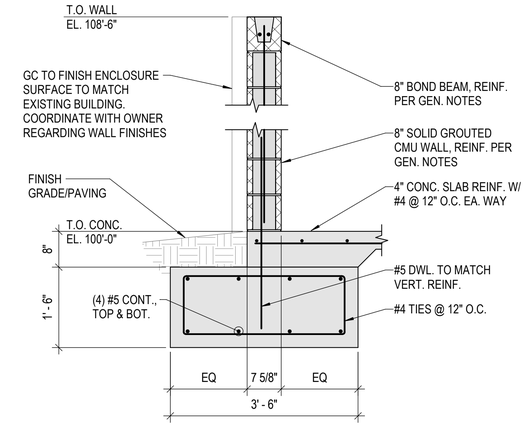
SMOOTH BAR DOWELS		
SLAB DEPTH	DOWEL DIMENSION	DOWEL SPACING
4" TO 6"	3/4" DIA.X1'-2"	12" O.C.
7" TO 8"	1" DIA.X1'-4"	12" O.C.
9" TO 11"	1-1/4" DIA. X1'-6"	12" O.C.



REINFORCING CONSTRUCTION JOINT (C.J.) DETAIL

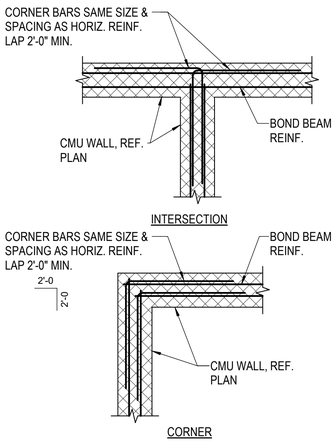
1 TYP. SLAB ON GRADE JOINT

NO SCALE



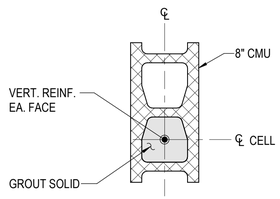
2 CONT. FTG. AT 8" CMU WALL

3/4" = 1'-0"



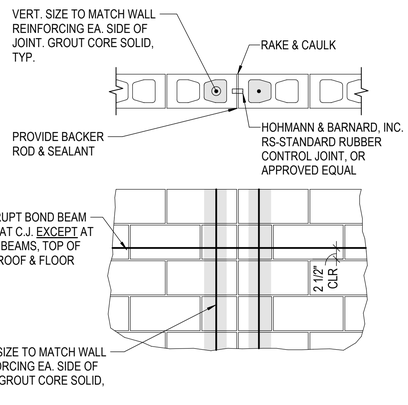
3 CORNER AND INTERSECT. REINF.

3/4" = 1'-0"



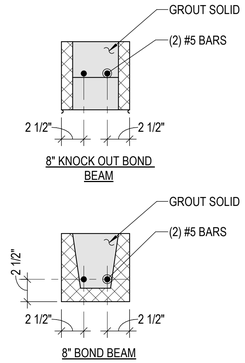
5 TYP. CMU VERTICAL CELL REINF.

NO SCALE



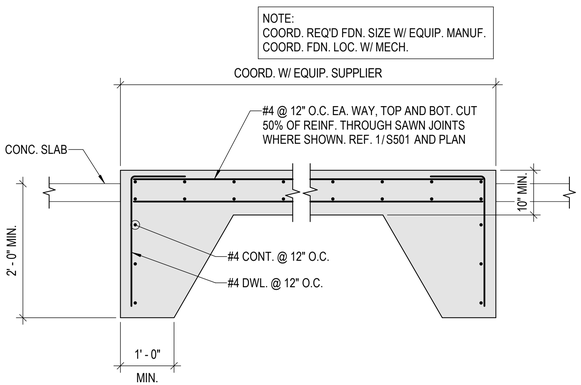
6 TYP. CMU CONTROL JOINT

NO SCALE



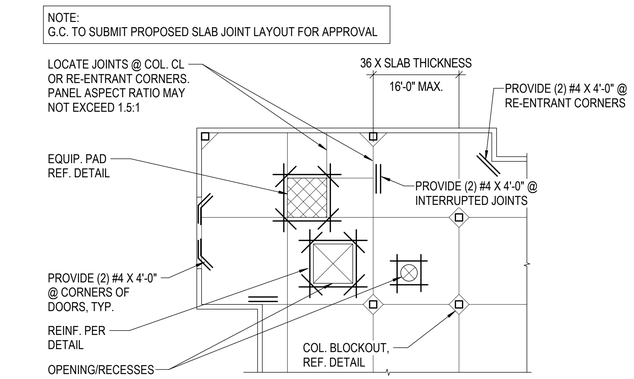
7 TYP. CMU BOND BEAM REINF.

NO SCALE



8 EXT. EQUIP. PAD

3/4" = 1'-0"



9 TYP. SLAB JOINT DETAIL

NO SCALE

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GENERAL NOTES

1. ALL ELECTRICAL WORK SHALL COMPLY WITH THE LATEST EDITION OF THE NATIONAL ELECTRICAL CODE (NEC) & THE AMERICANS WITH DISABILITIES ACT (ADA).
2. REFER TO RELATED ARCHITECTURAL, MECHANICAL, STRUCTURAL, TECHNOLOGY, AND CIVIL DRAWINGS FOR RELATED INFORMATION.
3. REFER TO THE SPECIFICATIONS FOR DATA NOT ON THE DRAWINGS.
4. E.C. SHALL REFER TO MECHANICAL DRAWINGS AND SPECIFICATIONS FOR THE REQUIREMENTS ASSOCIATED WITH WIRING AND CONNECTION OF INTERLOCKING AND CONTROLS OF MECHANICAL UNITS AND THERMOSTAT LOCATIONS.
5. COORDINATE OUTLET BOX LOCATIONS WITH MASONRY TO MINIMIZE CUTTING OF BRICK OR BLOCK.
6. ALL MOUNTING HEIGHTS TO CENTERLINE OF ITEM UNLESS OTHERWISE NOTED. VERIFY ALL OUTLET LOCATIONS ON THE JOB PRIOR TO ROUGH-IN.
7. CONDUIT RUN W/CONDUCTORS AS INDICATED & GROUND WIRE SIZED PER N.E.C. 250.122. CONDUIT SIZE AS REQUIRED.
8. WHEN INCREASED CONDUCTOR SIZES ARE SHOWN ON THE PLANS, THE LARGER CONDUCTOR SIZE SHALL BE USED THROUGHOUT THE LENGTH OF THE CIRCUIT, INCLUDING NEUTRAL AND GROUND.
9. E.C. SHALL REFERENCE ARCHITECTURAL FINISH DRAWINGS FOR LOCATIONS AND HEIGHTS OF RIGID WALL COVERINGS, TILE, CHAIR RAIL, WAINSCOATING, ETC. AND ADJUST ELECTRICAL BOX ROUGH-IN HEIGHTS SO THAT COVERPLATES DO NOT PARTIALLY OVERLAP THESE ITEMS.
10. BRANCH CIRCUITS ARE INDICATED AS ONE CIRCUIT HOME RUNS WITH INDIVIDUAL NEUTRALS. A MAXIMUM OF THREE CIRCUITS (MAXIMUM OF THREE PHASE CONDUCTORS) MAY BE GROUPED IN A SINGLE CONDUIT. WHERE MULTIPLE CIRCUITS ARE LOCATED IN THE SAME RACEWAY, JUNCTION BOX OR ENCLOSURE, NEUTRALS SHALL BE MARKED OR LABELED TO INDICATE WHICH CIRCUIT THEY ARE ASSOCIATED WITH. SEE SPECIFICATION SECTION "LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES" FOR ADDITIONAL INFORMATION.
11. JUNCTION BOX OR RECEPTACLE FOR DRINKING FOUNTAINS SHALL BE LOCATED BEHIND THE EQUIPMENT SKIRT UNLESS OTHERWISE NOTED. COORDINATE CONNECTION TYPE AND LOCATION WITH EQUIPMENT PROVIDED.
12. LABEL THE FRONT OF EACH RECEPTACLE COVERPLATE WITH PANEL DESIGNATION AND CIRCUIT NUMBER USING CLEAR THERMAL TRANSFER (ELECTRONIC DYMO) LABELS WITH 1/8" HIGH BLACK LETTERS (OR CONTRASTING COLOR IF COVERPLATES ARE BLACK OR BROWN). LABELS SHALL BE SUITABLE FOR INDOOR/OUTDOOR USE. LABEL THE BACK OF EACH LIGHT SWITCH COVERPLATE WITH PANEL DESIGNATION AND CIRCUIT NUMBER USING A FINE BLACK PERMANENT MARKER.
13. PROVIDE 18" LONG (MIN.) CONDUIT SLEEVES THRU ALL WALLS WHERE CABLES ARE INDICATED OR REQUIRED TO PASS THRU WALLS. PROVIDE BUSHINGS ON BOTH ENDS. SIZE CONDUIT FOR CABLES INSTALLED. AT CABLE TRAYS, PROVIDE ONE 4" CONDUIT SLEEVE FOR EACH 4" WIDTH OF CABLE TRAY. MAXIMUMS SHALL BE:
    1"C. = 10 CABLES
    2 1/2"C. = 20 CABLES
    3"C. = 30 CABLES
    4"C. = 50 CABLES
14. LOCATE CABLE TRAYS 6" ABOVE CEILING. OFFSET TRAY UP AND OVER LIGHT FIXTURES AND DUCTWORK (FIELD VERIFY AND PROVIDE AS REQUIRED). IF PHYSICALLY IMPOSSIBLE TO RUN CABLE TRAY UP AND OVER, THEN PROVIDE CABLE SUPPORT HOOKS FROM STRUCTURE ABOVE, SIZED AND RATED FOR INSTALLED CABLES PLUS 25% SPARE.
15. PROVIDE DIMMER PER THE SPECIFICATIONS. COORDINATE DIMMER TYPE AND WIRING WITH ASSOCIATED LIGHT FIXTURE DIMMING REQUIREMENTS (I.E. 3-WIRE, 0-10V, ELECTRONIC OR MAGNETIC LOW VOLTAGE, ETC.) OR WITH LIGHTING CONTROL SYSTEM PROPRIETARY REQUIREMENTS (I.E. LUTRON, nLIGHT, DALI, ETC.) AS NECESSARY. 3-WIRE DIMMERS SHALL BE PROVIDED WITH A DEDICATED NEUTRAL FOR EACH CONTROL ZONE. 0-10V DIMMERS SHALL BE PROVIDED WITH DIM/ON/OFF CONTROL. COORDINATE PHASE CONTROL OF LED DRIVERS (I.E. REVERSE PHASE, FORWARD PHASE, ETC.) WITH LIGHT FIXTURE MANUFACTURER'S RECOMMENDATIONS. LOW VOLTAGE CONTROL WIRING IS NOT SHOWN ON PLANS FOR CLARITY, BUT SHALL BE PROVIDED AS REQUIRED.
16. "CT" INDICATED ADJACENT TO DEVICE INDICATES DEVICE MOUNTED ABOVE BACKSPLASH OF COUNTER TOP. VERIFY EXACT HEIGHT WITH ARCHITECTURAL PLANS AND ELEVATIONS.

ELECTRICAL SHEET INDEX

SYMBOL LIST

SYMBOL	DESCRIPTION	MOUNTING
ONE-LINE		
LSIG, GFI, ST, K	CIRCUIT BREAKER ACCESSORIES: LSIG = LONG TIME, SHORT TIME, INSTANTANEOUS, GROUND FAULT GFI = GROUND FAULT ST = SHUNT TRIP K = KIRK KEY INTERLOCK	
G	INDICATOR LIGHT(G=GREEN, R=RED)	
B	ERMS INDICATING LIGHT & SWITCH)	
	CONTACTS (N.O., N.C.)	
	FUSE	
	CIRCUIT BREAKER	
	OVERLOADS	
	DRAWOUT CONTACTS	
	DISCONNECT SWITCH (SEE EQUIP CONN SCHED) (VOLTAGE / SWITCH SIZE / FUSE SIZE / # OF POLES - NOTED IF EQUIPMENT NOT SCHEDULED)	
	STARTER (SEE EQUIP CONN SCHED) (VOLTAGE / STARTER SIZE / # OF POLES - NOTED IF EQUIPMENT NOT SCHEDULED)	
	GROUND CONNECTION	
	LIGHTNING ARRESTOR	
1	FEEDER DESIGNATION	
SPD	SURGE PROTECTIVE DEVICE	
M	METER (UTILITY / PANEL MOUNTED)	
HP, KW	EQUIPMENT (SINGLE MOTOR / MULTI-MOTOR OR OTHER TYPE AS NOTED)	
VFD	VARIABLE FREQUENCY DRIVE (HP SIZE IF NOT SCHEDULED)	

SYMBOL	DESCRIPTION	MOUNTING
# A A 2P	FUSIBLE SWITCH (CIRCUIT NUMBER / SWITCH SIZE / FUSE SIZE / # OF POLES) (# OF POLES IF OTHER THAN 3)	
# A A 2P "1"	STARTER WITH FUSIBLE SWITCH (CIRCUIT NUMBER / SWITCH SIZE / FUSE SIZE / # OF POLES / STARTER SIZE) (# OF POLES IF OTHER THAN 3)	
# # A AF AT 2P 2P	CIRCUIT BREAKER (MOLDED CASE NON-ADJUSTABLE TRIP / ADJUSTABLE TRIP) (CIRCUIT NUMBER / TRIP SIZE / # OF POLES) (FRAME SIZE / TRIP SIZE) (# OF POLES IF OTHER THAN 3)	
	3Ø TRANSFORMER (DELTA PRIMARY / WYE SECONDARY)	
	1Ø TRANSFORMER	
PANEL SPD	PANELBOARD (BUILT-IN SPD)	
N E ATS	TRANSFER SWITCH (ATS = AUTOMATIC, MTS = MANUAL) (AMP SIZE / VOLTAGE / POLES / AIC RATING / NEMA RATING) (NEMA RATING IF OTHER THAN NEMA-1)	
"1" RV AT	MOTOR STARTER [SINGLE SPEED ACROSS-THE-LINE (UON)] (NEMA SIZE / RV AT= REDUCED VOLTAGE / AUTO-TRANSFORMER / SS = SOLID STATE)	

SYMBOL LIST

SYMBOL	DESCRIPTION	MOUNTING
ABBREVIATIONS		
NL	NIGHT LIGHT - WIRE AHEAD OF CONTROLS	
EM	ON EMERGENCY POWER	
WP	WEATHERPROOF	
CT	COUNTERTOP (SEE GEN. NOTE 16)	
UON	UNLESS OTHERWISE NOTED	
W	WALL	
AFF	ABOVE FINISHED FLOOR	
AFG	ABOVE FINISHED GRADE	
DF	DRINKING FOUNTAIN - SEE GENERAL NOTE 11	
GAP	GENERATOR ANNUNCIATOR PANEL	
CLG	CEILING	
CONDUIT AND WIRING		
	EMERGENCY CIRCUIT	CLG/WALL
	MASTER/SLAVE FIXTURE WHIP	CEILING
	LOW VOLTAGE WIRING	CLG/WALL
	CDT RUN 2#12 & 1#12 GRD.- 1/2"C. OR CDT RUN AS NOTED ON PLAN	CLG/WALL
	CDT RUN 2#12 & 1#12 GRD.- 3/4"C. OR CDT RUN AS NOTED ON PLAN	EARTH/ FLOOR
#10	CONDUIT HOME RUN, 1 CIRCUIT. 2#10 & 1#10 GRD. (GEN. NOTES 7 & 8)	CLG/WALL
	CONDUIT RUN PARTIAL CIRCUIT. 2#12 & 1#12 GRD. - 1/2"C.	CLG/WALL
	MISC. EQUIPMENT CONNECTION	
	CONDUIT SEAL OFF	
	CONDUIT HOME RUN, 1 CIRCUIT. 2#12 & 1#12 GRD. - 1/2"C.	CLG/WALL
	CONDUIT HOME RUN, 2 CIRCUITS. 4#12 & 1#12 GRD. - 1/2"C.	CLG/WALL
	CONDUIT HOME RUN, 3 CIRCUITS. 6#12 & 1#12 GRD. - 1/2"C.	CLG/WALL
	CONDUIT HOME RUN, 2 CIRCUITS PHASE CONDUCTORS/ NEUTRAL CONDUCTOR (#12 UON) SWITCH LEGS (#12 UON) GROUND CONDUCTOR (#12 UON)	CLG/WALL
POWER		
	SINGLE GROUNDED RECEPTACLE	18"
	DUPLEX GROUNDED RECEPTACLE	18"
	DUPLEX GROUNDED RECEPTACLE	CEILING
	DOUBLE DUPLEX GROUNDED REC	18"
	GROUND FAULT DUPLEX REC	18"
	GRD FAULT DOUBLE DUPLEX REC	18"
	DUPLEX GRD REC BOTTOM SWITCHD	18"
	TAMPER-PROOF DUPLEX REC	18"
	TAMPER-PROOF GFCI DUPLEX REC	18"
A A	SPECIAL OUTLET (SEE SCHEDULE OR AS NOTED)	FLOOR/WALL
	SPECIAL DEVICE (AS NOTED)	
2	FEEDER DESIGNATION	
IJ	JUNCTION BOX - 1-GANG	
J	JUNCTION BOX - 2-GANG	
F	FUSTAT BUSS #SSY	46"
TS	THERMOSTAT/TEMP SENSOR	46"
P	PLUG LOAD SENSOR	CEILING
H	HANDICAP DOOR PUSHBUTTON	36" AFF
A	BRANCH CIRCUIT PANEL AND PANEL DESIGNATION	72" TO TOP
	ELECTRICAL DISTRIBUTION EQUIP	
X-X	EQUIPMENT - SEE EQUIPMENT CONNECTION SCHEDULE	
	CONDUIT SLEEVE (GEN NOTE 13)	
	CABLE TRAY - WIRE BASKET,	
	LADDER (GEN NOTE 14)	
M	MOTOR	
	DISCONNECT SWITCH	
$M	MANUAL STARTER	
	CIRCUIT BREAKER	
	STARTER OR ATS (AS NOTED)	
	COMBINATION STARTER/DISC	
R	RELAY	
	PUSHBUTTON (1-, 2-, 3-BUTTON)	46"
T	BOX MOUNTED TRANSFORMER	
C	CONTACTOR	
	METER	
	PLUGMOLD SURFACE RACEWAY	WALL
	BUSDUCT PLUG	
LIGHTING, SWITCHES AND SENSORS		
A	LIGHT FIXTURE & FIXTURE LETTER	CLG SURF/ RECESSED
A	STRIP LIGHT FIXTURE & FIXTURE LETTER	CEILING
A	LIGHT FIXTURE & FIXTURE LETTER	CLG SURF/ RECESSED
A	LIGHT FIXTURE & FIXTURE LETTER	WALL
A	EXIT SIGN (SHADING DENOTES EXIT FACE SIDE)	CLG/WALL
A	LIGHT FIXTURE & FIXTURE LETTER	WALL
A	FIXTURE WITH SHADED LAMP(S) ON EMERGENCY POWER	CLG SURF/ RECESSED
A	EMERGENCY BATTERY LIGHT FIXT	CEIL/WALL
A	COMBO EXIT SIGN/EM BATTERY LIGHT	WALL
A	LIGHT FIXTURE & FIXTURE LETTER	POLE
A T	LIGHTING TRACK, TRACK FIXTURES, & FIXTURE LETTERS	CEILING
PC	PHOTOCELL	
$, $2, $3, $4	SWITCHES (1-POLE, 2-POLE, 3-WAY, 4-WAY)	46"
$K, $P, $T	SWITCHES (KEYED, PILOT, TIMER)	46"
a, b, c	INDICATES SWITCHING SCHEME	
M	1 RELAY OCCUPANCY SENSOR SW	46"
2M	2 RELAY OCCUPANCY SENSOR SW	46"
1D	1 RELAY OCCUPANCY SENSOR/ DIMMER SWITCH (GEN NOTE 15)	46"
D	DIMMER SWITCH (GEN NOTE 15)	46"
Ś	LOW VOLTAGE SWITCH	46"
Ś1	ON/OFF SWITCH	46"
Ś2	ON/OFF/0-10V DIMMING SWITCH	46"
Ś3	DUAL TECH ON/OFF SENSOR	46"
Ś4	16-SCENE WALL CONTROLLER	46"
Ś5	DUAL TECH ON/OFF/0-10V DIM SW	46"
	OCCUPANCY SENSOR	CLG/WALL
LP	LIGHTING CONTROL POWER PACK	
EP	UL-924 LISTED POWER PACK	
AV	AV SYSTEM/LIGHTING INTERFACE	
DS	DAYLIGHT SENSOR	CEILING

PEN WEIGHT LEGEND

ALL DEVICES, LIGHT FIXTURES, ETC., DRAWN IN DARK SOLID LINES ARE NEW TO BE INSTALLED	ALL DEVICES, LIGHT FIXTURES, ETC., DRAWN IN DARK DASHED LINES ARE EXISTING TO BE REMOVED
NEW DUPLEX GROUNDED RECEPTACLE	DUPLEX GROUNDED REC TO BE REMOVED
NEW LIGHT FIXTURE	LIGHT FIXTURE TO BE REMOVED
ALL DEVICES, LIGHT FIXTURES, ETC., DRAWN IN HALFTONE SOLID LINES ARE EXISTING TO REMAIN	ALL DEVICES, LIGHT FIXTURES, ETC., DRAWN IN LIGHT DASHED LINES ARE EXISTING TO BE RELOCATED
EXISTING DUPLEX GROUNDED REC TO REMAIN	DUPLEX GROUNDED REC TO BE RELOCATED
EXISTING LIGHT FIXTURE TO REMAIN	LIGHT FIXTURE TO BE RELOCATED

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ELECTRICAL GENERAL NOTES AND SYMBOLS

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E001

ELECTRICAL SITE GENERAL NOTES

1. UNLESS OTHERWISE NOTED, ALL CONDUIT ROUTED ON SITE SHALL BE 1" MINIMUM.
2. ALL RISERS AND BELOW GRADE ELLS SHALL BE PVC COATED RIGID GALVANIZED STEEL (RGS). PROVIDE WITH PVC TO STEEL ADAPTER(S) AS NECESSARY.
3. ALL ELECTRICAL WORK AND FEES ASSOCIATED WITH UTILITIES SHALL BE VERIFIED AND COORDINATED WITH LOCAL SERVICE PROVIDER PRIOR TO BID.
4. CONTRACTOR SHALL REFERENCE ALL RELATED CONTRACT DOCUMENTS, SITE SURVEY, AND OTHER RESOURCES FOR POSSIBLE CONFLICTS WITH OTHER UNDERGROUND UTILITIES. AT UTILITY CROSSINGS, CONTRACTOR SHALL VERIFY UTILITY DEPTHS AND COORDINATE CONDUIT ROUTING AS NECESSARY.
5. CONTRACTOR SHALL VERIFY AND COORDINATE EXISTING CONDITIONS OF PROJECT SITE PRIOR TO BID.

N

1 **ELECTRICAL SITE PLAN**

0' 50' 100' 150' 1" = 100'-0"

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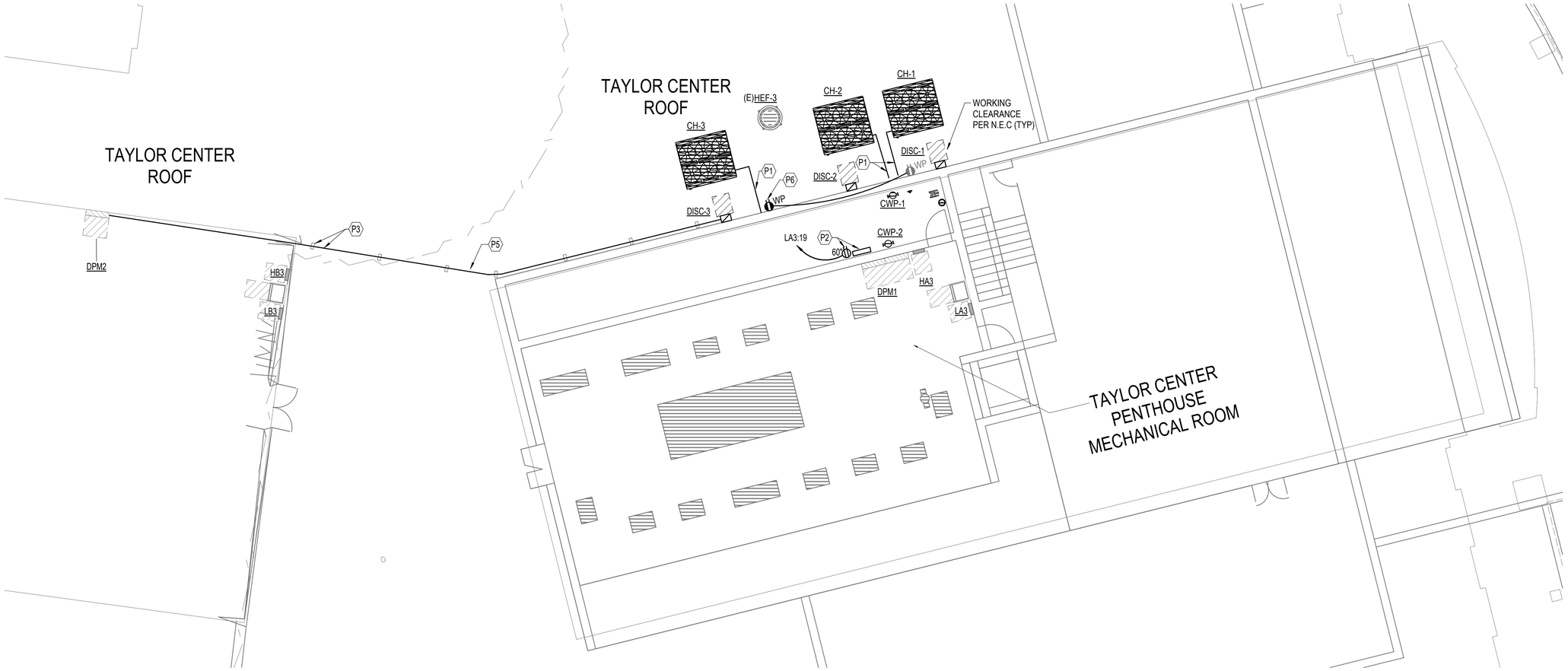
SHEET KEYNOTES

#	
P1	PROVIDE 1-INCH CONDUIT FOR CONTROL WIRING FROM CHILLER TO THE BUILDING MANAGEMENT SYSTEM (BMS) INTERFACE IN THE PENTHOUSE. COORDINATE WITH MECHANICAL CONTROLS CONTRACTOR FOR FINAL LOCATION PRIOR TO ROUGH-IN. OTHER EQUIPMENT PROVIDED AND INSTALLED BY CONTROLS CONTRACTOR PER MECHANICAL SHEET M701.
P2	PROVIDE 120V POWER TO CONTROL EQUIPMENT. COORDINATE WITH MECHANICAL CONTRACTOR FOR FINAL LOCATION OF CONTROL EQUIPMENT PRIOR TO ROUGH-IN. MECHANICAL CONTRACTOR SHALL FURNISH AND INSTALL ALL CONTROL EQUIPMENT. REFER TO MECHANCAIL SHEET M701.
P3	PROVIDE INTERMEDIATE METAL CONDUIT (IMC) INSTALLED ON THE ROOF AND RAISED 3/4-INCH FROM THE ROOF SURFACE. PROVIDE SUPPORT WITHIN 3 FEET OF EACH CONDUIT TERMINATION POINT AND AT INTERVALS NOT EXCEEDING 10 FEET.
P5	ROOF-MOUNTED CONDUCTORS ARE DERATED FOR HIGH AMBIENT TEMPERATURES AS INDICATED IN THE MECHANICAL SCHEDULE.
P6	CONNECT NEW RECEPTACLE TO EXISTING BRANCH CIRCUIT SERVING EXISTING RECEPTACLE.

POWER GENERAL NOTES

1. BRANCH CIRCUITS ARE INDICATED AS ONE CIRCUIT HOME RUNS WITH INDIVIDUAL NEUTRALS. A MAXIMUM OF THREE CIRCUITS (MAXIMUM OF THREE PHASE CONDUCTORS) MAY BE GROUPED IN A SINGLE CONDUIT. WHERE MULTIPLE CIRCUITS ARE LOCATED IN THE SAME RACEWAY, JUNCTION BOX OR ENCLOSURE, NEUTRALS SHALL BE MARKED OR LABELED TO INDICATE WHICH CIRCUIT THEY ARE ASSOCIATED WITH. SEE SPECIFICATION SECTION "LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES" FOR ADDITIONAL INFORMATION.
2. A GROUND CONDUCTOR SIZED PER N.E.C. ARTICLE 250 IS REQUIRED IN ALL CONDUITS.
3. FOR CONNECTION REQUIREMENTS TO MECHANICAL UNITS, SEE MECHANICAL EQUIPMENT CONNECTION SCHEDULE.
4. FOR ALL PENETRATIONS IN FIRE RATED WALLS AND CEILINGS, PROVIDE AN ASTM E814 COMPLIANT, U.L. LISTED THROUGH PENETRATION FIRE STOPPING SYSTEM THAT IS SPECIFIC TO THE WALL OR CEILING CONSTRUCTION ASSEMBLY. INSTALL SYSTEM IN STRICT COMPLIANCE WITH THE U.L. ASSEMBLY INDICATED IN THE ARCHITECTURAL DRAWINGS AND SPECIFICATIONS.
5. ALL PIPING, CONDUIT, AND OUTLET BOXES (ELECTRIC, TELEPHONE, COMPUTER, ETC.) IN FIRE RATED WALLS OR CEILINGS SHALL BE CONSTRUCTED OF NON-COMBUSTIBLE MATERIAL.
6. OUTLET BOXES (ELECTRIC, TELEPHONE, COMPUTER, ETC.) ON OPPOSITE SIDES OF FIRE RATED WALLS SHALL BE SEPARATED BY A HORIZONTAL DISTANCE OF 24 INCHES OR PROTECTED BY OTHER MEANS ALLOWED BY THE SPECIFIC U.L. ASSEMBLY.



N

1 ELECTRICAL ROOF POWER PLAN - TAYLOR CENTER

0' 4' 8' 12' 1/8" = 1'-0"

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REVISIONS

No.	Date	Description

LICENSED PROFESSIONAL ENGINEER WILLIAM E. RENNER OKLAHOMA
01-22-25

RSU Geothermal Chillers
1701 W. Will Rogers Blvd
Claremore, OK 74017

ELECTRICAL ROOF POWER PLAN - TAYLOR CENTER

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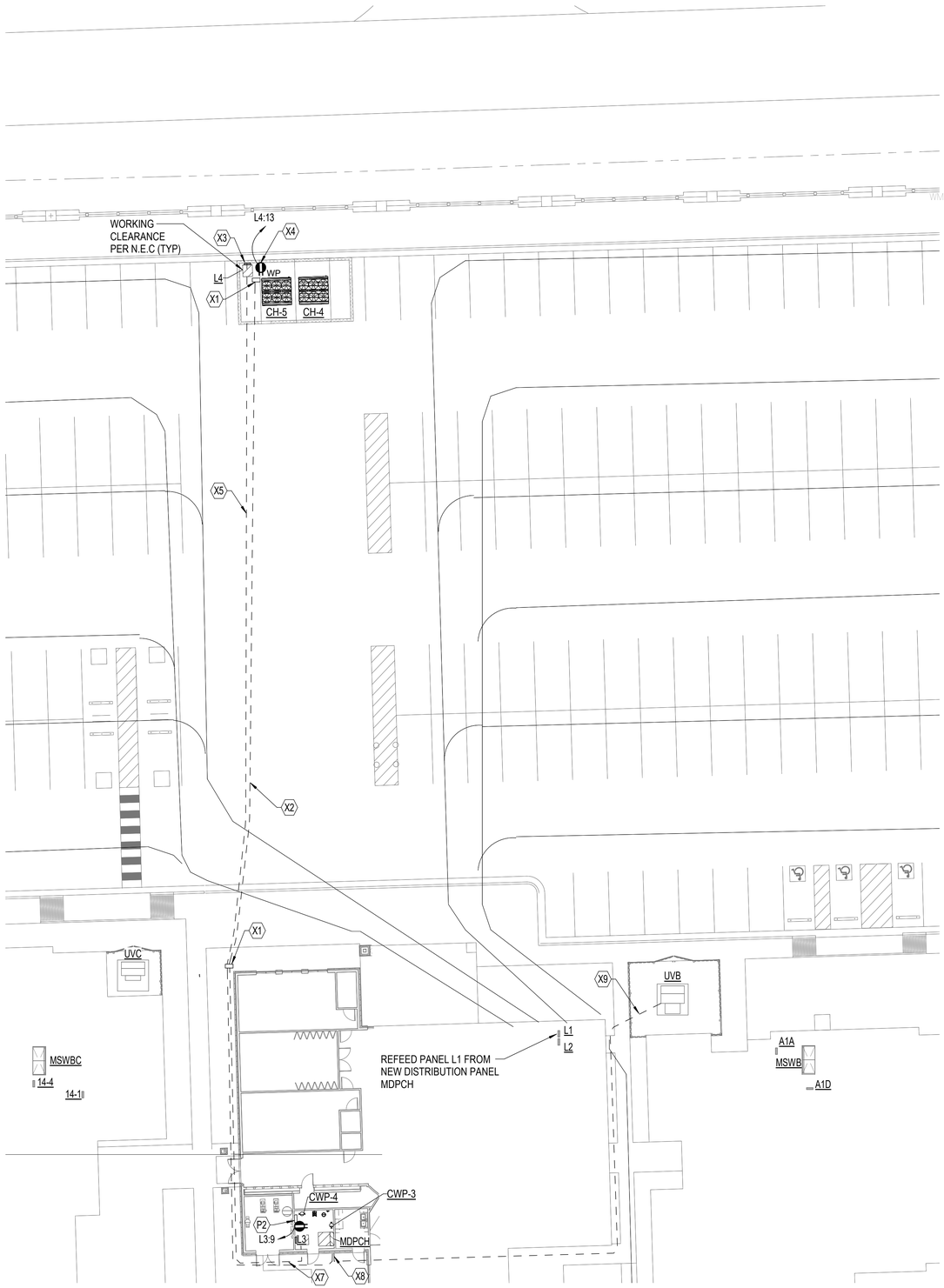

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1 POWER PLAN - CLUBHOUSE MECH ROOM

0' 8' 16' 24' 1/16" = 1'-0"

SHEET KEYNOTES

P2	PROVIDE 120V POWER TO CONTROL EQUIPMENT. COORDINATE WITH MECHANICAL CONTRACTOR FOR FINAL LOCATION OF CONTROL EQUIPMENT PRIOR TO ROUGH-IN. MECHANICAL CONTRACTOR SHALL FURNISH AND INSTALL ALL CONTROL EQUIPMENT. REFER TO MECHANCAIL SHEET M701.
X1	PROVIDE ELECTRICAL TIER 22 QUAZITE OR EQUAL JUNCTION BOX. FLUSH IN-GROUND JUNCTION BOX IN RUNS BETWEEN BUILDING AND CHILLER LOCATION. SIZE BOX TO ACCOMODATE REQUIRED CONDUITS.
X2	COORDINATE TRENCHING AND CONDUIT ROUTING WITH EXISTING UTILITIES, AND NEW MECHANICAL PIPING TO MINIMIZE CUTTING AND PATCHING IN THE EXISTING PARKING LOT.
X3	FURNISH AND INSTALL UNISTRUT TO MOUNT PANELBOARD L4 AND SERVICE RECEPTACLE. COORDINATE INSTALLATION ROUGH-INS FOR CONDUIT RUNS PRIOR TO CONCRETE PAD WORK.
X4	MOUNT THE GENERAL SERVICE RECEPTACLE ONUNISTRUT AT 36" ABOVE FINISHED GRADE.
X5	ROUTE UNDERGROUND CONDUCTORS FROM NEW DISTRIBUTION PANELBOARD MDPCH AND STUB-UP INTO CHILLER PANELBOARD L4.
X7	PROVIDE 1-INCH CONDUIT FOR CONTROL WIRING FROM CHILLER TO THE EXISTING BUILDING MANAGEMENT SYSTEM (BMS) INTERFACE IN THE MECHANICAL ROOM. COORDINATE WITH MECHANICAL CONTROLS CONTRACTOR FOR FINAL LOCATION PRIOR TO ROUGH-IN.
X8	STUB-UP TO THE OUTSIDE OF THE BUILDING AND PENETRATE INTO THE MECHANICAL ROOM TO TOP FEED MDPCH.
X9	ROUTE UNDERGROUND CONDUCTORS FROM EXISTING UVB TRANSFORMER TO NEW DISTRIBUTION PANELBOARD MDPCH. COORDINATE WITH UTILITY COMPANY FOR ALL SECONDARY REQUIREMENTS BEFORE WORK.

POWER GENERAL NOTES

1. BRANCH CIRCUITS ARE INDICATED AS ONE CIRCUIT HOME RUNS WITH INDIVIDUAL NEUTRALS. A MAXIMUM OF THREE CIRCUITS (MAXIMUM OF THREE PHASE CONDUCTORS) MAY BE GROUPED IN A SINGLE CONDUIT. WHERE MULTIPLE CIRCUITS ARE LOCATED IN THE SAME RACEWAY, JUNCTION BOX OR ENCLOSURE, NEUTRALS SHALL BE MARKED OR LABELED TO INDICATE WHICH CIRCUIT THEY ARE ASSOCIATED WITH. SEE SPECIFICATION SECTION "LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES" FOR ADDITIONAL INFORMATION.
2. A GROUND CONDUCTOR SIZED PER N.E.C. ARTICLE 250 IS REQUIRED IN ALL CONDUITS.
3. FOR CONNECTION REQUIREMENTS TO MECHANICAL UNITS, SEE MECHANICAL EQUIPMENT CONNECTION SCHEDULE.
4. FOR ALL PENETRATIONS IN FIRE RATED WALLS AND CEILINGS, PROVIDE AN ASTM E814 COMPLIANT, U.L. LISTED THROUGH PENETRATION FIRE STOPPING SYSTEM THAT IS SPECIFIC TO THE WALL OR CEILING CONSTRUCTION ASSEMBLY. INSTALL SYSTEM IN STRICT COMPLIANCE WITH THE U.L. ASSEMBLY INDICATED IN THE ARCHITECTURAL DRAWINGS AND SPECIFICATIONS.
5. ALL PIPING, CONDUIT, AND OUTLET BOXES (ELECTRIC, TELEPHONE, COMPUTER, ETC.) IN FIRE RATED WALLS OR CEILINGS SHALL BE CONSTRUCTED OF NON-COMBUSTIBLE MATERIAL.
6. OUTLET BOXES (ELECTRIC, TELEPHONE, COMPUTER, ETC.) ON OPPOSITE SIDES OF FIRE RATED WALLS SHALL BE SEPARATED BY A HORIZONTAL DISTANCE OF 24 INCHES OR PROTECTED BY OTHER MEANS ALLOWED BY THE SPECIFIC U.L. ASSEMBLY.

ELECTRICAL SITE GENERAL NOTES

1. UNLESS OTHERWISE NOTED, ALL CONDUIT ROUTED ON SITE SHALL BE 1" MINIMUM.
2. ALL RISERS AND BELOW GRADE ELLS SHALL BE PVC COATED RIGID GALVANIZED STEEL (RGS). PROVIDE WITH PVC TO STEEL ADAPTER(S) AS NECESSARY.
3. ALL ELECTRICAL WORK AND FEES ASSOCIATED WITH UTILITIES SHALL BE VERIFIED AND COORDINATED WITH LOCAL SERVICE PROVIDER PRIOR TO BID.
4. CONTRACTOR SHALL REFERENCE ALL RELATED CONTRACT DOCUMENTS, SITE SURVEY, AND OTHER RESOURCES FOR POSSIBLE CONFLICTS WITH OTHER UNDERGROUND UTILITIES. AT UTILITY CROSSINGS, CONTRACTOR SHALL VERIFY UTILITY DEPTHS AND COORDINATE CONDUIT ROUTING AS NECESSARY.
5. CONTRACTOR SHALL VERIFY AND COORDINATE EXISTING CONDITIONS OF PROJECT SITE PRIOR TO BID.

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RSU Geothermal Chillers

1701 W. Will Rogers Blvd
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POWER PLAN - CLUBHOUSE

100% CD

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POWER GENERAL NOTES

1. BRANCH CIRCUITS ARE INDICATED AS ONE CIRCUIT HOME RUNS WITH INDIVIDUAL NEUTRALS. A MAXIMUM OF THREE CIRCUITS (MAXIMUM OF THREE PHASE CONDUCTORS) MAY BE GROUPED IN A SINGLE CONDUIT. WHERE MULTIPLE CIRCUITS ARE LOCATED IN THE SAME RACEWAY, JUNCTION BOX OR ENCLOSURE, NEUTRALS SHALL BE MARKED OR LABELED TO INDICATE WHICH CIRCUIT THEY ARE ASSOCIATED WITH. SEE SPECIFICATION SECTION "LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES" FOR ADDITIONAL INFORMATION.
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4. FOR ALL PENETRATIONS IN FIRE RATED WALLS AND CEILINGS, PROVIDE AN ASTM E814 COMPLIANT, U.L. LISTED THROUGH PENETRATION FIRE STOPPING SYSTEM THAT IS SPECIFIC TO THE WALL OR CEILING CONSTRUCTION ASSEMBLY. INSTALL SYSTEM IN STRICT COMPLIANCE WITH THE U.L. ASSEMBLY INDICATED IN THE ARCHITECTURAL DRAWINGS AND SPECIFICATIONS.
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(#) SHEET KEYNOTES

P1	PROVIDE 1-INCH CONDUIT FOR CONTROL WIRING FROM CHILLER TO THE BUILDING MANAGEMENT SYSTEM (BMS) INTERFACE IN THE PENTHOUSE. COORDINATE WITH MECHANICAL CONTROLS CONTRACTOR FOR FINAL LOCATION PRIOR TO ROUGH-IN. OTHER EQUIPMENT PROVIDED AND INSTALLED BY CONTROLS CONTRACTOR PER MECHANICAL SHEET M701.
X3	FURNISH AND INSTALL UNISTRUT TO MOUNT PANELBOARD L4 AND SERVICE RECEPTACLE. COORDINATE INSTALLATION ROUGH-INS FOR CONDUIT RUNS PRIOR TO CONCRETE PAD WORK.
X6	MOUNT CHILLER DISCONNECTING MEANS AT 48" ABOVE FINISHED GRADE ON UNISTRUT.

N

1 ALTERNATE 1 - POWER PLAN - PREP HALL

0' 8' 16' 24' 1/16" = 1'-0"

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RSU Geothermal Chillers

1701 W. Will Rogers Blvd
Claremore, OK 74017

ALTERNATE 1 - POWER PLAN - PREP HALL

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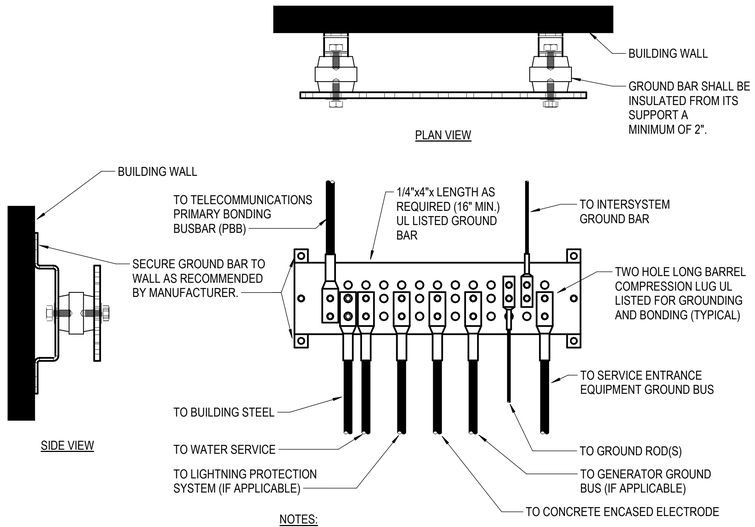
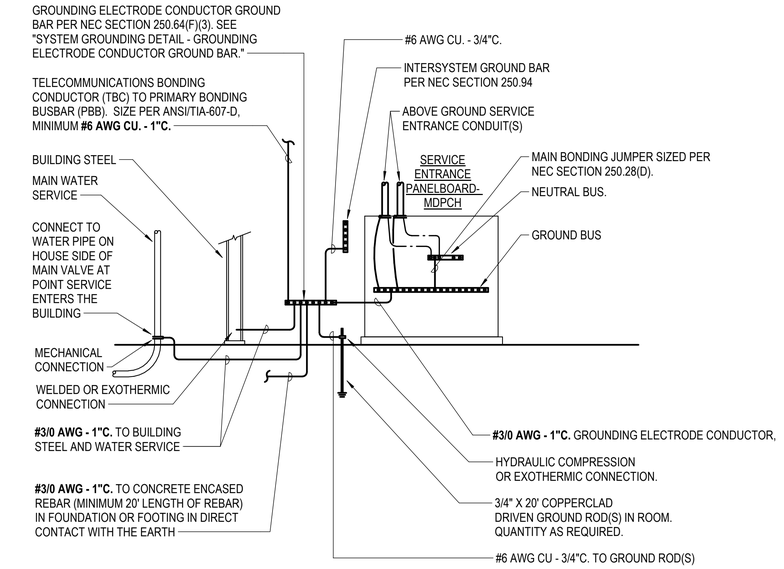


NOTES:

1. PROVIDE OTHER GROUNDING CONNECTIONS AS SPECIFIED IN NEC SECTION 250.50.
2. LABEL EACH GROUND CONDUCTOR TO INDICATE USE.
3. PROVIDE NON-FERROUS CONDUIT (SIZE AS NOTED) WHERE CONDUCTORS ARE SUBJECT TO PHYSICAL DAMAGE. IF FERROUS CONDUIT IS USED, BOND EACH END OF THE CONDUCTOR TO THE CONDUIT.
4. PROVIDE GROUND BAR WITH FIBERGLASS ENCLOSURE WITH HINGED LID AND BUSHINGS IF GROUND BAR IS SUBJECT TO PHYSICAL DAMAGE.

5 SYSTEM GROUNDING DETAIL - GROUNDING ELECTRODE CONDUCTOR GROUND BAR

NTS

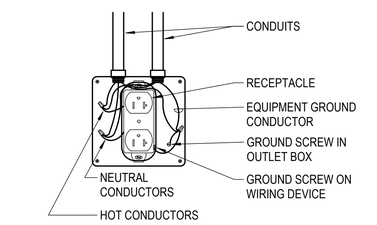


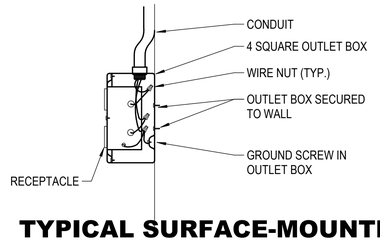
NOTES:

1. PROVIDE OTHER GROUNDING CONNECTIONS AS SPECIFIED IN NEC SECTION 250.50.
2. LABEL EACH GROUNDING ELECTRODE CONDUCTOR AND BONDING JUMPER.
3. WHERE CONDUCTORS ARE ROUTED IN FERROUS CONDUIT, BOND BOTH ENDS OF THE CONDUIT TO THE CONDUCTOR.

4 SYSTEM GROUNDING DETAIL

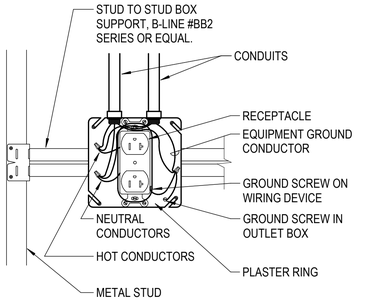
NTS

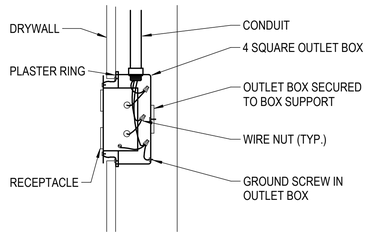




3 TYPICAL SURFACE-MOUNTED RECEPTACLE MOUNTING DETAIL

NTS





2 TYPICAL RECEPTACLE MOUNTING DETAIL

NTS

ALL CONTROL PANELS: PROVIDE THERMAL TRANSFER STYLE LABEL WITH ELECTRICAL PANEL AND CIRCUIT NUMBER SERVING CONTROL PANEL

1/8" / 1/4"
SERVES
CHILLER #1
BREAKER/SWITCH FOR SWITCHBOARD/DISTRIBUTION PANEL/MOTOR CONTROL CENTER

TYPICAL RECEPTACLE
THERMAL TRANSFER STYLE LABEL WITH RECEPTACLE PANEL AND CIRCUIT NUMBER
LP1W:6

1/8" / 1/4" / 1/4" / 1/4"
SERVES
CHILLER #1
FED FROM DP:**
LPJ 200AMP
DISCONNECT SWITCH

TYPICAL J-BOX
THERMAL TRANSFER STYLE LABEL INDICATING ALL CIRCUITS OR LOW VOLTAGE SYSTEM WITHIN J-BOX
LP1W:6

1 TYPICAL NAMEPLATES AND LABELS

NTS

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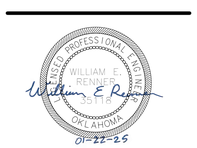

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ELECTRICAL DETAILS

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FEEDER SCHEDULE

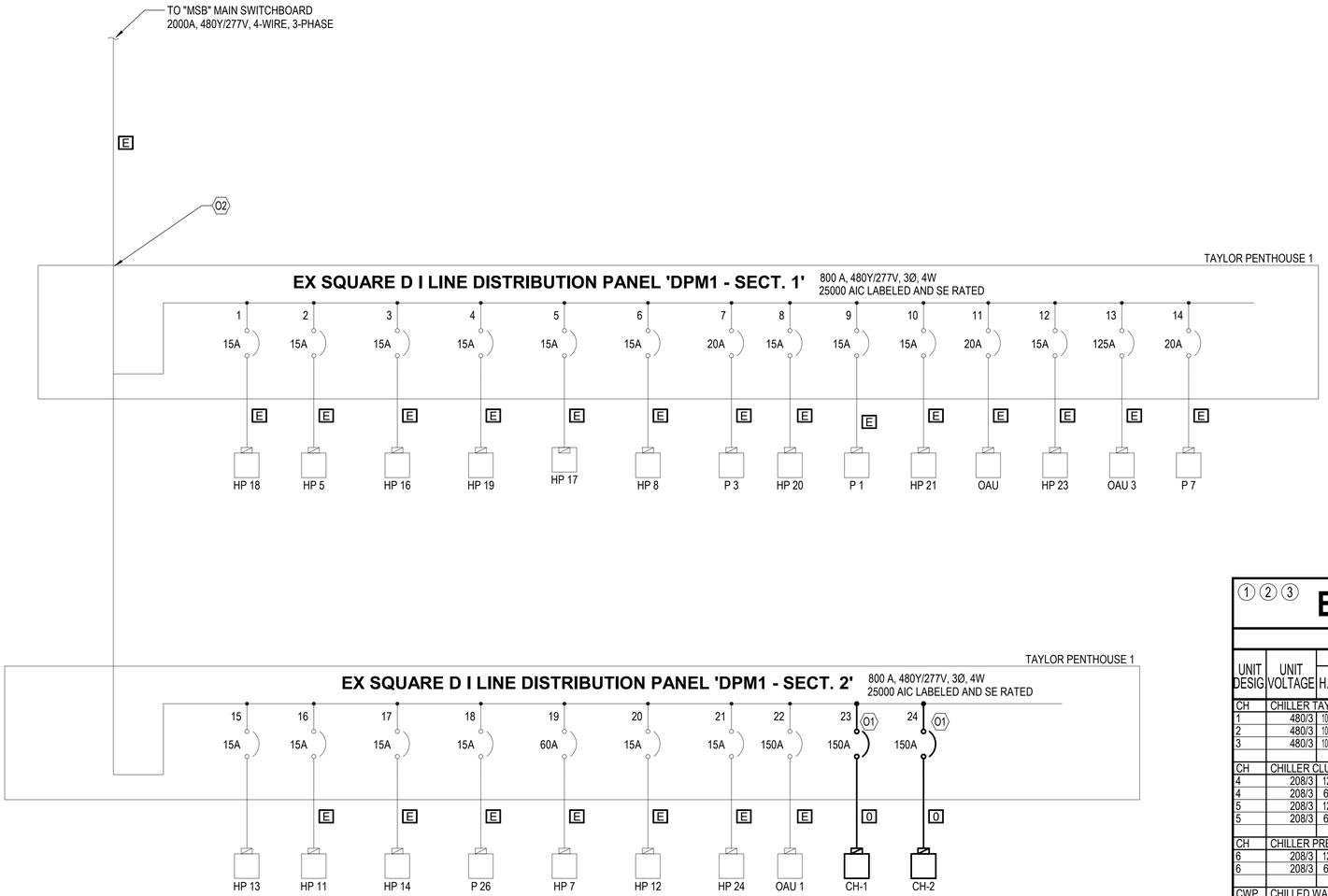
DESIG.	EQUIPMENT SERVED	CONDUCTORS SETS	CONDUCTORS NO.	CONDUCTORS SIZE	GROUND SIZE PER SET	ISOLATED GROUND SIZE	CONDUIT SIZE PER SET	SPARE CONDUIT
0	REFERENCE EQUIPMENT CONNECTION SCHEDULE							
E	EXISTING FEEDER TO REMAIN							

ONE-LINE DIAGRAM GENERAL NOTES

1. UNLESS OTHERWISE NOTED, ALL CIRCUIT BREAKERS AND/OR SWITCHES ARE THREE POLE.
2. ALL ELECTRICAL EQUIPMENT AND WIRING SHOWN IN A LIGHT LINE, IS EXISTING TO REMAIN.
3. ALL ELECTRICAL EQUIPMENT AND WIRING SHOWN IN A DARK LINE, IS NEW WORK UNDER THIS CONTRACT.
4. ALL ELECTRICAL EQUIPMENT AND WIRING SHOWN IN A DARK DASHED LINE, IS TO BE REMOVED UNDER THIS CONTRACT.

SHEET KEYNOTES

O1	PROVIDE AND INSTALL CIRCUIT BREAKER IN EXISTING SPACE. CIRCUIT BREAKER SHALL MATCH EXISTING CIRCUIT BREAKERS AND SHALL BE RATED FOR THE MAXIMUM AIC RATING WITHIN THE EXISTING PANEL.
O2	PROVIDE A 30-DAY LOAD MONITORING METERING FOR ELECTRICAL SYSTEM ANALYSIS. THE METER SHALL CONTINUOUSLY RECORD LOAD DATA INCLUDING PEAK DEMAND, REAL -TIME LOAD AND ENERGY CONSUMPTION TO JUSTIFY ADDITIONAL LOAD ON PANEL. SEND REPORT FOR EACH PANEL NOTED TO ENGINEER OF RECORD FOR REVIEW.



1 EXISTING ONE-LINE TAYLOR BUILDING -PENTHOUSE 1 MODIFIED

NTS

EQUIPMENT CONNECTION SCHEDULE

(1) (2) (3)

MECHANICAL EQUIPMENT CONNECTIONS

UNIT DESIG	UNIT VOLTAGE	LOAD H.P.	LOAD FLA	LOAD KVA	PANEL DEVICE CIRCUIT NUMBER	PANEL DEVICE BKR. AMPS	PANEL DEVICE SW. AMPS	PANEL DEVICE FUSE AMPS	PANEL DEVICE S NEMA START SIZE	DEVICE AT UNIT BKR. AMPS	DEVICE AT UNIT SW. AMPS	DEVICE AT UNIT FUSE AMPS	DEVICE AT UNIT S NEMA START SIZE	DEVICE AT UNIT OTHER	STS	FEEDER DESCRIPTION OR SEE THE FEEDER SCHEDULE	REMARKS OR SEE THE INDICATED NOTES BELOW
CH	CHILLER TAYLOR CENTER																
1	480/3	105.6A	105.6	87.79	DPM1:23	150		3		200	150	3		NEMA-3R	1	3 #1/0 AWG THWN; #6 AWG GRD; 2"C.	
2	480/3	105.6A	105.6	87.79	DPM1:24	150		3		200	150	3		NEMA-3R	1	3 #1/0 AWG THWN; #6 AWG GRD; 2"C.	
3	480/3	105.6A	105.6	87.79	DPM2:7	150		3		200	150	3		NEMA-3R	1	3 #2/0 AWG THWN; #6 AWG GRD; 1-1/2"IMC	
CH	CHILLER CLUBHOUSE																
4	208/3	128A	128.0	46.11	L4:1	175		3		200	175	3		NEMA-3R	1	3 #2/0 AWG THWN; #6 AWG GRD; 2"C.	CONNECTION 1 OF 2
4	208/3	64A	64.0	23.05	L4:2	100		3		100	90	3		NEMA-3R	1	3 #1 AWG THWN; #8 AWG GRD; 1-1/2"C.	CONNECTION 2 OF 2
5	208/3	128A	128.0	46.11	L4:7	175		3		200	175	3		NEMA-3R	1	3 #2/0 AWG THWN; #6 AWG GRD; 2"C.	CONNECTION 1 OF 2
5	208/3	64A	64.0	23.05	L4:8	100		3		100	90	3		NEMA-3R	1	3 #1 AWG THWN; #8 AWG GRD; 1-1/2"C.	CONNECTION 2 OF 2
CH	CHILLER PREP HALL																
6	208/3	128A	128.0	46.11	MSB-ANNEX:12	175		3		200	175	3		NEMA-3R	1	3 #2/0 AWG THWN; #2/0 AWG GRD; 2"C.	CONNECTION 1 OF 2
6	208/3	64A	64.0	23.05	MSB-ANNEX:1	100		3		100	90	3		NEMA-3R	1	3 #1 AWG THWN; #6 AWG GRD; 1-1/2"C.	CONNECTION 2 OF 2
CWP	CHILLED WATER PUMP																
1	480/3	5	7.6	6.319	HA3:33	20		3		30	12	3			1	3 #12 AWG THWN; #12 AWG GRD; 1/2"C.	VFD BY MECHANICAL
2	480/3	2	3.4	2.827	HB3:21	20		3		30	5.6	3			1	3 #12 AWG THWN; #12 AWG GRD; 1/2"C.	VFD BY MECHANICAL
3	208/3	5	16.7	6.016	L3:2	30		3		30	25	3			1	3 #10 AWG THWN; #10 AWG GRD; 3/4"C.	VFD BY MECHANICAL
4	208/3	1.5	6.6	2.378	L3:1	20		3		30	10	3			1	3 #12 AWG THWN; #12 AWG GRD; 1/2"C.	VFD BY MECHANICAL
5	208/3	1.5	6.6	2.378	A3:1	20		3		30	10	3			1	3 #12 AWG THWN; #12 AWG GRD; 1/2"C.	VFD BY MECHANICAL
6	208/3	1	4.6	1.657	A3:2	20		3		30	8	3			1	3 #12 AWG THWN; #12 AWG GRD; 1/2"C.	VFD BY MECHANICAL

(1) ALL CONNECTIONS AND ELECTRICAL EQUIPMENT LISTED IN SCHEDULE SHALL BE PROVIDED AND INSTALLED BY THE ELECTRICAL CONTRACTOR. FIELD VERIFY CONNECTION REQUIREMENTS AND EQUIPMENT PROVIDED BY OTHERS PRIOR TO ROUGH-IN.

(2) REFER TO MECHANICAL DRAWINGS AND SPECIFICATIONS FOR THE REQUIREMENTS ASSOCIATED WITH WIRING AND CONNECTIONS OF INTERLOCKING, THERMOSTAT LOCATIONS, EXHAUST FAN CONTROL SWITCHES, AND OTHER CONTROLS OF MECHANICAL EQUIPMENT.

(3) SIZE FUSES FOR MOTOR FUSTATS BASED ON 125% OF MANUFACTURER'S NAMEPLATE FULL LOAD AMPERAGE UNLESS OTHERWISE NOTED ON THE DRAWINGS.

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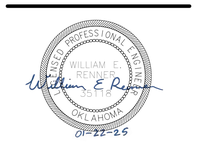

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ELECTRICAL ONE-LINE DIAGRAM -TAYLOR 1

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FEEDER SCHEDULE

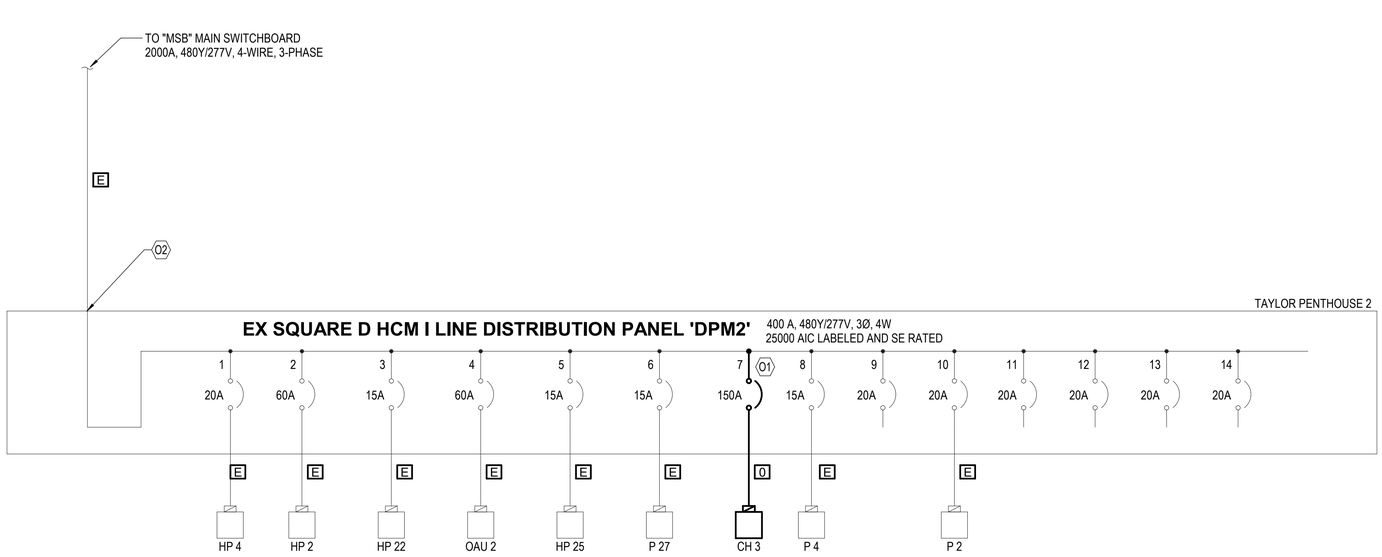
DESIG.	EQUIPMENT SERVED	CONDUCTORS			GROUND SIZE PER SET	ISOLATED GROUND SIZE	CONDUIT SIZE PER SET	SPARE CONDUIT
		SETS	NO.	SIZE				
0	REFERENCE EQUIPMENT CONNECTION SCHEDULE							
E	EXISTING FEEDER TO REMAIN							

ONE-LINE DIAGRAM GENERAL NOTES

1. UNLESS OTHERWISE NOTED, ALL CIRCUIT BREAKERS AND/OR SWITCHES ARE THREE POLE.
2. ALL ELECTRICAL EQUIPMENT AND WIRING SHOWN IN A LIGHT LINE, IS EXISTING TO REMAIN.
3. ALL ELECTRICAL EQUIPMENT AND WIRING SHOWN IN A DARK LINE, IS NEW WORK UNDER THIS CONTRACT.
4. ALL ELECTRICAL EQUIPMENT AND WIRING SHOWN IN A DARK DASHED LINE, IS TO BE REMOVED UNDER THIS CONTRACT.

SHEET KEYNOTES

01	PROVIDE AND INSTALL CIRCUIT BREAKER IN EXISTING SPACE. CIRCUIT BREAKER SHALL MATCH EXISTING CIRCUIT BREAKERS AND SHALL BE RATED FOR THE MAXIMUM AIC RATING WITHIN THE EXISTING PANEL.
02	PROVIDE A 30-DAY LOAD MONITORING METERING FOR ELECTRICAL SYSTEM ANALYSIS. THE METER SHALL CONTINUOUSLY RECORD LOAD DATA INCLUDING PEAK DEMAND, REAL -TIME LOAD AND ENERGY CONSUMPTION TO JUSTIFY ADDITIONAL LOAD ON PANEL. SEND REPORT FOR EACH PANEL NOTED TO ENGINEER OF RECORD FOR REVIEW.



1 EXISTING ONE-LINE TAYLOR BUILDING -PENTHOUSE 2 MODIFIED

NTS

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PROFESSIONAL ENGINEERING CONSULTANTS
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TULSA, OK 74104
918-664-5400 www.pec1.com
C.O.A. #1046 PE/LS EXPIRES:
JUNE 30, 2025

REVISIONS

No.	Date	Description

RSU Geothermal Chillers

1701 W. Will Rogers Blvd
Claremore, OK 74017

ELECTRICAL ONE-LINE DIAGRAM -TAYLOR 2

100% CD

PEC PROJECT NUMBER: 231211-000
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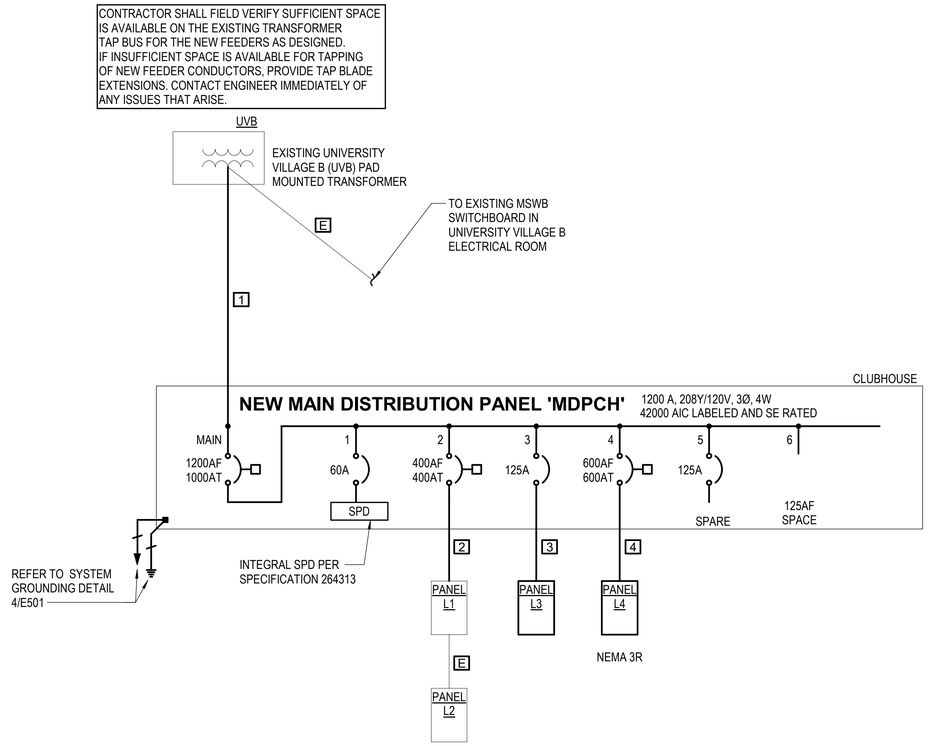
E602



1 ELECTRICAL ONE-LINE DIAGRAM CLUB HOUSE - MODIFIED

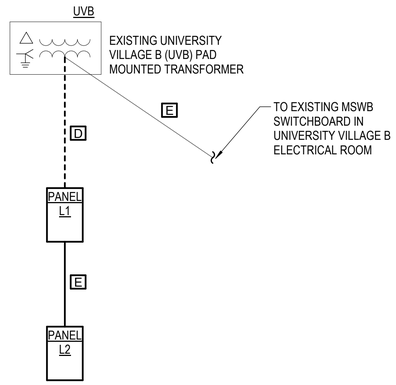
NTS

FEEDER SCHEDULE

DESIG.	EQUIPMENT SERVED	CONDUCTORS			GROUND SIZE PER SET	ISOLATED GROUND SIZE	CONDUIT SIZE PER SET	SPARE CONDUIT
		SETS	NO.	SIZE				
D	EXISTING TO BE DEMOLISHED							
E	EXISTING TO REMAIN							
1	DISTRIBUTION PANEL: MDPC	3	4	400 Kcmil CU	--	--	4"C.	--
2	PANELBOARD: L1	2	4	#3/0 AWG CU	#3	--	2-1/2"C.	--
3	PANELBOARD: L3	1	4	#1/0 AWG CU	#6	--	2"C.	--
4	PANELBOARD: L4	2	4	400 Kcmil CU	#1/0	--	4"C.	--

ONE-LINE DIAGRAM GENERAL NOTES

1. UNLESS OTHERWISE NOTED, ALL CIRCUIT BREAKERS AND/OR SWITCHES ARE THREE POLE.
2. ALL ELECTRICAL EQUIPMENT AND WIRING SHOWN IN A LIGHT LINE, IS EXISTING TO REMAIN. ———
3. ALL ELECTRICAL EQUIPMENT AND WIRING SHOWN IN A DARK LINE, IS NEW WORK UNDER THIS CONTRACT. ———
4. ALL ELECTRICAL EQUIPMENT AND WIRING SHOWN IN A DARK DASHED LINE, IS TO BE REMOVED UNDER THIS CONTRACT. - - - - - - - - - -



3 EXISTING PARTIAL ONE-LINE DIAGRAM CLUBHOUSE - DEMOLITION

NTS

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SUITE 1400
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C.O.A. #1046 PE/LS EXPIRES:
JUNE 30, 2025

REVISIONS

No.	Date	Description

RSU Geothermal Chillers

1701 W. Will Rogers Blvd
Claremore, OK 74017

ELECTRICAL ONE-LINE DIAGRAM - CLUBHOUSE

100% CD

PEC PROJECT NUMBER: 231211-000
DATE 01/22/2025
DRAWN BY EOO
CHECKED BY AR

E603

FEEDER SCHEDULE

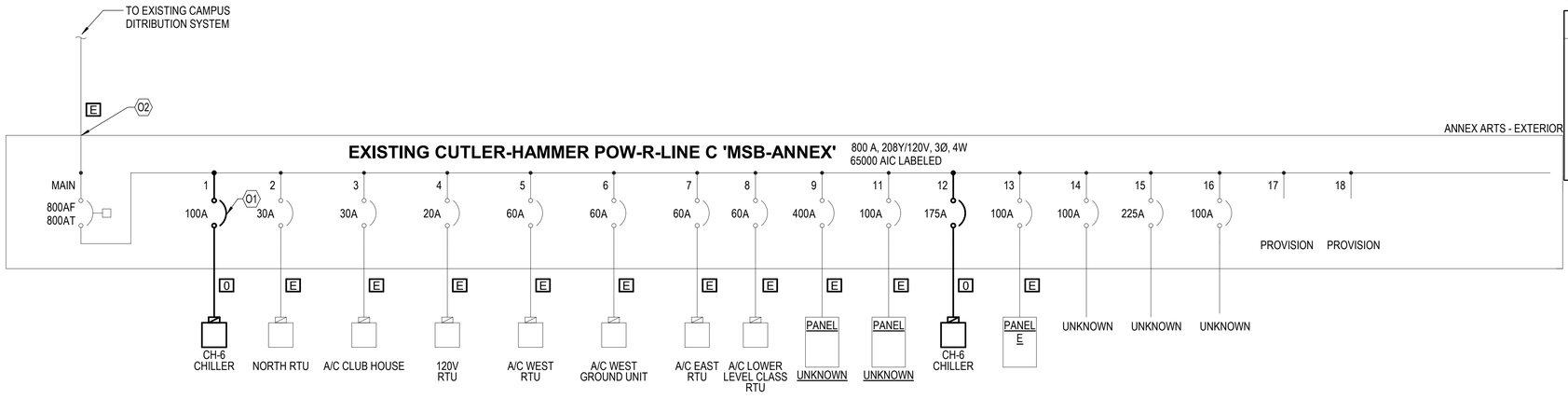
DESIG.	EQUIPMENT SERVED	CONDUCTORS SETS	CONDUCTORS NO.	CONDUCTORS SIZE	GROUND SIZE PER SET	ISOLATED GROUND SIZE	CONDUIT SIZE PER SET	SPARE CONDUIT
0	REFERENCE EQUIPMENT CONNECTION SCHEDULE							
E	EXISTING FEEDER TO REMAIN							

ONE-LINE DIAGRAM GENERAL NOTES

1. UNLESS OTHERWISE NOTED, ALL CIRCUIT BREAKERS AND/OR SWITCHES ARE THREE POLE.
2. ALL ELECTRICAL EQUIPMENT AND WIRING SHOWN IN A LIGHT LINE, IS EXISTING TO REMAIN.
3. ALL ELECTRICAL EQUIPMENT AND WIRING SHOWN IN A DARK LINE, IS NEW WORK UNDER THIS CONTRACT.
4. ALL ELECTRICAL EQUIPMENT AND WIRING SHOWN IN A DARK DASHED LINE, IS TO BE REMOVED UNDER THIS CONTRACT.

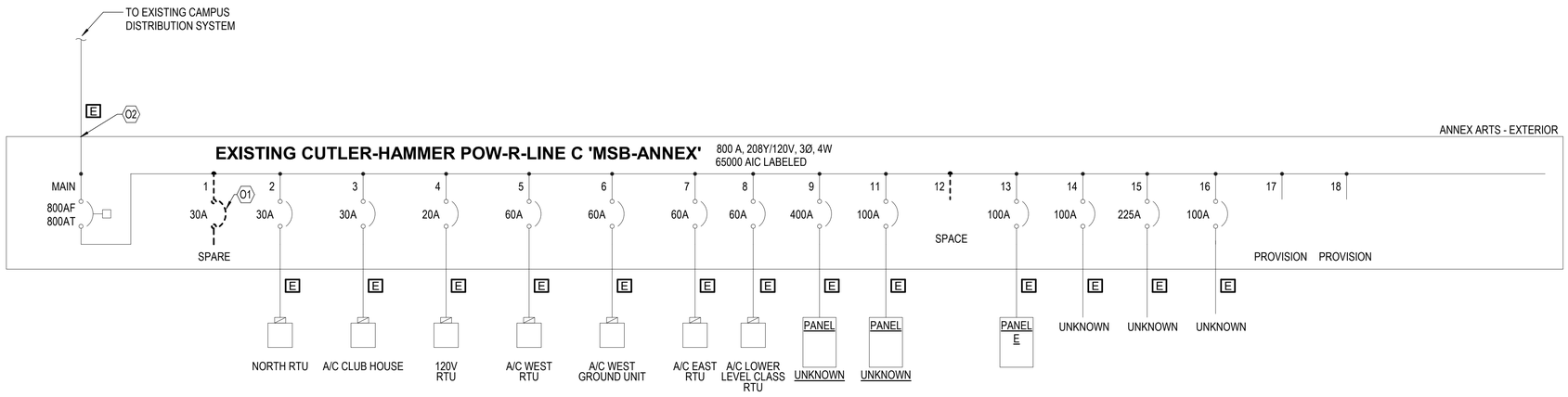
SHEET KEYNOTES

#	
O1	PROVIDE AND INSTALL CIRCUIT BREAKER IN EXISTING SPACE. CIRCUIT BREAKER SHALL MATCH EXISTING CIRCUIT BREAKERS AND SHALL BE RATED FOR THE MAXIMUM AIC RATING WITHIN THE EXISTING PANEL.
O2	PROVIDE A 30-DAY LOAD MONITORING METERING FOR ELECTRICAL SYSTEM ANALYSIS. THE METER SHALL CONTINUOUSLY RECORD LOAD DATA INCLUDING PEAK DEMAND, REAL -TIME LOAD AND ENERGY CONSUMPTION TO JUSTIFY ADDITIONAL LOAD ON PANEL. SEND REPORT FOR EACH PANEL NOTED TO ENGINEER OF RECORD FOR REVIEW.



2 EXISTING ONE-LINE ANNEX -MODIFIED

NTS



1 EXISTING ONE-LINE ANNEX-DEMOLITION

NTS

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REVISIONS

No.	Date	Description

RSU Geothermal Chillers

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ALTERNATE 1 - ONE-LINE DIAGRAM -ANNEX

100% CD

PEC PROJECT NUMBER: 231211-000
DATE 01/22/2025
DRAWN BY EOO
CHECKED BY AR

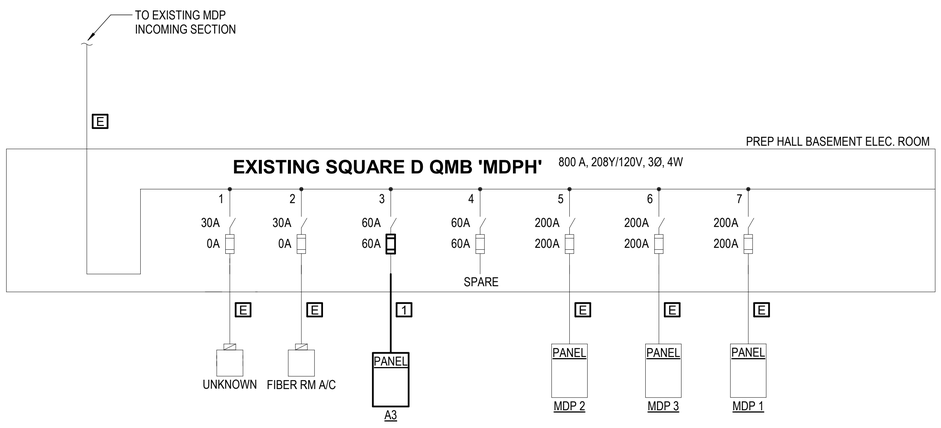
E604

FEEDER SCHEDULE

DESIG.	EQUIPMENT SERVED	CONDUCTORS			GROUND SIZE PER SET	ISOLATED GROUND SIZE	CONDUIT SIZE PER SET	SPARE CONDUIT
		SETS	NO.	SIZE				
0	REFERENCE EQUIPMENT CONNECTION SCHEDULE							
E	EXISTING FEEDER TO REMAIN							
1	PANELBOARD:A3	1	4	#4 AWG CU	#8	--	1 1/4-"C.	--

ONE-LINE DIAGRAM GENERAL NOTES

1. UNLESS OTHERWISE NOTED, ALL CIRCUIT BREAKERS AND/OR SWITCHES ARE THREE POLE.
2. ALL ELECTRICAL EQUIPMENT AND WIRING SHOWN IN A LIGHT LINE, IS EXISTING TO REMAIN.
3. ALL ELECTRICAL EQUIPMENT AND WIRING SHOWN IN A DARK LINE, IS NEW WORK UNDER THIS CONTRACT.
4. ALL ELECTRICAL EQUIPMENT AND WIRING SHOWN IN A DARK DASHED LINE, IS TO BE REMOVED UNDER THIS CONTRACT.



1 EXISTING PARTIAL ONE-LINE DIAGRAM PREP HALL -MODIFIED

NTS

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JUNE 30, 2025

REVISIONS

No.	Date	Description

RSU Geothermal Chillers

1701 W. Will Rogers Blvd
Claremore, OK 74017

ALTERNATE 1 - ONE-LINE DIAGRAM -PREP HALL

100% CD

PEC PROJECT NUMBER: 231211-000
DATE 01/22/2025
DRAWN BY EOO
CHECKED BY AR

E605

① EXISTING PANEL: HB3

480Y/277 VOLTS, 3 PHASE, 4 WIRE
225 AMP MLO, SURFACE MTD.
14000 AIC LABELED

SQUARE D NF, W/GRD. BUS

CIRC NO.	LOAD V. A.	LOAD TYPE	LOAD DESCRIPTION	P.	AMP SIZE	PHASE	AMP SIZE	P.	LOAD DESCRIPTION	LOAD TYPE	LOAD V. A.	CIRC NO.
1		EXST	EXISTING LOAD	1	20	A	45	3	EXISTING LOAD	EXST		2
3		EXST	EXISTING LOAD	1	20	B	|	---	----------	---	----	4
5		EXST	EXISTING LOAD	1	20	C	|	---	----------	---	----	6
7		EXST	EXISTING LOAD	1	20	A	20	1	EXISTING LOAD	EXST		8
9		EXST	EXISTING LOAD	1	20	B	20	1	EXISTING LOAD	EXST		10
11		EXST	EXISTING LOAD	1	20	C	20	1	EXISTING LOAD	EXST		12
13		EXST	EXISTING LOAD	1	20	A	20	1	EXISTING LOAD	EXST		14
15		EXST	EXISTING LOAD	1	20	B	20	1	EXISTING LOAD	EXST		16
17		EXST	EXISTING LOAD	1	20	C	20	1	EXISTING LOAD	EXST		18
19		EXST	EXISTING LOAD	1	20	A	20	1	EXISTING LOAD	EXST		20
② 21	2827	MOTR	CWP-2	3	20	B			SPACE			22
23	----	---	----------	---	|	C			SPACE			24
25	----	---	----------	---	|	A			SPACE			26
27			SPACE			B			SPACE			28
29			SPACE			C			SPACE			30
31			SPACE			A			SPACE			32
33			SPACE			B			SPACE			34
35			SPACE			C			SPACE			36
37			SPACE			A			SPACE			38
39			SPACE			B			SPACE			40
41			SPACE			C			SPACE			42

① EXISTING CIRCUIT BREAKER AND LOAD TO REMAIN.
② PROVIDE AND INSTALL CIRCUIT BREAKER IN EXISTING SPACE. CIRCUIT BREAKER SHALL MATCH EXISTING CIRCUIT BREAKERS AND SHALL BE RATED FOR THE MAX. AIC RATING WITHIN EXISTING PANEL. VERIFY ALL REQUIREMENTS IN FIELD.

① EXISTING PANEL: HA3

480Y/277 VOLTS, 3 PHASE, 4 WIRE
225 AMP MLO, SURFACE MTD.
14000 AIC LABELED

SQUARE D NF, W/GRD. BUS

CIRC NO.	LOAD V. A.	LOAD TYPE	LOAD DESCRIPTION	P.	AMP SIZE	PHASE	AMP SIZE	P.	LOAD DESCRIPTION	LOAD TYPE	LOAD V. A.	CIRC NO.
1		EXST	EXISTING LOAD	1	20	A	20	1	EXISTING LOAD	EXST		2
3		EXST	EXISTING LOAD	3	45	B	20	3	EXISTING LOAD	EXST		4
5	----	---	----------	---	|	C	|	---	----------	---	----	6
7	----	---	----------	---	|	A	|	---	----------	---	----	8
9		EXST	EXISTING LOAD	3	15	B	20	3	EXISTING LOAD	EXST		10
11	----	---	----------	---	|	C	|	---	----------	---	----	12
13	----	---	----------	---	|	A	|	---	----------	---	----	14
15		EXST	EXISTING LOAD	3	15	B	15	3	EXISTING LOAD	EXST		16
17	----	---	----------	---	|	C	|	---	----------	---	----	18
19	----	---	----------	---	|	A	|	---	----------	---	----	20
21		EXST	EXISTING LOAD	3	15	B	15	3	EXISTING LOAD	EXST		22
23	----	---	----------	---	|	C	|	---	----------	---	----	24
25	----	---	----------	---	|	A	|	---	----------	---	----	26
27		EXST	EXISTING LOAD	3	15	B	15	3	EXISTING LOAD	EXST		28
29	----	---	----------	---	|	C	|	---	----------	---	----	30
31	----	---	----------	---	|	A	|	---	----------	---	----	32
② 33	6319	MOTR	CWP-1	3	20	B	15	3	EXISTING LOAD	EXST		34
35	----	---	----------	---	|	C	|	---	----------	---	----	36
37	----	---	----------	---	|	A	|	---	----------	---	----	38
39			SPARE	1	20	B	20	1	SPARE			40
41			SPARE	1	20	C	20	1	SPARE			42

① EXISTING CIRCUIT BREAKER AND LOAD TO REMAIN.
② USE EXISTING SPARE BREAKER.

① EXISTING PANEL: LA3

208Y/120 VOLTS, 3 PHASE, 4 WIRE
225 AMP MAIN BKR, SURFACE MTD.
10000 AIC LABELED

SQUARE D NQOD, W/GRD. BUS

CIRC NO.	LOAD V. A.	LOAD TYPE	LOAD DESCRIPTION	P.	AMP SIZE	PHASE	AMP SIZE	P.	LOAD DESCRIPTION	LOAD TYPE	LOAD V. A.	CIRC NO.
1		EXST	EXISTING LOAD	1	20	A	20	1	EXISTING LOAD	EXST		2
3		EXST	EXISTING LOAD	1	20	B	20	1	EXISTING LOAD	EXST		4
5		EXST	EXISTING LOAD	1	20	C	20	1	EXISTING LOAD	EXST		6
7		EXST	EXISTING LOAD	1	20	A	20	1	EXISTING LOAD	EXST		8
9		EXST	EXISTING LOAD	1	20	B	20	1	EXISTING LOAD	EXST		10
11		EXST	EXISTING LOAD	1	15	C	20	1	EXISTING LOAD	EXST		12
13		EXST	EXISTING LOAD	1	20	A	20	1	EXISTING LOAD	EXST		14
15		EXST	EXISTING LOAD	1	20	B	20	1	EXISTING LOAD	EXST		16
17		EXST	EXISTING LOAD	1	20	C	20	1	EXISTING LOAD	EXST		18
② 19	200	RCPT	CHILLER CONTROL PANEL	1	20	A	20	1	EXISTING LOAD	EXST		20
21			SPARE	1	20	B	20	1	EXISTING LOAD	EXST		22
23		EXST	EXISTING LOAD	1	20	C	20	1	EXISTING LOAD	EXST		24
25		EXST	EXISTING LOAD	1	20	A	20	1	EXISTING LOAD	EXST		26
27		EXST	EXISTING LOAD	1	20	B	20	1	EXISTING LOAD	EXST		28
29		EXST	EXISTING LOAD	1	20	C	20	1	EXISTING LOAD	EXST		30
31		EXST	EXISTING LOAD	1	20	A	20	1	EXISTING LOAD	EXST		32
33		EXST	EXISTING LOAD	1	20	B	20	1	EXISTING LOAD	EXST		34
35		EXST	EXISTING LOAD	1	20	C	20	1	EXISTING LOAD	EXST		36
37		EXST	EXISTING LOAD	1	20	A	20	1	EXISTING LOAD	EXST		38
39		EXST	EXISTING LOAD	1	20	B	20	1	EXISTING LOAD	EXST		40
41		EXST	EXISTING LOAD	1	20	C			EXISTING LOAD	EXST		42

① EXISTING CIRCUIT BREAKER AND LOAD TO REMAIN.
② PROVIDE AND INSTALL CIRCUIT BREAKER IN EXISTING SPACE. CIRCUIT BREAKER SHALL MATCH EXISTING CIRCUIT BREAKERS AND SHALL BE RATED FOR THE MAX. AIC RATING WITHIN EXISTING PANEL. VERIFY ALL REQUIREMENTS IN FIELD.

PANELBOARD: L3

208Y/120 VOLTS, 3 PHASE, 4 WIRE
125 AMP MLO, SURFACE MTD.
22000 AIC LABELED

W/GRD. BUS

CIRC NO.	LOAD V. A.	LOAD TYPE	LOAD DESCRIPTION	P.	AMP SIZE	PHASE	AMP SIZE	P.	LOAD DESCRIPTION	LOAD TYPE	LOAD V. A.	CIRC NO.
1	2378	MOTR	CWP-4	3	20	A	30	3	CWP-3	MOTR	6016	2
3	----	---	----------	---	|	B	|	---	----------	---	----	4
5	----	---	----------	---	|	C	|	---	----------	---	----	6
7	200	RCPT	CHILLER CONTROL PANEL	1	20	A	30	3	SPARE			8
9			SPARE	1	20	B	|	---	----------	---	----	10
11			SPARE	1	20	C	|	---	----------	---	----	12
13			SPARE	1	20	A			SPACE			14
15			SPARE	1	20	B			SPACE			16
17			SPARE	1	20	C			SPACE			18
19			SPARE	1	20	A			SPACE			20
21			SPARE	1	20	B			SPACE			22
23			SPARE	1	20	C			SPACE			24
25			SPARE	1	20	A			SPACE			26
27			SPARE	1	20	B			SPACE			28
29			SPARE	1	20	C			SPACE			30

PANELBOARD: L3

	CONNECTED KVA: PH-A	PH-B	PH-C	TOTAL	DEMAND FACTOR	KVA	CONT. FACT	SIZING AMPS: TOTAL	PH-A	PH-B	PH-C
Receptacle	0.2	0.0	0.0	0.2	1	0.2	1	0.6	1.7	0.0	0.0
Largest Motor	0.0	0.0	0.0	0.0	1	0.0	0.25	4.2	4.2	4.2	4.2
Motor	2.8	2.8	2.8	8.4	1	8.4	1	23.3	23.3	23.3	23.3
Spare					0.2	1.7	1	4.8	4.8	4.8	4.8
TOTAL KVA:	3.0	2.8	2.8	8.6			10.3	TOTAL AMPS:	PH-A	PH-B	PH-C
TOTAL AMPS:	25.0	23.3	23.3	23.9				32.8	33.9	32.3	32.3

PANELBOARD: L4

208Y/120 VOLTS, 3 PHASE, 4 WIRE
600 AMP MAIN BKR, SURFACE MTD.
22000 AIC LABELED

W/SPD - SURGE PROTECTION DEVICE, W/GRD. BUS NEMA 3R

CIRC NO.	LOAD V. A.	LOAD TYPE	LOAD DESCRIPTION	P.	AMP SIZE	PHASE	AMP SIZE	P.	LOAD DESCRIPTION	LOAD TYPE	LOAD V. A.	CIRC NO.
1	46114	MOTR	CH-4	3	175	A	100	3	CH-4	MOTR	23057	2
3	----	---	----------	---	|	B	|	---	----------	---	----	4
5	----	---	----------	---	|	C	|	---	----------	---	----	6
7	46114	MOTR	CH-5	3	175	A	100	3	CH-5	MOTR	23057	8
9	----	---	----------	---	|	B	|	---	----------	---	----	10
11	----	---	----------	---	|	C	|	---	----------	---	----	12
13	200	RCPT	SERVICE RECEPTACLE	1	20	A			SPACE			14
15			SPARE	1	20	B			SPACE			16
17			SPARE	1	20	C			SPACE			18
19			SPARE	1	20	A			SPACE			20
21			SPARE	1	20	B			SPACE			22
23			SPACE			C			SPACE			24

PANELBOARD: L4

	CONNECTED KVA: PH-A	PH-B	PH-C	TOTAL	DEMAND FACTOR	KVA	CONT. FACT	SIZING AMPS: TOTAL	PH-A	PH-B	PH-C
Receptacle	0.2	0.0	0.0	0.2	1	0.2	1	0.6	1.7	0.0	0.0
Largest Motor	0.0	0.0	0.0	0.0	1	0.0	0.25	32.0	32.0	32.0	32.0
Motor	46.1	46.1	46.1	138.3	1	138.3	1	384.0	384.3	384.3	384.3
					0.2	27.7	1	76.9	77.0	77.0	77.0
TOTAL KVA:	46.3	46.1	46.1	138.5		166.3		TOTAL AMPS:	PH-A	PH-B	PH-C
TOTAL AMPS:	386.0	384.3	384.3	384.6				493.5	494.9	493.3	493.3

PANELBOARD: A3

208Y/120 VOLTS, 3 PHASE, 4 WIRE
60 AMP MAIN BKR, SURFACE MTD.
22000 AIC LABELED

BASMENT MECH. RM, W/GRD. BUS

CIRC NO.	LOAD V. A.	LOAD TYPE	LOAD DESCRIPTION	P.	AMP SIZE	PHASE	AMP SIZE	P.	LOAD DESCRIPTION	LOAD TYPE	LOAD V. A.	CIRC NO.
1	2378	MOTR	CWP-5	3	20	A	20	3	CWP-6	MOTR	1657	2
3	----	---	----------	---	|	B	|	---	----------	---	----	4
5	----	---	----------	---	|	C	|	---	----------	---	----	6
7			SPARE	3	20	A	20	3	SPARE			8
9	----	---	----------	---	|	B	|	---	----------	---	----	10
11	----	---	----------	---	|	C	|	---	----------	---	----	12
13			SPARE	2	20	A	20	2	SPARE			14
15	----	---	----------	---	|	B	|	---	----------	---	----	16
17	200	RCPT	SERVICE RECEPTACLE	1	20	C	20	1	CHILLER CONTROL PANEL	RCPT	200	18
19			SPARE	1	20	A	20	1	SPARE			20
21			SPARE	1	20	B	20	1	SPARE			22
23			SPARE	1	20	C	20		SPARE			24
25			SPACE			A			SPACE			26
27			SPACE			B			SPACE			28
29			SPACE			C			SPACE			30

PANELBOARD: A3

	CONNECTED KVA: PH-A	PH-B	PH-C	TOTAL	DEMAND FACTOR	KVA	CONT. FACT	SIZING AMPS: TOTAL	PH-A	PH-B	PH-C
Receptacle	0.0	0.0	0.4	0.4	1	0.4	1	1.1	0.0	0.0	3.3
Largest Motor	0.0	0.0	0.0	0.0	1	0.0	0.25	1.6	1.6	1.6	1.6
Motor	1.3	1.3	1.3	4.0	1	4.0	1	11.2	11.2	11.2	11.2
Spare					0.2	0.9	1	2.5	2.5	2.5	2.5
TOTAL KVA:	1.3	1.3	1.7	4.4			5.3	TOTAL AMPS:	PH-A	PH-B	PH-C
TOTAL AMPS:	11.2	11.2	14.5	12.3				16.4	15.3	15.3	18.7

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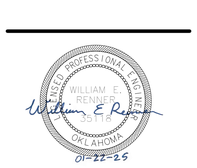
REVISIONS

No.	Date	Description



RSU Geothermal Chillers

1701 W. Will Rogers Blvd
Claremore, OK 74017

ELECTRICAL SCHEDULES

100% CD

PEC PROJECT NUMBER: 231211-000
DATE 01/22/2025
DRAWN BY EOO
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E611

MECHANICAL ABBREVIATIONS

Ø	ROUND DIAMETER	HTG	HEATING
ABV	ABOVE	IN	INCH
AC	AIR CONDITIONING	INV	INVERT
ADD	ADDENDUM	LB / (#)	POUND
AFF	ABOVE FINISHED FLOOR	LB/HR	POUNDS PER HOUR
AFMS	AIRFLOW MEASURING STATION	LAT	LEAVING AIR TEMPERATURE
AFUE	ANNUAL FUEL UTILIZATION EFFICIENCY	LWT	LEAVING WATER TEMPERATURE
ALT	ALTERNATE	MAT	MIXED AIR TEMPERATURE
ARCH	ARCHITECT/ARCHITECTURAL	MAX	MAXIMUM
BFF	BELOW FINISHED FLOOR	MBH	ONE THOUSAND BTU PER HOUR
BFG	BELOW FINISHED GRADE	MC	MECHANICAL CONTRACTOR
BLW	BELOW	MECH	MECHANICAL
BOD	BOTTOM OF DUCT ELEVATION ABOVE FLOOR	MFR	MANUFACTURER
BOP	BOTTOM OF PIPE ELEVATION ABOVE FLOOR	MIN	MINIMUM
BOS	BOTTOM OF STEEL	MISC	MISCELLANEOUS
BTU	BRITISH THERMAL UNITS	MTR	MOTOR
BTUH	BRITISH THERMAL UNITS PER HOUR	NCR	NOISE CRITERIA RATING
CAP	CAPACITY	NC	NORMALLY CLOSED
CFM	CUBIC FEET PER MINUTE	NO	NORMALLY OPEN
CI	CAST IRON	NTS	NOT TO SCALE
CLG	CEILING	OBD	OPPOSED BLADE DAMPER
COP	COEFFICIENT OF PERFORMANCE	PC	PLUMBING CONTRACTOR
CV	CONSTANT AIR VOLUME	PD	PRESSURE DROP
DB	DECIBELS	PIV	POST INDICATOR VALVE
DB	DRY BULB TEMPERATURE	PLBG	PLUMBING
DIA	DIAMETER	PRESS	PRESSURE
DEMO	DEMOLISH	PVC	POLYVINYL CHLORIDE PIPE
DN	DOWN	PSI	POUNDS PER SQUARE INCH
DP	DIFFERENTIAL PRESSURE	PSIG	POUNDS PER SQUARE INCH GAUGE
(E)	EXISTING COMPONENT DESIGNATION	PWR	POWER
EA	EACH	(R)	RELOCATED COMPONENT DESIGNATION
EAT	ENTERING AIR TEMPERATURE	RH	RELATIVE HUMIDITY
EC	ELECTRICAL CONTRACTOR	RM	ROOM
ELEC	ELECTRICAL	RPM	REVOLUTIONS PER MINUTE
ETR	EXISTING TO REMAIN	SF	SQUARE FOOT
EQUIP	EQUIPMENT	SP	STATIC PRESSURE
EWT	ENTERING WATER TEMPERATURE	STM	STEAM
°F	DEGREES FAHRENHEIT	TCC	TEMPERATURE CONTROL CONTRACTOR
FDC	FIRE DEPARTMENT CONNECTION	TOD	TOP OF DUCT ELEVATION ABOVE FLOOR
FHC	FIRE HOSE CABINET	TOP	TOP OF PIPE ELEVATION ABOVE FLOOR
FLR	FLOOR	TEMP	TEMPERATURE
FL	FLOW LINE	TYP	TYPICAL
FOG	FUEL OIL GAUGE	UG	UNDERGROUND
FOV	FUEL OIL VENT	VAV	VARIABLE AIR VOLUME
FPM	FEET PER MINUTE	VVT	VARIABLE VOLUME AND TEMPERATURE
FT	FOOT/FEET	VCP	VITRIFIED CLAY PIPE
GAL	GALLON	VENT	VENTILATION
GC	GENERAL CONTRACTOR	VFD	VARIABLE FREQUENCY DRIVE
GPM	GALLONS PER MINUTE	VTR	VENT THROUGH ROOF
HP	HORSE POWER	WB	WET BULB TEMPERATURE
HR	HOSE REEL		

COMPONENT ABBREVIATIONS

AC-#	AIR CONDITIONING UNIT	HWP-#	HEATING WATER PUMP
AD-#	AREA DRAIN	HWPP-#	HEATING WATER PRIMARY PUMP
AHU-#	AIR HANDLING UNIT	HWSP-#	HEATING WATER SECONDARY PUMP
AS-#	AIR SEPARATOR	HRU-#	HEAT RECOVERY UNIT
B-#	BOILER	IU-#	INDOOR UNIT
BF-#	BOTTLE FILLER	L-#	LOUVER
BT-#	BATH TUB	LV-#	LAVATORY
CH-#	CHILLER	MAU-#	MAKE-UP AIR UNIT
CRAC-#	COMPUTER ROOM AIR CONDITIONING UNIT	MB-#	MOP BASIN
CO	CLEANOUT	MSS-#	MINI SPLIT SYSTEM
CT-#	COOLING TOWER	ORD	OVERFLOW ROOF DRAIN
CU-#	AIR COOLED CONDENSING UNIT	OU-#	OUTDOOR UNIT
CUH-#	CABINET UNIT HEATER	PRV	PRESSURE REDUCING VALVE
CWP-#	CHILLED WATER PUMP	RCP-#	RADIANT CEILING PANEL
CWPP-#	CHILLED WATER PRIMARY PUMP	RD	ROOF DRAIN
CWSP-#	CHILLED WATER SECONDARY PUMP	RF-#	RETURN/RELIEF FAN
DWBP-#	DOMESTIC WATER BOOSTER PUMP	RH-#	ROOF HOOD
DF-#	DRINKING FOUNTAIN / WATER COOLER	RHD-#	ROOF HYDRANT
DHWP-#	DOMESTIC HOT WATER CIRCULATING PUMP	RTU-#	ROOFTOP UNIT
EE-#	EMERGENCY EYE WASH	SF-#	SUPPLY AIR FAN
EF-#	EXHAUST FAN	SH-#	SHOWER
EDH-#	ELECTRIC DUCT HEATER	SK-#	SINK
ES-#	EMERGENCY SHOWER	SP-#	SUMP PUMP
ET-#	EXPANSION TANK	ST-#	STEAM TRAP
F-#	FURNACE	TD	TRENCH DRAIN
FCO	FLOOR CLEANOUT	TMV-#	THERMOSTATIC MIXING VALVE
FCU-#	FAN COIL UNIT	TU-#	TERMINAL UNIT
FD-#	FLOOR DRAIN	UH-#	UNIT HEATER
FS-#	FLOOR SINK	UR-#	URINAL
FTU-#	FAN POWERED TERMINAL UNIT	UV	ULTRAVIOLET STERILE CONDITIONER
FP-#	FIRE PUMP	WB-#	WALL BOX (PLUMBING UTILITY)
FTR-#	FIN TUBE RADIATOR	WC-#	WATER CLOSET
GI-#	GREASE INTERCEPTOR	WH-#	WATER HEATER
H-#	HUMIDIFIER	WHD-#	WALL HYDRANT
HB-#	HOSE BIBB		

NOTE:
ALL GENERAL NOTES ON THIS SHEET ARE TO BE APPLIED TO ALL OTHER DRAWINGS IN THIS SET. THE SYMBOLS AND ABBREVIATIONS SHOWN ON THIS SHEET MAY OR MAY NOT BE USED IN THIS SET OF DRAWINGS.

MECHANICAL SHEET INDEX

MECH. PIPING SYMBOLS

- HWS — HEATING WATER SUPPLY
- HWR — HEATING WATER RETURN
- CWS — CHILLED WATER RETURN
- CWR — CHILLED WATER RETURN
- CHWS — CHILLED/HEATING WATER SUPPLY
- CHWR — CHILLED/HEATING WATER RETURN
- CS — CONDENSER WATER RETURN
- CR — CONDENSER WATER RETURN
- RL — REFRIGERANT LIQUID LINE (SUPPLY)
- RS — REFRIGERANT SUCTION LINE (RETURN)
- RLS — REFRIGERANT DUAL TEMPERATURE LINE
- FOS — FUEL OIL SUPPLY
- FOR — FUEL OIL RETURN
- BFW — BOILER FEEDWATER
- BMW — BOILER MAKEUP WATER
- LPS — LOW PRESSURE STEAM SUPPLY
- LPR — LOW PRESSURE STEAM RETURN
- MPS — MEDIUM PRESSURE STEAM SUPPLY
- MPR — MEDIUM PRESSURE STEAM RETURN
- HPS — HIGH PRESSURE STEAM SUPPLY
- HPR — HIGH PRESSURE STEAM RETURN
- T1.1 (0.75) — EQUIPMENT CALLOUT / WATER COIL FLOW (GPM)

PIPE SYMBOLS

- DIRECTION OF FLOW
- PIPE DROP / SIDE CONNECTION / PIPE RISE
- TEE OUTLET DOWN / TEE OUTLET UP
- BOTTOM / TOP CONNECTION, 45° OR 90°
- CAP / CAPPED OUTLET
- BALL VALVE / GLOBE VALVE
- CONCENTRIC / ECCENTRIC REDUCER OR INCREASER
- ANCHOR / FLEXIBLE CONNECTION
- BUTTERFLY VALVE
- CIRCUIT SETTER
- CHECK VALVE
- STRAINER / UNION
- BLIND FLANGE / FLOW METER
- BACKFLOW PREVENTER (BFP)
- PRESSURE REDUCING VALVE / PLUG VALVE
- WATER METER / IRRIGATION WATER METER
- PLUG VALVE / NEEDLE VALVE
- GAS COCK
- PRESSURE REGULATING VALVE / PETE'S PLUG
- WATER HAMMER ARRESTOR (WHA)
- SLEEVE / EXPANSION JOINT
- PIPE PITCH DOWN / PIPE RISE UP
- SOLENOID VALVE / PNEUMATIC 3-WAY CONTROL VALVE
- ELECTRIC 3-WAY / 2-WAY CONTROL VALVE
- MANUAL / EMERGENCY 3-WAY CONTROL VALVE
- THERMOMETER / PRESSURE GAUGE
- STEAM TRAP
- TEMPERATURE/PRESSURE RELIEF VALVE

GENERAL NOTES

1. VERIFY JOB SITE CONDITIONS AND DIMENSIONS BEFORE BEGINNING WORK. PLANS ARE SCHEMATIC IN NATURE. LAYOUT IS BASED ON BEST AVAILABLE INFORMATION. CONTRACTOR SHALL FIELD VERIFY EXISTING CONDITIONS AND DIMENSIONS.
2. NO PIPING, DUCTWORK, ETC. SHALL PENETRATE STRUCTURAL MEMBERS.
3. PROVIDE MISCELLANEOUS CUTTING, PATCHING AND REPAIRING OF FINISHES, ROOF, WALLS, ETC., AS REQUIRED TO ACCOMMODATE THE NEW WORK.
4. G.C. IS TO PATCH ANY OPENINGS IN CORRIDORS REQUIRED TO BE CONSTRUCTED TO LIMIT THE TRANSFER OF SMOKE AND IN SMOKE BARRIERS AS REQUIRED TO MEET CODE REQUIREMENTS. SEE ARCHITECTURAL DRAWINGS FOR LOCATIONS.
5. IT IS THE CONTRACTOR'S RESPONSIBILITY TO FIELD VERIFY EXACT LOCATION, CONFIGURATION AND ROUTING OF EXISTING SYSTEMS REQUIRED TO REMAIN IN OPERATION DURING THE PROJECT TO PREVENT DAMAGE DURING DEMOLITION AND PHASING.
6. REMOVE ALL EXISTING EQUIPMENT, DUCTWORK AND PIPING THAT IS NOT REQUIRED FOR A WORKING INSTALLATION.
7. COORDINATE ALL WORK WITH OTHER TRADES PRIOR TO INSTALLATION.
8. ALL CUTTING AND PATCHING SHALL BE CLOSELY COORDINATED WITH THE G.C.
9. COORDINATE ROUTING OF PLUMBING, AND HVAC PIPING WITH DUCTWORK, LIGHTS, ARCHITECTURAL CEILING AND STRUCTURAL ELEMENTS. PIPING SHALL RISE AND DROP, JOG OR OFFSET AS REQUIRED TO AVOID CONFLICTS. DUCTWORK SHALL TAKE PRECEDENCE OVER ALL PIPING, EXCEPT WHERE GRADE MUST BE MAINTAINED FOR DRAINAGE. REWORK OF INSTALLED WORK TO RESOLVE CONFLICTS RISING FROM LACK OF COORDINATION SHALL NOT JUSTIFY AN INCREASE IN THE CONTRACT AMOUNT.
10. ALL PENETRATIONS THROUGH FIRE RATED ASSEMBLIES SHALL BE FIRE STOPPED BY THE TRADE MAKING THE PENETRATION. REFER TO ARCHITECTURAL DRAWINGS AND SPECIFICATIONS FOR REQUIREMENTS.
11. DO NOT ROUTE PIPING OVER ELECTRICAL PANELS OR EQUIPMENT. PIPING SHALL NOT BE ROUTED THROUGH ELECTRICAL ROOMS, TELECOM ROOMS OR ELEVATOR EQUIPMENT ROOMS UNLESS SPECIFICALLY SERVING THAT ROOM. COORDINATE WITH E.C. PROVIDE WATERTIGHT DRIP PAN WITH DRAIN TO NEAREST APPROVED RECEPTOR WHERE REQUIRED.
12. COORDINATE SIZE AND LOCATION OF ACCESS DOORS IN CONSTRUCTION REQUIRED FOR ACCESS TO MECHANICAL EQUIPMENT WITH G.C.
13. COORDINATE SIZE AND LOCATION OF MECHANICAL EQUIPMENT PADS WITH G.C.
14. ALL WORK IS TO CONFORM WITH APPLICABLE CODES AND STANDARDS.
15. ALL EQUIPMENT SUPPORT STANDS SHALL BE PRIMED AND PAINTED WITH EPOXY ENAMEL.
16. WHERE HYDRONIC RUNOUT SIZES ARE NOT INDICATED, SIZE PER THE FOLLOWING:
    UP TO 3 GPM - 3/4"; UP TO 6 GPM - 1"; UP TO 10 GPM - 1-1/4"; UP TO 17 GPM - 1-1/2".
17. HYDRONIC PIPING SHALL BE MAINTAINED FULL SIZE UP TO COIL CONNECTIONS. SHUT-OFF VALVES, STRAINERS, BALANCE VALVES, ETC. WILL NOT BE ALLOWED TO REDUCE FROM LINE/RUNOUT SIZE. CONTROL VALVES MAY BE DOWN SIZED FOR FLOW RATE, NOT TO EXCEED 4 PSIG PRESSURE DROP AT DESIGN FLOW.
18. TEMPERATURE CONTROLS CONTRACTOR (T.C.C.) SHALL FURNISH AND INSTALL ALL LOW VOLTAGE WIRING AND ASSOCIATED CONDUIT REQUIRED FOR MECHANICAL CONTROL SYSTEM. WIRING SHALL BE IN CONDUIT INSIDE WALLS, IN ROOMS WITH EXPOSED CEILINGS, AND ABOVE HARD CEILINGS. LINE VOLTAGE WIRING AND ASSOCIATED CONDUIT SHALL BE PROVIDED AND INSTALLED BY E.C. CONTROL SYSTEM SHALL BE INSTALLED IN ACCORDANCE WITH SPECIFICATIONS.
19. ALL CONTROL DAMPERS SHALL BE FURNISHED BY T.C.C. AND INSTALLED BY THE M.C. MOTOR OPERATORS SHALL BE FURNISHED AND INSTALLED BY THE T.C.C.
20. COORDINATE ACCESS TO EQUIPMENT AND VALVES INSTALLED ABOVE 'HARD' CEILINGS AND IN MASONRY CHASES WITH GENERAL CONTRACTOR. PROVIDE LOCKING ACCESS DOORS FOR INSTALLATION BY CONTRACTOR AS REQUIRED TO SERVICE CONCEALED DAMPERS, VALVES AND EQUIPMENT. CEILING ACCESS DOORS FOR FIRE DAMPERS, SMOKE DAMPERS AND FIRE SMOKE DAMPERS FURNISHED AND INSTALLED BY CONTRACTOR.
21. THESE DRAWINGS ARE ACCOMPANIED BY SPECIFICATIONS. REFER TO SPECIFICATIONS FOR FURTHER INFORMATION.
22. EQUIPMENT THAT REQUIRES MAINTENANCE SHALL BE LOCATED A MINIMUM OF 10'-0" FROM THE BUILDING ROOF EDGE WHERE REQUIRED BY CODE.
23. MANUAL BALANCE DAMPERS, HYDRONIC AND PLUMBING VALVES, CIRCUIT SETTERS AND OTHER ACCESSORIES REQUIRING ACCESS SHALL BE ACCESSIBLE VIA A STANDARD LADDER SO COMPONENTS MAY BE REPLACED, REPAIRED, OR UTILIZED WITHOUT THE NEED FOR EXTENSIVE CEILING REMOVAL, SCAFFOLDING OR A MAN LIFT. WHERE POSSIBLE NO MORE THAN 48" ABOVE THE FINISHED CEILING.

GENERAL SYMBOLS

- (#) (#) (#) — REFER TO PLAN NOTES
- EXISTING COMPONENT PEN WEIGHT
- DEMOLITION PEN WEIGHT - COMPONENT SHADED
- ROOM 111 — ROOM CALLOUT
- AREA NOT IN SCOPE HATCHING
- 1 — REVISION NUMBER
- CONNECT NEW TO EXISTING - VERIFY EXACT LOCATION
- DISCONNECT FROM EXISTING - VERIFY EXACT LOCATION
- PIPE / DUCT CONTINUATION SYMBOL
- 5 / M3.6 — DETAIL NUMBER / SHEET NUMBER WHERE DRAWN
- B / M3.6 — SECTION LETTER / SHEET NUMBER WHERE DRAWN
- FC-01 — UNIQUE I.D. (FAN COIL UNIT NO. 1) / TYPICAL EQUIPMENT CALLOUT / EQUIPMENT TYPE (FC=FAN COIL UNIT)

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JUNE 30, 2025

REVISIONS

No.	Date	Description

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Joshua R. Bowman
31830
01/24/2025
OKLAHOMA

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1701 W. Will Rogers Blvd
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MECHANICAL COVER SHEET

100% CD

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MP001

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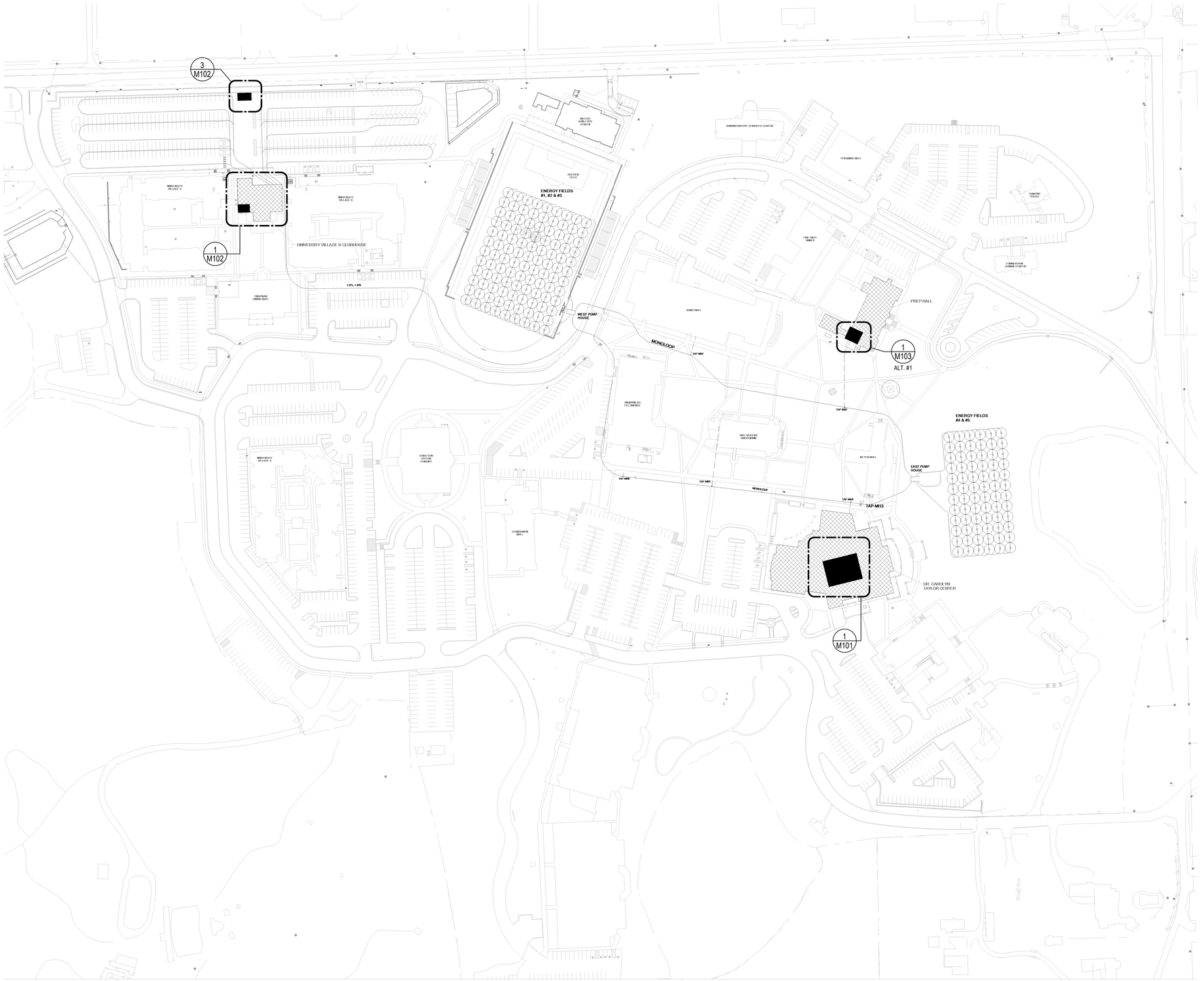

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1 **MECHANICAL SITE PLAN**

0' 50' 100' 150' 1" = 100'-0"

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MECHANICAL
SITE PLAN

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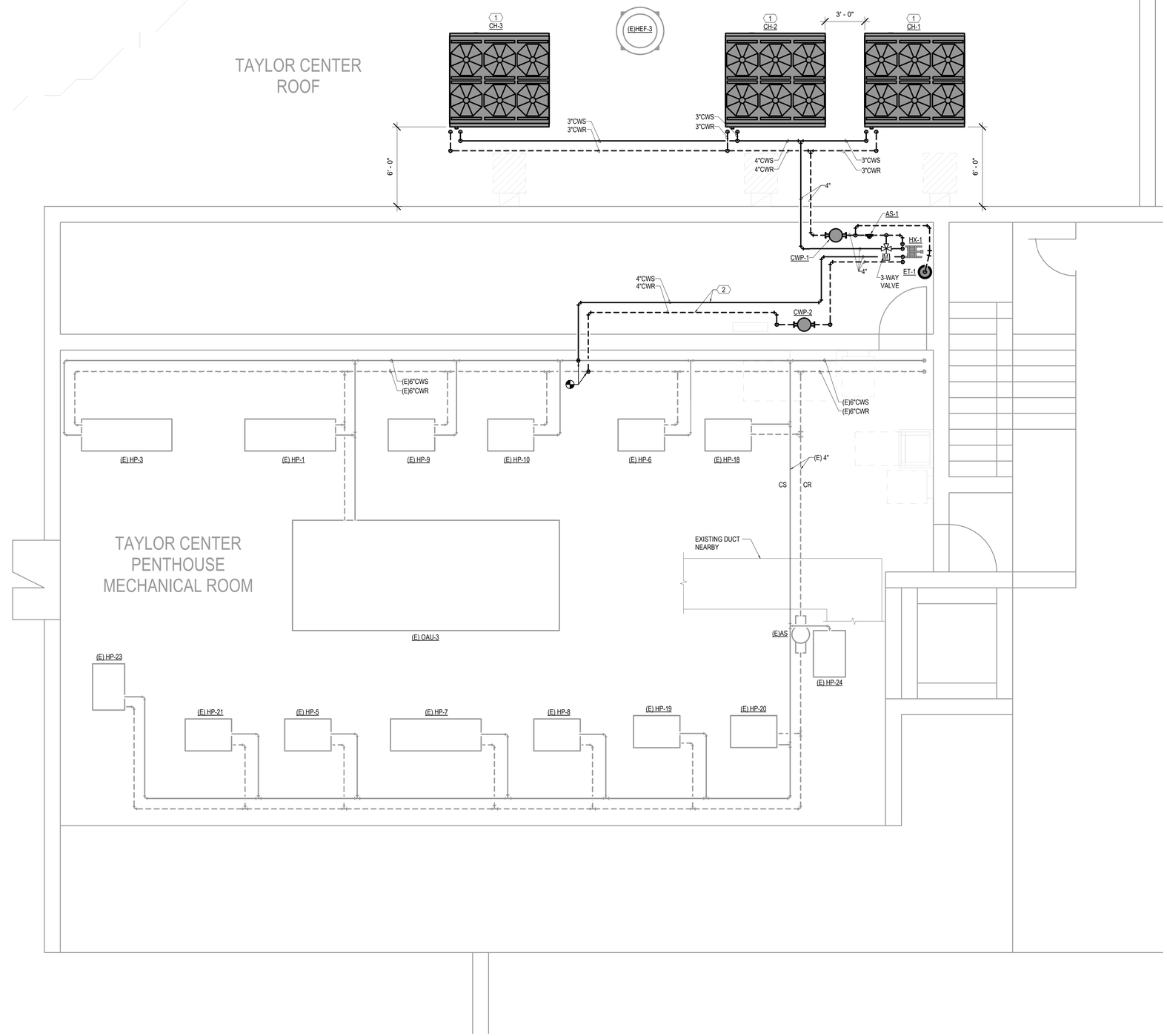
M100

MECH. PIPING GENERAL NOTES

1. PIPING ON EXTERIOR WALLS OR PRE-CAST CONCRETE WALLS TO BE ROUTED IN FRAMED WALL ON INTERIOR SIDE OF INSULATION.
2. AVOID ROUTING PIPING OVER ELECTRICAL ROOMS OR ELECTRICAL PANELS; MAINTAIN N.E.C. CLEARANCES. COORDINATE ROUTING WITH ELECTRICAL CONTRACTOR.
3. ALL VALVES SHALL BE INSTALLED IN ACCESSIBLE LOCATIONS, OR WITH ACCESS PANELS. ACCESS PANELS SHALL BE 24X24 UNLESS NOTED OTHERWISE.

SHEET KEYNOTES

1 CHILLER MOUNTED ON VIBRATION ISOLATION RAILS.
2 COORDINATE NEW PIPE ROUTING WITH EXISTING DUCTWORK AND STRUCTURE. ROUTE PIPING AS HISH AS POSSIBLE TO MAINTAIN ACCESSIBILITY. ADJUST ROUTING AS NECESSARY.



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1 **HVAC ROOF PLAN - TAYLOR CENTER ROOF AND PENTHOUSE**

0' 4' 8' 12' 1/4" = 1'-0"

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HVAC ROOF PLAN - TAYLOR CENTER

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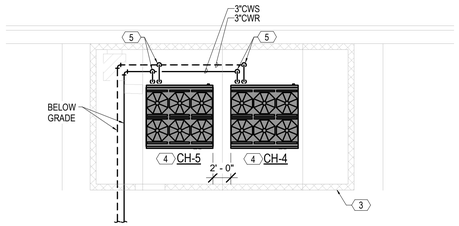
M101

MECH. PIPING GENERAL NOTES

1. PIPING ON EXTERIOR WALLS OR PRE-CAST CONCRETE WALLS TO BE ROUTED IN FRAMED WALL ON INTERIOR SIDE OF INSULATION.
2. AVOID ROUTING PIPING OVER ELECTRICAL ROOMS OR ELECTRICAL PANELS; MAINTAIN N.E.C. CLEARANCES. COORDINATE ROUTING WITH ELECTRICAL CONTRACTOR.
3. ALL VALVES SHALL BE INSTALLED IN ACCESSIBLE LOCATIONS, OR WITH ACCESS PANELS. ACCESS PANELS SHALL BE 24X24 UNLESS NOTED OTHERWISE.

SHEET KEYNOTES

1. TIE IN NEW 4" CHILLED WATER SUPPLY AND 4" CHILLED WATER RETURN TO EXISTING BLIND FLANGES IN THIS LOCATION.
2. PROVIDE A NEW BLIND FLANGE IN THE VERTICAL WITH SHUT-OFF VALVE.
3. NEW EQUIPMENT ENCLOSURE. REFER TO STRUCTURAL DRAWINGS FOR ADDITIONAL INFORMATION. CONTRACTOR SHALL COORDINATE WITH OWNER ON FINISH COLOR AND TYPE.
4. CHILLER MOUNTED ON EQUIPMENT PAD. REFER TO STRUCTURAL FOR DETAILS.
5. CHILLED WATER PIPING UP FROM BELOW GRADE.
6. COORDINATE NEW PIPE ROUTING WITH EXISTING STRUCTURE. ROUTE PIPING AS HISH AS POSSIBLE TO MAINTAIN ACCESSIBILITY. ADJUST ROUTING AS NECESSARY.



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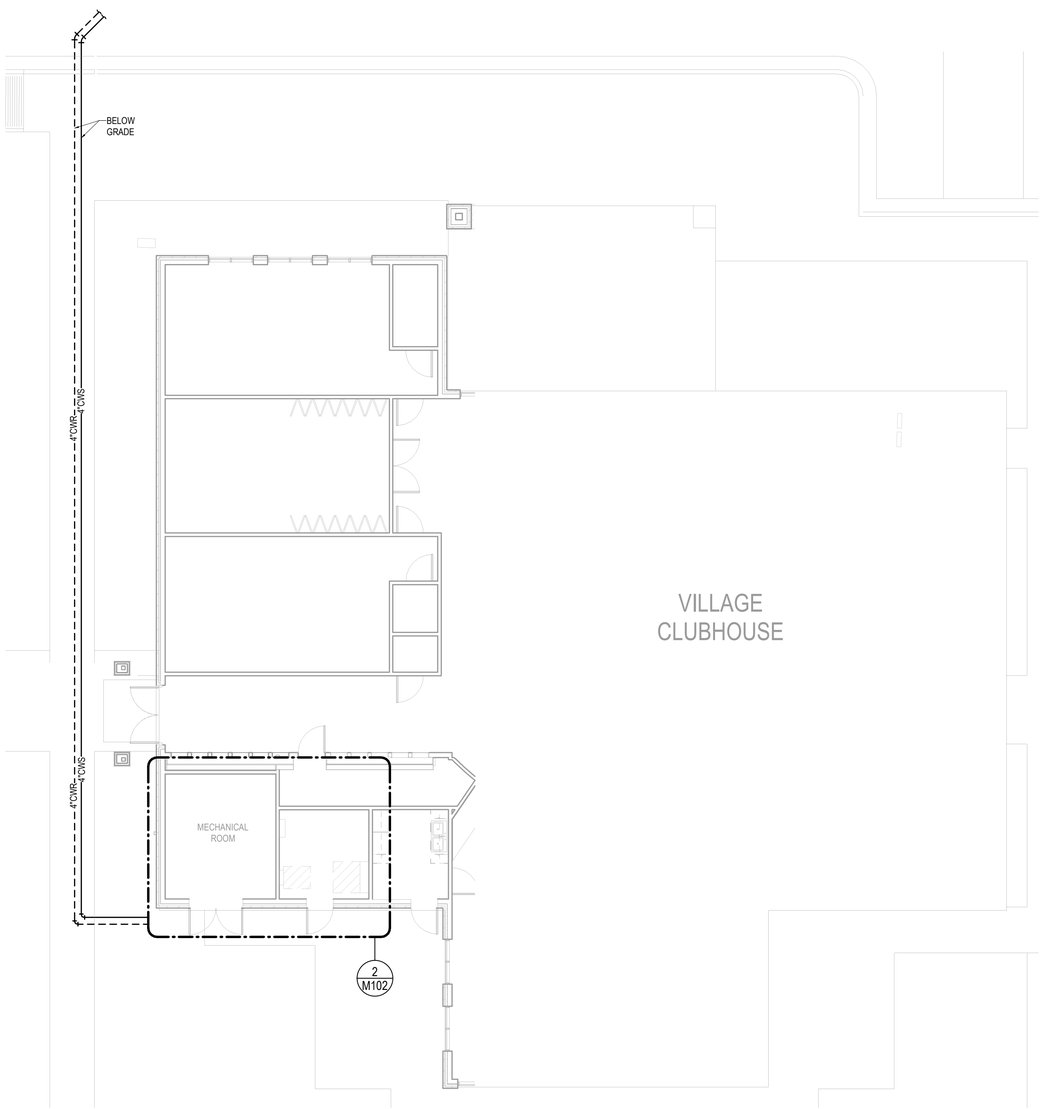
3 HVAC FLOOR PLAN - CLUBHOUSE

0' 4' 8' 12' 1/8" = 1'-0"



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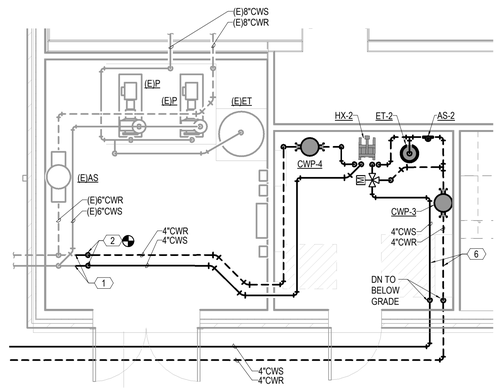
1 HVAC FLOOR PLAN - CLUBHOUSE

0' 4' 8' 12' 1/8" = 1'-0"



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2 HVAC FLOOR PLAN - CLUBHOUSE

0' 2' 4' 6' 1/4" = 1'-0"

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HVAC FLOOR PLAN - CLUBHOUSE

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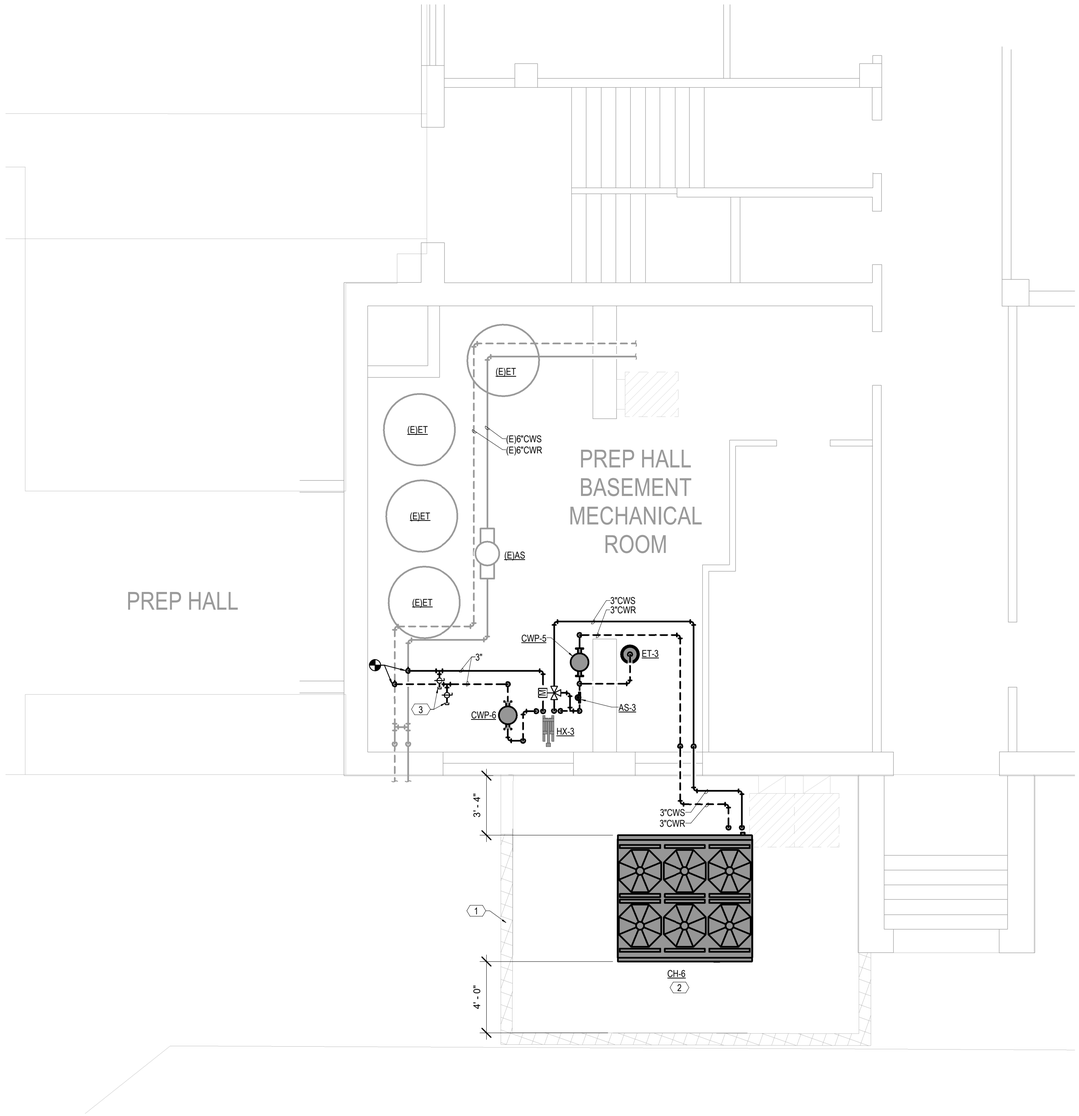
M102

MECH. PIPING GENERAL NOTES

1. PIPING ON EXTERIOR WALLS OR PRE-CAST CONCRETE WALLS TO BE ROUTED IN FRAMED WALL ON INTERIOR SIDE OF INSULATION.
2. AVOID ROUTING PIPING OVER ELECTRICAL ROOMS OR ELECTRICAL PANELS; MAINTAIN N.E.C. CLEARANCES. COORDINATE ROUTING WITH ELECTRICAL CONTRACTOR.
3. ALL VALVES SHALL BE INSTALLED IN ACCESSIBLE LOCATIONS, OR WITH ACCESS PANELS. ACCESS PANELS SHALL BE 24X24 UNLESS NOTED OTHERWISE.

SHEET KEYNOTES

1. NEW EQUIPMENT ENCLOSURE. REFER TO STRUCTURAL DRAWINGS FOR ADDITIONAL INFORMATION. CONTRACTOR SHALL COORDINATE WITH OWNER ON FINISH COLOR AND TYPE.
2. CHILLER MOUNTED ON EQUIPMENT PAD. REFER TO STRUCTURAL FOR DETAILS.
3. PROVIDE A NEW BLIND FLANGE WITH SHUT-OFF VALVE.



N

1 ALTERNATE 1 - HVAC FLOOR PLAN - PREP HALL

0' 4' 8' 12' 1/4" = 1'-0"

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ALTERNATE 1 - HVAC FLOOR PLAN - PREP HALL

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M103

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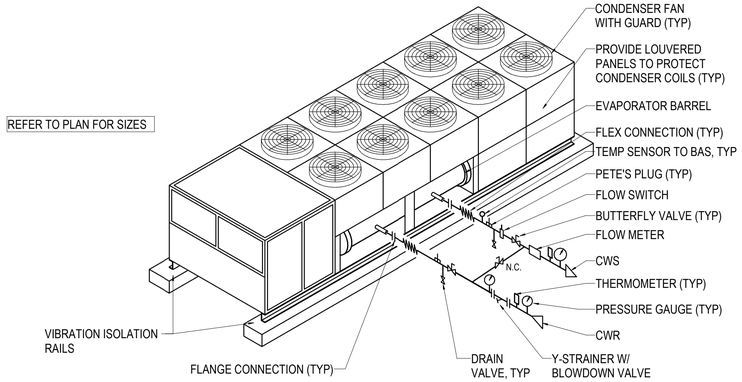
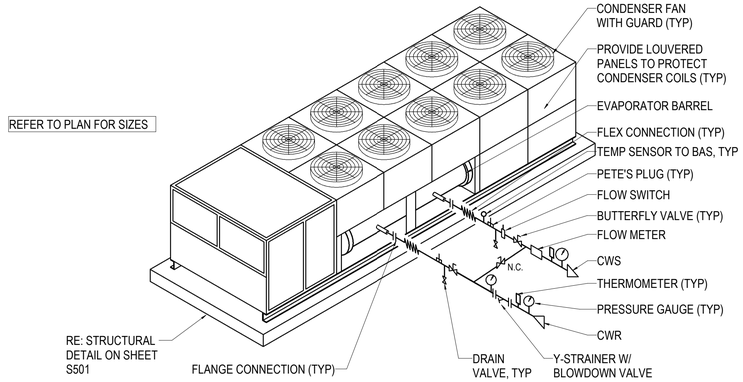


MECH. CONTRACTOR SHALL COORDINATE REQUIREMENTS OF MANUFACTURER RECOMMENDED CLEARANCES. CLEARANCES SHALL BE MAINTAINED.

4 CHILLER DETAIL - AIR COOLED - ROOF

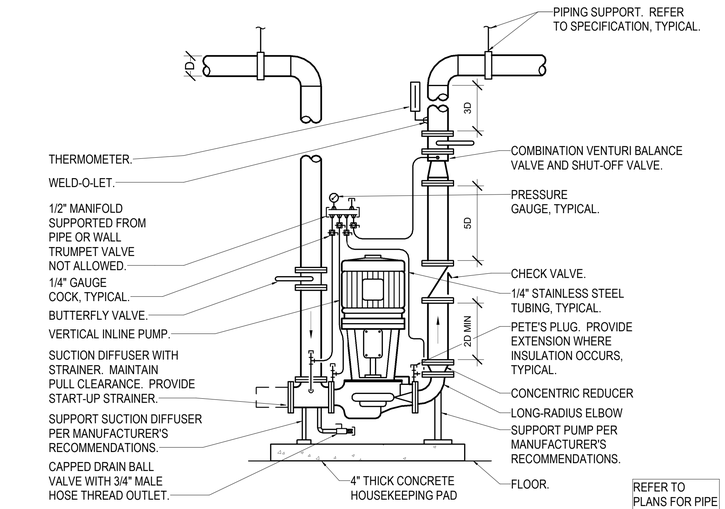
NO SCALE



MECH. CONTRACTOR SHALL COORDINATE REQUIREMENTS OF MANUFACTURER RECOMMENDED CLEARANCES. CLEARANCES SHALL BE MAINTAINED.

3 CHILLER DETAIL - AIR COOLED - GROUND

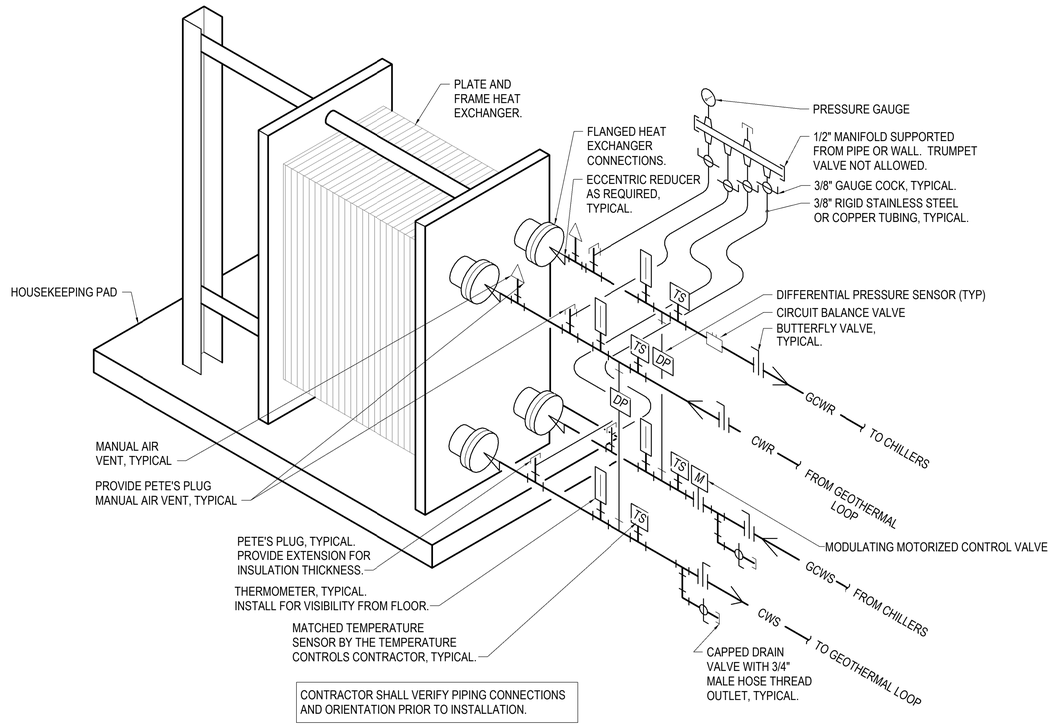
NO SCALE



NOTE: PUMPS CONTROLLED BY VFD'S SHALL HAVE INVERTER DUTY RATED MOTORS AND 1,600 VOLT INSULATION. REFER TO SPECIFICATIONS FOR ADDITIONAL MOTOR REQUIREMENTS.

2 PUMP PIPING DETAIL - FLOOR MOUNTED VERTICAL IN-LINE

NO SCALE



CONTRACTOR SHALL VERIFY PIPING CONNECTIONS AND ORIENTATION PRIOR TO INSTALLATION.

1 HEAT EXCHANGER DETAIL

NO SCALE

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918-664-5400 www.pec1.com
C.O.A. #1046 PE/LS EXPIRES: JUNE 30, 2025

REVISIONS

No.	Date	Description

LICENSED PROFESSIONAL ENGINEERS — Joshua R. Bowman — 31830 — 01/24/2025 — OKLAHOMA

RSU Geothermal Chillers

1701 W. Will Rogers Blvd
Claremore, OK 74017

HVAC DETAILS

100% CD

PEC PROJECT NUMBER: 231211-000
DATE 01/22/2025
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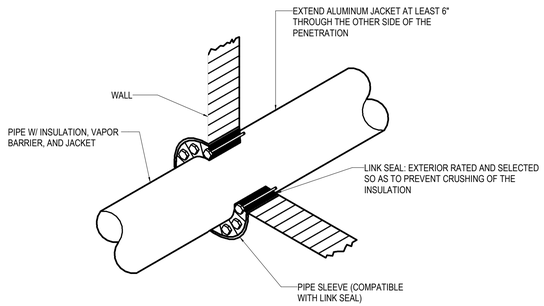
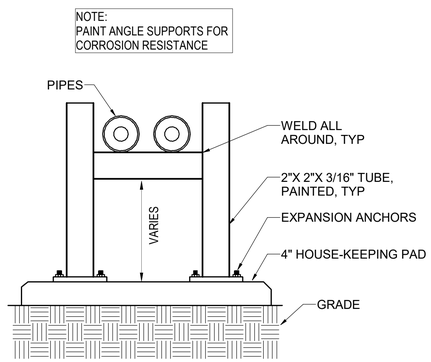
M501



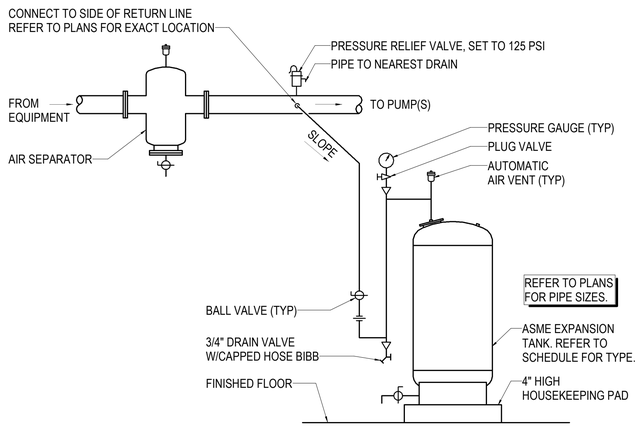
6 EXTERIOR PIPE PENETRATION LINK SEAL DETAIL

NO SCALE



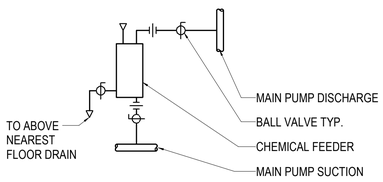
5 GRADE PIPE SUPPORT DETAIL

NO SCALE



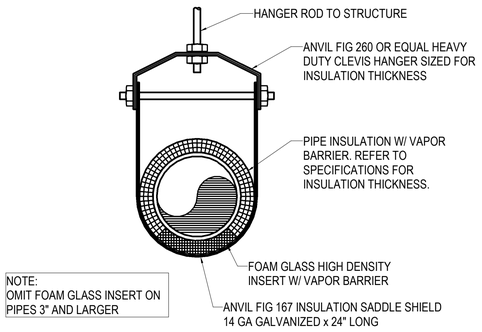
4 EXPANSION TANK/AIR SEPARATOR DETAIL - GLYCOL MAKE-UP

NO SCALE



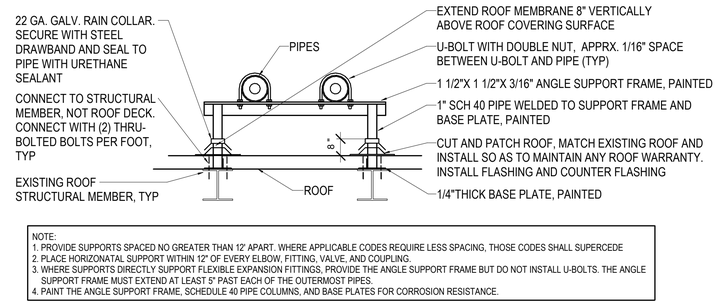
3 CHEMICAL FEEDER DETAIL

NO SCALE



2 PIPE HANGER DETAIL

NO SCALE



NOTE:
1. PROVIDE SUPPORTS SPACED NO GREATER THAN 12' APART. WHERE APPLICABLE CODES REQUIRE LESS SPACING, THOSE CODES SHALL SUPERCEDE
2. PLACE HORIZONATAL SUPPORT WITHIN 12" OF EVERY ELBOW, FITTING, VALVE, AND COUPLING.
3. WHERE SUPPORTS DIRECTLY SUPPORT FLEXIBLE EXPANSION FITTINGS, PROVIDE THE ANGLE SUPPORT FRAME BUT DO NOT INSTALL U-BOLTS. THE ANGLE SUPPORT FRAME MUST EXTEND AT LEAST 5" PAST EACH OF THE OUTERMOST PIPES.
4. PAINT THE ANGLE SUPPORT FRAME, SCHEDULE 40 PIPE COLUMNS, AND BASE PLATES FOR CORROSION RESISTANCE.

1 HYDRONIC ROOF PIPING SUPPORT DETAIL

NO SCALE

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OKLAHOMA

RSU Geothermal Chillers

1701 W. Will Rogers Blvd
Claremore, OK 74017

HVAC DETAILS

100% CD

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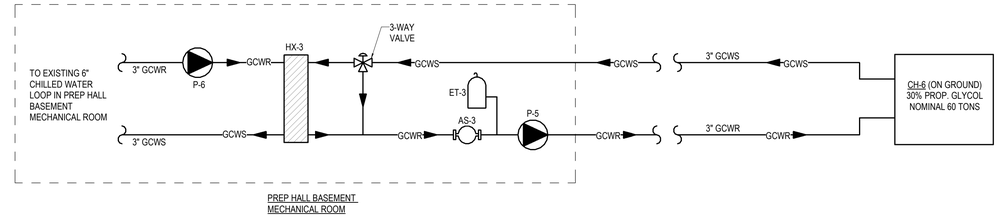
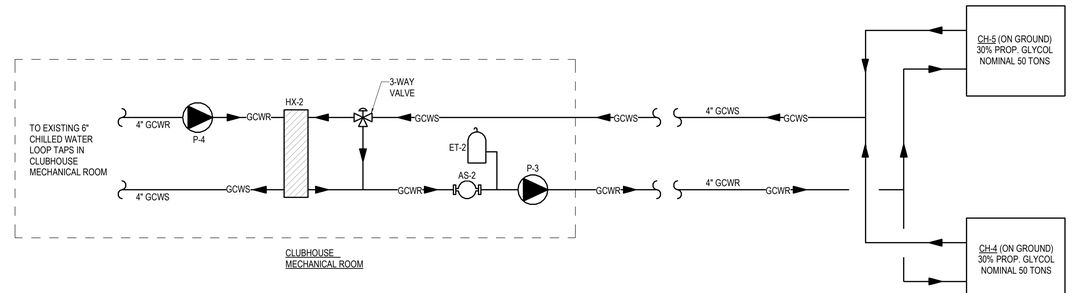


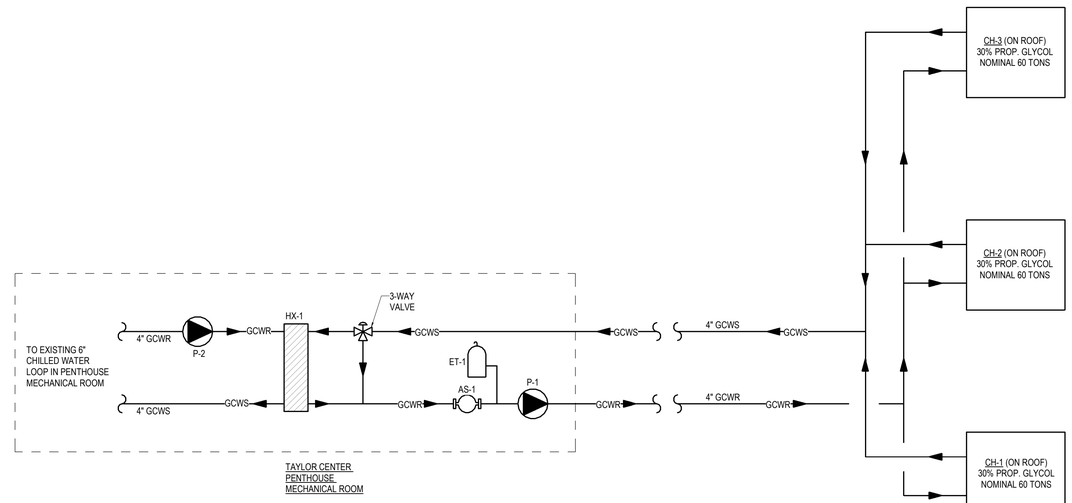
3 FLOW DIAGRAM - PREP HALL CHILLER SYSTEM

NO SCALE



2 FLOW DIAGRAM - CLUBHOUSE CHILLER SYSTEM

NO SCALE



1 FLOW DIAGRAM - TAYLOR CENTER CHILLER SYSTEM

NO SCALE

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HVAC DETAILS

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CHILLER SCHEDULE - AIR COOLED

REMARKS:

1. THE CONTRACTOR SHALL INSTALL THE CHILLER IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS AND REQUIREMENTS.
2. PROVIDE HAIL GUARDS.
3. THE UNIT MUST BE COMPATIBLE AND SELECTED WITH A SOLUTION OF INHIBITED 30% PROPYLENE GLYCOL.
4. PROVIDE INTEGRAL NON-FUSED DISCONNECT WITH EXTERIOR DISCONNECT HANDLE.
5. PROVIDE LOW-AMBIENT OPERATION DOWN TO 0F.
6. PROVIDE NEOPRENE ISOLATION PADS, MINIMUM 0.25" DEFLECTION.
7. PROVIDE ISOLATION SPRINGS, MINIMUM 1.5" DEFLECTION.
8. CHILLER IS PART OF ALTERNATE #1.

MARKS	MFR	MODEL	NOMINAL TONS	NET COOLING CAPACITY (MBH)	EER	EVAPORATOR						CONDENSER		ELECTRICAL				SOUND PRESSURE (5 FT / 30 FT) (dBA)	WEIGHT LBS	REMARKS
						AMB °F	EWT °F	LWT °F	DESIGN FLOW RATE (GPM)	FLUID	TOTAL PD (FT H20)	AMB °F	TYPE	VOLTS	PHASE	MCA	MOP (A)			
CH-1	LG	KCHH060LDGC	60	710.6	14.14	105	97	77	72.2	30% PROPYLENE GLYCOL	4.42	105	SCROLL	460	3	132	150	76 / 61	3135	1,2,3,4,5,7
CH-2	LG	KCHH060LDGC	60	710.6	14.14	105	97	77	72.2	30% PROPYLENE GLYCOL	4.42	105	SCROLL	460	3	132	150	76 / 61	3135	1,2,3,4,5,7
CH-3	LG	KCHH060LDGC	60	710.6	14.14	105	97	77	72.2	30% PROPYLENE GLYCOL	4.42	105	SCROLL	460	3	132	150	76 / 61	3135	1,2,3,4,5,7
CH-4	LG	KCHH050LDGC	50	623.2	14.64	105	97	77	63.3	30% PROPYLENE GLYCOL	3.85	105	SCROLL	208	3	160 / 80	175 + 90	74 / 61	3065	1 - 6
CH-5	LG	KCHH050LDGC	50	623.2	14.64	105	97	77	63.3	30% PROPYLENE GLYCOL	3.85	105	SCROLL	208	3	160 / 80	175 + 90	74 / 61	3065	1 - 6
CH-6	LG	KCHH060LDGC	60	710.6	14.14	105	97	77	72.2	30% PROPYLENE GLYCOL	4.42	105	SCROLL	208	3	160 / 80	175 + 90	76 / 61	3135	1,2,3,4,5,6,8

EXPANSION TANK SCHEDULE

REMARKS:

1. BASED ON ELBI HTS HYDRONIC EXPANSION TANK.
2. INSTALL PER MANUFACTURER'S RECOMMENDATIONS; INSTALL UPSTREAM OF THE PUMPS AS CLOSE TO THE INLET AS FEASIBLE. REFER TO DETAIL.
3. PROVIDE ASME RATED CONSTRUCTION.
4. TANK BLADDER SHALL BE COMPATIBLE WITH A HYDRONIC SOLUTION INCLUDING INHIBITED 30% PROPYLENE GLYCOL.
5. EXPANSION TANK IS PART OF ALTERNATE #1.

UNIT NO	SYSTEM	APPROX SYSTEM VOL GAL	SYSTEM TEMP RANGE °F		TANK CHARGE PSIG	FILL PRESS PSIG	MIN ACCEPT VOLUME	PIPE SIZE	REMARKS
			MIN	MAX				TO TANK	
ET-1	GLYCOL CHILLED WATER	205	45	110	12	12	9	1"	1,2,3,4
ET-2	GLYCOL CHILLED WATER	445	45	110	12	12	15	1"	1,2,3,4
ET-3	GLYCOL CHILLED WATER	70	45	110	12	12	3	1"	1,2,3,4,5

AIR / DIRT SEPARATOR SCHEDULE

REMARKS:

1. INSTALL PER MANUFACTURER'S RECOMMENDATIONS; INSTALL UPSTREAM OF THE PUMPS AS CLOSE TO THE INLET AS FEASIBLE. REFER TO DETAIL ON M-501.
2. AIR SEPARATOR SHALL BE COMPATIBLE WITH A HYDRONIC SOLUTION INCLUDING UP TO 30% PROPYLENE GLYCOL (INHIBITED).
3. AIR SEPARATOR SHALL BE PROVIDED WITH REMOVABLE HEAD AT BOTTOM OF UNIT FOR CLEANING AND MAINTENANCE.
4. AIR SEPARATOR IS PART OF ALTERNATE #1.

MARK	MFR	MODEL	FLOW GPM	MAX OPERATING TEMP °F	MAX WORKING PRESSURE PSI	PRESSURE DROP FEET OF HEAD	REMARKS
AS-1	SPIROTHERM	VDN-400	216.6	150	125	1	1,2,3
AS-2	SPIROTHERM	VDN-300	121.8	150	125	1	1,2,3
AS-3	SPIROTHERM	VDN-250	72.2	150	125	1	1,2,3,4

HEAT EXCHANGER SCHEDULE

REMARKS:

1. BASED ON MUELLER ACCU-THERM PLATE HEAT EXCHANGER MODEL AT20FG ICF-150 C/S.
2. BASED ON MUELLER ACCU-THERM PLATE HEAT EXCHANGER MODEL AT10FG ICF-150 C/S.
3. BASED ON MUELLER ACCU-THERM PLATE HEAT EXCHANGER MODEL AT4FG ICF-150 C/S.
4. THE FLOW AND TEMPERATURE CHARACTERISTICS SHOWN BELOW ARE THE DESIGN OPERATING FLOWS AND TEMPERATURES, AND THE ASSOCIATED CONTROLS AND VALVES SHOULD BE ADJUSTED ACCORDINGLY FOR NORMAL OPERATION.
5. HEAT EXCHANGER IS PART OF ALTERNATE #1.

MARK	LOOP SIDE						CHILLER SIDE						REMARKS
	GPM	EWT °F	LWT °F	PD PSI	CONN SIZE	FLUID	GPM	EWT °F	LWT °F	PD PSI	CONN SIZE	FLUID	
HX-1	216.6	120.0	100.0	9.3	1"	30% PROPYLENE GLYCOL	216.6	77.0	96.9	9.7	1"	WATER	1,4
HX-2	121.8	120.0	100.0	9.1	1"	30% PROPYLENE GLYCOL	121.8	77.0	96.9	9.4	1"	WATER	2,4
HX-3	72.2	120.0	100.0	9.4	1"	30% PROPYLENE GLYCOL	72.2	77.0	96.9	9.9	1"	WATER	3,4,5

CHILLED WATER PUMP SCHEDULE

REMARKS:

1. INSTALL PER MANUFACTURER'S REQUIREMENTS.
2. PROVIDE WITH VARIABLE FREQUENCY DRIVE.
3. PROVIDE INVERTER DUTY-RATED MOTORS WITH INTEGRAL SHAFT GROUNDING RINGS.
4. PROVIDE CONCRETE INERTIA BASE WITH SPRING ISOLATORS HAVING A MINIMUM 1.5" DEFLECTION. REFER TO ASHRAE HVAC APPLICATIONS MANUAL, TABLE 47, BASE TYPE C, ISOLATOR TYPE 3.
5. PROVIDE SPRING ISOLATORS WITH MINIMUM DEFLECTION OF 0.75" OF DEFLECTION. REFER TO ASHRAE HVAC APPLICATIONS MANUAL, TABLE 47, BASE TYPE A, ISOLATOR TYPE 3.
6. CHILLED WATER PUMP IS PART OF ALTERNATE #1.

MARK	LOC AT ROOM	MANUFACTURER	MODEL	TYPE	MIN. CAPACITY		FLUID	MOTOR (BY M.C.)		REMARKS
					GPM	FEET HEAD		HP	ELEC	
CWP-1	TAYLOR CENTER PENTHOUSE MECHANICAL ROOM	GRUNDFOS	VL30707	VERTICAL INLINE	216.6	39	30% PROP. GLYCOL	5	460/3	1,2,3,4
CWP-2	TAYLOR CENTER PENTHOUSE MECHANICAL ROOM	GRUNDFOS	VL40707	VERTICAL INLINE	216.6	24	WATER	2	460/3	1,2,3,4
CWP-3	CLUBHOUSE MECHANICAL ROOM	GRUNDFOS	VL20955	VERTICAL INLINE	121.8	73	30% PROP. GLYCOL	5	208/3	1,2,3,5
CWP-4	CLUBHOUSE MECHANICAL ROOM	GRUNDFOS	VL25709	VERTICAL INLINE	121.8	24	WATER	1-1/2	208/3	1,2,3,5
CWP-5	PREP HALL MECHANICAL ROOM	GRUNDFOS	VL20705	VERTICAL INLINE	72.2	41	30% PROP. GLYCOL	1-1/2	208/3	1,2,3,5,6
CWP-6	PREP HALL MECHANICAL ROOM	GRUNDFOS	VL15709	VERTICAL INLINE	72.2	25	WATER	1	208/3	1,2,3,5,6

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MECHANICAL SCHEDULES

100% CD

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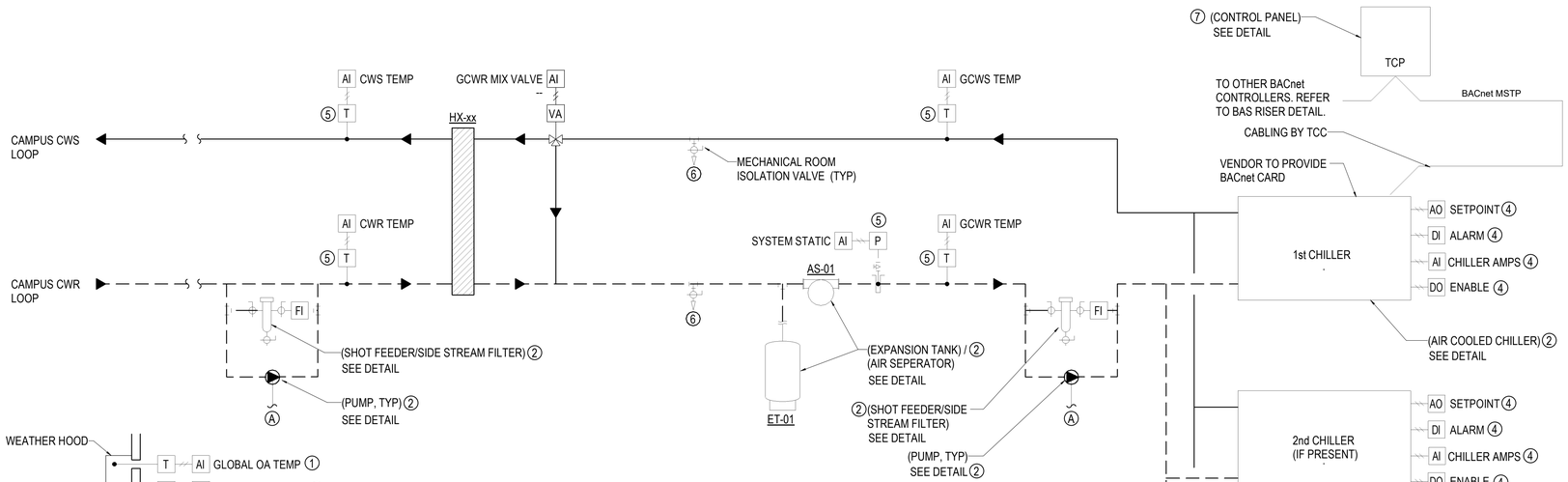
M601

CONTROL POINT LIST (TYPICAL OF 3 CHILLER ARRAYS)

NOTES:
1. ALL POINT SHOWN IN SCHEDULE AND DIAGRAM SHALL BE ON GRAPHICS.
2. ADDITIONAL I/O OBTAINED THRU INTEGRATIONS ARE SUBJECT TO ALARMING AND TRENDING. COORDINATE INTEGRATION DATABASE WITH EQUIPMENT VENDOR, ENGINEER AND OWNER PRIOR TO STARTUP.

NOTE: THIS POINTS LIST INDICATES THE MINIMUM ANTICIPATED POINTS NEEDED BY THE OWNER AND NEEDED TO EXECUTE THE SEQUENCE OF OPERATIONS. THE CONTRACTOR SHALL SUPPLY THESE AND ALL OTHER POINTS NEEDED TO EXECUTE THE SEQUENCE OF OPERATIONS AND TO MEET THE CODE REQUIREMENTS FOR THE PROJECT.

MARK	CONTROL POINT		DESCRIPTION	FAIL POSITION	SETPOINT		ALARM				TREND HISTORY				COMMENTS
	NAME	TYPE			VALUE	RANGE	PARENT	TYPE	THRESHOLD	TIME DELAY	TREND	TYPE	SAMPLES	INTERVAL	
--	CWR TEMP	AI	IMMERSION TEMP SENSOR	--	--	--	--	--	--	--	Yes	TIME	600	5 MIN	--
--	CWS TEMP	AI	IMMERSION TEMP SENSOR	--	--	--	--	THRESHOLD	T<60 DEG F, T>80 DEG F	30 SEC, 20 MIN	Yes	TIME	600	5 MIN	--
--	GCWR MIX VALVE	AO		--	--	--	--	--	--	--	No	--	--	--	--
--	GCWR TEMP	AI	IMMERSION TEMP SENSOR	--	--	--	--	--	--	--	Yes	TIME	300	5 MIN	--
--	GCWS TEMP	AI	IMMERSION TEMP SENSOR	--	--	--	--	THRESHOLD	T<40 DEG F, T>100 DEG F	30 SEC, 20 MIN	Yes	TIME	300	5 MIN	--
--	GLOBAL OA HUMID	AI	TEMPERATURE SENSOR	--	--	--	--	--	--	--	Yes	TIME	600	5 MIN	--
--	GLOBAL OA TEMP	AI	TEMPERATURE SENSOR	--	--	--	--	--	--	--	Yes	TIME	600	5 MIN	--
--	SYSTEM STATIC	AI	PRESSURE TRANSMITTER (4-20mA)	--	--	--	--	THRESHOLD	< 12 PSIg	30 SEC	Yes	COV	50	--	--
1st CHILLER	ALARM	DI	RELAY	OFF	--	--	--	GEN ALARM CONTACT	--	30 SEC	No	COV	50	--	--
1st CHILLER	ENABLE	DO	RELAY	--	--	--	1st CHILLER	--	--	--	Yes	COV	50	--	--
1st CHILLER	SETPOINT	AO	0-10 VDC	--	RESET	80-105 DEG F	--	--	--	--	Yes	TIME	300	5 MIN	--
2nd CHILLER (IF PRESENT)	ALARM	DI	RELAY	OFF	--	--	--	GEN ALARM CONTACT	--	30 SEC	No	COV	50	--	--
2nd CHILLER (IF PRESENT)	ENABLE	DO	RELAY	--	--	--	2nd CHILLER (IF PRESENT)	--	--	--	Yes	COV	50	--	--
2nd CHILLER (IF PRESENT)	SETPOINT	AO	0-10 VDC	--	RESET	80-105 DEG F	--	--	--	--	Yes	TIME	300	5 MIN	--
3rd CHILLER (IF PRESENT)	ALARM	DI	RELAY	OFF	--	--	--	GEN ALARM CONTACT	--	30 SEC	No	COV	50	--	--
3rd CHILLER (IF PRESENT)	ENABLE	DO	RELAY	--	--	--	3rd CHILLER (IF PRESENT)	--	--	--	Yes	COV	50	--	--
3rd CHILLER (IF PRESENT)	SETPOINT	AO	0-10 VDC	--	RESET	80-105 DEG F	--	--	--	--	Yes	TIME	300	5 MIN	--
CWP-0x	START/STOP	DO	RELAY	OFF	--	--	--	--	--	--	No	--	--	--	--
CWP-0x	STATUS	DI	CURRENT RELAY	--	--	--	--	STATUS	--	30 SEC	Yes	COV	50	--	--
HEAT EXCHANGER	CHILLER SIDE DIFF PRESSURE	AI	DIFF PRESSURE SENSOR	--	--	--	--	--	--	--	--	--	--	--	--
HEAT EXCHANGER	GEO SIDE DIFF PRESSURE	AI	DIFF PRESSURE SENSOR	--	--	--	--	--	--	--	--	--	--	--	--



NOTE: TEMPERATURE SENSORS AND OTHER CONTROL DEVICES NECESSARY FOR CHILLER OPERATION SHALL BE PROVIDED BY THE CHILLER MANUFACTURER. CONTRACTOR IS RESPONSIBLE FOR PROVIDING ALL REQUIRED RELAYS, WIRING, AND CONTROL DEVICES NECESSARY FOR A FUNCTIONAL SYSTEM. THE DEVICES SHOWN IN THIS SCHEMATIC ARE IN ADDITION TO THE DEVICES PROVIDED BY THE CHILLER MANUFACTURER AND ARE FOR MONITORING PURPOSES. CHILLER CONTROL PANEL OR ON-BOARD CONTROLS SHALL HAVE BACNET INTERFACE FOR MONITORING AT THE DDC SYSTEM.

(#) PLAN NOTES

1. CHILLER OUTSIDE TEMP SENSOR AND HUMIDITY SENSOR PROVIDED BY TCC AND INSTALLED BY MC. ONLY ONE SET OF GLOBAL SENSORS ARE REQUIRED.
2. EQUIPMENT SUPPLIED AND INSTALLED BY M.C. SEE MECHANICAL DETAILS FOR MECHANICAL PIPING, EQUIPMENT, AND ACCESSORIES.
3. MOTOR RELAY PROVIDED AND INSTALLED BY TCC. SEE MECHANICAL PUMP DETAILS FOR MECHANICAL PIPING, EQUIPMENT, AND ACCESSORIES.
4. I/O IS REQUIRED TO BE HARDWIRED.
5. I/O PROVIDED BY TCC, IMMERSION WELL, OR PIPE TAP INSTALLED BY MC.
6. DRAIN TAPS AND ISOLATION VALVE. REFER ON HYDRONIC FLOOR PLAN. PROVIDED AND INSTALLED BY MC.
7. EQUIPMENT PROVIDED AND INSTALLED BY TCC. REFER TO FLOOR PLAN FOR PROPOSED LOCATION. COORDINATE LOCATION AND CONNECTION WITH EC.

1 CHILLED WATER CONTROL - AIR COOLED - CONSTANT VOLUME

NO SCALE

SEQUENCE OF OPERATION: CHILLER PLANT

Glycol Chiller Run Conditions:
1. The Heat Pump Chiller shall be available to run continuously.
2. When the unmixed campus geothermal loop incoming water temperature exceeds the loop cooling setpoint of 100°F (adj.) for more than 15 minutes (adj.) then the chiller shall be in cooling mode and shall modulate to maintain the loop cooling setpoint.
3. When the unmixed campus geothermal loop incoming water temperature is between 65°F (adj.) and 100°F (adj.) for more than 15 minutes (adj.) then the chiller shall cease operating and shall be in standby mode.
4. When the unmixed campus geothermal loop incoming water temerature drops below the loop heating setpoint of 65°F (adj.) for more than 15 minutes (adj.) then chiller shall be in heating mode and shall modulate to maintain the loop heating setpoint.

Chillers shall have a minimum run time as recommended by the manufacturer, or 15 minutes (adj.), whichever is greater.

The user interface shall include the option to manually set the chiller operation capacity of each chiller in increments no larger than 10%, subject to a minimum capacity as determined by the manufacturer.

PUMPS:
When the chillers enter cooling mode or heating mode, the condenser water pumps and glycol condenser water pumps shall energize. The chillers shall not start until flow has proven for at least 15 seconds.
When the chillers enter stand-by mode, the pumps shall continue to operate for 15 seconds before de-energizing.

MIXING VALVE MODULATION:
The 3-Way Mixing Valve shall modulate to prevent the chiller from receiving water that exceeds 97°F, except during startup.

ALARMS:
Alarms will include alarm modes, time delays, as well as value thresholds.

Source alarms, such as chiller fault will disable conditional tier alarms such as supply water temperature so that multiple alarms are not caused by a single fault.

Alarms will be assigned by priority.
1. Critical alarms will be reported to the workstation and emailed to designated staff.
2. Common alarms will be alarmed at the workstation only.

COOLING MODE ALARMS:
High Supply Water Temp Alarm:
If the glycol chilled water supply temperature leaving the chiller is greater than 80°F (adj.)

High Return Water Temp Alarm:
If the glycol chilled water return temperature entering the chiller is greater than 100°F (adj.)

HEATING MODE ALARMS:
Low Supply Water Temp Alarm:
If the glycol chilled water supply temperature leaving the chiller is less than 60°F (adj.)

Low Return Water Temp Alarm:
If the glycol chilled water return temperature entering the chiller is less than 40°F (adj.)

GENERAL ALARMS:
Chilled Water Pump Alarm:
1. Failure: Commanded on, but the status is off.
2. Running in Hand: Commanded off, but the status is on.
3. Runtime exceeded: Status runtime exceeds a user definable limit.
4. VFD fault.

Chiller Alarm:
1. Failure: Commanded on, but the status is off.
2. Running in Hand: Commanded off, but the status is on.

Heat Exchanger Differential Pressure Alarm 1 (geothermal loop side):
If the differential pressure across the loop side of the heat exchanger exceeds a user definable set-point.

Heat Exchanger Differential Pressure Alarm 2 (chiller side):
If the differential pressure across the chiller side of the heat exchanger exceeds a user definable set-point.

Low System Pressure Alarm:
Anytime system pressure drops below 12 PSIg (threshold), and after delay of 30 sec, then a common alarm is reported. This condition is automatically reset once static pressure rises above 15 PSIg.

CONTROLS GENERAL NOTES

1. INTEGRATE NEW EQUIPMENT INTO THE EXISTING JCI METASYS BUILDING AUTOMATION SYSTEM. ALL CONTROLS WORK AND COMPONENTS MUST BE FULLY COMPATIBLE WITH THE EXISTING SYSTEM, INTEGRATE SEAMLESSLY INTO THE USER INTERFACE (INCLUDING REMOTE USER INTERFACES), AND PROVIDE ALL NECESSARY FEATURES AND COMPONENTS TO BE VISIBLE AND CONTROLLABLE FROM THE OWNER'S EXISTING USER INTERFACE.
2. PROVIDE NEW CONTROLLERS AND CONTROL PANELS AS NECESSARY. COORDINATE THE LOCATION OF ANY NEW PANELS WITH THE OWNER.
3. POWER WIRING (PWR) BY THE ELECTRICAL CONTRACTOR. TCC IS RESPONSIBLE FOR POWER WIRING FROM FIELD EQUIPMENT PANEL TO CONTROLS REQUIRING POWER. ALL CONTROL WIRING BY DIVISION 23.
4. CONTROL VALVES ARE FURNISHED AND WIRED BY THE TCC. INSTALLED IN PIPING BY THE MECHANICAL CONTRACTOR.

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REVISIONS

No.	Date	Description

LICENSED PROFESSIONAL ENGINEER
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31830
01/24/2025
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CONTROL DETAILS

100% CD

PEC PROJECT NUMBER: 231211-000
DATE 01/22/2025
DRAWN BY LCB
CHECKED BY JRB

M701