

UNION COUNTY BOARD OF EDUCATION CONTRACT ROUTING SHEET

Contractor Name: Superior Mechanical Services, Inc.
 Address: 607 Industrial Avenue
 City, State, Zip: Greensboro, NC 27406
 Contact Name: James Fields
 Telephone Number: 336.274.3008

UCPS Contract Number: 1-97336074

Purpose of Contract (location and brief description): Monroe High School-HVAC Renovation

Submitting Department: Facilities Department

Date Submitted: 5/27/2021

Budget Account Number: 4.9015.817.523.336.153-4.9015.817.523.336.165 Funding Source: 19-20 390,000 20-21 87,000

Contract Amount: \$ \$477,000.00

Contract Period: Completion by December 31, 2021

UCPS Employee to Contact: Penny Helms/Dave Burnett

Phone Number: 704-296-3160

NOTE: Individuals listed below should initial, date, and forward this form after completing their responsibilities relating to this Contract.

	Date Received	Date Processed	Initials
1. Approved by Fund Owner/Acquire Vendor Signature and proper Insurance Certificate with UCBOE NAMED as CERTIFICATE HOLDER.		<u>5/27/2021</u>	PLH DS
A. Insurance Certificate Reviewed/Approved by Risk Management			SH DS
2. Approved by Appropriate Representative(s) of UCPS:			DS
<input checked="" type="checkbox"/> UCPS Project Coordinator			DS
<input checked="" type="checkbox"/> UCPS Department Head/School Principal			DS
<input checked="" type="checkbox"/> Asst. Supt. for Administration & Operations			DS
<input type="checkbox"/> Asst. Supt. for Human Resources	N/A	N/A	N/A
<input type="checkbox"/> Asst. Supt. for Instructional Programs Asst.	N/A	N/A	N/A
<input type="checkbox"/> Asst. Supt. of Student Support	N/A	N/A	N/A
<input type="checkbox"/> Chief School Performance Officer	N/A	N/A	N/A
<input type="checkbox"/> Chief Technology Officer	N/A	N/A	N/A
FORWARD TO UCPS GENERAL COUNSEL OFFICE			
3. Approved by Legal Counsel	DS SS	DS KB	DS MM
FORWARD TO SUPERINTENDENT/BOARD OF EDUCATION			
4. Approved by Superintendent			
5. Approved by Board of Education			
FORWARD TO FINANCE			
6. Pre-audited by Representative of Finance Officer			DS SM
FORWARD TO PURCHASING			
7. Purchase Order Number assigned by Purchasing Director, or designee, and contract distributed			

Contract #:1-97336074

**CONTRACT FOR SERVICES
MONROE HIGH SCHOOL-HVAC RENOVATION**

This Contract for Services ("Contract") is made and entered into 1st day of June 2021 between The Union County Board of Education, with a mailing address of 400 North Church Street, Monroe, North Carolina 28112 ("UCBOE") and Superior Mechanical Services, Inc. with a mailing address of 607 Industrial Avenue, Greensboro, NC 27406. ("Vendor" or "Contractor" or "Service Provider").

For and in consideration of the mutual promises set forth in this Contract, the parties do mutually agree as follows:

1. Obligations of Vendor. The Vendor agrees to provide the services, goods, materials, equipment, and/or software (the "Services" and/or "Goods," as appropriate) to fully, timely and properly complete the PROJECT as more particularly described in the Scope of Work document attached hereto and incorporated herein by reference as Exhibit 1 and includes corresponding documents. Contract does not include the Insulation of Pipes in areas identified within Addendum 2.

The UCBOE and Vendor recognize that time is of the essence to this Agreement and that the UCBOE will suffer financial loss if the work is not completed within the times specified herein. Both parties also recognize the delays, difficulties and expense involved in proving, in a legal or arbitration proceeding, the actual loss suffered by the UCBOE if the Work is not completed on time. Accordingly, in lieu of requiring such proof, the UCBOE and Vendor agree that as liquidated damages for delay (but not as penalty) the Vendor shall pay to the UCBOE for each day in excess of the term allowed for completion of the Work, the sum of \$200 as liquidated damages.

The term of this Contract shall be per the Project Schedule identified within Exhibit 2.

This Contract does not grant the Vendor the right or the exclusive right to provide specified Services and/or Goods to UCBOE. Similar Services and/or Goods may be obtained from sources other than the Vendor (or not at all) at the discretion of UCBOE.

The Vendor shall begin work immediately upon issuance of a written notice to proceed and be complete within the time identified within Exhibit 1. The Vendor agrees to perform the Services and supply the Goods or in a timely, complete, and professional manner and in accordance with the terms and conditions of this Contract. Furthermore, the Vendor represents and warrants that (i) it is duly qualified and, if required by law, licensed to provide the Services and/or Goods; (ii) it will provide the Services and/or Goods in a manner consistent with the level of care and skill ordinarily exercised by contractors providing similar Services and/or Goods under similar conditions; (iii) it possesses sufficient experience, personnel, and resources to provide the Services and/or Goods; (iv) it shall provide the Services and/or Goods in compliance with applicable laws, statutes, ordinances, codes, orders, rules and regulations; and (v) its reports, if any, shall be complete, accurate, and unambiguous.

2. Obligations of UCBOE. UCBOE hereby agrees to pay to the Vendor for the faithful performance of this Contract, and the Vendor hereby agrees to provide all of the Services and/or Goods, for the sum not to exceed \$477,000, Four Hundred, Seventy-Seven Dollars and Zero Cents ("Contract Price") subject to adjustments as provided for in the Contract Documents.

Project Amount: \$ 467,000

Allowance Funds: \$ 10,000

3. Project Coordinator. Karl Todd is designated as the Project Coordinator for UCBOE. The Project Coordinator shall be UCBOE's representative in connection with the Vendor's performance under this Contract. UCBOE has complete discretion in replacing the Project Coordinator with another person of its choosing.
4. Vendor Supervisor. James Fields is designated as the Vendor Supervisor for the Vendor. The Vendor Supervisor is fully authorized to act on behalf of the Vendor in connection with this Contract.
5. Terms and Methods of Payment. UCBOE will make payment after invoices are approved on a net 30-day basis. UCBOE will not pay for services or materials in advance without the prior approval of the Finance Officer. 5% Retainage will be held as allowed by NCGS.
6. Standard Terms and Conditions: Vendor agrees to the Standard Terms and Conditions set forth as Attachment A attached hereto and incorporated herein by reference.
7. Counterpart Execution. This Contract may be executed and recorded in two or more counterparts, each of which shall be deemed an original and all of which, when taken together, shall constitute one and the same instrument. Each party shall be entitled to rely upon executed copies of this Contract transmitted by facsimile or electronic "PDF" to the same and full extent as the originals.

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[SIGNATURES ON NEXT PAGE]

IN WITNESS WHEREOF, UCBOE and the Vendor have executed this Contract on the day and year first written above.

Superior Mechanical Services, Inc.

Vendor Name

DocuSigned by:

Jim Fields

6/3/2021 | 12:42 PM EDT

Signature of Authorized Representative

Date

Vendor's Federal Identification #

[if Contract is with Organization or Social Security Number if individual]

THE UNION COUNTY BOARD OF EDUCATION

Authorized Representative

Date

This instrument has been preaudited
in the manner required by the School Budget

and Fiscal Control Act.

Shanna McLamb

6/3/2021 | 12:57 PM PDT

6/3/2021 | 9:11 AM EDT

Finance Office

Date

Risk Management

Date

As to form:

DocuSigned by:

Michele Morris

6/2/2021 | 7:35 PM PDT

UCBOE Attorney

Date

Attachment A

Standard Terms and Conditions

I. Standard Terms and Conditions for All Contracts

1. Defined Terms, "Contract" means the agreement between UCBOE and Vendor which consists of the applicable Contract Documents. "Contract Documents" means: (i) any applicable purchase order between Vendor and UCBOE specifically including all terms and conditions set forth or referenced herein and on the face of a Purchase Order, (ii) any attachments hereto, (iii) any applicable solicitation documentation related to hereto (including without limitation any request for proposals or invitation for bids and Vendor's response thereto), and (iv) any other terms and conditions of a written agreement signed by Vendor and UCBOE that deals with the same subject matter. "Goods" means any supplies, materials, products or other tangible personal property provided by Vendor to UCBOE. "Purchase Order" mean any applicable purchase order issued by UCBOE. "Services" means services, specifically including without limitation construction services, design services, professional or consulting services and software as a service, "UCBOE" means the Union County Board of Education. "Vendor" means the party contracting with UCBOE and includes individual and entities that may be referred to in Contract Documents as "vendor", "seller", "service provider", or "contractor".
2. Written Agreement Signed by Both Parties; Acceptance of Purchase Order Terms and Conditions when there is not a Separate Written Agreement Signed by Both Parties. When a Contract is signed by both UCBOE and Vendor then the Purchase Order issued by UCBOE is for administrative convenience and is not part of the Contract Documents. When there is not a separate Contract signed by both UCBOE and Vendor, then Vendor's acknowledgment of the terms of any Purchase Order, without timely objection, or Vendor's shipment or performance of any part of a Purchase Order, constitutes an agreement to all terms and conditions set forth or referenced herein and on the face of the Purchase Order, together with the terms and conditions of any other applicable Contract Documents. The terms and provisions set forth in the Contract Documents shall constitute the entire agreement between Vendor and UCBOE with respect to the purchase by UCBOE of the Services and/or Goods work performed as described in the Contract Documents. In the event of any conflict between any terms and conditions of the Contract Documents, the terms and conditions most favorable to UCBOE shall control. A Purchase Order constitutes an offer by UCBOE and expressly limits acceptance to the terms and conditions stated therein. No additional or supplemental provision or provisions in variance herewith that may appear in Vendor's quotation, acknowledgment, invoice, or in any other communication from Vendor to UCBOE shall be deemed accepted by or binding on UCBOE. UCBOE hereby expressly rejects all such provisions which supplement, modify or otherwise vary from the terms of the Contract Documents, and such provisions are superseded by the terms and conditions stated in the Contract Documents, unless and until UCBOE's authorized representatives expressly assent, in writing, to such provisions. Stenographic and clerical errors and omissions by UCBOE are subject to correction.
3. Cancellation of Purchase Order. UCPS may cancel any Purchase Order or portion thereof without liability, if:
 - (a) Vendor fails upon request to give reasonable assurance of timely performance or UCPS otherwise determines that it has reasonable grounds for insecurity regarding Vendor's performance; (b) conforming Goods or Services (including the quantities specified for delivery) are not delivered within the time specified or, if no time is specified, within a commercially reasonable time; (c) Vendor otherwise breaches the Contract and such breach is not corrected within thirty (30) days following written notice of breach; or (d) cancellation is otherwise required or allowed by law.
4. Quantities. Shipments must equal exact amounts ordered unless otherwise agreed in writing by UCBOE. The award of a term contract neither implies nor guarantees any minimum or maximum purchases. Materials received in excess of quantity specified on the purchase order, at UCBOE option's, may be returned at the Vendor's expense.
5. Prices. If Vendor's price or the regular market price of any of the Goods covered hereunder is lower than the price stated in the Contract Documents on the date of shipment of such Goods, Vendor agrees to give UCBOE the benefit of such lower price on any such Goods. In no event shall Vendor's price be higher than the price last quoted or last charged to UCBOE unless otherwise agreed in writing. No charges for transportation, boxing, crating, etc. are allowable unless such charges are included in the Contract Documents.
6. Invoices. It is understood and agreed that orders will be shipped at the established Contract prices in effect on dates orders are placed. Invoicing at variance with this provision may subject the Contract to cancellation.

Applicable North Carolina sales tax shall be invoiced as a separate item. Invoices shall be sent to UCBOE's accounts payable department with a copy to UCBOE Project Coordinator.

7. Freight on Board. All shipments of Goods are FOB destination unless otherwise stated in the Contract Documents. Any freight charges prepaid by Vendor are to be itemized on the invoice unless stated otherwise in writing by form of quote, bid, contract. In instances where Goods are shipped against this order by parties other than those specified on the Purchase Order, the third-party shipper must be instructed to list the UCBOE purchase order number on all packages, bills of lading, etc. to insure prompt identification of order.
8. Taxes. Taxes are included in the Contract Price. Applicable taxes shall be invoiced as a separate item for UCBOE's records.
9. Payment Terms. Payment terms are Net 30 days after receipt of correct invoice or acceptance of Goods, whichever is later.
10. Condition and Packaging. Unless otherwise provided by special terms and conditions or specifications, it is understood and agreed that any item offered or shipped has not been sold or used for any purpose and shall be in first class condition. All containers/packaging shall be suitable for handling, storage or shipment.
11. Safety Data Sheets. Safety Data Sheets must be provided with shipment of all chemicals."
12. Delays in Shipment. Time and date of delivery are of the essence, except when delay is due to causes beyond Vendor's reasonable control and without Vendor's fault or negligence.
13. Risk of Loss. Vendor shall have the risk of loss of and damage to the Goods subject to the Contract Documents until such Goods are delivered to the destination and accepted by UCBOE or its nominee.
14. Rejection. All Goods shall be received subject to UCBOE's inspection. Goods that are defective in workmanship or material or otherwise not in conformity with the requirements of the Contract Documents may be rejected and returned at Vendor's expense or may be accepted at a reduced price. UCBOE may require Vendor to promptly replace or correct any rejected Goods Services and, if Vendor fails to do so, UCBOE may contract with a third party to replace such Goods Services and charge Vendor the additional cost.
15. Warranties. Vendor warrants that all Goods delivered hereunder will be free from defects in materials and workmanship and will conform strictly to the specifications, drawings, or samples specified or furnished. This warranty shall survive any inspection, delivery, acceptance or payment by UCBOE of the Goods and shall run to UCBOE and any user of the Goods. This express warranty is in addition to Vendor's implied warranties of merchantability and fitness for a particular purpose which shall not be disclaimed. In addition to any other rights available at law or equity, UCBOE shall be entitled to all rights and remedies provided by the Uniform Commercial Code, Chapter 25 of the North Carolina General Statutes, for breach of express warranties and implied warranties of merchantability or fitness for a particular purpose, including but not limited to consequential and incidental damages.
16. Compliance with All Laws. Vendor warrants that all performance hereunder shall be in accordance with all applicable federal, state and local laws, regulations and orders. The right of Vendor to proceed may be terminated immediately by written notice if UCBOE determines that Vendor, its agent or another representative, has violated any provision of law.
17. Use of Federal Funds. If the source of funds for this Contract is federal funds, the following federal provisions apply pursuant to 2 C.F.R. § 200.326 and 2 C.F.R. Part 200, Appendix II (as applicable): Equal Employment Opportunity (41 C.F.R. Part 60); Davis-Bacon Act (40 U.S.C. 3141-3148); Copeland "Anti-Kickback" Act (40 U.S.C. 3145); Contract Work Hours and Safety Standards Act (40 U.S.C. 3701-3708); Clean Air Act (42 U.S.C. 7401-7671q.) and the Federal Water Pollution Control Act (33 U.S.C. 1251-1387); Debarment and Suspension (Executive Orders 12549 and 12689); Byrd Anti-Lobbying Amendment (31 U.S.C. 1352); Procurement of Recovered Materials (2 C.F.R. § 200.322); and Record Retention Requirements (2 CFR § 200.324).
18. Registered Sex Offenders; Jessica Lunsford Act. Under North Carolina law, certain sex offenders are prohibited from coming onto school campuses. Vendor agrees to conduct an annual check of the N.C. Sex Offender and Public Protection Registration Program, the N.C. Sexually Violent Predator Registration Program and the National Sex Offender Registry for all of its employees whose job involves direct interaction with students as part of the job. UCBOE prohibits any personnel listed on such registries from being on any property owned or operated by UCBOE and from having any direct interaction with students. As a term of the Agreement, said checks must be performed by the Vendor and reported to UCBOE's Superintendent or designee, if Vendor's employees will be working directly with students. Under provisions set forth in the Jessica Lunsford Act under North Carolina law, the signature below certifies that neither Vendor nor any employee or agent of Vendor is

listed as a sex offender on the N.C. Sex Offender and Public Protection Registration Program, the N.C. Sexually Violent Predator Registration Program, and/or the National Sex Offender Registry.

19. Nondiscrimination. During the performance of the Contract, Vendor shall not discriminate against or deny the Contract's benefits to any person on the basis of sexual orientation, national origin, race, ethnic background, color, religion, gender, age or disability.
20. FERPA Electronically Stored Data Compliance: Vendor is expressly prohibited from selling or trading any education records or personally identifiable information acquired under the Agreement. Furthermore, Vendor agrees not to attempt to re-identify students from aggregated data. Further, Vendor will not use any personally identifiable information or education records to advertise or market to students of UCBOE or their parents. Any personally identifiable information and education records held by Vendor pursuant to the Agreement will be made available to UCBOE upon request. Vendor will store and process all data using appropriate administrative, physical, and technical safeguards to secure personally identifiable information and education records from unauthorized access, disclosure, and use. Vendor will conduct periodic risk assessments and remediate any identified security vulnerabilities in a timely manner. Vendor will also have a written incident response plan, to include prompt notification to UCBOE in the event of a security or privacy incident, as well as procedures for responding to a breach of data. Vendor agrees to share its incident response plan upon request. Vendor shall, for all personally identifiable data and education records in its possession and in the possession of any subcontractors, or agents to which it has transferred data as permitted herein, destroy or de-identify such data when such data is no longer needed to perform the Agreement. Vendor hereby agrees to abide by all Board of Education policies and procedures governing the confidentiality of student records and the responsible use of technology and internet safety. If Vendor experiences a security breach concerning any information covered by the Agreement, and such breach is covered by N.C.G.S. § 75.61(14), then Vendor will (a) fully comply with Vendor's obligations under the N.C. Identity Theft Protection Act, (b) immediately notify UCBOE with the information listed in N.C.G.S. § 75-65(d)(1-4), and (c) fully cooperate with UCBOE in carrying out its obligations under said Identity Theft Protection Act. Vendor will indemnify UCBOE for any breach of confidentiality or failure of its responsibilities to protect confidential information, and for cost of notification of affected persons as a result of its accidental or negligent release of personally identifiable information or education records provided to Vendor pursuant to the Agreement.
21. North Carolina Public Records Law: Vendor acknowledges that UCBOE is subject to the requirements of North Carolina's Public Records Law ("NCPRL"), N.C.G.S. § 132-1, et. seq. The Agreement and any related documents, papers, letters, maps, books, photographs, films, sound recordings, magnetic or other tapes, electronic data-processing records, artifacts, or other documentary material, regardless of physical form or characteristics, made or received by UCBOE in connection with the transaction of the Agreement may be considered a "public record," subject to disclosure under the NCPRL. UCBOE is under no obligation to notify Vendor prior to its compliance of its duties under NCPRL.
22. Conflict of Interest. Vendor represents and warrants that no member of UCBOE or any of its employees or officers who may obtain a direct benefit, personal gain or advantage for themselves or a relative or associate as a result of the Contract, subcontract or other agreement related to the Contract is in a position to influence or has attempted to influence the making of the Contract, has been involved in making the Contract, or will be involved in administering the Contract. Vendor also represents and warrants that, if the Contract is funded by any amount of federal funds, no violation of 2 C.F.R. § 200.318(c) or any other applicable federal conflict of interest law has occurred or will occur. Vendor shall cause this paragraph to be included in all Contracts, subcontracts and other agreements related to the Contract.
23. Gratuities. Vendor represents and warrants that no member of UCBOE or any of its employees has been or will be offered or given a gratuity to an official or employee of UCBOE in violation of applicable law or policy.
24. Kickbacks to Vendor. Vendor shall not permit any kickbacks or gratuities to be provided, directly or indirectly, to itself, its employees, subcontractors or subcontractor employees for the purpose of improperly obtaining or rewarding favorable treatment in connection with a UCBOE Contract or in connection with a subcontract relating to a UCBOE Contract. When Vendor has grounds to believe that a violation of this clause may have occurred, Vendor shall promptly report to UCBOE in writing the possible violation.
25. Iran Divestment Act. Vendor certifies that, as of the date listed below, it is not on the Final Divestment List, as created by the State Treasurer pursuant to N.C.G.S. § 143-6A-4, in violation of the Iran Divestment Act. In compliance with the requirements of the Iran Divestment Act and N.C.G.S. § 143C-6A-5(b), Vendor shall not

utilize in the performance of the contract any subcontractor that is identified on the Final Divestment List. The Final Divestment List can be found on the State Treasurer's website at the address www.nctreasurer.com/Iran and should be updated every 180 days.

26. Divestment from Companies that Boycott Israel. The Vendor certifies that it has not been designated by the North Carolina State Treasurer as a company engaged in the boycott of Israel pursuant to N.C.G.S. 147-86.81. It is the responsibility of each vendor or contractor to monitor compliance with this restriction. Contracts valued at less than \$1,000.00 are exempt from this restriction.
27. E-Verification. Vendor shall comply with the requirements of Article 2 of Chapter 64 of the North Carolina General Statutes
28. Indemnification. To the fullest extent permitted by law, Vendor shall indemnify and hold harmless UCBOE, its officers, agents, employees and assigns from and against all claims, losses, costs, damages, expenses, attorneys' fees and liability that any of them may sustain (a) arising out of Vendor's failure to comply with any applicable law, ordinance, regulation, or industry standard or (b) arising directly or indirectly out of Vendor's performance or lack of performance of the terms and conditions of the Contract. In the event that any Services and/or Goods sold and delivered or sold and performed under the Contract Documents shall be defective in any respect whatsoever, Vendor shall indemnify and save harmless UCBOE, its officers, agents, employees and assigns from all loss or the payment of all sums of money by reason of all accidents, injuries or damages to persons or property that shall happen or occur in connection with the use or sale of such Services and/or Goods and are contributed to by said condition. In the event Vendor, its employees, agents, subcontractors and or lower-tier subcontractors enter premises occupied by or under the control of UCBOE in the performance of the Contract Documents, Vendor agrees that it will indemnify and hold harmless UCBOE, its officers, agents, employees and assigns, from any loss, costs, damage, expense or liability by reason of property damage or personal injury of whatsoever nature or kind arising out of, as a result of, or in connection with such entry.
29. Insurance. Unless such insurance requirements are waived or modified by UCBOE or risk management ("DIRM"), Vendor certifies that it currently has and agrees to purchase and maintain during its performance under the Contract the following insurance from one or more insurance companies acceptable to UCBOE and authorized to do business in the State of North Carolina: Automobile - Vendor shall maintain bodily injury and property damage liability insurance covering all owned, non-owned and hired automobiles. The policy limits of such insurance shall not be less than \$1,000,000 combined single limit each person/each occurrence. Commercial General Liability - Vendor shall maintain commercial general liability insurance that shall protect Vendor from claims of bodily injury or property damage which arise from performance under the Contract. This insurance shall include coverage for contractual liability. The policy limits of such insurance shall not be less than \$1,000,000 combined single limit each occurrence/annual aggregate. Worker's Compensation and Employers' Liability Insurance - If applicable to Vendor, Vendor shall meet the statutory requirements of the State of North Carolina for worker's compensation coverage and employers' liability insurance. Vendor shall also provide any other insurance or bonding specifically recommended in writing by the DIRM or required by applicable law. Certificates of such insurance shall be furnished by Vendor to UCBOE and shall contain the provision that UCBOE be given 30 days' written notice of any intent to amend or terminate by either Vendor or the insuring company. Failure to furnish insurance certificates or to maintain such insurance shall be a default under the Contract and shall be grounds for immediate termination of the Contract.
30. Termination for Convenience. In addition to all of the other rights which UCBOE may have to cancel this Contract or an applicable Purchase Order, UCBOE shall have the further right, without assigning any reason therefore, to terminate the Contract (or applicable Purchase Order), in whole or in part, at any time at its complete discretion by providing 10 days' notice in writing from UCBOE to Vendor. If the Contract is terminated by UCBOE in accordance with this paragraph, Vendor will be paid in an amount which bears the same ratio to the total compensation as does the Services and/or Goods actually delivered or performed to the total originally contemplated in the Contract. UCBOE will not be liable to Vendor for any costs for completed Goods, Goods in process or materials acquired or contracted for if such costs were incurred prior to the date of this Contract or an applicable Purchase Order.
31. Termination for Default. UCBOE may terminate the Contract, in whole or in part, immediately and without prior notice upon breach of the Contract by Vendor. In addition to any other remedies available to UCBOE law or equity, UCBOE may procure upon such terms as UCBOE shall deem appropriate, Services and/or Goods

substantially similar to those so terminated, in which case Vendor shall be liable to UCBOE for any excess costs for such similar goods, supplies, or services and any expenses incurred in connection therewith.

32. **Contract Funding.** It is understood and agreed between Vendor and UCBOE that UCBOE's obligation under the Contract is contingent upon the availability of appropriated funds from which payment for Contract purposes can be made. No legal liability on the part of UCBOE for any payment may arise until funds are made available to UCBOE's Finance Officer and until Vendor receives notice of such availability. Should such funds not be appropriated or allocated, the Contract shall immediately be terminated. UCBOE shall not be liable to Vendor for damages of any kind (general, special, consequential or exemplary) as a result of such termination.
33. **Accounting Procedures.** Vendor shall comply with any accounting and fiscal management procedures prescribed by UCBOE to apply to the Contract and shall assure such fiscal control and accounting procedures as may be necessary for proper disbursement of and accounting for all project funds.
34. **Improper Payments.** Vendor shall assume all risks attendant to any improper expenditure of funds under the Contract. Vendor shall refund to UCBOE any payment made pursuant to the Contract if it is subsequently determined by audit that such payment was improper under any applicable law, regulation or procedure. Vendor shall make such refunds within thirty (30) days after UCBOE notifies Vendor in writing that a payment has been determined to be improper.
35. **Contract Transfer.** Vendor shall not assign, subcontract or otherwise transfer any interest in the Contract without the prior written approval of UCBOE.
36. **Contract Personnel.** Vendor agrees that it has, or will secure at its own expense, all personnel required to provide the Services and/or Goods set forth in the Contract.
37. **Key Personnel.** Vendor shall not substitute for key personnel (defined as those individuals identified by name or title in the Contract Documents or in written communication from Vendor) assigned to the performance of the Contract without prior written approval from UCBOE Project Coordinator (the individual at UCBOE responsible for administering the Contract).
38. **Contract Modifications.** The Contract may be amended only by written amendment duly executed by both UCBOE and Vendor.
39. **Relationship of Parties.** Vendor is an independent contractor and not an employee of UCBOE. The conduct and control of the work will lie solely with Vendor. The Contract shall not be construed as establishing a joint venture, partnership or any principal-agent relationship for any purpose between Vendor and UCBOE. Employees of Vendor shall remain subject to the exclusive control and supervision of Vendor, which is solely responsible for their compensation.
40. **Advertisement.** The Contract will not be used in connection with any advertising by Vendor without prior written approval by UCBOE.
41. **Monitoring and Evaluation.** Vendor shall cooperate with UCBOE, or with any other person or agency as directed by UCBOE, in monitoring, inspecting, auditing or investigating activities related to the Contract. Vendor shall permit UCBOE to evaluate all activities conducted under the Contract. UCBOE has the right at its sole discretion to require that Vendor remove any employee of Vendor from UCBOE Property and from providing Services and/or Goods under the Contract following provision of notice to Vendor of the reasons for UCBOE's dissatisfaction with the Services and/or Goods of Vendor's employee.
42. **Financial Responsibility.** Vendor is financially solvent and able to perform under the Contract. If requested by UCBOE, Vendor agrees to provide a copy of its latest audited annual financial statements or other financial statements as deemed acceptable by UCBOE's Finance Officer. In the event of any proceedings, voluntary or involuntary, in bankruptcy or insolvency by or against Vendor, the inability of Vendor to meet its debts as they become due or in the event of the appointment, with or without Vendor's consent, of an assignee for the benefit of creditors or of a receiver, then UCBOE shall be entitled, at its sole option, to cancel any unfilled part of the Contract without any liability whatsoever.
43. **Governmental Restrictions.** In the event any governmental restrictions are imposed which necessitate alteration of the material, quality, workmanship or performance of the items offered prior to their delivery, it shall be the responsibility of the Vendor to notify, in writing, the issuing purchasing office at once, indicating the specific regulation which required such alterations. UCBOE reserves the right to accept any such alterations, including any price adjustments occasioned thereby, or to cancel the Contract.
44. **Inspection at Vendor's Site.** UCBOE reserves the right to inspect, at a reasonable time, the equipment/item, plant or other facilities of a prospective contractor prior to Contract award, and during the Contract term as

necessary for UCBOE determination that such equipment/item, plant or other facilities conform with the specifications/requirements and are adequate and suitable for the proper and effective performance of the Contract.

45. **Confidential Information.** All information about UCBOE provided to the Vendor or its officers, employees, agents, representatives and advisors (the "Vendor Representatives"), and all copies or other full or partial reproductions thereof and notes, memoranda or other writings related thereto created by Vendor or any Vendor Representative, regardless of whether provided before or after the date of the Contract and regardless of the manner or medium in which it is furnished, is referred to as "Confidential Information". Confidential Information does not include any information that (a) is or becomes generally available to the public other than as a result of an impermissible disclosure by Vendor, (b) was known by or available on a nonconfidential basis to Vendor before it was disclosed by UCBOE or (c) becomes available to Vendor on a nonconfidential basis from a third party whom Vendor does not know to be bound by a confidentiality agreement with, or have an obligation of secrecy to, UCBOE. Except as and to the extent required by law or order or demand of any governmental or regulatory authority, Vendor and Vendor Representatives will (x) keep all Confidential Information confidential and (y) will only disclose or reveal any Confidential Information to Vendor Representatives who must have the information to fulfill Vendor's obligations under the Contract and who agree to observe the terms of this Section. Vendor and Vendor Representatives will not use the Confidential Information for any purpose other than fulfilling Vendor's obligations under the Contract. By way of example and not limitation, Vendor shall not sell, market, or commercialize Confidential Information, create derivative products or applications based on Confidential Information. If Vendor is requested or required, pursuant to applicable law or regulation or by legal process, to disclose any Confidential Information, Vendor will provide UCBOE with prompt and timely notice of the requests or requirements so that UCBOE can seek an appropriate protective order or other remedy and will not be prejudiced by delay. If UCBOE does not obtain a protective order or other remedy, Vendor will only disclose that portion of the Confidential Information which Vendor's legal counsel determines Vendor is required to disclose. Upon termination of the Contract or otherwise upon UCBOE's request, Vendor will promptly deliver to UCBOE all Confidential Information in the possession of Vendor or the Vendor Representatives.

Student Information: If, during the course of Vendor's performance of the Contract, Vendor should obtain any information pertaining to students or students' official records, Vendor agrees to keep any such information confidential and to not disclose or permit it to be disclosed, directly or indirectly, to any person or entity. The Contract shall not be construed by either party to constitute a waiver of or to in any manner diminish the provisions for confidentiality of students' records. Additionally, pursuant to N.C.G.S. 115C-401.1, it is unlawful for a person who enters into a contract with a local board of education to sell personally identifiable information that is obtained from a student as a result of that person's performance under the Contract.

Employee Personnel Information: If, during the course of Vendor's performance of the Contract, Vendor should obtain any information pertaining to employees of UCBOE's personnel records, Vendor agrees to keep any such information confidential and to not disclose or permit it to be disclosed, directly or indirectly, to any person or entity. This section will survive the termination of this Contract.

46. **Intellectual Property.** Vendor agrees, at its own expense, to indemnify, defend and save UCBOE harmless from all liability, loss or expense, including costs of settlement and attorney's fees, resulting from any claim that UCBOE's use, possession or sale of the Services and/or Goods infringes any copyright, patent or trademark or is a misappropriation of any trade secret.
47. **No Pre-Judgment or Post-Judgment Interest.** In the event of any action by Vendor for breach of contract in connection with the Contract, any amount awarded shall not bear interest either before or after any judgment, and Vendor specifically waives any claim for interest.
48. **Background Checks.** At the request of UCBOE's Project Coordinator, Vendor (if an individual) or any individual employees of Vendor shall submit to UCBOE criminal background check and drug testing procedures.
49. **Mediation.** If a dispute arises out of or relates to the Contract, or the breach of the Contract, and if the dispute cannot be settled through negotiation, the parties agree to try in good faith to settle the dispute by mediation administered by the American Arbitration Association under its Commercial Mediation Rules before resorting to litigation.

50. No Third-Party Benefits. The Contract shall not be considered by Vendor to create any benefits on behalf of any third party. Vendor shall include in all contracts, subcontracts or other agreements relating to the Contract an acknowledgment by the contracting parties that the Contract creates no third-party benefits.
51. Force Majeure. Neither party shall be responsible to the other for any losses resulting from the failure to perform any terms or provisions of the Agreement if the party's failure to perform is attributable to war, riot or other disorder, strike or other work stoppage; fire; flood; storm; illness; pandemic, communicable disease, or any other act not within the control of the party whose performance is interfered with, and which, by reasonable diligence, such party is unable to prevent. However, UCBOE will be entitled to a refund for fees paid on account of services not rendered by Vendor including any and all deposits.
52. Ownership of Documents; Work Product. All documents created pursuant to the Contract shall, unless expressly provided otherwise in writing, be owned by UCBOE. Upon the termination or expiration of the Contract, any and all finished or unfinished documents and other materials produced by Vendor pursuant to the Contract shall, at the request of UCBOE, be turned over to UCBOE. Any technical knowledge or information of Vendor which Vendor shall have disclosed or may hereafter disclose to UCBOE shall not, unless otherwise specifically agreed upon in writing by UCBOE, be deemed to be confidential or proprietary information and shall be acquired by UCBOE free from any restrictions as part of the consideration of the Contract.
53. Strict Compliance. UCBOE may at any time insist upon strict compliance with these terms and conditions notwithstanding any previous course of dealing or course of performance between the parties to the contrary.
54. General Provisions. UCBOE's remedies as set forth herein are not exclusive. Any delay or omission in exercising any right hereunder, or any waiver of any single breach or default hereunder, shall not be deemed to be a waiver of such right or of any other right, breach, or default. If action be instituted by Vendor hereunder, UCBOE shall be entitled to recover costs and reasonable attorney's fees. Vendor may not assign, pledge, or in any manner encumber Vendor's rights under this Contract or applicable Purchase Order or delegate the performance of any of its obligations hereunder, without UCBOE's prior, express written consent.
55. Contract Situs. All matters, whether sounding in contract or tort relating to the validity, construction, interpretation and enforcement of the Contract, will be determined in Union County, North Carolina. North Carolina law will govern the interpretation and construction of the Contract.
56. Severability. Any provision of this Contract that is determined by any court of competent jurisdiction to be invalid or unenforceable will not affect the validity or enforceability of any other provision. Any provision of the Contract held invalid or unenforceable only in part or degree will remain in full force and effect to the extent not held invalid or unenforceable.

II. Additional Standard Terms and Conditions for Construction Contracts

1. Supervision and Provision for Labor and Supplies. The Vendor will supervise and direct the construction work (the "Work") and shall furnish, provide, and pay for all labor, materials, equipment, machinery, utilities, and services reasonably necessary for the execution and completion of the Work.
2. Coordination of Work and Notification of Progress. The Vendor agrees to coordinate its Work with the work of any other separate contractors or with the work of UCBOE's own forces to avoid delaying or interfering with their work. Vendor shall enforce good order and discipline among his employees and subcontractors on the Project. The Vendor further agrees to inform UCBOE on a regular basis or at UCBOE's request of the progress of the Work.
3. Provision for all Permits, Licenses, and Inspections. Unless otherwise provided, the Vendor shall secure and pay for all permits, licenses, and inspections necessary for the proper execution and completion of the Work.
4. Cleanliness. Vendor shall keep the Project reasonably free from waste materials or rubbish resulting from the Vendor's operations.
5. Additional Warranties. The Vendor warrants that the Vendor has visited the location of the Project and is familiar with all field conditions bearing upon the Vendor's performance of the Work; that the materials and equipment furnished under the Contract are of good quality and new (unless otherwise permitted); that the Work is non-negligent and meets or exceeds the standards ordinarily observed in the industry; and that the Work conforms to the requirements of the Contract and to all applicable codes, ordinances, laws, or regulations. The Vendor further warrants and promises that the Work shall be free from defects

and nonconformities in materials and workmanship for a period of one year from the later of the Date of Completion, which is the date UCBOE accepts the Work or such date as the Vendor actually completes all the Work (the "Date of Completion"). During such period, the Vendor will remedy at Vendor's expense nonconformities or defects in the Work within a reasonable time after receiving notice thereof from UCBOE.

6. Indemnity for Subcontractor Payment. In addition to the indemnification obligations contained in the attached terms and conditions to this Contract, the Vendor further agrees to defend and indemnify UCBOE from and against all claims, damages, losses, and expenses, including reasonable attorneys' fees, arising out of the Vendor's failure to pay subcontractors or materials suppliers.
7. Change Orders. The Vendor agrees that UCBOE may order changes in the general scope of the Work, including additions, deletions, and similar revisions. The parties agree to adjust the Contract Price and Date of Completion to reflect the effects of such changes, which adjustments shall be authorized only upon execution of a written change order (a "Change Order"). In case of emergency or extenuating circumstances or if a construction contingency is provided as stated below, approval of changes may be obtained verbally by telephone or field orders approved by UCBOE Project Coordinator and promptly thereafter substantiated in writing as outlined under normal procedures. The amount of any increase or decrease in the Contract Price shall be by mutual acceptance of a total amount supported by sufficient data and information to substantiate the change. Any decrease in Contract Price for a decrease in the Work will be the reasonable costs of the Work deleted, including a reasonable amount for the decrease in the Vendor's overhead.
8. Performance/Payment Bond. If required by law and/or the bidding documentation, the Vendor agrees to provide a Performance Bond and Labor and Material Payment Bond for its faithful performance in a form reasonably satisfying to UCBOE.
9. Payments Withheld. The UCBOE may withhold payment for the following reasons to the extent permitted under N.C. Gen. Stat. § 143-134.1(e): (1) defective Work not remedied; (2) third party claims filed or reasonable evidence indicating probable filing of such claims unless security acceptable to UCBOE is provided by the Vendor; (3) failure of the Vendor to make payments properly to subcontractors or for labor, materials or equipment; (4) reasonable evidence that the Work will not be completed with the time specified, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; (5) failure to carry out the Work in accordance with the Contract Documents; (6) failure to provide sales tax documentation in accordance with subparagraph 9.3.5; (7) failure or refusal of the Vendor to submit the required information on minority business enterprises; and (8) failure of the Vendor to comply with (a) the provisions of the Sedimentation and Pollution Control Act (N.C. Gen. Stat. § 113A-50 *et seq.*), and/or (b) any Notice of Violation issued by the North Carolina Department of Natural Resources.
10. Retainage. For public construction contracts costing an amount equal to or greater than \$100,000, the UCBOE will retain five percent of the amount of each progress payment on the project for as long as is authorized by N.C. Gen. Stat. § 143-134.1. At all times during the Project, the UCBOE may retain the maximum funds allowed by N.C. Gen. Stat. § 143-134.1. The UCBOE specifically reserves the right to withhold additional funds as authorized by this Contract and N.C. Gen. Stat. § 143-134.1. The Vendor may pay each subcontractor no later than seven days after receipt of payment from the UCBOE and in accordance with N.C. Gen. Stat. § 143-134.1 the amount to which the subcontractor is entitled, reflecting percentages actually retained from payments to the Vendor on account of the subcontractor's portion of the Work. The Vendor shall, by appropriate agreement with each subcontractor, require each subcontractor to make payments to sub-subcontractors in a similar manner and in accordance with N.C. Gen. Stat. § 143-134.1.
11. The Vendor shall use and submit applications for payment using a form reasonably satisfactory to UCBOE ("Application for Payment"). The Contractor shall submit with each Application for Payment a completed "Statement of Sales Tax Paid" and "Minority Business Enterprise" documentation in a form acceptable to UCBOE.

III. Additional Standard Term and Condition for Designer Contracts (which include Architectural, Engineering, Surveying, and Technical Services)

Additional Insurance. In addition to the insurance required pursuant to Section 22 of the Standard Terms and Conditions for All Contracts, the Vendor certifies that it currently has and agrees to purchase and maintain during its performance under the Contract the following insurance from one or more insurance companies acceptable to UCBOE and authorized to do business in the State of North Carolina: Professional liability insurance in commercially reasonable amounts as reasonably determined by UCBOE.

IV. Additional Standard Terms and Conditions for Information Technology Contracts

1. Definitions.

“Hardware” means the hardware the Vendor utilizes in the Hosted Environment for delivery and maintenance of the Hosted Software Services.

“Hosted Environment” means the Hardware, system software, hosting support software, network connectivity, and facility used by Vendor to support the Hosted Software Services.

“Hosted Software Services” means the application, including the Hosted Software and any applicable Third-Party Software, as run on the Hosted Environment.

“Hosted Software” means the software owned and controlled by Vendor or Vendor’s third-party contractor that supports the Hosted Software Services.

“Support Services” means application and technical support required to maintain the performance, uptime and connectivity of the Hosted Software Services for UCBOE access and use, including without limitation, telephone support, error correction, maintenance, and installation of Updates and Upgrades to the Hosted Software.

“Updates” means (i) modifications to or releases of the Hosted Software that (a) add new features, functionality, and/or improved performance, (b) operate on new or other databases, operating systems, or server platforms or (c) extend the Hosted Software functionality to take advantage of advances in coding language, hardware, network or wireless infrastructures; and (ii) deviation corrections, bug or error fixes, patches, workarounds, and maintenance releases.

“Upgrades” means any new version or new release of the Hosted Software typically provided on an annual or bi-annual basis by the Vendor that includes new features, functions, support or service that were not in place with the immediately prior version.

2. Grant of License. Vendor grants to UCBOE for the term of this Contract a non-exclusive, non-transferable license to access and use over the internet the Hosted Software (the “License”).
3. Updates and Upgrades. Vendor will make certain limited and applicable Hosted Software Updates and Upgrades available to UCBOE at no additional cost. All such Updates and Upgrades shall automatically become subject to the benefits and terms of this Contract and shall automatically be considered part of the License granted under this Contract.
4. Security. Vendor’s Hosted Environment shall maintain security measures in place to help protect against the loss, misuse, and alteration of the Hosted Software Services, and specifically the Confidential Information provided to Vendor by UCBOE.
5. Warranties. Vendor warrants the following: (a) Vendor has the full authority to grant the License; (b) the Hosted Software is free from material defects or viruses; (c) the Hosted Software contains no disabling devices; and (d) the Hosted Software conforms to all material specifications set forth in the documentation and any other written material provided to UCBOE for any purpose. Without limiting any other remedies available to UCBOE under this Contract, at law or in equity, in the event that any Hosted Software does not conform to the warranties set forth for the Hosted Software herein, Vendor shall, at UCBOE’s option, promptly correct or replace such Hosted Software and, in either case, Vendor shall perform any Support Services or other work required to restore the Hosted Software to the state that existed prior to any such breach, all at Vendor’s expense. UCBOE reserves the right to reject the Hosted Software and to hold Vendor responsible for any loss, direct or indirect, caused by any such breach of warranty. In the event Vendor is or becomes aware of a problem with any item of Hosted Software, Vendor shall notify UCBOE upon such determination. Acceptance or use of the Hosted Software shall not constitute a waiver of any claim under any warranty.
6. Effect of Termination and Orderly Transition. Upon termination or expiration of this Contract for any reason, Vendor will cooperate in good faith with UCBOE to provide for an orderly transfer of the Goods and Services

and Confidential Information to UCBOE or UCBOE's successor vendor ("Orderly Transition") and according to the terms of this section.

- a. **Scope of Work for Orderly Transition.** Within thirty (30) days of notification by UCBOE that it will transfer Goods and Services to itself or a successor vendor, the parties will create and execute a scope of work document detailing tasks, the responsible parties for individual tasks, and timeframes for completion of tasks necessary to complete an Orderly Transition. The final, executed Orderly Transition scope of work shall be incorporated into this Contract and become subject to its terms. Vendor's failure to (a) cooperate in developing the Orderly Transition scope of work, (b) execute an Orderly Transition scope of work, or (c) abide by the executed Orderly Transition scope of work shall be deemed a material breach of this Contract.
 - b. **Time Frame.** Unless otherwise mutually agreed in an executed Orderly Transition scope of work, Vendor shall continue to provide Goods and Services while UCBOE migrates its Confidential Information from Vendor's Hosted Software Services in the Orderly Transition process. Vendor agrees that, as part of the Orderly Transition process and within the specified time frame, it will transfer to UCBOE all of the Confidential Information provided to Vendor by UCBOE pursuant to this Contract. Vendor will provide the Confidential Information in commercially reasonable electronic format as agreed in the Orderly Transition scope of work at no additional cost.
 - c. **Time and Material Costs Only.** UCBOE will be obligated to pay for time and materials at a reasonable hourly rate of no more than \$75/hour for the Orderly Transition. No other fees will be assessed for the Orderly Transition. Fees shall be agreed upon in advance as part of developing the scope of work referenced in subsection (a) above.
 - d. **Destruction of Confidential Information after Orderly Transition.** Unless otherwise mutually agreed in an executed Orderly Transition scope of work, Vendor agrees that after returning all Confidential Information to UCBOE pursuant to subsection (b) above it will destroy all remaining copies of Confidential Information and back-up Confidential Information in its possession, contained in or on any medium (such as a storage area network or "SAN") or as may be stored offsite, within thirty (30) days of completion of Orderly Transition. Vendor shall provide UCBOE with a detailed summary of the destruction process and standards to be utilized by Vendor with respect to the Confidential Information, and UCBOE shall approve such process and standards prior to Vendor commencing such destruction.
7. **Intellectual Property Warranty.** In addition to the warranties set forth elsewhere in this Contract with respect to the Goods and Services, Vendor expressly represents, warrants and covenants that neither the furnishing of Hosted Services to UCBOE hereunder, nor does the Hosted Software, violate, in whole or in part, any provision of any law, common law or regulation concerning copyrights, trade secrets, trademarks, tradenames, service marks, patents or other provisions regulating or concerning intellectual property rights.
 8. **Additional Indemnification.** To the fullest extent permitted by law, Vendor shall indemnify, defend and hold harmless UCBOE, its and directors, officers, managers, employees and agents, from all suits, claims, costs, damages and other liabilities, including reasonable attorneys' fees as incurred by counsel of UCBOE's choice, relating to or arising from (a) Vendor's failure to maintain the security and integrity of Confidential Information, the Hosted Software Services and the Hosted Environment; (b) any claim for infringement of any copyright, trade secret, trademark, tradename, service mark, patent, or other law or regulation concerning intellectual and/or proprietary property rights; and (c) any claims by third party interests in the Hosted Software.
 9. **Data Use.** Notwithstanding the foregoing, Vendor acknowledges and agrees that all Confidential Information is proprietary to and owned exclusively by UCBOE, whether provided in tangible or electronic form and whether entered into any software or Hosted Software Services owned or licensed by Vendor (including without limitation the Hosted Software and Hosted Software Services) or otherwise provided in connection with any products provided and services performed by Vendor (including without limitation the Goods and Services) and whether to, by or through a Vendor-affiliated ASP or other Hosted Software Services. Furthermore, Vendor shall not sell, market, or commercialize Confidential Information, create derivative products or applications based on Confidential Information or otherwise use Confidential Information in any manner unrelated to the performance of Vendor's obligations under the Contract. Vendor shall not share Confidential Information with any parent or subsidiary company of Vendor or any other Vendor-affiliated entity without the express prior written consent of UCBOE detailing the scope of allowable disclosure. Vendor agrees that if it breaches this

section, UCBOE may, at its option, pursue any or all of the following remedies: (a) immediately terminate this Contract without liability to Vendor; (b) seek an injunction without posting a bond; and (c) pursue whatever other remedies may be available to it at law, in equity or pursuant to this Contract.

SCOPE OF WORK**PART 1-GENERAL**

Union County Public Schools is soliciting bids for Monroe High School's HVAC Renovation.

Contractor is to provide all labor, equipment, materials, permits, fees, inspections, etc. to provide a turnkey project as indicated on the drawings and specifications provided by McKnight Smith Ward Griffin Engineers. (Exhibit 2). Permits and Inspections shall be provided to assigned UCPS Project Coordinator.

Note: Drawings are provided in order to give a general description of the Work. Contractor is to visit the site and field verify all existing conditions that may affect the design and layout of this project prior to preparation of submittals.

Contractor shall comply with all current local, state, and national codes and regulations. This includes, but not limited to, complying with all ADA requirements. In the event of a conflict between the Scope of Work and code regulations, the Contractor shall notify the Engineer for direction.

Contractors shall be properly licensed within the state of North Carolina to complete work identified within the bid documents, have successfully completed projects of this type and size for a minimum of 5 years, and be able to provide references within 24 hours of request.

PART 2-SAFETY

Contractor is solely responsible for safeguarding the project areas through the duration of the project including, but not limited to, barricades, snow fencing.

The Contractor may setup on site at a location authorized by the assigned UCPS Project Coordinator. Any equipment or supplies left on school property shall be securely locked. UCPS will not be responsible for damages or theft of Contractor's or 3rd party (i.e. rental equipment) property.

Contractor shall require all employees to abide by the OSHA safety guidelines. A written safety policy shall be provided to the assigned UCPS Project Coordinator within 24 hours of request.

All representatives of Contractor shall dress appropriate for school environment and perform work in a professional manner. Compliance is at the sole discretion of Union County Public Schools. Any individual not in compliance will be asked to leave Union County Public School property.

There are not to be any drugs, firearms, tobacco, or weapons on school property.

Contractor's Project Manager shall provide daily, to front office of worksite, a list of employees working onsite that day.

PART 3-WARRANTY

Refer to Draft Contract for Warranty Information (Exhibit 3).

Contractor is responsible for damages to UCPS property as a direct result of this project. Contractor shall repair, replace to the fullest extent as needed to restore the property to the original state at no cost to Union County Public Schools.

PART 4-PROJECT SCHEDULE

June 17, 2021 Purchase Order expected to be released to Contractor (contact Procurement Lead if not received).
June 21, 2021 Contractor may commence work onsite.

Interior Work may be performed during operating hours provided no interruption to the students or staff. Exterior Work can take place anytime. Existing HVAC system must remain in operation until the change over takes place. All work is to be closely scheduled with assigned UCPS Project Coordinator to ensure no disruption to school activities.

If work cannot be completed during the Project Schedule listed above, Contractor shall list the number of consecutive calendar days required for completion.

Contractor shall appoint a Project Manager to be the sole point of contact through the duration of the project. The Project Manager shall be fluent in the English Language (speaking and writing). The Project Manager shall be easily accessible via telephone and email. At minimum, a status update shall be provided to the assigned UCPS Project Coordinator on Tuesday of every week.

PART 5-ALLOWANCE FUNDS

Definition: A designated amount of funds included in the contract amount for unforeseen conditions.

When an unforeseen condition arises, Contractor is to submit a written request for the amount of funds needed. The request shall be accompanied with backup documentation for the request (i.e. materials and labor quotes).

If approved, UCPS is to provide a signature of approval to the Contractor.

All unused funds will be credited to UCPS at the end of the project.

Amount of Allowance Funds allocated to this project is \$5,000.00

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COST PROPOSAL/EXECUTION OF PROPOSAL

Monroe High School
HVAC Renovation
BID NO. 1-97336074

By submitting this proposal, the potential contractor certifies the proposal is signed by an authorized representative of the firm.

The cost and availability of all equipment, materials, and supplies associated with performing the services described herein have been determined and included in the proposed cost.

All labor costs, direct and indirect, sales tax, etc. have been determined and included in the proposed cost.

The offeror is aware of prevailing conditions associated with performing these services.

The potential contractor has read and understands the conditions set forth in this bid and agrees to them with no exceptions.

Therefore, in compliance with this Request for Proposals, and subject to all conditions herein, the undersigned offers and agrees, if this proposal is accepted within 60 days from the date of the opening, to furnish the subject services for a cost not to exceed:

BID AMOUNT: \$ 477,000 (includes ^{+10,000} ~~\$5,000~~ Allowance Funds) 200 *CCD
 ALTERNATE: \$ N/A (Additional Cost) 0 *CCD

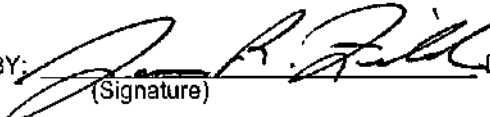
*CCD: Consecutive Calendar Days required to achieve Final Completion from issuance of Purchase Order

ADDENDA ACKNOWLEDGEMENT

ADDENDUM 1: ✓ ADDENDUM 2: ✓ ADDENDUM 3:

EXECUTION

OFFEROR: Superior Mechanical Services, Inc. FEDERAL ID NO. 56-1716717
 LICENSE DESCRIPTION: Mechanical/Plumbing LICENSE NO. 6911
 ADDRESS: 607 Industrial Avenue CITY, STATE, ZIP Greensboro, NC 27406
 TELEPHONE NUMBER: 336-274-3008 MOBILE: 336-580-1108 EMAIL: jfields@superiormechserv.com

BY:  DATE: 5/6/21 TITLE: President
 (Signature)

James R. Fields
 (Typed or printed name)

EXHIBIT 2

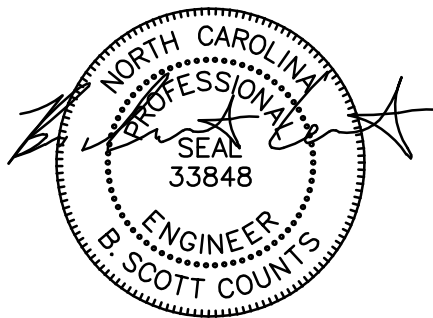
Specifications and Drawings by Mcknight Smith Ward Griffin
Minority Business Outreach

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04-26-21

SECTION 23 05 00 - MECHANICAL GENERAL PROVISIONS**PART 1 GENERAL****1.1 SCOPE**

- A. The Contractor shall coordinate the work and equipment of this Division with the work and equipment specified elsewhere in order to assure a complete and satisfactory installation. Work such as excavation, backfill, concrete, flashing, wiring, etc., which is required by the work of this section shall be performed in accordance with the requirements of the applicable section of the specifications.
- B. Minor details not usually shown or specified, but necessary for the proper installation and operation, shall be included in the work, the same as if herein specified or shown.

1.2 DEFINITION

- A. The word "Contractor" as used in this section of the specification refers to the HVAC Contractor unless specifically noted otherwise. The word "provide" means furnish, fabricated, complete, install, erect, including labor and incidental materials necessary to complete in place and ready for operation or use the item referred to or described herein and/or shown or referred to on the Contract Drawings.

1.3 CONTRACTOR'S QUALIFICATIONS

- A. It is assumed that the Contractor has had sufficient general knowledge and experience to anticipate the needs of a construction of this nature. The Contractor shall furnish all items required to complete the construction in accordance with reasonable interpretation of the intent of the Drawings and Specifications. Any minor items required by code, law or regulations shall be provided whether or not specified or specifically shown where it is a part of a major item of equipment, or of the control system specified or shown on the plans.

PART 2 PRODUCTS**2.1 MATERIALS AND WORKMANSHIP**

- A. All materials and apparatus required for the work, except as specifically specified otherwise, shall be new, of first-class quality, and shall be furnished, delivered, erected, connected and finished in every detail, and shall be so selected and arranged as to fit properly into the building spaces. Where no specific kind or quality of material is given, a first-class standard article as approved by the Engineer shall be furnished.
- B. The Contractor shall furnish the services of an experienced superintendent, who shall be constantly in charge of the installation of the work, together with all skilled workmen, fitters, metal workers, welders, helpers and labor required to unload, transfer, erect, connect-up, adjust, start, operate and test each system.
- C. Unless otherwise specifically indicated on the plans or specifications, all equipment and material shall be installed with the approval of the Engineer in accordance with the recommendations of the manufacturer. This shall include the performance of such tests as the manufacturer recommends.
- D. All work must be done by first-class and experienced mechanics properly supervised and it is understood that the Engineer has the right to stop any work that is not being properly done and has the right to demand that any workman deemed incompetent by the Engineer be removed from the job and a competent workman substituted therefor.

2.2 EQUIPMENT APPLICATION AND PERFORMANCE

- A. The Contractor and/or Equipment Supplier shall be responsible to see that equipment supplied is correct for the intended application and will perform within the limits of capacity, noise, life expectancy, pressure drop and space limitations intended for that equipment as shown on the plans or described in the specifications. The shop drawings shall show the capacity and operating characteristics of the equipment.

2.3 EQUIPMENT DEVIATIONS

- A. Where the Contractor proposes to use an item of equipment other than that specified or detailed on the drawings, which requires any redesign of the structure, partitions, foundations, piping, wiring or any other part of the mechanical, electrical, or architectural layout, all such redesign, and all new drawings and detailing required therefor, shall be prepared by the Subcontractor at his own expense and submitted for approval by the Engineer.
- B. Where such approved deviation requires a different quantity and arrangement of ductwork, piping, wiring, conduit, and equipment from that specified or indicated on the drawings, the Contractor shall furnish and install any such ductwork,

SECTION 23 05 00 - MECHANICAL GENERAL PROVISIONS

pipng, structural supports, insulation, controllers, motors, starters, electrical wiring and conduit, and any other additional equipment required by the system, at no additional cost to the Owner.

2.4 MOTORS

- A. Motors shall be built in accordance with the latest standards of NEMA and as specified. Motors shall be tested in accordance with standards of A.S.A. C40 and conform thereto for installation resistance and dielectric strength. Each motor shall be provided with conduit terminal box, adequate starting and protective equipment as specified or required. The capacity shall be sufficient to operate associated driven devices under all conditions of operation and load and without overload, and at least shall be the horsepower indicated or specified. Each motor shall be selected for quiet operation. Motors 1 HP or more shall be premium efficient with a minimum efficiency as specified by NEMA MG1-2006, Table 12-12. Motors shall be TEFC or TEO construction as appropriate. ODP motors are not allowed. Motors shall be 1800 RPM whenever possible. Single phase motors shall be electrically commutated type.
- B. Motors connected to variable speed drives shall be inverter duty rated and shall be provided with a maintenance free, circumferential, conductive micro fiber shaft grounding ring (AEGIS® SGR or equal) shall be installed on the AC motor to discharge shaft currents to ground.

2.5 DRIVES

- A. Machinery drives shall be provided for all power driven equipment specified in this section.
- B. Drives shall be V-belt and shall be selected to overcome the starting inertia of the equipment without slippage, but in no case shall be less than 150% of the full motor load. Drives 1/2 HP and smaller may be provided with single belts. Drives 3/4 HP and larger shall be provided with the number of belts necessary to transmit the required power with 95% minimum efficiency.
- C. Where adjustable type sheaves are indicated they shall be selected such that the schedule speed of the driven equipment is at the midpoint in the adjustment range of the sheave.
- D. Where fixed type sheaves are indicated the Contractor shall include in his price changing sheave sizes once during the balancing period to achieve proper air quantities.
- E. Sheaves shall be machined cast iron of the same manufacturer as the belt provided. Shop drawings shall be submitted of each drive which shall include actual transmission capacity of each drive.

2.6 FOUNDATIONS, SUPPORTS, PIERS, ATTACHMENTS

- A. This Contractor shall furnish and install all necessary foundations, supports, pads, bases and piers required for all air conditioning equipment, piping, pumps, tanks, compressors, and for all other equipment furnished under this contract, and shall submit drawings to the Engineer for approval before purchase, fabrication or construction of same.
- B. For pumps, compressors, and other rotating machinery and for all equipment where foundations are indicated, furnish and install concrete pads minimum 4 inches thick or as shown. All pads shall be extended six (6) inches beyond machine base in all directions with top edge chamfered. Insert six (6) inch long, 1/2" round steel dowel rods at 12" on center into floors to anchor pads. Shop drawings for all foundations and pads shall be submitted to the Engineer for approval before same are constructed.
- C. Construction of foundations, supports, pads, bases, and piers where mounted on the floor, shall be of the same materials and same quality of finish as the adjacent and surrounding flooring material.
- D. All equipment, unless otherwise shown, shall be securely attached to the building structure in an approved manner. Attachments shall be of a strong and durable nature and any attachments that are, in the opinion of the Engineer, not strong enough shall be replaced as directed.

2.7 VIBRATION ISOLATION

- A. All work shall operate under all conditions of loads without any sound or vibration which is objectionable in the opinion of the Engineer. If requested, the Contractor shall record sound power level readings in all areas adjacent to mechanical rooms, over, under or beside, after all equipment is fully operational and all wall and ceiling systems are completed. Sound level readings shall not exceed NC levels as recommended in Table 1, Chapter 48 of 2011 ASHRAE Applications Handbook.

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- B. The readings are to be tabulated in the Maintenance and Operating Instruction Booklets.
- C. Sound or vibration conditions in excess of listed quantities shall be corrected in an approved manner by the Contractor at his expense.
- D. Unless otherwise noted mechanical equipment over one horsepower shall be isolated from the structure with resilient vibration and noise isolators supplied by one manufacturer to the Mechanical Contractor. Where isolator type and required deflection are not shown, equipment shall be isolated in accordance with the 2011 ASHRAE Applications Handbook, Chapter 48, Table 47. Submittals shall include complete design for the equipment bases, a tabulation of the design data for the isolators, including lateral stiffness, O.D., free operating and solid height of the spring isolators, free and operating height of the neoprene or fiberglass isolators. Selection of isolators for proper loading to obtain desired efficiency shall be the responsibility of the manufacturer of isolating units to suit the equipment being supplied on the job and shall be fully guaranteed by this supplier. All vibration isolation equipment complete with thorough selection data shall be submitted. Units shall be Vibration Eliminator Company, Mason, Peabody, or approved equal.
- E. Flexible duct connections shall be provided at inlet and outlet of all fans or cabinets containing fans and shall be constructed such as to allow a minimum movement of 2 inches in any direction and will not restrict normal movement of any equipment.

2.8 CONNECTIONS FOR DISSIMILAR METALS

- A. Brass fittings shall be used at any points within the piping systems where dissimilar metals meet. Careful attention shall be given to support brackets and hangers to select proper materials to avoid dissimilar metal contact at these points.

2.9 DRAINS AND VENTS

- A. In addition to the drains and vents indicated on the plans and piping details, the Contractor shall install additional drains and vents as required to remove all water and air from the piping systems.

2.10 MOTOR STARTERS AND DISCONNECTS

- A. Individual motor controllers, motors using variable frequency drives, complete with auxiliary contacts, control transformers, push buttons, selector switches and remote push button stations not specifically specified to be furnished with the equipment shall be provided under this section. Motor controllers shall comply with NEMA Standards and be complete with proper size heaters and auxiliary contacts and shall be in NEMA enclosures as required. Unless otherwise noted, push button stations shall be oil-tight heavy duty type. Controllers shall be manual, magnetic, or combination type with disconnect switch or circuit breaker as indicated on the drawings or where required by the NEC. Controllers shall include motor overcurrent protection in each phase conductor. Each motor controller shall be provided with phenolic nameplate, black with 1/4" high letters and white border, indicating equipment served, attached using counter sunk screws.
- B. The Electrical Contractor shall furnish and install all disconnecting switches unless otherwise indicated or specified. Where disconnecting switches are indicated to be furnished under this Section, they shall be General Electric, Type TH in NEMA 1 enclosures, with voltage and amperage rating appropriate to the application. Unless otherwise noted, fuses shall be Buss "Fusetrons", or approved equal. Unfused motor disconnecting switches shall be Type TH in NEMA 1 or 4 applicable enclosures. Similar and equivalent equipment as manufactured by I.T.E., Square D, or Westinghouse is equally acceptable. Switches used as service switches shall bear such U.L. Label and nameplate on switch shall so indicate.

2.11 PAINTING

- A. Paint material shall be selected from the products listed below and, insofar as practical, products of only one manufacturer shall be used. Contractor shall submit to the Engineer the listed manufacturer he proposes to use in the work. Should the Contractor desire to use products of a manufacturer not listed below, or products made by a listed manufacturer but not scheduled herein, Contractor shall submit complete technical information on the proposed products to the Engineer for approval. Only products approved by the Engineer shall be used.
 - 1. Rust Inhibitive Primer:
 - a. Devco: Ready-Mixed Red No. 20.
 - b. Duron: Deluxe Red Primer.
 - c. Glidden: Rustmaster Tank and Structure Primer.
 - d. Pittsburgh: Inhibitive Red Primer.
 - 2. Galvanized Metal Primer:
 - a. Devco: Devco Zinc Dust Primer.

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- b. Duron: Duron Deluxe Galvanized Metal Primer
- c. Glidden: Rustmaster Galvanized Iron Metal Primer.
- d. Pittsburgh: Speedhigh Galvanized Steel Primer.

PART 3 EXECUTION**3.1 DUTIES OF CONTRACTOR**

- A. Contractor shall furnish and install all materials called for in these Specifications and accompanying drawings, and must furnish the apparatus complete in every respect. Anything called for in the specifications and not shown on the drawings or shown on the drawings and not called for in the specifications must be furnished by the Contractor.
- B. The Contractor shall follow drawings in laying out work and check drawings of other trades to verify spaces in which work will be installed. Maintain maximum headroom and space conditions at all points. Where headroom or space conditions appear inadequate, Engineer shall be notified before proceeding with installation.
- C. The plans are diagrammatic and are not intended to show each and every fitting, valve, pipe, pipe hanger, or a complete detail of all the work to be done; but are for the purpose of illustrating the type of system, showing pipe sizes, etc., and special conditions considered necessary for the experienced mechanic to take off his materials and lay out his work. This Contractor shall be responsible for taking such measurements as may be necessary at the job and adapting his work to local conditions.
- D. The right to make any responsible change in location of apparatus, equipment, routing of piping up to the time of roughing in, is reserved by the Engineer without involving any additional expense to the Owner.

3.2 CODES, RULES, PERMITS AND FEES

- A. All materials furnished and all work installed shall comply with the National Fire Codes of the National Fire Protection Association, and with the requirements of all governmental departments having jurisdiction.
- B. All materials and equipment for the electrical portion of the mechanical system shall bear the approval label, and shall be listed by the Underwriters' Laboratories, Inc.
- C. All work shall be done in accordance with the North Carolina State Building Code, and requirements of governmental agencies having jurisdiction.
- D. It shall be the responsibility of this Contractor to complete installation of the specified fired and unfired pressure vessels, and their safety devices, in accord with requirements of the latest edition of the North Carolina Boiler Inspection Law, Rules and Regulations. Contractor shall have the equipment which is installed under this contract inspected and approved by the State of North Carolina, Department of Labor, Bureau of Boiler Inspections. Contractor shall be responsible for notifying State Boiler Inspector in writing at least two weeks prior to date of completion of all equipment requiring inspection.
- E. Furnish and install a suitable metal frame, having a removable glass cover, for posting certificates of inspection furnished by the North Carolina Department of Labor, Boiler Bureau. Certificates are to be installed in frames by this Contractor before requesting final inspection of complete job by the Owner and Engineer. Final payment will not be made until such certificate has been duly posted. All fees or expenditures necessary for this requirement shall be paid by this Contractor.

3.3 COOPERATION WITH OTHER TRADES

- A. This Contractor shall give full cooperation to other trades and shall furnish any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.
- B. Where the work of the Contractor will be installed in close proximity to, or may interfere with the work of other trades, he shall assist in working out space conditions to make a satisfactory adjustment. If so directed by the Engineer, the Contractor shall prepare composite working drawings and sections at a suitable scale not less than 3/8" = 1'-0", clearly showing how his work is to be installed in relation to the work of other trades. If the Contractor installs his work before coordination with other trades, or so as to cause any interference with work of other trades, he shall make the necessary changes in his work to correct the condition without extra charge.
- C. The Contractor shall furnish to other trades, as required, all necessary templates, patterns, setting plans, and shop details for the proper installation of work and for the purpose of coordinating adjacent work.

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3.4 RECORD DRAWINGS

- A. The Contractor shall furnish drawings showing dimensioned location and depths of all exterior piping and structures, and shall indicate any and all changes in location of piping, ductwork, equipment or valves from that shown on the Contract Drawings. The drawings shall consist of clean, legible sepia prints of the Contract Drawings, available from the Engineer on which the Contractor shall mark all notes, dimensions, sizes and information required. The sepia prints shall be kept for this purpose only. Before final inspection the Contractor shall submit to the Engineer eight (8) sets of black line prints of the sepia prints.

3.5 SURVEYS AND MEASUREMENTS

- A. This Contractor shall base all measurements, both horizontal and vertical, from established bench marks. All work shall agree with these established lines and levels. Verify all measurements at the site and check the correctness of same as related to the work.
- B. Should the Contractor discover any discrepancy between actual measurements and those indicated, which prevents following good practice or the intent of the drawings and specifications. He shall notify the Engineer and shall not proceed with his work until he has received instructions from the Engineer.

3.6 SAFETY REQUIREMENTS

- A. All systems shall be installed so as to be safe operating and all moving parts shall be covered where subject to human contact. All rough edges of equipment and materials shall be made smooth.
- B. All safety controls shall be checked under the supervision of the Engineer's representative and eight (8) copies of test data showing setting and performance of safety controls shall be submitted to the Engineer. All pressure vessels shall be ASME stamped and shall have stamped relief valves. Boilers shall be provided with ASME stamped T & P relief valve.
- C. An emergency shutoff switch shall be provided at the door to each equipment room containing gas burners. Activation of the switch shall cause each burner within that equipment room to cease operation.

3.7 SHOP DRAWINGS

- A. The Contractor shall submit for approval eight (8) sets of detailed shop drawings of all equipment and all material required to complete the project, and no materials or equipment may be delivered to the job site or installed until the Contractor has in his possession the approved shop drawings for the particular material or equipment. The shop drawings shall be complete as described herein.
- B. Catalogs, pamphlets, or other documents submitted to describe items on which approval is being requested, shall be specific and identification in catalog, pamphlet, etc. of item submitted shall be clearly marked. Data of a general nature will not be accepted. Data shall include eight (8) copies of computation sheets indicating how unit capacity was determined where ratings are at other than standard conditions. No payment for any equipment or labor will be allowed until all major pieces of equipment specified have been submitted to the Engineer for approval.
- C. The Contractor, as part of the shop drawing submitted, shall submit shop drawing of all ductwork in the mechanical rooms, the risers including takeoffs to the floors with their associated dampers, and elbows with unequal legs showing turning vanes.
- D. Static pressure drops across fittings, dampers, heaters, attenuators, etc. shall not exceed minimum ASHRAE Standards when not specified.

3.8 ACCESSIBILITY

- A. The Contractor shall locate all equipment which must be serviced, operated, or maintained in fully accessible positions. Equipment shall include but not be limited to valves, traps, cleanouts, motors, controllers, switch-gear, and drain points. If required for better accessibility, furnish access doors for this purpose. Minor deviations from drawings may be made to allow for better accessibility and any change shall be submitted for approval.

3.9 CONCEALED PIPE

- A. In general, all pipe in finished spaces shall be run concealed in floors, walls, partitions and above ceilings.

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- B. Concealment of pipe and covering of same shall not be done until authorized by the Engineer, after proper tests have been made. This applies to all interior work and exterior work.

3.10 CUTTING AND PATCHING

- A. This Contractor shall provide all cutting and patching necessary to install the work specified in this section.

3.11 SLEEVES AND PLATES

- A. This Contractor shall provide and locate all sleeves and inserts required before the floors and walls are built, or shall be responsible for the cost of cutting and patching required where sleeves and inserts were not installed, or where incorrectly located. This Contractor shall do all drilling required for the installation of his hangers.
- B. Sleeves shall be provided for all mechanical piping passing through concrete floor slabs and concrete, masonry, tile and gypsum wall construction. Sleeves shall not be provided for piping running imbedded in concrete or in insulating concrete slabs on grade.
- C. Where sleeves are placed in exterior walls below grade, the space between the pipe or conduit and the sleeves shall be packed with oakum and lead and made completely watertight.
- D. Where pipe motion due to expansion and contraction will occur, make sleeves of sufficient diameter to permit free movement of pipe. Where sleeves pass insulated pipes, the sleeves shall be large enough to pass the pipe and insulation. Check floor and wall construction finishes to determine proper length of sleeves for various locations; make actual lengths to suit the following:
- E. Terminate sleeves flush with walls, partitions and ceiling.
- F. In areas where pipes are concealed, as in chases, terminate sleeves flush with floor or as shown on the plans.
- G. In all areas where pipes are exposed, extend sleeves 1/4 inch above finished floor, except in rooms having floor drains, where sleeves shall be extended 3/4 inches above floor.
- H. Sleeves shall be constructed of schedule 40 black steel pipe unless otherwise indicated on the drawings. Sleeves through concrete beams shall be constructed as indicated on the drawings.
- I. Fasten sleeves securely in floor, walls, so that they will not become displaced when concrete is poured or when other construction is built around them. Take precautions to prevent concrete, plaster, or other materials being forced into the space between pipe and sleeve during construction.
- J. Where piping penetrates fire rated floors or walls, penetrations shall be sealed with a U.L. approved fire stopping system. System shall be as manufactured and detailed by 3M Company or approved equal.
- K. Escutcheon plates shall be provided for all exposed pipes and all exposed conduit passing through walls, floors and ceilings. Plates shall be nickel plated, of the split ring type, of size to match the pipe or conduit. Where plates are provided for pipes passing through sleeves which extend above the floor surface, provide deep recessed plates to conceal the pipe sleeves.

3.12 SCAFFOLDING, RIGGING, HOISTING

- A. This Contractor shall furnish all scaffolding, rigging, hoisting and services necessary for erection and delivery into the premises of any equipment and apparatus furnished. Remove same from premises when no longer required.

3.13 EXCAVATING AND BACKFILLING

- A. Each trade shall perform all excavation and backfill required for the installation of its work.
- B. Particular care shall be taken not to disturb or damage work of other Contractors.
- C. The Contractor shall do all trench and pit excavation and backfilling required for work under this section of the specifications, inside and outside the building, including repairing of finished surfaces and all required shoring, bracing, pumping and all protection for safety of persons and property. State and OSHA Safety Codes shall be strictly observed. In addition, it shall be the responsibility of the Contractor to check the indicated elevations of the utilities entering and leaving the building. If such elevations require excavations lower than the footing levels, the Engineer shall be notified of such conditions and a redesign shall be made before excavations are commenced. It is also the

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responsibility of the Contractor to make the excavations at the minimum required depths in order to avoid undercutting the footings.

- D. No backfilling shall be done until work involved has been tested and approved by the Engineer.
- E. Contractor shall schedule excavation work so as not to unduly interfere with work of other trades on the job. Contractor shall be responsible for establishing all lines and grades required for proper location of his work.
- F. When rock is encountered in excavation, it shall be paid for as outlined under the specifications.
- G. In backfilling pipe trenches, approved fill shall first be compacted firmly and evenly on both sides of pipe in 6" layers to a depth of 12" over the top of the pipe. Remainder of trench shall be backfilled to established grade in 6" layers. Compact between each layer with a high-frequency vibrator tamper such as Dart Soil Compactor (as manufactured by Dart Manufacturing Company, Denver, Colorado). Fill shall be compacted to density specified under Earth Work Section of specifications for specified area through which trench passes. Compact fill to 95% maximum density at optimum moisture content all other areas. Earth bearing pressure as indicated shall be verified by a testing laboratory, which following the criteria specified for foundation wall trench, etc. in the Earth Work Section of the specifications. The reports shall be forwarded to the Engineer for approval unless otherwise specified; the cost will be borne by this contractor, before any work is performed. If the earth bearing pressure is less than that required, the Contractor shall not begin additional work until notified by the Engineer to do so. A copy of the report shall be forwarded to the Engineer in triplicate.
- H. Excess earth shall be distributed on premises as directed by the Engineer.
- I. Where ditches occur outside the building, the surface shall be finished to match existing surfaces. Any existing work or work of other trades which is damaged or disturbed shall be repaired or replaced, and left in good order.

3.14 ELECTRICAL CONNECTIONS

- A. The Electrical Contractor shall furnish and install all wiring except: (1) temperature control wiring; (2) equipment control wiring and (3) interlock wiring. The Electrical Contractor shall receive from the Mechanical Contractor and mount all individually mounted motor starters and provide all power wiring to the motor terminals unless otherwise indicated. The Electrical Contractor will provide branch circuit protection and disconnects unless otherwise indicated or specified. The Mechanical Contractor shall provide all other control and protective devices, and perform all control and interlock wiring required for the operation of the equipment. Power wiring, from nearest panel, for control components (dampers, panels, etc.) shall be provided by the Mechanical Contractor.
- B. After all circuits are energized and complete, the Electrical Contractor shall be responsible for all power wiring, and all control wiring shall be the responsibility of this Contractor. Motors and equipment shall be provided for current characteristics as shown on the drawings.
- C. It shall be the responsibility of this Contractor to check with the Electrical Contractor on service outlets provided for this Contractor, to determine that the switches and wiring provided are of adequate size to meet Code requirements for this Contractor's equipment. Any discrepancy shall be brought to the attention of the Engineer before work is installed. Otherwise, any cost for changes shall be at the expense of this Contractor, and in any case electrical cost increase due to equipment substitution of different electrical characteristics shall be this Contractor's expense.

3.15 PIPE WORK

- A. All pipe work shown on the drawings and/or specifications or implied herein and required for a complete and operating system shall be done by experienced mechanics in a neat and workmanlike manner and subject to the approval of the Engineer.
- B. Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings and accessories which may be required and it shall be the responsibility of the Contractor to furnish and install all materials and equipment required for the operating systems.
- C. The piping shall be installed as shown on the plans with strict conformity to the sizes listed and due provisions for expansion and contraction.
- D. Unless otherwise noted on the plans, all piping shall be installed inside the insulated envelope of the building.

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- A. All bearing, except those specifically requiring oil lubrication, shall be pressure lubricated. All lubrication points shall be readily accessible, away from locations dangerous to workmen. In areas where lubrication points are not readily accessible Contractor shall provide extended lubrication tubes to positions where lubrication can be easily accomplished. Pressure grease lubrication fittings shall be "Zerk-Hydraulic" type as made by the Stewart-Warner Corporation, or approved equal, for each type of grease required.
- B. The Contractor shall furnish lubrication charts or schedules for each piece of equipment or machinery. The charts or schedules shall designate each point of lubrication. Eight (8) copies of charts and schedules shall be submitted to the Engineer prior to final inspection and approved copies of each schedule and chart shall be framed by the Contractor in metal frames with glass front and installed in the Equipment Room.

3.17 PROTECTION

- A. The Contractor shall protect all work and material from damage, and shall be liable for all damage during construction.
- B. The Contractor shall be responsible for work and equipment until all construction is finally inspected, tested and accepted. He shall protect work against theft, injury or damage; and shall carefully store material and equipment received on site which is not immediately installed. He shall close open ends of work including pipe, duct, or equipment with temporary covers or plugs during storage and construction to prevent entry of obstructing materials or dust and debris.
- C. Provide a protective covering of not less than 0.004" thick vinyl sheeting (or a similar approved material) to be used in covering all items of equipment, immediately after the equipment has been set in place, (or if in a place of storage within the building under construction) to prevent the accumulation of dirt, sand, cement, plaster, paint or other foreign materials from collecting on the equipment and/or fouling working parts.

3.18 CLEANING

- A. Clean from all exposed insulation and metal surfaces grease, debris or other foreign material.
- B. Chrome plated fittings, fixtures, piping and trim shall be polished upon completion.

3.19 LABELS AND INSTRUCTIONS

- A. Label all switches and controls furnished under this Section with engraved bakelite permanent labels to indicate the function of each and the apparatus serviced.
- B. Post in the Equipment Room framed under glass the following:
 - 1. Lubrication instructions listing all equipment which requires lubrication, the type of lubricant to be used and the frequency of lubrication.
 - 2. Photostatic copy of wiring diagram of temperature controls.
 - 3. Step-by-step operating instruction for each piece of equipment with control sequence description.
- C. All units shall be marked with unit numbers in three inch high letters with unit designated numbers.
- D. A tabulation shall be made of each panel number and circuit number serving each air conditioning unit, fan or other device with electrical service. This list shall be prepared and be ready to turn over to inspectors prior to calling for final inspection.
- E. Labeling shall be as follows:
 - 1. Air-Cooled Chiller - ACCH
 - 2. Air Handling Unit - AHU
 - 3. Boiler - B
 - 4. Pumps - primary chilled water (CHWP), secondary chilled water (BCWP), primary hot water (HWP), secondary hot water (BHWP).
 - 5. Hot water supply and return piping - HWS/HWR with flow direction arrows in mechanical areas and above ceilings
 - 6. Chilled water supply and return piping - CHS/CHR with flow direction arrows in mechanical areas and above ceilings
- F. Labeling shall be in 4 inch letters and every ten feet on exposed piping. Above ceilings labeling shall be every 25 feet in a location easily seen, usually on the bottom of the pipe. Labeling shall occur on both sides of a wall, ceiling or floor.

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- G. Provide engraved plastic laminated (5 in x 4 in) labels on all equipment. Labels shall include equipment number, area(s) served (use actual room numbers), substantial completion date (S.C.D.), extended warranty period, number and size of filters and capacity.

3.20 VALVE, MOTOR AND DAMPER TAGS AND SCHEDULE

- A. Each valve, motor and damper shall be provided with an engraved black finish, phenolic tag indicating service and number. Tag lettering shall be at least 1/4" high etched white letters and beveled white trim. Tags to be attached using brass chains.
- B. The Contractor shall submit eight (8) copies of charts indicating number, location, service, "normal" position, manufacturer, size and model number to the Engineer for approval.
- C. Prior to final inspection an approved copy of each chart shall be framed by the Contractor in a metal frame with glass front and installed in the Equipment Room.

3.21 EQUIPMENT SERVICEABILITY

- A. All equipment shall be serviceable. All equipment shall be installed so that it can be removed. All equipment in or connected to piping systems shall have valves to isolate this equipment from the piping system. This includes, but not necessarily limited to control valves, sensors, switches, pumps, traps and strainers. Unions (screwed or flanged) shall be provided so that all equipment is removable.
- B. Equipment installed in walls, ceilings or floors shall be accessible for service or removal without cutting walls, etc.
- C. Equipment requiring periodic service shall be installed to allow clearance for service and have removable panels, access doors, etc. through which the service is to be performed.
- D. Serviceability to equipment shall include a minimum of 36" in front of all equipment per NEC 110.26.

3.22 ACCEPTANCE OF EQUIPMENT

- A. In the event that the Engineer considers it impractical, because of unsuitable test conditions, or some other factors, to execute simultaneous final acceptance of all equipment portions of the installation may be certified by the Engineer for final acceptance when that portion of the system is complete and ready for operation.
- B. Contractor shall make all necessary tests, trial operation balancing and balance tests, etc., as may be required as directed by the engineer to prove that all work under these plans and specification is in complete serviceable condition and will function as intended. Fully trained service technicians employed or recommended by the manufacturers representative(s) providing the main mechanical room equipment such as boiler(s), chiller(s), pump(s), etc. shall perform start up (**Chillers only by manufacturer technicians**). After start up, technicians shall complete start up form and include in the closeout manuals). This start up shall note any deficiencies and corrections to the initial start up. Manufacturers' representative shall warrant all equipment to be free from defect.
- C. Upon completion of all work the system shall be tested to determine if any excess noise or vibration is apparent during operation of the system. If any such objections are detected in the system or noisy equipment found, the Contractor shall be responsible for correcting same. Ducts, plenums and casings shall be cleaned of all debris and blown free of all particles of rubbish and dust before installing outlet faces. Equipment shall be wiped clean with all traces of oil, dust, dirt and paint spots removed. Temporary filters shall be provided for all fans that are operated during construction and after all construction dirt has been removed from the building, new filters shall be installed. Bearings shall be lubricated as recommended by the equipment manufacturer. All control valves and equipments shall be adjusted to setting indicated. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions.

3.23 GUARANTEE

- A. The Contractor shall guarantee the complete mechanical system against defect due to faulty materials, faulty workmanship or failure due to negligence of the Contractor. This guarantee will exclude normal wear and tear, maintenance lubrication, replacement of expendable components, or abuse. The guarantee period shall begin on the date of the final acceptance and shall continue for a period of 12 months during which time the Contractor shall make good such defective workmanship and materials and any damage resulting therefrom, within a reasonable time of notice given by the Owner.

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- B. The period of Guarantee for equipment driven by electrical motors, etc., shall be 12 months from the date of final acceptance. Refrigeration compressors shall have a five (5) year warranty.

3.24 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Submit 3 sets of complete operating and maintenance instructions. Manuals shall be submitted at 50% construction completion point.
- B. Bind each set in plain black vinyl-covered, hard back, 3-ring binder. Individual paper shall be Boorum and Pease Reinforced Ring Book Sheet, No. S-212-101 or equivalent.
- C. Organize material in the following format:
1. Section I:
 - a. Name of Project
 - b. Address
 - c. Owner's Name
 - d. General Contractor's Name and Address
 - e. Contractor's Name and Address
 - f. Control Subcontractor's Name and Address
 - g. Warranty Dates
 2. Section II:
 - a. Major Equipment List (name, manufacturer, serial no., H.P. and voltage) (include all equipment with motors)
 - b. Control Sequence Description
 - c. Routine Maintenance Instructions in Step-by-Step form
 - d. Lubrication Charts and Schedules
 - e. Valve Schedules
 - f. Test and Balance Reports
 - g. Sound Power Level Readings (Where Required)
 3. Section III:
 - a. Operating and Maintenance Instructions by Manufacturer
 - b. Approved Shop Drawings (Major Requirement)
 - c. Wiring Diagrams
 - d. Control Drawings

3.25 PAINTING

- A. All surfaces to receive paint shall be dry and clean.
- B. Before priming, all surfaces shall be thoroughly cleaned of all dirt, oil, grease, rust, scale and other foreign matter. Cleaning shall be done with sandpaper, steel scraper, or wire brush where appropriate and necessary. Metallic surfaces which have been soldered shall be cleaned with benzol and all other metal surfaces washed with benzine.
- D. Mixing shall be in galvanized iron pans. Paint shall be mixed in full compliance with manufacturer's directions. Thinning shall be done only in full compliance with manufacturer's directions.
- E. Workmanship shall be highest quality, free from brush marks, laps, streaks, sags, unfinished patches, or other blemishes. Edges where paint joins other material or colors shall be sharp and clean without overlapping. Paint shall be brushed or sprayed on in strict compliance with manufacturer's directions and shall work evenly and be allowed to dry at least 48 hours before subsequent coating. Paint shall not be applied in damp or rainy weather or until surface has thoroughly dried. Contractor shall furnish and lay drop-cloths in all areas where painting is done as necessary to protect work of other trades. Varnish and enamel shall not be applied when temperature in the area is less than 60 degrees Fahrenheit nor paint when under 50 degrees Fahrenheit. Prior to final acceptance, Contractor shall touch up or restore any damaged finish. All insulation materials shall be provided with a paint suitable jacket.
- F. The following materials and equipment require painting as noted:
1. All concealed piping, sheet metal, hangers and accessories except galvanized sheet metal or piping:
 - a. One coat rust-inhibitive primer except where exterior insulation is provided.
 2. All exposed, exterior and interior, piping, sheet metal, hangers and accessories, air handling units, chillers, pumps, etc. except galvanized sheet metal or piping:
 - a. One coat rust-inhibitive primer except where exterior insulation is provided.
 3. All concealed galvanized sheet metal, piping and accessories.
 - a. One coat galvanized metal primer on threaded portions of piping and any damaged galvanized surfaces.
 4. All exposed, exterior and interior galvanized sheet metal, piping and accessories.
 - a. One coat galvanized metal primer except where exterior insulation is provided.

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5. All exposed, exterior and interior, insulation equipment.
 - a. Two coats exterior glass enamel over paint suitable insulation jacket.
- G. All piping in Equipment Rooms shall be painted (color shown below) and identified by stenciling with letters minimum 1/2" high in a contrasting color. Piping outside Equipment Rooms shall be stenciled. Stenciling shall occur at each change of direction and every 20 feet. Arrows should be placed adjacent to letters signifying direction of flow.
 1. Standard piping color codes:
 - a. Heating Hot Water - Orange
 - b. Chilled Water - Blue
 - c. Drains - Natural with Walls
 - d. Electrical - Natural with Walls
- H. All gas piping in shall be painted Light Yellow and identified by stenciling with letters minimum 1/2" high in a contrasting color. Stenciling shall occur at each change of direction and every 20 feet. Arrows should be placed adjacent to letters signifying direction of flow.

END OF SECTION 23 05 00

SECTION 23 05 14 – VARIABLE FREQUENCY DRIVES**PART 1 GENERAL****1.1 SCOPE**

- A. The provisions of Section 23 05 00 apply to all the work in this section.
- B. Furnish and install adjustable frequency controller as required to provide fan speed control.

1.2 SUBMITTALS: Submit the following in accordance with Section 23 05 00.

- A. Manufacturer's Cuts.
- B. Certified Capacity Ratings.
- C. Installation Instructions.
- D. Operating and Maintenance Instructions.

PART 2 PRODUCTS**2.1 ADJUSTABLE FREQUENCY CONTROLLER (AFC)**

- A. Furnish complete variable frequency drives as specified herein for the fans and pumps designated on the drawing schedules to be variable speed. All standard and optional features shall be included within the VFD enclosure, unless otherwise specified. VFD enclosure shall be NEMA 1 with inlet air filters. Drives shall be as manufactured by ABB, Yaskawa, Allen Bradley, or Mitsubishi. All VFDs in the project shall be by the same manufacturer.

2.2 REGULATORY REQUIREMENTS

- A. UL listed.
- B. EN Standard CE marked for the following:
 - 1. Low Voltage Directive (73/23/EEC)
 - 2. EN50178
 - 3. EMC Directive (89/336/EEC)
 - 4. EN61800-3 Adjustable Speed electrical power drive systems Part 3.
- C. Designed, constructed and tested in accordance with NEMA, ICS, NFPA and IEC standards.

2.3 ENVIRONMENTAL REQUIREMENTS

- A. The AC drive construction ½ hp to 5 hp 230V and 1 hp to 7.5 hp 480V shall be IP20/open according to Standard EN50178. 7.5 hp to 10 hp 230V and 10 hp to 20 hp 480V shall be Type 1. Both are designed to operate as Pollution degree 2 conforming to IEC 664-1, EN50718 and NEMA ICS-1. Drives above 20 hp 480V and 15 hp 230V shall meet Type 1 Pollution degree 3 according to IEC 664-1, EN50718 and NEMA ICS-1.
- B. The AC drive will be designed to operate in an ambient temperature from 32 to 104 degrees F.
- C. The storage temperature range shall be -25 to 70 degrees C.
- D. The maximum relative humidity shall be 95% at 40 degrees C, non-condensing.
- E. The AC drive shall be rated to operate at altitudes less than or equal to 3300 ft.
- F. The AC drive shall meet the IEC 68-2-6-vibration specification.
- G. The AC drive shall be designed and constructed to be of finger safe construction with enclosure open to operator access according to IP20 standards.

2.4 EQUIPMENT

SECTION 23 05 14 – VARIABLE FREQUENCY DRIVES**A. General Description**

1. The AC drive shall utilize soft switching technology and voltage vector control.
2. The AC drive shall provide a harmonic analysis showing compliance with IEEE-519.
3. The AC drive shall have the Hand/Off/Auto function.
4. The AC drive shall have a VFD/bypass system design that is serviceable while operating in bypass mode. This includes a drive disconnect to ensure service personnel safety, a 2-contactor bypass for full speed operation, and an isolation barrier to ensure service personnel safety and repair of the drive while operating in full speed bypass mode.
5. Each AC drive shall have voltage/single phase protection of the drive and bypass system to ensure continued operation after utility power failures. Drive protection modules shall be ATC Diversified Electronics SLU-100-ASA 0315PB or equivalent. Protection modules shall monitor incoming 480V 3-phase power and shall interrupt 120V control circuit. Install modules in drive cabinet.
6. The AC drive shall have common control in both drive and bypass modes.
7. Each AC drive shall have M.O.V. lightning protection.
8. The AC drive shall have safety interlocks for all modes of operation.
9. A manufacturers warranty shall be provided on all materials and workmanship of no less than 1 year from the date of start-up or 18 months form date of shipment.

B. Ratings

1. The AC drive shall be designed to operate from an input voltage of 208/230 +/-15% VAC or 400/460 +/-15% VAC.
2. The AC drive shall operate from an input voltage frequency range from 47.5 to 63 Hz.
3. The displacement power factor shall not be less than 0.95 lagging under any speed or load condition.
4. The efficiency of the AC drive at 100% speed and load shall not be less than 96%.
5. The constant torque overtorque capacity will be 150% for 1 minute (The variable torque overtorque capacity will be 110% for 1 minute).
6. The output switching frequency of the drive will be randomly modulated and selectable at 2 kHz, 4 kHz, 12 kHz or 16 kHz depending on drive rating for low noise operation.
7. The output frequency shall be from 0.1 to 500 Hz (selectable at 50 Hz, 60 Hz, 200 Hz, 500 Hz).
8. The AC drive will be able to provide rated motor torque at 0.5 Hz in a Sensorless Flux Vector mode using a standard motor and no tachometer feedback.

C. Protection

1. Upon power-up, the AC drive shall automatically test for valid operation of memory, option module, loss of analog reference input, loss of communication, (dynamic brake failure), DC to DC power supply, control power, and the pre-charge circuit.
2. The AC drive shall be protected against short circuits between output phases; between output phases and ground; on the control terminal outputs; and the internal supplies. The logic and analog outputs shall also be optically isolated.
3. The AC drive shall have a minimum of power loss ride-through of 200 msec. The AC drive shall have the user-defined option of frequency fold-back to increase the duration of the power loss ridethrough.
4. The AC drive shall have a selectable ride through function which will allow the logic to maintain control for a minimum of one second without faulting.
5. For a fault condition other than ground fault, short circuit or internal fault, an auto restart function will provide restart.
6. The deceleration mode of the AC drive shall be programmable for normal and fault conditions. The stop modes shall include freewheel stop, fast stop and DC injection braking.
7. A synchronized restart shall be provided that will catch a spinning motor by sensing the motor frequency and rotational direction and synchronize the AC drive's output prior to restarting.
8. Upon loss of the analog process follower reference signal, the AC drive shall fault ad/or operate at a user defined speed set between software programmed low speed and high speed settings.
9. The AC drive shall have solid state protection that is UL listed and meets UL 508C as a Class 20 overload protection and meets IEC 947. The adjustment shall be from 0.45 to 1.05 percent of the current output of the AC drive.
10. The AC drive shall have a thermal switch with a user selectable pre-alarm that will provide a minimum of 60 seconds delay before over temperature fault.

D. Operator Interface

1. The full English operator interface terminal will offer the modification of AC drive adjustments via a touch keypad. All electrical values, configuration parameters, drive menu parameters, application and activity function access, faults, local control, adjustment storage, self-test and diagnostics will be shown.
2. The AC drive keyboard will announce horsepower and voltage.
3. The display shall be capable to be configured to display multiple parameters with numeric data that is selectable and scalable by the operator. A user defined display value proportional to output frequency shall be available. As a

SECTION 23 05 14 – VARIABLE FREQUENCY DRIVES

minimum the display values shall consist of speed reference, output frequency, output current, motor torque, output voltage, line voltage, DC voltage, motor thermal state, drive thermal state, motor speed and output power.

PART 3 - EXECUTION**3.1 START-UP SERVICE**

- A. The manufacturer shall provide start-up commissioning of the variable frequency drive and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. The commissioning personnel shall be the same personnel that will provide the factory service and warranty repairs at the customer's site. Sales personnel and other agents who are not factory certified technicians for drive field repair shall not be acceptable as commissioning agents.
- B. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system. Included in this service shall be (as a minimum):
 - 1. Verification of contractor wire terminations to the VFD and its optional circuitry.
 - 2. Installation verification for proper operation and reliability of the VFD, the motor being driven, and the building automation system.
 - 3. Measurement for verification of proper operation on each of the following items:
 - a. Motor voltage and frequency. Verification of proper motor operation.
 - b. Control input for proper building automation system interface and control calibration.
 - c. Calibration check for the following set points (and adjustment as necessary) (1) minimum speed, (2) maximum speed, (3) acceleration and deceleration rates.
- C. Warranty.
 - 1. The VFD shall be warranted by the manufacturer for a period of 36 months from date of shipment. The warranty shall include parts, labor, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service.
 - 2. The motor(s) which are directly connected to the VFD shall be warranted by the VFD manufacturer against insulation breakdown which is directly attributed to the VFD. The length of the motor insulation warranty shall be the same as the VFD warranty. The motor must never have been driven by another VFD.

3.2 EXAMINATION

- A. Contractor to verify that jobsite conditions for installation meet factory recommended and code required conditions for VFD installation prior to start-up. These shall include as a minimum:
 - 1. Clearance spacing.
 - 2. Temperature, contamination, dust, and moisture of the environment.
 - 3. Separate conduit installation of the motor wiring, power wiring, and control wiring.
 - 4. Installation per the manufacturer's recommendations.

3.3 INSTALLATION

- A. The installation shall be in compliance with the manufacturer's instructions, drawings and recommendations. The AC drive manufacturer shall provide a factory certified technical representative to supervise the contractor's installation, testing and start-up of the AC drive(s). All drives shall be installed in the same room and within 25 feet of the associated piece of equipment.
- B. The contractor shall assume the responsibility for coordinating the purchased equipment with the motor served and with the automatic temperature control system, paying specific attention to the signal sent and received, the ground source and the required speed range.
- C. The manufacturer shall provide start-up of the variable frequency drive and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. The commissioning personnel shall be the same personnel that will provide the factory service and warranty repairs at the customer's site. Sales personnel and other agents who are not factory certified technicians for VFD field repair are not acceptable as commissioning agents. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system. Start-up shall include customer operator training at the time of the equipment commissioning.
- D. The VFD shall be mounted with operator interface between 4'-6" and 5'-6" above finished floor for visibility and accessibility.

SECTION 23 05 14 – VARIABLE FREQUENCY DRIVES

3.4 TRAINING

- A. An on-site training session of (4) hours duration shall be provided by a representative of the AC drive manufacturer and shall included in the base bid for the project.

END OF SECTION 23 05 14

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING**PART 1 GENERAL****1.1 SCOPE**

- A. The provisions of Section 23 05 00 apply to all the work in this Section.
- B. Work shall be performed by an independent balancing company certified by AABC or NEBB. Technicians shall be competent in the trade of testing and balancing environmental systems and shall be done in an organized manner utilizing appropriate test and balance forms.
- C. The test and balance contractor shall be a sub-contractor to the HVAC contractor.
- D. The test and balance report shall be submitted prior to the final inspection. The TAB sub-contractor shall attend the final to spot check air and water flows.

1.2 SUBMITTALS

- A. Submit the following in accordance with Section 23 05 00:
 - 1. Manufacturer's cut sheets for all equipment to be used.
 - 2. Sample balancing charts and forms.
 - 3. Completed final balancing data.

PART 2 PRODUCTS**2.1 INSTRUMENTATION**

- A. Instruments for use in the test and balancing procedures shall be of first quality and be accurately calibrated at the time of use. The following list is provided to indicate the instruments expected, however, other instruments as necessary to properly perform the work will be provided and subject to approval of the Architect.
 - 1. Inclined manometer calibrated in no less than .006-inch divisions.
 - 2. Combination inclined and vertical manometer (0 to 10 inch is generally the most useful).
 - 3. Pitot Tubes. (Usually 18 and 48 inch tube covers most balance requirements).
 - 4. Tachometer. This instrument should be of the high quality self-timing type.
 - 5. Clamp-on ampere meter with voltage scales.
 - 6. Deflecting vane anemometer.
 - 7. Rotating vane anemometer.
 - 8. Thermal type (hot wire) anemometer.
 - 9. Hook gage.
 - 10. Dial and glass stem thermometers.
 - 11. Sling psychrometer.
- B. The accuracy of calibration of the field instruments used is of the utmost importance. All field instruments used in the balance should have been calibrated at least within the previous three months. Naturally, any suspect instruments should be checked more frequently.

PART 3 EXECUTION**3.1 SYSTEM START-UP**

- A. Starting date for mechanical system shall be scheduled well in advance of expected completion date and shall be established a minimum of two weeks prior to acceptance date. The system shall be in full operation with all equipment functional prior to acceptance date.
- B. Performance readings shall be taken and recorded on all air and water distribution devices and the system shall be balanced out prior to acceptance. Balancing of the system shall be accomplished with duct dampers and only minor adjustments made with grille dampers. Record and submit results in table form along side of scheduled quantities.
- C. All controls shall be calibrated by qualified personnel prior to acceptance date. Thermostats shall be in close calibration with one another and shall operate their respective units without interference from adjacent units.
- D. All units shall be checked out thoroughly and the following information recorded on each machine which shall include, but not be limited to information listed below. Check sheets shall be included in Operating and Maintenance instructional Manual.
 - 1. Compressor

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING

- a. Check General Condition
- b. Check Sight Glass
- c. Check Moisture Indicator
- d. Check Oil Level
- e. Read Oil Pressure
- f. Read Head Pressure
- g. Read Suction Pressure
- h. Read Ambient Air
- i. Read Motor Volts Each Phase
- j. Read Motor Amps Each Phase
- k. Lubricate Motor Bearing
- l. Oil Safety Device Op.
- m. Capacity Control Op.
- n. Crankcase Heater Op.
- o. Check Pressure Switch Op.
- p. Check Superheat: Suction Temperature, Suction Pressure
- 2. Pumps (Each)
 - a. Pump No.
 - b. Manufacturer and Model
 - c. Motor Manufacturer, Frame and Nameplate Data
 - d. Water Flow Rate, GPM
 - e. Water Pressure Increase (Ft. H₂O)
 - f. Motor Amperage
 - g. Voltage
 - h. RPM
 - i. Check Lead-Lag Controls
- 3. Coils (Each)
 - a. Unit Number and Location
 - b. Manufacturer and Model No.
 - c. Return Air, Supply Air and Outside Air Temperature
 - d. Discharge Temperature, Cooling or Heating
 - e. Air Flow CFM, Entering and Leaving Static Pressure
 - f. Hot Water, Pressure Drop, and EWT, LWT
 - g. Water Flow
- 4. Boilers (Each):
 - a. Unit No.
 - b. Manufacturer and Model
 - c. Boiler Nameplate Data
 - d. Verify Power and Control Connections
 - e. Verify Fuel Source
 - f. Check All Delay Timers
 - g. Check Manual Auto Firing Control
 - h. Check High and Low Water Controls
 - i. Check High and Low Firing Rates
 - j. Check All Flame Safety Controls
- 5. Fans and Miscellaneous
 - a. Unit No. and Use
 - b. Manufacturer and Model
 - c. Motor Nameplate Data
 - d. Motor Amps and Volts
 - e. Entering and Leaving Static Pressure
 - f. Fan RPM
 - g. Damper Operation

E. Contractor shall have in his possession a copy of a letter from the responsible Control Representative stating that the controls have been installed according to the plans; that the control sequence has been checked and that all controls have been calibrated.

F. Systems shall be balanced to +/- 10% of the specified values.

3.2 SPECIAL REQUIREMENTS:

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING

- A. Variable Volume Pumping System Differential Pressure Setpoint: TAB contractor shall determine the optimum differential pressure setpoint as follows: Determine and record in the TAB report, the hydraulically most remote coil. Lock its control valve in fully open position and open the balancing valve. Set all other coils downstream of control differential pressure transmitter to balanced flow with control valve in wide open position. Adjust variable volume pump speed manually until most remote coil flow equals its design value. Record the corresponding sensed differential pressure at the differential pressure sensor location as the optimum differential pressure setpoint. If necessary to provide diversity, coil control valves that are not downstream of the duct pressure transmitter may be closed.
- B. Variable Volume Pumping System Pump Balancing: After optimum differential pressure setting has been determined as described above, open all coil control valves and balance coil flows to 120% of specified values while pump speed is under automatic control maintaining the optimum setpoint. Record pump data, including pump speed, under these conditions. Turn variable volume pump off. Start constant volume pump. Throttle pump discharge valve until control differential pressure falls to the recorded optimum setpoint. Record constant volume pump data. Do not throttle pump discharge valve on variable volume pumps. Leave discharge valve on variable volume pumps wide open.
- C. Calibrate controls flow meters for chilled water and hot water.
- D. Provide TAB result to ATC contractor for use in control logic.

END OF SECTION 23 05 93

PART 1 GENERAL**1.1 DESCRIPTION**

- A. This section of specifications and related drawings describe requirements pertaining to insulation.
- B. Provide all insulation in conjunction with equipment and piping furnished under this division.
- C. The provisions of Section 23 05 00 apply to all the work in this section.

1.2 QUALITY ASSURANCE

- A. Products of the manufacturers listed under MATERIALS will be acceptable for use for the specific functions noted. Adhesives, sealers, vapor barriers, and coatings shall be compatible with the materials to which they are applied, and shall not corrode, soften or otherwise attack such material in either the wet or dry state.
- B. Materials shall be applied subject to their temperature limits. Any methods of application of insulating materials or finishes not specified in detail herein shall be in accordance with the particular manufacturer's published recommendations.
- C. Insulation shall be applied by experienced workers regularly employed for this type of work.

1.3 SUBMITTALS

- A. Submit the following in accordance with Section 23 05 00:
 - 1. Catalog cuts.
 - 2. Materials ratings.
 - 3. Insulation instructions.

1.4 RATING

- A. Insulation and accessories such as adhesives, mastics, cements, tape and jackets, unless noted otherwise, shall have a flame spread rating of not more than 25 and a smoke developed rating of not more than 50. Materials that are factory applied shall be tested individually. No fugitive or corrosive treatments shall be employed to impart flame resistance.
- B. Flame spread and smoke developed ratings shall be determined by Method of Test of Surface Burning Characteristics of Building Materials, NFPA No. 255, ASTM E-84, UL 723.
- C. Products of their shipping cartons shall bear a label indicating that flame and smoke ratings do not exceed above requirements.
- D. Treatment of jackets or facings to impart flame and smoke safety shall be permanent. The use of water-soluble treatment is prohibited.
- E. Certify in writing, prior to installation, that products to be used will meet RATING criteria.

PART 2 PRODUCTS**2.1 PIPE INSULATION**

- A. Hot water piping insulation materials shall be heavy density fiberglass with an all-service jacket (all-service jacket to be used only in mechanical equipment rooms) composed of an outer layer of vinyl, fiberglass scrim cloth, aluminum foil, and kraft paper, in that order, from outside to inside of pipe covering. Chilled water piping insulation materials shall be closed cell polystyrene insulation.
 - 1. Chilled water supply and return piping, including drain lines from chilled water coils or apparatus handling chilled water.
 - 2. Hot water heating supply and return piping.
 - 3. Insulation shall have a minimum density of 1¼ lb/ft³, per ASTM C-303 and D-1622.
 - 4. Insulation shall have a "k" value of 0.255 (BTU-IN/hr-sq ft-F) at 75° F per ASTM C-177 or C-518.
 - 5. Compressive strength must maintain a minimum of 15 psi at 10% deflection per ASTM D-1621.
 - 6. Water vapor permeability should not exceed 4.0 perm-inch per ASTM E-96.
 - 7. Fittings (valves, flanges, 90° and 45° elbows) shall be manufactured 1-¼ lb/ft³ pre-molded closed cell insulation.
 - 8. Fitting insulation thickness is to be equal to the adjacent pipe insulation thickness.

SECTION 23 07 00 - INSULATION

- B. Thicknesses:
 1. Chilled water supply and return piping: All pipe sizes 1-1/2".
 2. Condensate drain lines: 1".
 3. Hot water heating supply and return lines - Pipe size 2" and larger - 2", Pipe size 1 1/2" and smaller – 1 1/2".

2.2 EQUIPMENT

- A. Pump and other equipment handling chilled water. Insulate with closed cell polystyrene blocks cut to fit and finished with 8 oz. canvas jacket. Pump insulation shall be removable to allow servicing of pump.
- B. Tanks and other equipment handling hot water (not factory insulated). Insulate with semi-rigid fiberglass board 1-1/2" thick. Cut to fit and cover with 8 oz. canvas jacket.

2.3 DUCT INSULATION

- A. Materials. Insulation shall be Owens-Corning as specified hereinafter or products of Certain-Teed/St. Gobain or Manville. Adhesives shall be as manufactured by 3-M Foster or Insulation Manufacturer. Insulation shall have composite (insulation, jacket and adhesive) fire and smoke hazard rating as tested by ASTM E-84, not exceeding Flame Spread -25 and Smoke Developed -50.

PART 3 EXECUTION**3.1 PIPE INSULATION**

- A. Application. Insulation and surfaces to be insulated shall be clean and dry when insulation is installed and during the application of any finish. Installation shall comply with Midwest Insulation Contractors Association "National Commercial and Industrial Insulation Standards", (MICA).
- B. Fiberglass Insulation. All fiberglass pipe covering shall be furnished with self-seal lap and 3" wide butt joint strips. The release paper is pulled from adhesive edge, pipe covering closed tightly around pipe and self-seal lap rubbed hard in place with the blunt edge of an insulation knife. This procedure applies to longitudinal as well as circumferential joints. Under no circumstances will staples be allowed. Care shall be taken to keep jacket clean, as it is the finish on all exposed work. All adjoining insulation sections shall be firmly butted together before butt joint strip is applied, and all chilled water and cold water service lines shall have vapor seal mastic thoroughly coated to pipe at butt joints every 21' and at all fittings. All insulation outside shall be protected with aluminum weather-proof jacketing with lap-seal, and factory attached moisture barrier. The aluminum shall be .016 gauge (3303-H14 alloy) of embossed pattern. It shall be applied with a 2" circumferential and 1-1/2" longitudinal lap and be secured with aluminum bands 3/8" wide 8" o.c.. All elbows shall be covered with the same .016 aluminum with factory applied moisture barrier. All fittings, valve bodies, unions, and flanges shall be finished as follows:
 1. Apply molded or segmental insulation to fittings equal in thickness to the insulation on adjoining pipe and wire in place with 2#14 copper wires.
 2. Apply a skim coat of insulating cement to the insulated fitting, if needed, to produce a smooth surface. After cement is dry, apply Owens-Corning Fiberglass Fitting Mastic, Type C, UL labeled.
 3. Wrap the fitting with fiberglass reinforcing cloth overlapping the preceding layer by 1 to 2". Also, overlap mastic and cloth by 2" on adjoining sections of pipe insulation.
 4. Apply a second coat of mastic over cloth, working it well into mesh of cloth and smooth the surface. Mastic to be applied at the rate of 40 square feet per gallon. All flanges and fittings on hot and cold lines in utility tunnels shall be insulated according to above. Omit insulation on flanges and unions over 60 degrees F. If painting is required, no sizing is necessary. To maintain the non-combustibility of the system only Glidden acrylic latex paint (#5370) is to be used.
 5. All piping in equipment rooms shall be covered with an 8 oz. canvas jacket.
- C. Delivery, Preparation, Storage and Handling:
 1. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
 2. Store insulation in original wrapping and protect from weather and construction traffic.
 3. All insulation and surfaces to be insulated shall be kept dry and free from all moisture prior to and during the application of insulation and vapor barrier. It is critical to keep the entire insulation system free from moisture. All wet insulation and wet vapor barrier jacketing; tapes, joint sealers and mastics will be removed from the job site at the insulation contractor's expense.
- D. Examination

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1. Before applying insulation, M.C. shall verify that piping has been prime coated, inspected, tested and approved.
 2. Before applying insulation, verify that surfaces are clean (foreign material removed) and dry.
 3. Before applying insulation, verify that brass thermowells with 2.5" lagging extensions have been installed.
 4. Before applying insulation, verify that 4" long brass nipples for gage cocks have been installed.
- E. Joint Sealant
1. A ¼" bead of non-hardening vapor retardant butyl rubber joint sealant shall be used to seal all longitudinal and circumferential joints on both indoor and outdoor applications.
 2. Layers of insulation should not be bonded together. Excessive sealer in the joints should be avoided during application. Do no feather edge. It is important that all insulation sections be trimmed and tightly butted to eliminate voids, gaps or open joints. Joint sealer shall not be used to fill these imperfections. Insulation ends shall be rubbed against each other to achieve a tight fit prior to application of joint sealer.
 3. Joint sealer shall be vapor barrier type, moisture and water resistant, 97% solids by weight, non-hardening, flexible with a service temperature range from -50°F to 180°F.
 4. All joint sealers shall be compatible with closed cell insulation and be absolutely free of solvents or any chemicals that will attack EPS.
 5. Joint sealant material shall be recommended by closed cell manufacturer.
- G. Installation and Warranty
1. Refer to Manufacturer's Installation Specification for complete installation procedure.
 2. Prior to delivery of pipe and vessel insulation to the project, the insulation contractor will submit a certification from the manufacturer that all insulation material to be provided will meet all the above performance and property requirements. All polystyrene shall be manufactured from virgin materials. No recycled or regrind material shall be permitted. Any material which is found in violation of these requirements shall be removed from the project by the contractor and replaced at his own expense with materials which do meet these specification requirements. Any product substitutions must be approved by PermaTherm, Inc. in writing prior to commencement of installation or all product warranties will be voided.

3.2 DUCT INSULATION

- A. All vapor barriers and joints shall be sealed to prevent condensation. Clean and dry all ductwork before installing insulation. All weld joints shall be wire brushed and give one (1) coat of red lead before insulating. Staples will not be permitted in insulation.
- B. Wrapped Duct
1. All supply and outside air ducts unless noted shall be insulated by wrapping with 2" thick, ¾ lb density fiberglass with vapor barrier jacket with joints overlapped a minimum of two inches. Insulation shall be adhered to duct with non-combustible insulation bonding adhesive applied in 4" strips, 8" on center. All joints shall be secured with flare door staples on 3" centers through all laps over duct tape.
- C. Ducts Installed In Unconditioned Spaces
1. Ductwork exposed to weather shall be insulated by sealing all joints with hard cast sealer, applying 2" thick polystyrene insulation (min R value 8), and covering with two (2) individual layers of glassfab and white mastic. Paint to match background color.

END OF SECTION 23 07 00

PART 1 GENERAL**1.1 WORK INCLUDED**

- A. Direct Digital Controls (DDC)
- B. Programming and Graphics
- C. Controllers (Global, Standalone, Application Specific)
- D. Communications
- E. Sensors
- F. Valves and actuators
- G. Electrical appurtenances and wiring systems
- H. Sequence of Operation

1.2 RELATED WORK

- A. Section 23 05 00 -Mechanical General Requirements
- B. Electrical Contract Documents

1.3 SHOP DRAWINGS

- A. System Architecture
- B. Wiring diagrams
- C. Valves and actuators
- D. System schematics for all mechanical systems
- E. Material lists with part numbers and quantities, as appropriate
- F. Technical/Product data sheets for each piece of equipment
- G. Sequence of Operation for each system
- H. As-built drawings of installed system

1.4 SUBMITTALS

- A. Submit Shop Drawings of the complete Building Automation System (DDC System) for review and approval.
- B. Drawings shall be submitted on standard sheet size format (8-1/2" x 11", 11" x 17", or 24" x 36").
- C. Drawings shall be bound within a standard 3-ring binder, cover, or other suitable permanent binder. For projects in which the controls submittals will be less than one-half inch thick, the submittal documents may be securely stapled in the upper left hand corner provided the cover sheet and back sheet are printed on card stock (heavy bond paper).
- D. Submit five (5) copies of submittal drawings for review by the Owner.
- E. At completion, furnish as-built drawings in bound form and on CD.
- F. Submit documentation for all DDC programming in graphical form (AutoCAD or Visio format, or equal) as a part of the as-built documentation.

SECTION 23 09 00 BUILDING AUTOMATION SYSTEM (BAS)

- G. Submit manufacturer's operating instruction manual for the DDC control system for use in owner training.
- H. Submit Certificate of Training upon completion of all scheduled training of the owner's operating personnel.

1.5 CODES AND REFERENCE STANDARDS

- A. The latest edition of the following standards and codes in effect and amended as of the date of the supplier's proposal, and any subsections thereof as applicable, shall govern the design and selection of equipment and material supplied.
 - 1. NFPA 70 - National Electrical Code (NEC)
 - 2. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers (Handbooks)
 - 3. ANSI/ASHRAE Standard 135 (1995) – BACnet: A Data Communication Protocol for Building Automation and Control Networks
 - 4. UL 916 - Standard for Energy Management Equipment
 - 5. FCC – Part 15, Subpart J
 - 6. City, County, State and Federal regulations and codes in effect as of the date of the Contract

1.6 PERMITS

- A. Except as otherwise indicated, the system supplier shall secure and pay for all permits, inspections, and certifications required for his work and arrange for all necessary approvals by the governing authorities.

1.7 QUALITY ASSURANCE

- A. Responsibility: The supplier of the HVAC digital logic control system shall be responsible for inspection and Quality Assurance (QA) for all materials and workmanship furnished by him.
- B. Component Testing: Maximum reliability shall be achieved through extensive use of high quality, pre-tested components. The manufacturer prior to shipment shall individually test each and every controller, sensor, and all other DDC components.
- C. Tools, Testing and Calibration Equipment: The control system supplier shall provide all tools, testing, and calibration equipment necessary to ensure reliability and accuracy of the control system.
- D. Authorized Representative: The systems control contractor shall have been in business a minimum of three years and be the authorized representative for the manufacturer of the BACnet components.

1.8 WARRANTY

- A. The DDC control system installed under this Specification shall be free from defects in material and workmanship under normal use and service for a period of twelve (12) months after final acceptance by the Owner. If within the twelve (12) month warranty period, any equipment, software, or labor is found to be defective in workmanship or materials, it shall be replaced free of charge by the Controls system installer. Warranty service shall be available to the job site during normal working hours.

1.9 PREVENTATIVE MAINTENANCE

- A. The DDC control system installed as part of this project shall include a preventative maintenance schedule including two four hour inspections per building twice within the first year of operation. The college desires one service company to have responsibility for maintaining the entire campus-wide automation system. Therefore, the successful bidder shall be responsible for conducting similar inspections at all campus buildings with DDC controls.

1.10 CONTROL AND INTERLOCK WIRING

- A. All electrical work required under this section of specifications shall comply with the latest National Electrical Code. Control system power supply shall be served by a separate breaker and fused in control center for secondary protection.

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- B. The mechanical contractor shall furnish and turn over to the electrical contractor, motor starters for mounting and power connections through starter to motor. Disconnect switches, when required, shall be furnished by electrical contractor.
- C. All control wiring shall be run in rigid conduit below grade or, on outdoor installation. Galvanized EMT may be run in dry wall construction, above ceilings, or in equipment rooms where permitted by electrical specifications.
- D. Control wiring shall be color-coded #16 TFF of TFFN wire with 600 volt insulation. Run all wiring between terminal points without changing color. Color code of control wiring shall be as indicated on control wiring diagram. Multi-conductor thermostat cable will not be acceptable.

PART 2 PRODUCTS**2.1 SCOPE OF WORK**

- A. The required system will be Tridium based and shall be a new system to replace existing pneumatic control systems. All equipment will consist of approved products specified below. Contractor to provide needed quantities of product specified below based on jobsite visit and plans provided. All Graphics, Alarms, Trending and Scheduling shall be added to existing FX server and match existing layout and function of other schools unless approved in writing by UCPS.
 - 1. Contractor to provide job documentation, including System Layout, Comm bus layout, sequence of operation, point to point controller diagrams and all product data sheets. The documentation is to be provided via 3 hard copies and also place on FX server to be access via system graphics.
 - 2. All Products to be warrantied for a period of 3 years from the date of purchase, all labor to be warrantied 1 year from Job Completion and Sign-off.
 - 3. System to be BACNET/IP based, all controllers need to be connected via UCPS Ethernet network. Contractor to provide switches listed below. UCPS will install and setup switches in existing IT closets located on each classroom wing. All Ethernet cable for HVAC equipment will be Cat-6 and orange in color. The Contractor will pull CAT-6 cable via existing cable tray from field controllers to new switches.

B. APPROVED PRODUCTS

- 1. VG-20 Controllers for Fan Coils
- 2. VG-32 Controllers for Chillers, Boilers, Air Handling Units, and Roof Top Units.
- 3. VC-20 Expansion Controllers for Chillers, Boilers, Air Handling Units
- 4. A/CP-S Room Sensors
- 5. EX3300-48 48 Port switch (1 Per Wing)
- 6. FX-7021 Jace (Located in Mechanical Room and will be provided by UCPS)
- 7. A/10K-CP-6 Duct Temp Sensors for Fan Coils
- 8. RIXGA CT Switches for Fan Coil Fan Status (Fan Coils, Air Handling Units, Chillers, Boilers)
- 9. PA Series JCI UL Listed Control Panels (if needed) Chiller, Boiler Plant
- 10. A/10K-CP Immersion Sensors Chillers, Boilers

C. APPROVED MANUFACTURER'/INSTALLERS

- 1. Facility Systems Services Inc
- 2. Platinum Building Automation
- 3. Environmental Controls
- 4. Carolina Air Solutions
- 5. Carrier
- 6. Hoffman/HBT
- 7. Johnson/JCI
- 8. Schneider Electric
- 9. Trane

2.2 SYSTEM REQUIREMENTS

- A. The Building Automation System (BAS) shall consist of Network Server/Controllers (NSCs), a family of Standalone Digital Control Units (SDCUs), Administration and Programming Workstations (APWs), and Web-based Operator Workstations (WOWs). The BAS shall provide control, alarm detection, scheduling, reporting and information management for the entire facility, and Wide Area Network (WAN) if applicable.

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- B. An Enterprise Level BAS shall consist of an Enterprise Server, which enables multiple NSCs (including all graphics, alarms, schedules, trends, programming, and configuration) to be accessible from a single Workstation simultaneously for operations and engineering tasks.
- C. The Enterprise Level BAS shall be able to host up to 250 servers, or NSCs, beneath it.
- D. For Enterprise reporting capability and robust reporting capability outside of the trend chart and listing ability of the Workstation, a Reports Server shall be installed on a Microsoft Windows based computer. The Reports Server can be installed on the same computer as the Enterprise Server.
- E. The system shall be designed with a top-level 10/100bT Ethernet network, using the BACnet/IP.
- F. BACnet MS/TP, BACnet IP, LonTalk FTT-10A, and WebServices shall be native to the NSCs. There shall not be a need to provide multiple NSCs to support all the network protocols, nor should there be a need to supply additional software to allow all three protocols to be natively supported. A sub-network of SDCUs using the BACnet MS/TP, LonTalk FTT-10A, and/or Modbus RTU protocol shall connect the local, stand-alone controllers with Ethernet-level Network Server Controllers/IP Routers.
- G. The TCP/IP layer connects all of the buildings on a single Wide Area Network (WAN) isolated behind the campus firewall. Fixed IP addresses for connections to the campus WAN shall be used for each device that connects to the WAN.
- H. Fieldbus Level with Standalone Digital Control Units (SDCUs)
- I. The fieldbus layer shall be support all of the following types of SDCUs:
 - J. BACnet SDCU requirements: The system shall consist of one or more BACnet MS/TP field buses managed by the Network Server Controller. Minimum speed shall be 76.8kbps. The field bus layer consists of an RS485, token passing bus that supports up to 127 Standalone Digital Control Units (SDCUs) for operation of HVAC and lighting equipment. These devices shall conform to BACnet standard 135-2007. The NSCs shall be capable of at least two BACnet MS/TP field buses for a total capability of 254 SDCUs per NSC.
 - K. NETWORK 8000 SDCU requirements: The system shall consist of one or more ASD or LCM field buses managed by the Network Server Controller. The field bus layer shall consist of up to 128 ASD SDCUs or 31 LCM SDCUs for operation of HVAC, power metering, and lighting equipment.
 - M. I/NET SDCU requirements: The system shall consist of one or more controller LANs and subLANs managed by the Network Server Controller. The network shall consist of up to 100,000 I/NET points capable through numerous links and devices for operation of HVAC, power metering, and lighting equipment.
- N. The BAS shall be capable of being segmented, through software, into multiple local area networks (LANs) distributed over a wide area network (WAN). Workstations can manage a single LAN (or building), and/or the entire system with all portions of that LAN maintaining its own, current database.
- O. All NSCs, Workstation(s) and Servers shall be capable of residing directly on the owner's Ethernet TCP/IP LAN/WAN with no required gateways. Furthermore, the NSC's, Workstation(s), and Server(s) shall be capable of using standard, commercially available, off-the-shelf Ethernet infrastructure components such as routers, switches and hubs. With this design the owner may utilize the investment of an existing or new enterprise network or structured cabling system. This also allows the option of the maintenance of the LAN/WAN to be performed by the owner's Information Systems Department as all devices utilize standard TCP/IP components.
- P. The BAS system shall be scalable and expandable at all levels of the system using the same software interface, and the same TCP/IP level and fieldbus level controllers. Systems that require replacement of either the workstation software or field controllers in order to expand the system shall not be acceptable.
- Q. Web-based operation shall be supported directly by the NSCs and require no additional software, other than a Java supported network browser.
- R. The system shall be capable of using graphical and/or line application programming language for the Network Server Controllers.

2.3 SENSORS, TRANSMITTERS AND THERMOSTATS

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- A. Temperature Sensors: Thermistor type with an accuracy of plus or minus 0.40 degree F over the entire control range. Sensors for pipe installations shall be immersion type, brass well, and thermistor with integral lead wire. Sensors for duct application shall be insertion probe type, stainless steel probe, integral handibox, and thermistor with integral lead wire. Space temperature sensors shall be compatible with the unit controller and shall be provided in a decorative metal or plastic enclosure. Space temperature sensors shall be provided with setpoint adjustment (lever or slide type), and override pushbutton, and connection port for field service tool. Outdoor temperature sensors shall be mounted inside a protective weather and sun shield.
- B. Space Temperature Sensor: Wall mounted room controller with integral digital display and user function keys to control room temperature setpoints, select fan speeds (where appropriate), view room and outside air temperatures, view room setpoints or discharge temperature, or initiate after-hours operation of the associated terminal unit or system. The controller shall also be capable of functioning as a field service tool to allow maintenance personnel to observe and adjust all control parameters resident in the terminal unit controller. These control parameters shall also be adjustable from the global controller. Sensor shall be standard two-wire connection and have a thermistor, housed in a decorative plastic enclosure.
- C. Humidity Sensors: Thin-film capacitive type sensor with on-board nonvolatile memory, accuracy to plus or minus two percent (2%) at 0 to 90% RH, 12 - 30 VDC input voltage, analog output (0 - 10 VDC or 4 - 20mA output). Operating range shall be 0 to 100% RH and 32 to 140 degree F. Duct mounted type sensors shall have a stainless steel insertion element, sealed to prohibit corrosion. Sensors shall be selected for wall, duct or outdoor type installation as appropriate.
- D. Current Switches (Type 1): For proving fan or pump operational status, provide split-core type current status switches with adjustable setpoint and solid state internal circuitry. Current switch shall have induced power, trip point set adjustment to plus or minus 1% over a range of 1 to 135 amps, trip and power LED, and field adjustable to indicate both On-Off conditions and loss of load (broken belt, etc.). Units shall have a five-year manufacturer's warranty. Current switches shall be Hawkeye Series H-908 by Veris Industries, or approved equal.
- E. Low Temperature Sensors: For sensing low temperatures in air handling units, provide SPST type switch, 35 to 45 degree F range, manual reset, vapor charged twenty foot long sensing element, and 120 volt electrical power connection.

2.4 MISCELLANEOUS MATERIALS

- A. Panels: All enclosures for DDC controllers and devices shall be fabricated in accordance with UL Standards from code gauge steel. Enclosures shall be provided with a continuous hinge on the door and a flush latching mechanism. Enclosures shall be shop painted with standard grade enamel coating. Back panels shall be furnished when required to facilitate installation of boards or accessories. All enclosures installed outdoors shall be constructed to NEMA 3R standards. All controllers shall be installed within an approved enclosure unless the controller will be installed within the control cabinet section of the equipment that it is intended to control. Enclosures shall facilitate the mounting of gauges, switches, pilot lights, and the like, on the face panel when required. Control devices that are mounted on the face of the panel shall be identified with engraved nameplates.
- B. Power Transformers: Step-down power transformers shall be provided for all DDC controllers and associated accessory devices as required. Transformers shall be sized and selected to accommodate all connected accessory items. Transformers shall be UL Listed Class 2 type with 120 VAC primary, 24 VAC secondary.
- C. Relays: Miscellaneous control relays shall be provided as required to energize or control equipment and devices within the control system. Relays shall be located as close as practical to the controlled device (motor, motor starter, etc.). Where approved by NEC, relays may be installed within starters and equipment control panels where space is available. Relays installed outside of the controlled device shall be provided with a NEMA enclosure suitable for the location where installed.
- D. Wiring: All wiring shall be installed raceways. Control wiring shall not be installed in power circuit conduits.
 - 1. Provide all interlock and control wiring. Provide wiring as required by functions as specified and as recommended by equipment and device manufacturers to achieve the specified control functions.
 - 2. Low voltage conductors shall be stranded bare or tinned-copper with premium grade polymer alloy insulation. For shielded cable, furnish multi-conductor of overall polyester supported aluminum foil with stranded tinned copper drain wire to facilitate grounding. Coaxial shield shall be copper braided type.

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Provide shielded cable where recommended by the equipment or device manufacturer, grounded in strict accordance with the manufacture's recommendations.

3. Low voltage wiring shall be UL Listed type for the intended application. Non-plenum type cable shall be UL Type CM and /or CMR. Plenum type cable shall be UL type CMP and /or CL3P for approved plenum installations.

2.5 DIRECT DIGITAL CONTROL SYSTEM

- A. The Direct Digital Control (DDC) System shall consist of native BACnet type global controller(s) and standalone or application specific unitary controller(s) configured as a distributed communications network composed of one or more levels of BACnet compliant local area networks (LAN). No gateways shall be used except when required to interface with specific equipment furnished by another manufacturer (e.g.: chiller controllers, packaged equipment controllers, etc.). The intent of the distributed control strategy is to install the controllers in close proximity to the equipment being controlled, and to distribute the processing to each standalone DDC panel. In the event of a communications failure of the BACnet LAN, the controllers shall be capable of operating in standalone mode. All devices (global controllers, standalone controllers, programmable controllers, etc.) shall be UL Listed, FCC approved, and BACnet compliant.
- B. Furnish a totally native BACnet -based system based on distributed logic control in accordance with this specification section. The existing operator's terminal, all global controllers, logic controllers, and all input/output devices shall communicate using the protocols and local area network (LAN) standards as defined by ANSI/ASHRAE Standard 135-1995, BACnet. All DDC controllers, including unitary controllers, shall be native BACnet devices. In general, no gateways shall be used except when required to interface with specific equipment furnished by another manufacturer. Scope of work will include, but not be limited to, the following:
 1. Provide all necessary BACnet compliant hardware and software to meet the system's functional specifications. Provide Protocol Implementation Conformance Statement (PICS) for every controller in the system, including unitary controllers. All direct digital logic hardware is to comply with BACnet.
 2. Prepare individual hardware layouts, interconnection drawings, and software configuration from project design data.
 3. Implement the detailed design for all system-standard analog and binary objects, distributed control and system databases, graphic displays, logs, and management reports based on control descriptions, logic drawings, configuration data, and bid documents.
 4. Design, provide, and install all equipment enclosures, panels, data communication network cables needed, and all associated hardware.
 5. Provide and install all interconnecting cables between supplied enclosures, logic controllers, and input/output devices.
 6. Provide and install all interconnecting cables between all operator's terminals and peripheral devices (such as printers, etc.) supplied under this contract.
 7. Provide complete manufacturer's product data for all items that are supplied. Include vendor name of every item supplied.
 8. Provide qualified supervisory personnel and technicians at the job site to assist in all phases of system installation, startup, and commissioning.
 9. Provide for operator training as described in this Section.
 10. Provide "as-built" documentation, operator's terminal software, diagrams, and all other associated project operational documentation (such as technical manuals) on approved media, the sum total of which accurately represents the final system.
 11. Provide new dampers, valves, actuators, sensors, controllers, and the like. No used components shall be provided as any part or piece of the installed system.

2.6 SYSTEM DESCRIPTION

- A. General Requirements
 1. A distributed logic control system complete with Direct Digital Control (DDC) and Direct Analog Control (DAC) software shall be provided. System shall be totally based on ANSI/ASHRAE Standard 135 – 1995, BACnet or LON. This system is to control all mechanical equipment, including all unitary equipment such as packaged air conditioning units, and all air handling units, boilers, chillers, and any other listed equipment on this project using native BACnet -compliant components.
 2. The entire processing system shall be in complete compliance with the BACnet standard. The system shall use BACnet protocols and LAN types throughout and exclusively. Non-BACnet compliant or proprietary equipment or systems (including gateways, except as specified previously) shall not be acceptable and are specifically prohibited.

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3. All logic controllers for terminal units, air handlers, central mechanical equipment, and Microsoft Windows-based operator's terminal(s) shall communicate and share data, utilizing only BACnet communication protocols.
 4. All logic controllers shall be fully programmable. Programmable controllers for every terminal unit, air handler, all central plant equipment, and any other piece of controlled equipment shall be provided. Programming tools shall be provided as part of the operator workstation for every controller supplied for the project.
 5. The Controls Contractor shall assume complete responsibility for the entire controls system as a single source. He shall certify that he has factory-trained personnel on staff under his direct employ on a daily basis. These employees shall be qualified to engineer, program, debug, and service all portions of the BACnet based logic control system. This shall include operator's terminal, global controllers, routers, programmable controllers, terminal unit controllers, sensors and all other components of the system.
- B. Trendlog Information
1. DDC system shall be capable of periodically monitoring the values or status of selected feedback or control data from the system global controller(s) or field controllers, and archiving this information on the operator's terminal. Archived files shall be appended with new sample data, allowing samples to be accumulated over a user defined period. Systems that overwrite previously archived data samples shall not be allowed, unless limited file size is specified. Samples in a trendlog shall be available for viewing at the operator's terminal. Displays of trendlog data shall be in spreadsheet format. Operator shall be capable of scrolling through all trendlog data. System shall automatically open archive files as needed to display archived data when the operator scrolls through the data vertically. All trendlog information displays shall be shown in standard engineering units.
 2. Software shall be included that is capable of graphing the trend logged object data. Software shall be capable of creating two-axis (x, y) graphs that display up to six object types at the same time in different colors. Graphs shall show object type values relative to time.
 3. Operator shall be able to change trendlog setup information. This shall include the data points and status information being trendlogged as well as the interval at which the information is to be logged. All trendlog functions shall be password protected. The operator shall be capable of viewing or setting up a trendlog for any prompted or read-only item.
 4. The system shall provide a means for the operator to directly export data to a comma-delimited file format for use in third-party software spreadsheets or other database programs. The system operation shall not be affected in any way by this data exchange.
- C. Energy Log Information
1. DDC system shall periodically gather energy log data stored in field terminal controllers and archive this information on the operator terminal's hard disk. Archive data shall be appended with the new data and allow data to be accumulated over several years. Systems that overwrite archived data shall not be allowed unless limited file size is specified. System shall automatically open archive files as needed to display archived data when the operator scrolls through the data. All energy log information shall be displayed in standard engineering units.
 2. System software shall be capable of graphing the Energy Log data. Software shall be capable of creating graphs in two-axis (x, y) format that shows recorded data relative to time. All data shall be stored in comma-delimited file format for direct use by third party software spreadsheets or other database programs. System operation shall not be affected by on-line access to the energy information.
 3. Operator shall be able to modify the energy log setup information. This shall include which meters are to be logged, meter pulse value, and what types of energy units are being logged. All energy meters monitored by the system shall be capable of being logged. All energy logging operations shall be password protected.
 4. Provide capability for the operator to export to a comma-delimited file format all energy-logged data for use by third party software spreadsheets or other database programs. System operation shall not be affected by on-line access to the energy information.
- D. Configuration/Setup
1. Provide means for the operator to display and change the system configuration. This shall include, but not be limited to: system time, day of the week, date of daylight savings time set forward/back, printer termination, port addresses, modem port and speed, and the like. Items shall be modified utilizing easily understood terminology by means of simple mouse/cursor key movements.
- E. Programming Tools
1. Operator's Terminal shall include programming tools for all controllers supplied. If a new software package is proposed it is the contractor's responsibility to load all programming tools/ engineering software

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on all of the owner's existing operator terminals and laptops, as well as provide all connectors for connection to field devices with portable terminals. All controllers shall be programmed using graphical tools that allow the user to connect function blocks on screen that provide sequencing of all control logic. Function blocks shall be represented by graphical displays that are easily identified and distinct from different types of blocks. Graphical programming that uses simple rectangles and squares is not acceptable.

2. User shall be able to pick graphical function block from the menu and place on screen. Programming tools shall place lines connecting appropriate function blocks together automatically. Provide zoom in and zoom out capabilities. Function blocks shall be downloaded to controller without any reentry of data.
3. Programming tools shall include a test mode. Test mode shall show user the real-time data on top of graphical display of selected function blocks. Data shall be updated real-time with no interaction by the user. Function blocks shall be animated to show status of data inputs and outputs. Animation shall show change of status on logic devices and countdown of timer devices in graphical format.

2.7 GLOBAL BUILDING CONTROLLERS (GBCs)

- A. The controls contractor shall supply one or more global controller as part of this contract. Number of global controllers required is dependent on the type and quantity of DDC devices.
- B. The Global Building Controller shall provide the interface between the LAN and the field control devices, and provide global supervisory control functions over the control devices connected to the GBC. It shall be capable of executing application control programs to provide:
 1. Calendar functions
 2. Scheduling
 3. Trending
 4. Alarm monitoring and routing
 5. Time synchronization
 6. Integration of LonWorks controller data and BACnet controller data
 7. The GBC must provide the following hardware features as a minimum:
 - a. One Ethernet Port - 10 Mbps
 - b. One RS-232 port
 - c. One BACnet MS/TP Port
 - d. Battery Backup
 - e. Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
 - f. The GBC must be capable of operation over a temperature range of 0 to 55°C
 - g. The GBC must be capable of withstanding storage temperatures of between 0 and 70°C.
 - h. The GBC must be capable of operation over a humidity range of 5 to 95% RH, non-condensing.
 - i. The GBC shall provide multiple user access to the system and support for ODBC or SQL. A database resident on the GBC shall be an ODBC-compliant database or must provide an ODBC data access mechanism to read and write data stored within it.
 - j. Event Alarm Notification and actions
 - k. The GBC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
 - l. The GBC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up telephone connection, or wide-area network.
 - m. Alarm generation shall be selectable for annunciation type and acknowledgement requirements.
 8. Provide for the creation of a minimum of eight alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.
 9. Provide timed (schedule) routing of alarms by class, object, group, or node.
 10. Provide alarm generation from binary object "runtime" and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.
 11. Control equipment and network failures shall be treated as alarms and annunciated.
 12. Alarms shall be annunciated in any of the following manners as defined by the user:
 13. Screen message text
 14. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
 - a. Day of week
 - b. Time of day
 - c. Recipient
 15. Pagers via paging services that initiate a page on receipt of email message
 16. Graphic with flashing alarm object(s)

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17. Printed message, routed directly to a dedicated alarm printer
18. Audio messages
19. The following shall be recorded by the NAC for each alarm (at a minimum):
 - a. Time and date
 - b. Location (building, floor, zone, office number, etc.)
 - c. Equipment (air handler #, accessway, etc.)
 - d. Acknowledge time, date, and user who issued acknowledgement.
 - e. Number of occurrences since last acknowledgement.
20. Alarm actions may be initiated by user defined programmable objects created for that purpose.
21. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
22. A log of all alarms shall be maintained by the GBC and/or a server (if configured in the system) and shall be available for review by the user.
23. Provide a "query" feature to allow review of specific alarms by user defined parameters.
24. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.
25. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

C. DATA COLLECTION AND STORAGE

1. The GBC shall have the ability to collect data for any property of any object and store this data for future use.
2. The data collection shall be performed by log objects, resident in the GBC that shall have, at a minimum, the following configurable properties:
3. Designating the log as interval or deviation.
4. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
5. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
6. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
7. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.
8. All log data shall be stored in a relational database in the NAC and the data shall be accessed from a server (if the system is so configured) or a standard Web Browser.
9. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.
10. All log data shall be available to the user in the following data formats:
11. HTML
12. XML
13. Plain Text
14. Comma or tab separated values
15. Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable.
16. The GBC shall have the ability to archive it's log data either locally (to itself), or remotely to a server or other GBC on the network. Provide the ability to configure the following archiving properties, at a minimum:
17. Archive on time of day
18. Archive on user-defined number of data stores in the log (buffer size)
19. Archive when log has reached it's user-defined capacity of data stores
20. Provide ability to clear logs once archived

D. AUDIT LOG

1. Provide and maintain an Audit Log that tracks all activities performed on the NAC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached it's user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network, or to a server. For each log entry, provide the following data:
2. Time and date
3. User ID
4. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

E. DATABASE BACKUP AND STORAGE

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1. The NAC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.
2. Copies of the current database and, at the most recently saved database shall be stored in the NAC. The age of the most recently saved database is dependent on the user-defined database save interval.
3. The NAC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

PART 3 EXECUTION**3.1 TRAINING**

- A. The Controls Contractor shall provide complete on-site training for the Owner's designated operating personnel. Training shall include all functional aspects of the control system and all modes of system operation. System modes include occupied/unoccupied, heating/cooling, economizer, startup/shutdown, energy management, and alarm event operations. Training of Owner's operating personnel shall include a minimum of eight (8) hours of system instruction, conducted during one or two site visits for a combined total of eight hours of instruction. Additional instruction time may be requested by the Owner for an additional fee if needed for training additional personnel or if more instruction is requested. Training is not intended to include in-depth instruction in system programming.
- B. Training shall be conducted during normal working hours, Monday through Friday, at the project site. When applicable, the training may be conducted at the Owner's central energy management office in addition to training on site.
- C. Contractor shall furnish one (1) copy of the system Operator's Manual to the Owner. This manual should be delivered to the Owner at the time of training. This manual is in addition to the system As-built documents which are intended to show wiring configurations and sensor locations.

PART 4 SEQUENCE**4.1 SEQUENCE OF OPERATION**

- A. DUAL TEMPERATURE PUMPS
 1. Dual temperature water is provided to the primary loops through two pumps in parallel. The pumps shall be energized when the building is in occupied mode or on any call for heating or cooling. Pumps shall operate anytime outside air temperature is below 32F.
 2. Upon initiation, the lead pump (alternated weekly), shall provide water to the building. Delta T across the pump exceeds 10F in cooling mode and 20F in heating mode for 30 minutes, the lag pump shall be brought on line.
 3. Set point in heating mode shall be per the following reset schedule.

Outside Air	Hot Water Supply
20 Deg. F.	160 Deg. F.
60 Deg. F.	100 Deg. F.
 4. Both pumps shall remain in simultaneous operation until the next time event change.
 5. The system shall enter heating mode when the outdoor temperature is less than 50F for two hours. System shall remain in heating mode until outdoor temperature exceeds 55F for two hours.
 6. The system shall enter cooling mode when the outdoor temperature exceeds 60F for two hours. System shall remain in cooling mode until outdoor temperature is less than 55F for two hours.
 7. Changeover valves shall modulate during transition from one setting to the other in order to prevent shocking boiler/chiller.
 8. Dual temp system points list.
 - a. Water supply temperature
 - b. Water return temperature
 - c. Outside air temperature.
 - d. Primary pump start/stop/status.
 - e. Secondary pump start/stop/status.
- B. Hot Water System
 1. Hot water is provided to the building by gas-fired boilers and secondary pumps.
 2. Pumps shall be energized through the BAS whenever the dual temperature loop enters heating mode. Upon proof of flow the boilers will be energized.

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3. Upon proof of flow, the boilers and secondary pumps shall be energized. The boilers shall operate under its internal control to provide 180F water. The three way changeover valve shall modulate to maintain the loop temperature noted above.
 4. The hot water supply and return temperatures shall be monitored and alarmed at the DDC. Each boiler shall be energized from the DDC with a status contact monitored and alarmed.
 5. Boiler system points list.
 - a. Hot water supply temperature (each boiler).
 - b. Hot water return temperature (each boiler).
 - c. Pump start/stop/status.
- C. Chilled Water System
1. Chilled water is provided to the building by one or two chillers as shown on the plans. Each chiller shall have a dedicated secondary pump.
 2. Secondary pumps shall be energized through the BAS upon a call for cooling or dehumidification. Upon proof of flow, the chiller shall be energized. The chiller shall operate under its own controls to provide 44F chilled water to the loop.
 3. Where two chillers are provided, they shall alternate weekly. The lead chiller shall operate until the delta T across the chiller exceeds 10F for 30 minutes. At that point the lag chiller shall be energized. When the delta T across both chillers falls below 4F for 30 minutes, the lag chiller shall de-energize. The lag chiller shall also de-energize upon entering un occupied mode.
 4. Chiller system points list with local display at chiller and at the BMS.
 - a. Chilled water supply temperature (secondary loop)
 - b. Chilled water return temperature (secondary loop).
 - c. Pump start/stop/status.
- D. Fan Coil Units
1. A programmable controller capable of stand-alone operation will control the unit. The unit will be started via pre-determined optimum start through the Building Automation System (BAS). The unit will be de-energized in accordance with time schedules through the BAS.
 2. Occupied Mode: In occupied mode, the supply fan will be indexed on and will run continuously. In unoccupied mode, the fan shall cycle on as required to maintain space set points.
 3. Temperature Control: The unit shall index mode based on dual temperature system setting. In cooling mode, on a rise in space temperature above the setpoint, the controller will modulate the chilled water valve open to the coil. On a drop in space temperature, the chilled water valve will modulate closed. In heating mode, on a drop in space temperature below the heating set point, the controller will modulate the valve open to the coil. On a rise in space temperature, the reverse will occur. Unique temperature set points shall be provided for occupied and unoccupied mode.
 4. Fan coil point list.
 - a. Fan start/stop/status.
 - b. Discharge air temperature.
 - c. Control valve outputs.
 - d. Space temperature
- E. Unit Ventilators
1. A programmable controller capable of stand-alone operation will control the unit. The unit will be started via pre-determined optimum start through the Building Automation System (BAS). The unit will be de-energized in accordance with time schedules through the BAS.
 2. Occupied Mode: In occupied mode, the supply fan will be indexed on and will run continuously. In unoccupied mode, the fan shall cycle on as required to maintain space set points.
 3. Temperature Control: The unit shall index mode based on dual temperature system setting. In cooling mode, on a rise in space temperature above the setpoint, the controller will modulate the chilled water valve open to the coil and the face and bypass damper shall modulate to maintain temperature set point. On a drop in space temperature, the chilled water valve will modulate closed. In heating mode, on a drop in space temperature below the heating set point, the controller will modulate the valve open to the coil. On a rise in space temperature, the reverse will occur. In heating mode the face and bypass dampers shall be fully open to the coil. Unique temperature set points shall be provided for occupied and unoccupied mode.
 4. Fan coil point list.
 - a. Fan start/stop/status.
 - b. Discharge air temperature.
 - c. Face and bypass damper output
 - d. Control valve outputs.

SECTION 23 09 00 BUILDING AUTOMATION SYSTEM (BAS)

- e. Space temperature
- F. Existing Constant Volume Air Handling Units
 1. A programmable controller capable of stand-alone operation will control the unit. The unit will be started via pre-determined optimum start through the Building Automation System (BAS). The unit will be de-energized in accordance with time schedules through the BAS. The unit is a constant volume unit with dual temperature coil.
 2. Occupied Mode: In occupied mode, the supply fan will be indexed on and will run continuously. In unoccupied mode, the fan shall cycle on as required to maintain space set points. In occupied mode the outside air damper shall modulate to minimum position. In unoccupied mode the damper shall remain closed.
 3. Temperature Control: The unit control valve shall modulate as required to maintain space heating or cooling setpoint.
 4. AHU point list.
 - a. Fan start/stop/status.
 - b. Discharge air temperature.
 - c. Control valve outputs.
 - d. Space temperature.
 - e. Outside air damper position
- G. Packaged Unitary Equipment
 1. A programmable controller capable of stand-alone operation will control the unit. The unit will be started via pre-determined optimum start through the Building Automation System (BAS). The unit will be de-energized in accordance with time schedules through the BAS.
 2. Occupied Mode: In occupied mode, the supply fan will be indexed on and will run continuously. In unoccupied mode, the fan shall cycle on as required to maintain space set points. In occupied mode the outside air damper shall modulate to minimum position. In unoccupied mode the damper shall remain closed.
 3. Temperature Control: The unit components shall modulate as required to maintain space heating or cooling setpoint.
 4. Points list.
 - a. Start/stop/status.
 - b. Discharge air temperature.
 - c. Space temperature.
- H. Fans shall be started and stopped through the building automation system.
- I. Other
 1. Provide emergency switch at entrance of Boiler Room that shall upon activation shutdown all burners within the Boiler Room.
 2. All points (unit start/stop, temperature settings, etc.) shall be viewable and adjustable through the building graphics.
 3. Main page shall have a holiday setting that will enable the owner to put the entire building in "unoccupied" mode.
 4. Provide morning warmup/cooldown mode. In warmup mode all fans shall be off. All outside air dampers shall remain closed. All units shall operate in heating mode until space temperature setpoints are achieved.
 5. In unoccupied mode, units shall operate to maintain setback space setpoints.
- J. Variable Speed Pumping
 1. For each energy plant, primary pumps shall be provided with a variable speed drive.
 2. Provide two differential pressure sensors in for each system. Locations shall be determined during construction.
 3. Pump speed shall vary to maintain differential pressure of both sensors as required.
 4. Point list.
 - a. Drive speed
 - b. Differential pressure (each location)

END OF SECTION 23 09 00

SECTION 23 11 23 - GAS PIPING (NATURAL GAS)

PART 1 GENERAL

1.1 SCOPE

- A. The provisions of Section 23 05 00 apply to all the work in this Section.
- B. Contractor shall furnish and install all gas piping as shown on the plans complete in all respects.
- C. Installation shall be in accordance with ALL state, local and national codes including NFPA Pamphlet No. 54 and NBFU Pamphlet No. 58.

PART 2 PRODUCTS

2.1 GAS PIPING

- A. All piping shall be steel or copper as follows:
 - 1. Steel pipe; ANSI/ASTM A53 "welded and seamless steel pipe".
 - 2. Copper pipe; ANSI/ASTM B42 "seamless copper pipe".

2.2 GAS PIPE FITTINGS

- A. Fittings shall be steel, copper or malleable iron. Pipe joints in steel or copper pipe may be screwed, welded or brazed. Fittings shall be suitable for the appropriate working pressure.

PART 3 EXECUTION

3.1 GAS PIPING

- A. Gas piping shall be extended from the meter as shown.
- B. All gas piping shall be tested with air at 150 psig minimum. All joints shall be checked to determine if any leaks occur, using soap solution. Any joint or fitting found defective shall be removed and replaced. No caulking or other artificial means will be used to make repairs.
- C. Ground plug shutoff cocks shall be installed at each equipment service stub. Piping shall be installed with valves, drip pockets, stop cocks, and other accessories that may be required to give proper service.

END OF SECTION 23 11 23

PART 1 GENERAL**1.1 SCOPE**

- A. The provisions of Section 23 05 00 apply to all work in this Section.
- B. Furnish and install all chilled water, hot water, dual temperature water, make up water, refrigerant and condensate drain piping as shall be required in order to provide a complete and satisfactory system.
- C. The Mechanical Contractor shall furnish and install all necessary valves and specialties to make the installation complete and as specified below. All specialty items unless otherwise noted shall be for operation on at least 125 pound psig working pressure as rated in accordance with the standards of ASA.

1.2 SUBMITTAL

- A. Submit the following in accordance with Section 23 05 00:
 - 1. Manufacturer's cuts.
 - 2. Installation instructions.
 - 3. Operating and Maintenance Instructions.

1.3 SAFETY AND RELIEF VALVES

- A. The Mechanical Subcontractor shall furnish and install safety and relief valves on all fired and unfired pressure vessels in accordance with current requirements of North Carolina Department of Labor, Boiler Bureau. All valves shall bear the stamp and approval of the American Society of Mechanical Engineers Boiler Construction Code, and shall be proper size for the respective equipment it serves.

PART 2 PRODUCTS**2.1 CHILLED WATER, HOT WATER AND DUAL TEMPERATURE WATER PIPING**

- A. All new pipe used in entire system except where otherwise shown or specified, shall be standard weight Schedule 40 black steel pipe with weights and dimensions in accordance with American Standard Association B36-10 as manufactured by National Tube Company, Birmingham Tank Company, Bethlehem Steel Company or approved equal.
- B. At the contractor's option, piping 2" and smaller may be hard drawn copper tubing ASTM B 88 Type "L". Fittings for copper tubing shall be ANSI B16.18 or B16.22 solder joint fittings. Ends of pipe shall be reamed, pipe and fittings cleaned. Use only 95-5 (95% tin and 5% antimony) solder with non-corrosive flux on 1-1/4" and smaller and on 1-1/2" and larger use silver solder (Minimum 12% Silver), with a melting point greater than 1000°F. Submit solder for approval.

2.2 MAKE-UP WATER PIPING

- A. Make-up water piping above grade, shall be Type "L" hard copper tubing with wrought copper sweated fittings. Copper pipe to conform to ASTM Specifications B-88 and fittings to conform to ASA Specifications B-16-22.
- B. Joints in copper piping to be reamed, cleaned, fluxed and soldered with 95% tin, 5% antimony solder. Joints between dissimilar metals to be made with red brass fittings.

2.3 DRAIN PIPING

- A. All drain lines shall be Type "L" hard drawn copper [or PVC drain pipe conforming to ASTM D 1785]. Drains shall be run in a neat manner to the floor drain and turned down at the floor drain, unless otherwise indicated. Minimum of 1-1/4" unless otherwise shown.

2.4 REFRIGERANT PIPING

- A. All refrigerant piping shall be Type "K" hard drawn copper of "ACR" tubing with wrought copper sweat fittings. All joints are to be made with hard solder such as "Sil-Fos" or "Silver Solder."
- B. All joints in refrigeration pipe work shall be soldered with the use of nitrogen gas. Refrigerant piping shall be tested, evacuated, charged with nitrogen and completely dried before charging with freon.
- C. All refrigerant piping underground shall be encased in plastic or PVC conduit.

SECTION 23 20 00 - HVAC PIPING

- D. Refrigerant piping shall include best grade brass refrigerant fittings, consisting of expansion valve, solenoid valve, sight glass with moisture indicator, filter dryer, check valves and/or specialties as may be recommended or required by the manufacturer or as shown on the drawings.

2.5 VALVES

- A. All new valves shall be as specified below by figure number and shall be one manufacturer throughout.
- B. Spring check valves shall be installed on water lines 2-1/2 inches and above. Valves shall be non-slam type of such design that closing is controlled by spring action so designed to return disc or leaves to seat at zero velocity or before reversal of flow. Disc or leaves shall be free-flowing with no greasing or counterweights required. Body shall be semi-steel, 125 psi rated. Disc or leaves and seat shall be bronze with stainless steel spring.

<u>Manufacturer</u>	<u>Wafer 125#</u>	<u>Flanged 125#</u>
NIBCO	W910-B	F910-B
MUELLER	91-AP	105M-AP
MISSION		

- C. Butterfly valves shall be lug type and suitable for water service. Valves shall have EPDM seats suitable for temperature up to 275 degrees Fahrenheit and pressure up to 150 psig. Body shall be cast iron, disc shall be aluminum bronze, and shafts shall be stainless steel. Valves 2" to 6" shall be interim positive lock, lever operators. Valves 8" and larger shall have encased gear operators with hand whl. Bodies shall be lug type. All working parts shall be field replaceable. All valves shall be equipped with extended neck for insulation up to 2" thick. Manufacturer must certify valves (2" through 16") to be capable of providing bubble tight seal at 200 psi when used for end of line service without the need of a flange on the down stream side. Valves 18" and larger must be capable of 150 psi end of line service.

<u>Manufacturer</u>	<u>Lug 150#</u>
NIBCO	LD2000
CRANE	14-TL
STOCKHAM	LD-711-BS3-E

- D. Hose end gate valves shall be screwed connection, bronze as specified above. Hose connection shall be as specified above. Hose connection shall be suitable for 1/2" hose.

<u>Manufacturer</u>	<u>Hose End 125#</u>
NIBCO	T113-HC
CRANE	451
STOCKHAM	-

- E. Ball valves shall be bronze, two piece construction rated for 125 SWP/400 WOG. Valves shall have full port with Teflon seats. Stem shall be of silicon bronze. Sizes 1/4"-2".

<u>MANUFACTURER</u>	<u>THREADED 125#</u>	<u>SOLDER 125#</u>
NIBCO	T580	S580
APOLLO	70-100	70-200
STOCKHAM	S214-BR-T-T	S214-BR-T-S

2.6 VALVE TAGS AND CHARTS

- A. Furnish for each valve and gas cock in the HVAC system a brass tag fitted to each valve so that it may not be removed. Each tag shall be numbered consecutively with the Numbers V-1, V-2, V-3, etc..
- B. Furnish two (2) copies of a master valve chart denoting valve number, location and purpose. One (1) chart shall be in a suitable black wood frame with glass cover and mounted where directed.

2.7 SPECIALTIES

- A. Gaskets: This Contractor shall furnish and install at each flange connection, Johns-Manville Service Gasket N. 60, or approved equal.

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- B. Flow Balance Valves: Flow balance valves, where shown, shall be Bell and Gossett Circuit Setter, or approved equal, size indicated in each case. Provide (1) differential meter to be turned over to Owner with operation and maintenance manuals.
- C. Water Pressure Reducing Valve: Furnish and install in the heating and cooling system water pressure reducing valves as shown with a bypass line around the valve and fittings. Pressure reducing valve shall be installed at each fill connection to the HVAC system. Reducing valve shall be of bronze body construction with Buna-N- Nylon diaphragms, and stainless renewable seats. Set valve to pressure shown on plans. Setting shall be adjustable. Set valve at 12 psi. (adj.). Pressure reducing valves shall be 3/4" and shall be as manufactured by Cash, Bell and Gossett, Watts or approved equal.
- D. Automatic Control Valves: All automatic control valves shall be of the modulating or proportioning type. See temperature controls.
- E. Compression Tanks. Furnish and install the ASME and National Board Labeled Code constructed steel compression tanks indicated on plans with necessary tapings for connections to heating system. Tanks shall be supported from over head with hanger rods connected to suitable overhead structure and as called for on the plans. Equip each tank with Bell and Gossett or approved equal air control valve and separate tank drain. Drain shall be globe valve. "Boiler Drain Valves" prohibited. Tank shall be given three (3) coats of high temperature aluminum rust preventative paint on the exterior. The tanks shall be a part of the "Air Control System" in the heating system and must be furnished, guaranteed and installed in strict accordance with the manufacturer's instructions.
- F. Provide drain valve with hose connection end at each zone valve in the Equipment Room and at the bottom of each pair of risers to unit throughout the building for convenient complete drainage of each zone or unit.
- G. Strainers for water service with end suction pumps shall be bolted top basket type with 40-mesh monel screen. For other water service where space is insufficient for basket strainers, and for steam service strainers shall be Y-type with 40-mesh monel screen. Strainers shall have blow-down tapings, removable baskets and be iron bodied with flanged ends.
- H. Pressure gauges shall be designed for the service. Gauge size shall be 4-1/2" diameter with black lettering on a white field. Provide snubber and shutoff cock. Gauge scale shall be twice the normal pressure of the line in which it is installed. Gauge shall be Bourdon tube type with bushed movement and cast aluminum case. Accuracy shall be 90% of the entire range. Gauges no higher than 6' above finish floor. Scale range shall be 0-100 psi.
- I. Pipe thermometers shall be adjustable angle type and shall be provided with extensions for all thermometers mounted through insulation. thermometers shall have ranges suitable for the service. Minimum length shall be 12" and each graduation of the scale shall represent not more than 2°F. All exposed parts of the thermometer, except the case, shall be heavy chrome plated brass.
 - 1. Scale Range for Chilled-Water Piping: 0 to 100 deg F.
 - 2. Scale Range for Heating, Hot-Water Piping: 40 to 250 deg F.
- J. Flow indicators shall be Bell and Gossett Type TFI, or equal (size as required).
- K. Backflow preventers, reduced pressure (RPZ) backflow preventers shall be installed at each connection between any HVAC system and the domestic water supply system. Preventers shall be of bronze body construction with stainless steel internal parts and flange bolts. Assembly shall be furnished with unions at inlet and outlet to facilitate servicing. Unit shall be rated for a working pressure of 150 psi and a working temperature of 210 degrees Fahrenheit and be tested and certified in accordance with the American Society of Sanitary Engineering Standard 1013-1071.
- L. Pressure reducing valves shall be installed at each fill connection of the HVAC System. Reducing valves shall be of bronze body construction with Buna-N-Nylon diaphragms, and stainless steel renewable seats.
- M. Water flow meters shall be differential pressure Venturi or Orifices type, pipe mounted. Each meter shall be complete with quick disconnect valves for gauge connection. Master gauge shall be dry type with a scale reading from 0 to 5 inches of water pressure. Gauge shall be portable.
- N. Relief valves shall be ASME pressure relief valve set to 15 psi above maximum normal system operating pressure. The discharge from valves on water lines shall be piped to the nearest floor drain; valves on steam lines shall be piped to the outside.

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- O. Air Separators: Air separators for water systems shall be tangential type with vortex separation action. Separator shall be constructed of galvanized steel, suitable for 125 working pressure in accordance with ASME Code for Unfired Pressure Vessels. Separator shall have basket strainer. (See Strainer Specification this Section.)

2.8 PRESSURIZATION AND AIR ELIMINATION SYSTEM

- A. Furnish and install as shown on the drawings, a pressurization and air elimination system to accommodate the expanded water generated by the increase in temperature in a water heating or chilled water system and to control the increase in pressure at all critical components in the system to the maximum allowable for those components.
- B. The pressurization and air elimination system shall ensure that all air in the system shall be eliminated. The only air in the system shall be the permanent sealed-in air cushion contained in the pressurization controller component of the system a diaphragm-type expansion tank, pre-charged to the minimum operating pressure at the location indicated on the drawings.
- C. The diaphragm-type expansion tank shall be manufactured by a manufacturer who has supplied substantially the same tanks, which on the date of opening of bids, have been in successful commercial use and operation for not less than five years in projects and units of comparable size. The right is reserved by the owner to require the contractor to submit a list of buildings where they have been in operation, so that such investigation as may be deemed necessary may be made before approval.
- D. The diaphragm-type expansion tank shall be welded steel, constructed tested and stamped in accordance with Section VIII of the ASME Code for a working pressure of 125 psi and shall be supported by steel legs or a base for vertical installation or steel saddles for horizontal installations.
- E. All free air originally contained in the system, and all entrained air bubbles carried by the system water shall be eliminated at all points in the lowest (the point of lowest solubility), and as indicated on the drawings. The air separating and elimination component shall separate entrained air from flowing system water by the creation of a vortex which will allow free air to rise in the center, the point of lowest velocity, to an air elimination valve.
- F. The air separator shall be capable of effectively separating not less than 80% of the entrained air on the first passage of water and not less than 80% of the residual air on each subsequent passage.
- G. The pressure drop through the air separator at the specified flow rate shall be as shown on the drawing.
- H. The air separator shall be cast iron or welded steel, constructed, tested and stamped in accordance with Section VIII of the ASME Code for a working pressure of (125).
- I. Piping shall be as shown on the drawings.
- J. Air shall be eliminated to the atmosphere at fast as it is separated from system water through a float activated remote pressure operated air elimination valve installed at the top of the air separator. The air elimination valve shall have a high removal rate at low pressure differentials and shall be fully open for the removal of air at all pressures in the operating range from 2 psi to 140 psi. It shall be tightly sealed against loss of system water and prevent entrance of air in negative pressure situations.
- K. The valve shall be constructed of metal and all working parts shall be non-corrosive. Working pressure shall be 150 psi.

PART 3 EXECUTION**3.1 GENERAL**

- A. Contractor shall install valves and specialties according to the best practice and manufacturer's recommendations.

3.2 PIPE AND PIPE FITTINGS

- A. Provide all piping and connections to all items of equipment as shown and/or required to fully complete the system indicated, including drains and other connections. The drawings show the arrangement desired and the Contractor shall follow the drawings as accurately as possible. If conflict should arise, the Contractor shall verify all measurements on the job and cut pipe unless specifically noted for expansion loops. All piping shall be reamed or filed and cleaned to remove burrs and other obstructions.

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- B. The Contractor shall be responsible for installing all piping work in a neat workmanlike manner. This shall be interpreted to mean that all piping shall be neatly aligned, installed and supported in equally spaced parallel runs using trapeze hangers where applicable, install square, true and plumb with walls, equipment or other related surfaces using standard fittings. Any pipe work installed in a disorderly or unworkmanlike manner as adjudged by the Architect shall be corrected by the Contractor at the Contractor's expense.

3.3 CHILLED WATER, HOT WATER AND DUAL TEMPERATURE WATER PIPING

- A. Piping and Pipe Work: Grade all piping properly to insure noiseless circulation of water without formation of pockets. Unless otherwise called for in the plans and specifications, horizontal pipe runs shall be graded to permit complete drainage of the system. Temperature and pressure gauges and sensors shall be installed no higher than six feet above finished floor.
- B. All piping 2" diameter or smaller shall be threaded. Piping 2-1/2 inches and larger shall be welded. Joints at valves and equipment in piping 2-1/2 inches and larger shall be flanged. All threads shall be cut with clean and true dies.
- C. Install eccentric reducers to change size of mains installed with eccentricity up to keep the top of mains level in the piping.
- D. Welding: All welding of joints in piping connections done in the field shall be in accordance with the requirements of the American Standard Code for Pressure Piping.
- E. Welding may be either by Metal Arc-Welding Process or the Oxyacetylene Welding Process and in general conformance with procedures established in the latest edition of Appendix B to Section 6 of the ASA Code for Pressure Piping B31.1.
- F. Welding fittings shall be used with welded piping. These shall be welding pattern in accordance with ASTM Specifications A-234 and ASA Standard B16.9. Such fittings shall be provided at all changes in direction or changes in pipe size except as hereinafter provided.
- G. Weldolet or Thredolet fittings may be used in lieu of welded fittings for branch connection to size 2-1/2" and larger mains, provided branch is two or more pipe sizes smaller than the main.
- H. Fittings: Fittings in welded piping shall be standard weight welding fittings, with radii of 1-1/2" the diameter and equal to Tube Turns, Ladish, Taylor Forge or approved equal. See "welding" section for lateral connections and welding fittings standards.
- I. Fittings in threaded piping shall be standard weight, malleable iron, screw pattern. Except where otherwise noted, fittings shall be rated for 125 pounds per square inch gauge working pressure and shall be manufactured by Crane, Flagg, Stockham or approved equal.
- J. During erection, care shall be taken to remove all dirt, scale and other foreign matter from inside the piping before tying in long sections or installing valves.
- K. Copper piping:
1. Piping shall be installed so as to be free floating. 125 pound copper sweat pattern unions shall be provided in the piping as indicated on the drawings.
 2. Unions shall be installed at each piece of equipment.

3.4 BLOWING-OUT SYSTEM

- A. All piping and equipment shall be thoroughly blown-out under pressure and clean of all foreign matter wasting condensate through temporary connections so long as necessary to thoroughly clean before system is placed in operation. Use every precaution to prevent pipe compound, scale, dirt, welding and other objectionable matter getting into piping system and equipment.

3.5 HANGERS

- A. All piping shall be supported on not less than 10' centers and within 30" of each change of direction except that piping 1-1/4" size and smaller shall be supported on 8'-0" centers.
- B. All piping shall be hung by means of split type wrought iron hanger rings similar to Grinnell Figure 104 except as otherwise noted. Copper piping not insulated shall be hung from copper plated hangers similar to Figure CT-97. All insulated piping shall be hung by means of clevis type hangers sized to fit outside of insulation, Grinnell Figure 260.

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- C. Pipe hangers shall be supported by means of iron hanger rods from the building construction or from structural steel members, and in an approved manner. Where required, piping shall be hung from angle iron slips or suitable brackets attached to sides of masonry construction.
- D. All insulated piping shall be provided with insulating protection sheet metal saddles. These shall be 20 gauge galvanized iron. Saddles shall be of a length equal to two times the outside diameter of the insulation and shall extend to above the center line of the pipe.
- E. Spring type isolators and wood blocking under insulation jacket shall be provided at large piping subject to vibrations as indicated in the plans and details. Contractor shall provide spring isolator submittal indicating construction, spacing, loading and efficiency.
- F. Where piping passes through masonry construction, steel pipe sleeves shall be provided, sized to allow at least 1/2" clearance around pipe or insulation where pipe is insulated. Sleeves shall be flush with finished walls and extend 1/2" above finish floors. A watertight seal shall be provided between floor and sleeve and space between pipe and sleeve shall be caulked with lead wool.

3.6 TEST

- A. Pressure test all chilled water, hot water dual temperature water piping at a pressure of 150 psig for 24 hours. Engineer shall be notified 24 hours before test is to be performed.

END OF SECTION 23 20 00

PART 1 GENERAL**1.1 SCOPE**

- A. The provisions of Section 23 05 00 apply to all the work in this Section.
- B. Furnish and install pumps as required to provide a complete and satisfactory job.

1.2 SUBMITTALS

- A. Submit the following in accordance with Section 23 05 00:
 - 1. Manufacturer's cuts.
 - 2. Certified capacity ratings.
 - 3. Installation instructions.
 - 4. Operating and Maintenance Instructions.

PART 2 PRODUCTS**2.1 INLINE PUMPS**

- A. The pump shall be of In-Line, close-coupled, single stage, design of bronze fitted construction. Impeller and shaft construction shall be bronze or stainless steel for extended life. The pump internals shall be capable of being serviced without disturbing piping connections.
- B. The sealing off of the liquid cavity shall be by:
 - 1. Mechanical Seal.
- C. A replaceable shaft sleeve shall be employed to completely cover the wetted area under the seal or packing.
- D. The impeller shall be of the enclosed type, hydraulically and dynamically balanced, and keyed to the shaft and secured by a suitable locking capscrew.
- E. The motor shall meet NEMA specifications and be up to standards required for industrial use. It shall be furnished with re-greasable ball bearings completely adequate for the maximum load for which the motor is designed.
- F. Each pump shall be factory tested. It shall then be thoroughly cleaned and painted with at least one coat of high grade machinery enamel prior to shipment.
- G. Pump manufacturer shall ensure a non-overloading condition at any point along the pump curve with the motor furnished.
- H. Where inline pumps are used in a chilled water application, field install a drip pan under the entire pump, motor, and end connections. Drip pan shall be constructed of 16 gauge galvanized sheet steel with welded seams. Drip pan shall be 1-1/2" deep with a 3/4" threaded drain tapping. Interior and exterior of the pan shall have a rust inhibitive coating. Exterior of pan shall be insulated as specified in Section 23 07 00 - INSULATION. A 3/4" drain line shall be piped from the pan to the nearest floor drain.
- I. Where variable frequency drives are required, provide inverter-duty rated motors and electrically insulated bearings.
- J. BAS interface – Modbus RTU, BACNET, Lonworks capability.
- K. Pre-approved manufacturers are B & G, Taco, and Armstrong.

2.2 END SUCTION PUMPS

- A. The pump shall be of the end suction design, in cast iron and bronze fitted construction. Impeller and shaft construction shall be bronze or stainless steel for extended life. The pump internals shall be capable of being serviced without disturbing piping connections or motor.
- B. The impeller shall be of the enclosed type, dynamically balanced and keyed to the shaft and secured with a suitable lockout.
- C. Pump seal shall be by:

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1. Standard single mechanical seal with carbon seal ring and ceramic seat.
- D. A replacement shaft sleeve shall be furnished to cover the wetted area of the shaft under the seal or packing.
- E. The bearing assembly of the pump shall be fitted with re-greaseable ball bearings equivalent to electric motor bearing standards for quiet operation.
- F. The pump and motor shall be mounted on a common baseplate of heavy structural steel design with securely welded cross members and open grouting area. A flexible coupler, capable of absorbing torsional vibration, shall be employed between the pump and motor, and it shall be equipped with a suitable coupling guard as required. The pumps shall have a foot mounted volute and a spacer drop out for true back pull out service.
 1. Chilled water pumps shall be equipped with a factory-installed welded seam drain pan under the pump head. The drain pan shall be constructed of 16 gauge galvanized sheet steel and shall have a 3/4" drain tapping. A 3/4" drain line shall be piped from the drain pan to the nearest floor drain or open sight drain. The interior and exterior of the drain pan shall be coated with a rust resistant coating.
- G. The pump shall be factory tested, thoroughly cleaned, and painted with one coat of machinery enamel prior to shipment. A set of installation instructions shall be included with the pump at the time of shipment.
- H. Pump manufacturer shall ensure a non-overloading condition at any point along the pump curve with the motor furnished.
- I. Where variable frequency drives are required, provide inverter-duty rated motors and electrically insulated bearings.
- J. BAS interface – Modbus RTU, BACNET, Lonworks capability.
- K. Pre-approved manufacturers are B & G, Taco, and Armstrong.

PART 3 EXECUTION**3.1 INSTALLATION**

- A. Pump base shall be grouted to the support pad. After grouting the pump base and connecting the suction and discharge piping, the pump and motor shall be realigned in accordance with the standards of the hydraulic institute.
- B. Pump impeller shall be trimmed as required to balance system in accordance with N. C. Energy Code.

END OF SECTION 23 21 23

SECTION 23 25 00 - WATER TREATMENT**PART 1 GENERAL****1.1 SCOPE**

- A. The provisions of Section 23 05 00 apply to all the work in this Section.
- B. Furnish and install water treatment including equipment required to provide a complete and satisfactory job.

1.2 SUBMITTALS

- A. Submit the following in accordance with Section 23 05 00:
 - 1. Manufacturer's cuts.
 - 2. Certified capacity ratings.
 - 3. Installation instructions.
 - 4. Operating and Maintenance Instructions.

PART 2 PRODUCTS**2.1 GENERAL**

- A. The Contractor will furnish, install and provide all equipment, chemicals and the necessary service for a Water Treatment Program. A single water treatment company shall be responsible for all products and services and be a recognized specialist in the field of industrial water treatment for a minimum of ten years. The water treatment company shall have regional water analysis laboratories, research and development facilities, plus technical service representatives located within the trading area of the job site. All HVAC water lines and related equipment shall be thoroughly flushed out with a liquid alkaline compound with emulsifying agents and detergents to remove any grease and petroleum products. The cleaning chemicals shall be designed to remove deposition such as pipe dope, oils, loose rust and mill scale and other extraneous materials. Inspect, remove sludge and flush low points with clean water after cleaning process is completed; also remove, clean and replace strainer screens. The system shall be flushed, drained and filled until no foreign objects are observed in the system and the total alkalinity of the rinse water is equal to that of the make-up water. All closed loop cleaning shall take place as soon as possible when all new piping and new equipment have been installed so as not to have impure water circulate through the new equipment.
- B. The water treatment products and service shall be provided by a company that has a minimum of 3 years experience shall supply chemicals, service and equipment. The company shall have local representatives with water analysis laboratories and fulltime service personnel.
- C. The Company shall meet/conform to all applicable federal, state, and local codes for the addition of non-potable chemicals to building mechanical systems.
- D. Piping System Cleaning - The Company shall provide and supervise the cleaning and shall provide a certification of completion of cleaning procedures. For chilled water systems the following is required: 1) Circulate for 48 hours, then drain as quickly as possible. 2) Refill with clean water; circulate for 24 hours, then drain. 3) Refill with clean water and repeat until system cleaner is removed. All HVAC water lines and related equipment shall be thoroughly flushed out with a liquid alkaline compound with emulsifying agents and detergents to remove any grease and petroleum products. The cleaning chemicals shall be designed to remove deposition such as pipe dope, oils, loose rust and mill scale and other extraneous materials. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed; also remove clean and replace strainer screens. The system shall be flushed, drained and filled until no foreign objects are observed in the system and the total alkalinity of the rinse water is equal to that of the make-up water. All closed loop cleaning shall take place as soon as possible when all new piping and new equipment have been installed as so not to have impure water circulate through the new equipment.

2.2 PRE-OPERATIONAL SYSTEM CLEAN-OUT

- A. All water lines and related equipment shall be thoroughly flushed out with pre-cleaning chemicals designed to remove deposition such as pipe dope, oils, loose rust and mill scale and other extraneous materials. Add recommended dosages of pre-cleaner chemical products and circulate throughout the water system. Drain, fill and flush water system until no foreign matter is observed and total alkalinity of the rinse water is equal to that of the makeup water. The following is required: 1) circulate for 48 hours, then drain as quickly as possible. 2) Refill with clean water; circulate for 24 hours, then drain. 3) Refill with clean water and repeat until system cleaner is removed.

2.3 CHEMICAL FEEDING AND CONTROL EQUIPMENT

SECTION 23 25 00 - WATER TREATMENT

- A. For each water system, contractor shall install a one-shot feeder with funnel, and air release valve. The one-shot feeder shall have a minimum capacity of the five gallons (quick opening cap) and be designed to meet the pressure requirements of the system. The feeder shall be installed such that the inlet/outlet is piped for the suction/discharge of the system pumps. The feeder shall have isolating valves, air relief valves, and drain valves (piped to drain).
- B. The chemical treatment shall consist of a liquid corrosion inhibitor for the proper corrosion protection of the system. The closed loop inhibitor will not contain chromate, hydrazine, or other carcinogenic materials. This treatment product shall be applied such that a minimum pH of 8.0 is achieved and at sufficient concentration for the achievement of acceptable corrosion control.

2.4 WATER TREATMENT CHEMICALS

- A. Furnish one year's supply of the recommended formula for scale and corrosion protection of close recirculating system. Formulation shall not contain any ingredients which are harmful to system materials of construction.

2.5 TESTING EQUIPMENT

- A. Furnish basic water test equipment, spare re-agents for maintaining control of program standards in the chilled water and boiler systems. Provide service, maintenance, and sufficient chemicals for treatment and testing of the system for 90 days following the date of substantial completion. A representative shall check the system every 30 days during the 90 day period and mail all field test reports to the CMS HVAC Dept. 3301 Stafford Drive, Charlotte, NC 28208. Test kits will include the following:
 - 1. Re-agents and apparatus for determination of corrosion inhibitor level in the chilled water system.
 - 2. Re-agents and apparatus for determination of pH, P & M, alkalinity and chlorides.

PART 3 EXECUTION**3.1 WATER TREATMENT SERVICE PROGRAM**

- A. The chemical supplier shall provide all consulting services for a period of one year from start-up of the cooling system which will include:
 - 1. Installation and system start-up procedure recommendations.
 - 2. Pre-operation system clean-out procedure supervision.
 - 3. Initial water analysis and recommendations.
 - 4. Training of operating personnel on proper feeding and control techniques.
 - 5. Periodic field service and consultation meetings.
 - 6. Any necessary log sheets and record forms.
 - 7. Any required laboratory and technical assistance.
- B. All services will be provided by a qualified, full-time representative of the chemical supplier.

END OF SECTION 23 25 00

SECTION 23 30 00 AIR DISTRIBUTION**PART 1 GENERAL****1.1 SCOPE**

- A. Furnish and install all sheet metal work shown or called for including ductwork and connections to fans and equipment.
- B. Ductwork shall be provided and installed as shown on the drawings. All details of ductwork are not indicated, and necessary bends, offsets and transformation must be furnished whether shown or not.
- C. The provisions of Section 23 05 00 apply to all the work in this Section.

1.2 SUBMITTALS

- A. Submit the following in accordance with Section 23 07 00.
 - 1. Manufacturer's cuts.
 - 2. Certified capacity ratings.
 - 3. Installation instructions.

1.3 RELATED DOCUMENTS

- A. Section 23 07 00 - Insulation.

PART 2 PRODUCTS**2.1 GENERAL**

- A. All ductwork, plenums and casings shall be constructed of sheet metal, as herein specified. All sheet metal construction shall conform to the pressure classification shown on the contract drawings, or herein specified and shall be in accordance with the construction and installation details in Chapter 19 of the 2012 ASHRAE Systems and Equipment Handbook or the appropriate SMACNA Standards.
- B. Duct sizes on drawings represent gross sheet metal dimensions. Allowance has been made, where applicable, for duct liner.

2.2 LOW PRESSURE DUCTWORK

- A. Low pressure ductwork shall be constructed of zinc coated sheet steel and shall conform to the 1st Edition of SMACNA HVAC Duct Construction Standards -Metal and Flexible, 1985, as follows:
 - 1. Rectangular Duct
 - a. 1" w.g. pressure class - Table 1-4.
 - 2. Round Duct
 - a. 2" w.g. pressure class - Table 3-2.

2.3 GENERAL EXHAUST DUCTWORK

- A. Unless otherwise noted, all exhaust ductwork shall be constructed the same as specified for low pressure ductwork.

2.4 FLEXIBLE DUCTWORK

- A. Flexible air duct for connections between medium pressure duct and terminals units and between low pressure duct to diffusers shall be equal to Thermaflex M-KE. Duct shall be listed by Underwriter's Laboratories under UL 181 standards as Class 1 flexible air duct material and shall comply with NFPA Standards 90A and 90B. Duct shall be rated to operate at pressures up to 6" w.g. for sizes 10" and 4" w.g. for sizes 12" and above. Maximum length of flexible air duct shall be 6 feet.
- B. Duct shall be a factory fabricated assembly composed of a polymeric liner duct bonded permanently to a coated spring steel wire helix and supporting a fiberglass insulating blanket. Outer vapor barrier shall be of fiberglass reinforced film laminate. Connections shall be made with Thermaflex, or equal, duct straps.

2.5 INSTRUMENT TEST HOLES

- A. Ventlock No. 699 with gasket. Provide a minimum of one in each zone supply duct.

2.6 TURNING VANES

SECTION 23 30 00 AIR DISTRIBUTION

- A. Turning vanes and Deflector Controls, Barber-Colman, Carnes Corporation, Kruger or Titus in length up to 18"; Aero-Dyne Duro-Dyne, or Airsan double thickness about 24" in length, installed in rails.

2.7 FLEXIBLE CONNECTIONS

- A. Flexible duct connections shall be provided where ductwork connects to equipment; ventifabrics or Duro-Dyne 28 ounce minimum waterproof and fire retardant woven glass fabric double coated with neoprene, approved by UL. Maximum length of flexible connections shall be 10 inches.

2.8 MANUAL AND MOTOR OPERATED DAMPERS

- A. American Warming and Ventilating Company Type DAA-P-50, opposed blade, constructed with 15 gauge steel blades. Manual dampers shall be provided with Ventlock No. 637 hand operated locking quadrants located outside of ducts. Locking quadrants shall be elevated 1-1/2" for insulation. Manual dampers 18" x 10" or smaller may be single blade type construction of 16 gauge galvanized sheet metal. Dampers of Ruskin, Krueger, Louvers and Dampers, or Advanced Air, Inc. will be acceptable.

2.9 SPLITTER DAMPERS

- A. Install where shown and at duct splits; provide with Ventlock No. 690 self-locking device; constructed of 16 gauge galvanized steel with hemmed leading edge and reinforced at hinged side.

2.10 GRILLES, REGISTERS AND DIFFUSERS

- A. Grilles, registers and diffusers shall be of the type, size and design as shown on the drawings and/or as specified below. Grilles within the same room or areas shall be of the same type and style to provide architectural uniformity.
- B. Each supply, return and exhaust device shall be of the proper design as indicated to handle quantities of air within the space with maximum diffusion and without objectionable air movement or noise level.
- C. Each supply outlet and register shall have a volume damper control operable from the front of the device with removable key. Where indicated on the drawings, all side wall registers shall be equipped with deflectors.

PART 3 EXECUTION**3.1 DUCTWORK**

- A. All ductwork shall be provided in a neat workmanlike manner. The ducts shall be properly braced and reinforced. All slip joints shall be made in the direction of flow. All ducts shall be true to the dimension indicated and shall be straight and smooth on the inside with neatly finished airtight joints. The ducts shall be securely anchored into the building construction in an approved manner and shall be completely free from vibration under all conditions of operation. All supply, return fresh-air and exhaust systems shall be completely balanced.
- B. No duct transformation shall be of a ratio less than four to one and where possible, shall be of a ratio of six to one. No less than three vertical splitters shall be provided where these ratios cannot be met. No elbow shall have a throat center line radius of less than one and one-half times the duct width at the turn. All turns of less than this amount in rectangular duct shall be provided with duct turning vanes of standard design. Splitters or multi-blade volume dampers, where indicated, shall be provided in all branch.
- C. Turning vanes shall be provided at all tees and square elbows. Turning vanes shall be factory fabricated and designed in accordance with the SMACNA or ASHRAE Guide for formed vanes. The first set of turning vanes on the leaving side of fans shall be of the acoustical type to aid in the elimination of unit noise with the exception of room fan coil units.
- D. Splitter dampers and volume extractors shall be provided in all low velocity ductwork for proper air distribution. Each damper shall be provided, lubricated bearings at both ends of the shafts, adjustments quadrant, and locking devices and shall be constructed of galvanized iron or steel sheet one gauge heavier than the duct in which they are installed. Access doors shall be located at all splitter dampers.
- E. Handholes of not less than 6" x 6" shall be provided at all points where access is required. Manholes of not less than 18" x 24" shall be provided at all points where it is necessary to clean or remove parts of equipment. All access doors and handholes shall be rubber gasketed insulated type with frame and latches.

SECTION 23 30 00 AIR DISTRIBUTION

- F. Install access doors at each fire damper and smoke detector. Label all access doors.
- G. All ductwork must be sealed in accordance with Seal Class C as defined in SMACNA HVAC Duct Construction Standards - Metal and Flexible, 1985.
- H. All joints and seams in ductwork exposed to weather shall be sealed watertight with a suitable non-aging sealer.

3.2 DUCT HANGERS AND SUPPORTS

- A. Duct hangers and supports shall conform to those shown in Tables 4-1 and 4-2 of SMACNA HVAC Ductwork 1985, 1st Edition.

3.3 WALL PENETRATIONS

- A. Where ducts pass through non-rated walls and is exposed to view the duct shall be finished with suitable metal collar.
- B. Where ducts pass through one hour fire walls, provide not less than 1/2" clearance between the duct and combustible material. Seal the clearance space with non-combustible material retained, and the duct secured in place by steel collars of a gauge equivalent to that of the duct and fastened to both the duct and the enclosure.
- C. Where fire dampers are shown or required, dampers shall be installed per manufacturer's UL listing.

3.4 CLEANING DUCT SYSTEMS

- A. Before fan systems are put in operation, vacuum clean inside of air units, plenums and apparatus housing. Filters are to be installed before moving air through duct systems.

END OF SECTION 23 30 00

SECTION 23 64 00 AIR COOLED WATER CHILLERS

PART 1 GENERAL**1.1 SCOPE**

- A. The Provisions of Section 23 05 00 apply to all the work in this section.
- B. The Contractor shall furnish and install air cooled water chillers as shown as scheduled on the contract documents. The chillers shall be installed in accordance with this specification and perform at the specified conditions as scheduled.

1.2 SECTION INCLUDES

- A. Chiller package.
- B. Charge of refrigerant and oil.
- C. Controls and control connections.
- D. Chilled water connections.
- E. Starters.
- F. Electrical power connections.

1.3 REFERENCES

- A. ANSI/ARI 590 - Reciprocating Water - Chilling Packages.
- B. ANSI/ARI 550 - Centrifugal or Rotary Water Chilling Packages.
- C. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.
- D. ANSI/ASHRAE 90A - Energy Conservation in New Building Design.
- E. ANSI/ASME SEC 8 - Boiler and Pressure Vessel Code
- F. ANSI/NEMA MG 1 - Motors and Generators.
- G. ANSI/UL 465 - Central Cooling Air Conditioners.
- H. ANSI/UL 984 - Safety Standard for Hermetic Motor Compressors.
- I. ANSI/AFBMA 9-1978 - Load Ratings and Fatigue Life for Ball Bearings. Bearings must have life of not less than 200,000 hours.
- J. California Administrative Code - Title 24
- K. ASTM B117 - Standard Method of Salt Spray (Fog) Testing
- L. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- M. ASTM A525 - Zinc (Hot-Dip Galvanized) Coatings on Sheet Steel Products
- N. ASTM D1654 - Evaluation of Painted or Coated Specimens, Subjected to Corrosive Environments

1.4 SUBMITTALS

- A. Submit drawings indicating components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate accessories where required for complete system.
- B. Submit product data indicating rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.
- C. Submit manufacturer's installation instructions.

SECTION 23 64 00 AIR COOLED WATER CHILLERS

1.5 REGULATORY REQUIREMENTS

- A. Conform to ANSI/ARI 590 code for testing and rating of reciprocating water chillers or conform to ANSI/ARI 550 code for testing and rating of centrifugal and rotary chillers.
- B. Conform to ANSI/UL 465 code for construction of water chillers and provide UL label. In the event the unit is not UL approved, the manufacturer shall, at his expense, provide for a field inspection by an UL representative to verify conformance to UL standards. If necessary, contractor shall perform modifications to the unit to comply with UL, as directed by the UL representative.
- C. Conform to ANSI/ASME SEC 8 Boiler and Pressure Vessel Code for construction and testing of water chillers.
- D. Conform to ANSI/ASHRAE 15 code for construction and operation of water chillers.

1.6 STORAGE AND HANDLING

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Protect units from physical damage. Factory coil shipping covers shall be kept in place until installation.

1.7 WARRANTY

- A. Provide a five year warranty on parts, labor and refrigerant. Warranty begins at beneficial occupancy.

PART 2 PRODUCTS**2.1 APPROVED MANUFACTURES**

- A. Trane
- B. Carrier
- C. Daikin
- D. Substitutions: Prior approval required as indicated under the general and/or supplemental conditions of these specifications.

2.2 GENERAL UNIT DESCRIPTION

- A. Provide factory assembled and tested outdoor air cooled liquid chillers consisting of scroll or helical rotary compressors, condenser, evaporator, thermal or electronic expansion valve, refrigeration accessories, starter, and control panel. Construction and ratings shall be in accordance with ANSI/ARI 550 or ANSI/ARI 590.

2.3 COMPRESSORS

- A. Construct semi-hermetic scroll/helical rotary screw compressors with heat treated forged steel or ductile iron shafts, aluminum alloy connecting rods, automotive type pistons, rings to prevent gas leakage, discharge valves, and sealing surface immersed in oil. Rotors shall be of high grade steel alloy.
- B. Statically and dynamically balance rotating parts.
- C. Provide oil pump lubrication system with oil charging valve and oil filter to ensure adequate lubrication during starting, stopping, and normal operation.
- D. Provide compressor with automatic capacity reduction equipment consisting of suction valve unloaders or capacity control slide valve (rotary). Use lifting mechanism operated by solenoid valve. Compressor must start unloaded for soft start on motors.
- E. Provide constant speed rpm compressor motor, suction gas cooled with solid state sensor and electronic winding overheating protection, designed for across-the-line or star delta starting. Furnish with starter.
- F. Provide crankcase heater to evaporate refrigerant returning to crankcase during shut down. Energize heater when compressor is not operating.

SECTION 23 64 00 AIR COOLED WATER CHILLERS

2.4 EVAPORATOR

- A. Provide a brazed plate heat exchanger.
- B. Design, test, and stamp refrigerant side for 300 psig (2068 kPa) working pressure and water side for 215 psig (1482 kPa) working pressure, in accordance with ANSI/ASME SEC 8.
- C. Insulate with 0.75 inch minimum thick flexible elastomeric rubber closed cell insulation with maximum K value of 0.26. Provide heat tape to protect evaporator to -20 degrees F.
- D. Provide water drain connection, vent and fittings for factory installed leaving water temperature control and low temperature cutout sensors.
- E. Water connections shall be victaulic.
- F. Low ambient temperature protection: Ambient freeze temperature down to 0°F.

2.5 CONDENSER AND FANS

- A. Construct condenser coils microchannel. Provide sub-cooling circuits. Air test under water to 506 psig (3488kPa).
- B. Provide vertical discharge direct driven propeller type condenser fans with fan guard on discharge. Entire fan assembly shall be statically and dynamically balanced and fan assembly shall be either painted or zinc coated steel. Fan guard shall be either PVC, chrome or zinc coated.
- C. Provide fan motors with permanently lubricated ball bearings and built-in thermal overload protection.

2.6 ENCLOSURES

- A. House components in 12 gauge galvanized steel frame and mounted on welded structural steel base. Hot-dip galvanized steel frame coating shall be Underwriters laboratories Inc. (UL) recognized as G90-U, UL guide number DTHW2.
- B. Unit panels, and control panels shall be finished with a baked on powder paint. Paint system shall meet the requirements for outdoor equipment of Federal Government Agencies.
- C. Mount starters with full opening access doors.
- D. Condenser coils shall be protected with ½" steel painted louvered panels covering the complete condensing coil. Guards shall provide coil protection from outside objects and louvered profile for coils. Access guard shall be maximum 4" square heavy wire mesh covers the service area beneath the condenser coils protecting the unit components from outside access.

2.7 REFRIGERANT CIRCUIT

- A. All units shall have 2 independent refrigeration circuits, each with a separate single compressor for standby operation. No manifolded compressors will be accepted.
- B. Provide for each refrigerant circuit:
 - 1. Liquid line shutoff valve.
 - 2. Filter dryer (replaceable core type).
 - 3. Liquid line sight glass and moisture indicator.
 - 4. Electronic or thermal expansion valve sized for maximum operating pressure.
 - 5. Charging valve.
 - 6. Discharge and oil line check valve.
 - 7. Compressor discharge service valve.
 - 8. High side pressure relief valve.
 - 9. Full operating charge of refrigerant and oil.
 - 10. Unit factory leak tested at 200 psig.
- C. Capacity Modulation: Provide capacity modulation by either slide valve or unloader valves. Unit shall be capable of operation down to 10 %. In the event a manufacturer can not provide unit with modulation down to 10% Hot Gas Bypass must be provided.

SECTION 23 64 00 AIR COOLED WATER CHILLERS**2.8 CONTROLS**

- A. On chiller, mount weatherproof control panel, containing starters, power and control wiring, factory wired with terminal block power connection. Provide primary and secondary fused control power transformer and a single 115 volt single phase connection for evaporator heat tape.
- B. Provide wye-delta starter.
- C. Provide the following safety controls with indicating lights or diagnostic readouts.
 - 1. Low chilled water temperature protection.
 - 2. High refrigerant pressure - each compressor.
 - 3. Low oil flow protection- each compressor.
 - 4. Loss of chilled water flow.
 - 5. Contact for remote mounted emergency shut-down.
 - 6. Loss of refrigerant charge protection.
 - 7. Motor current and motor temperature overload.
 - 8. Phase reversal/unbalance/single phasing (30% current imbalance threshold)
 - 9. Over/under voltage.
 - 10. Failure of water temperature sensor used by controller.
- D. Provide the following operating controls:
 - 1. 8 or more step leaving chilled water temperature controller which cycles compressors and activates cylinder unloaders or slide valve based on PI algorithms. If manufacturer is unable to provide at least 8 steps of unloading providing hot gas by pass shall be required.
 - 2. Five minute solid state anti-recycle timer to prevent compressor from short cycling. If 10 minute solid state anti recycle timer is provided, hot gas bypass shall be provided to insure accurate temperature control in light load applications.
 - 3. Load limit thermostat to limit compressor loading on high return water temperature to prevent nuisance tripouts.
 - 4. Low ambient controls for operation down to 15 degrees F or lower.
 - 5. High ambient unloader pressurestat that unloads compressors to keep head pressure under control and help prevent high pressure nuisance tripouts on days when outside ambient is above design.
 - 6. Compressor current sensing unloader unit that unloads compressors to help prevent current overload nuisance tripouts.
 - 7. Auto lead lag functions that constantly evens out running hours and compressor starts automatically. If contractor can not provide this function then cycle counter and hour meter shall be provided so owner can be instructed by the contractor on how to manually change lead lag on compressors and even out compressor starts and running hours.
 - 8. Condenser fan sequencing which automatically cycles fans in response to ambient and expansion valve pressure differential thereby optimizing unit efficiency.
 - 9. Chiller shall have automatic restart/reset after voltage sag/interruption.
- E. Provide pre-piped gauge board with pressure gauges for suction and discharge refrigerant pressures or digital display of pressures on microprocessor.
- F. Provide ammeters for each compressor or digital display of % RLA on microprocessor.
- G. Provide remote mounted alarm and display panel with a minimum of the following features:
 - 1. Leaving chiller water temperature setpoint adjustment
 - 2. Display diagnostics
 - 3. Display ambient, entering and leaving water temperatures.
 - 4. Display active chilled water setpoint.
 - 5. Display parts failures:
 - a. Water temperature and ambient temperature sensors
 - b. Motor contactors
 - c. Unit Controller
 - d. Condenser and evaporator refrigerant temperature sensors.
- H. BAS interface – Modbus RTU, BACNET, Lonworks capability.

PART 3 EXECUTION**3.1 INSTALLATION**

SECTION 23 64 00 AIR COOLED WATER CHILLERS

- A. Install in accordance with manufacturer's instructions.
- B. Align chiller package on steel or concrete foundations.
- C. Install units on vibration isolators.
- D. Connect to electrical service.
- E. Connect to chilled water piping.
- F. Arrange piping for easy dismantling to permit tube cleaning.
- G. Provide flexible connections at each chiller.

3.2 MANUFACTURER'S FIELD SERVICES

- A. Supply service of factory trained representative for a period of 3 days to supervise testing, dehydration and charging of machine, start-up, and instruction on operation and maintenance to Owner.
- B. Supply initial charge of refrigerant and oil.

END OF SECTION 23 64 00

SECTION 23 73 13 MODULAR AIR HANDLING UNITS**PART 1 GENERAL****1.1 SCOPE**

- A. The provisions of Section 23 05 00 apply to all the work in this Section.
- B. Furnish and install air handling units as required to provide a complete and satisfactory job. Unit shall replace existing unit. Reconnect to existing piping, ductwork, electrical, etc. as required for unit operation. Provide new piping specialties per coil piping detail shown on the drawings.

1.2 SUBMITTALS

- A. Submit the following in accordance with Section 23 05 00.
 - 1. Manufacturer's cuts.
 - 2. Certified capacity ratings.
 - 3. Installation instructions.
 - 4. Operating and Maintenance Instructions.

PART 2 PRODUCTS**2.1 GENERAL**

- A. Any exceptions to the specifications must be clearly defined. The contractor shall be responsible for any additional expenses that may occur due to any exception made.
- B. Fabricate air handling units suitable for the scheduled air pressure operation.
- C. Fabricate units with fan section, coil section, mixing box, filter section, access sections.
- D. Factory fabricate and test air handling units of sizes, capacities, and configuration as indicated and specified. Units shall be fully assembled [on 6 inch base rail/housekeeping pad] up to practical shipping limitations. On units not shipped fully assembled, manufacturer shall tag each section to indicate location in direction of airflow to facilitate assembly at the job site.

2.2 CASING

- A. Construct unit casing exterior panels of minimum 18 gauge galvanized steel. Unit shall be designed and constructed such that all exterior panels are non-load bearing. Removal of all exterior panels shall not affect the structural integrity of the unit. Units with welds on exterior surfaces or welds that have burned through from interior welds shall receive a final shop coat of zinc-rich protective paint in manufacturer's standard color.
- B. Insulate all sections handling conditioned air with 1" thick 1 1/2 lb. per cubic ft. density matt faced fiberglass. Install insulation with adhesive. If edges of fiberglass insulation are exposed, the contractor shall be responsible for sealing exposed edges with mastic sealer to prevent erosion into the airstream. Insulation, adhesive, and mastic sealer (if required) shall conform to NFPA 90A.
- C. As required for routine service access, unit shall be supplied with full height, galvanized, double wall, hinged, removable access doors. Access door shall have a full perimeter automotive type gasket to prevent air leakage, and Ventlock style handle that can be opened from unit interior.
- D. Units shall have internal motor and drives and shall be provided with a full size removable service door on the drive side of the fan(s). Doors shall be constructed per Section 2.03 C. If unit is provided with external motor, unit shall include a totally enclosed belt guard over drive components to prevent possible injury. Belt guard shall be provided with tachometer holes to facilitate RPM readings of the fan.
- E. On units provided with cooling coils, the drain pan shall extend under the complete coil section. (On horizontal draw-through units, a drain pan shall also be provided under the complete supply fan section.) Drain connections shall be provided on both sides of each drain pan provided. All drain pans shall be of sealed double wall galvanized construction with the manufacturer's standard insulation sandwiched between the pan layers.

2.3 FANS

- A. Provide supply fan section(s) with FC (BI) double width, double inlet centrifugal fan designed and suitable for class of service indicated in the unit schedule. Fan shaft to be properly sized and protectively coated with lubricating oil. Fan

SECTION 23 73 13 MODULAR AIR HANDLING UNITS

shafts shall be solid and properly designed so that fan shaft does not pass through first critical speed as unit comes up to rated RPM. Fans shall be statically and dynamically tested as an assembly at the required RPM to meet design specifications. Fan wheel shall be properly secured to shaft to prevent slippage.

- B. Provide self-aligning, grease lubricated pillow-block ball bearings with lubrication fittings. Provide extended grease lines to drive side of unit casing, for all fan bearings, rigidly attached for easy service access. If extended grease lines are not provided, unit shall include an opposite drive side access door and service room must be allowed on the opposite side of the unit to perform regular maintenance. All bearings shall perform to L-50 200,000 hour average life.
- C. Fan shall be internally isolated with 2" spring isolators. If unit requires external isolation, the contractor shall be responsible for isolating the entire unit including the duct work and piping at the manufacturer's specified load points.
- D. Inlet vanes for FC fans shall be operated by an aluminum center rotating ball bearing hub located out of fan inlet. Inlet vanes shall be 14- gauge steel, welded to the vane rods and shall be plated to prevent corrosion. They shall be formed to fit the circumference of the inlet orifice of the fan housing. Vane blades that are not welded to vane rods will not be acceptable. Inlet vane rods shall be offset for rotation out of the fan housing inlet when open.
- E. Inlet vanes for BI fans 20-inches and larger shall be operated by a steel center, roller bearing, direct link hub. Inlet vanes shall be 14-gauge galvanized steel, rotated about the vane rods, and have edges formed to fit the circumference of the inlet cone. For BI fans 18" and smaller, provide external inlet vanes with a peripheral drive. Pneumatic inlet vane actuator shall be furnished and mounted by manufacturer at the factory.

2.4 MOTORS AND DRIVES

- A. Fan motors to be mounted and isolated on the same integral base as the fan.
- B. Fan Motors shall be heavy duty, open drip-proof to operable at 460 Volts, 60 Hz, 3-phase.
- C. V-Belt Drive shall be variable pitch rated at 1.5 times the motor nameplate.

2.5 COILS

- A. Coils shall be manufactured by the same company as the supplier of the air handling unit. Coils shall be designed with aluminum plate fins and copper tubes.
- B. Fins shall have collars drawn, belled and firmly bonded to the tubes by means of mechanical expansion of the tubes. No soldering or tinning shall be used in the bonding process. Coils shall be mounted in the unit casing to be accessible for service and can be removed from the unit either through the side or top. Capacities, pressure drops and selection procedure shall be certified in accordance with ARI Standard 410.
- C. Water Coils:
 - 1. All coils shall be enclosed in an insulated coil section. Coil headers and U-bends shall not be exposed.
 - 2. Waterflow shall be counter to airflow.
 - 3. Coils shall be proof tested to 300 psig and leak tested to 200 psig air pressure under water.
 - 4. Headers shall be cast iron. Steel pipe headers are not acceptable.

2.6 DAMPERS

- A. Provide internally mounted outside air, return air dampers. Dampers to be Ruskin CD60 or equivalent. Dampers shall be of airfoil design and galvanized construction; they shall be either parallel or opposed blade type with metal compressible jamb seals and extruded vinyl blade edge seals on all blades. Blades shall rotate on stainless steel sleeve bearings. Maximum damper blade length shall be 60 inches. Leakage rate shall not exceed 8 cfm/ square foot at one inch Wg and 12 cfm/square foot at 4 inches Wg. Pneumatic damper operators shall be furnished and mounted by manufacturer at the factory.
- B. Multi-zone damper blades to be airfoil blade type. Dampers shall have metal compressible jamb seals and extruded vinyl blade edge seals. Dampers shall rotate on stainless steel bearings. Leakage rate shall not exceed 8 cfm/square foot at in inch Wg. Electronic damper operators shall be furnished and mounted by the manufacturer at the factory.

2.7 FILTERS

- A. Provide filter rack of galvanized steel with filter guides and blockoffs as required to prevent air bypass. Access to filters shall be side access for easy filter service.

SECTION 23 73 13 MODULAR AIR HANDLING UNITS

- B. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction.
- C. Provide flat 2 inch deep [throwaway] [replaceable media filters on aluminum frames] in the prefilter position. Filter face velocity shall not exceed 500 feet per minute.

2.8 ACCESS SECTIONS

- A. Access sections shall be supplied as shown on the plans between unit sections. Access doors shall be provided on both sides of sections.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Unit shall be installed in accordance with the manufacturer's recommendations.
- B. Unit shall be installed in fully accessible locations.

END OF SECTION 23 73 13

SECTION 23 74 01 PACKAGED AIR CONDITIONING UNIT WITH GAS HEAT**PART 1 GENERAL****1.1 SCOPE**

- A. The provisions of Section 23 05 00 apply to all the work in this Section.
- B. Furnish and install packaged air conditioning units with gas heat as required to provide a complete and satisfactorily job. Scope includes removal of existing unit and replacement with new. Make all necessary modifications to duct, electrical, gas piping connections, concrete pad, etc. as required for new installation.

1.2 SUBMITTALS

- A. Submit the following in accordance with Section 23 05 00.
 - 1. Manufacturer's Cuts.
 - 2. Certified Capacity Ratings.
 - 3. Installation Instructions.
 - 4. Operating and Maintenance Instructions.

PART 2 PRODUCTS**2.1 PACKAGED AIR CONDITIONING UNITS**

- A. Unit shall be a one-piece air cooled electric cooling, gas heating unit and shall be mounted on grade.
- B. Unit compressor(s) shall be serviceable semi-hermetic or welded fully hermetic with crankcase heater(s) and suitable vibration isolators. Compressor shall be of the same manufacturer as unit and shall have a 5 year warranty.
- C. Coils: Indoor and outdoor coils shall be of nonferrous construction with aluminum plate fins mechanically bonded to seamless copper tubes with all joints brazed.
- D. Unit shall have 1" permanent washable filters.
- E. Fans and Motors: Indoor blowers shall be forward curved, centrifugal, belt driven type. Motor pulley shall be adjustable pitch. Indoor blower shall have permanently lubricated bearings. Outdoor fans shall be of the propeller type, with direct driven permanently lubricated motor. Outdoor fans shall discharge upward.
- F. Unit cabinet shall be constructed of galvanized steel, bonderized and coated with a baked enamel finish. Cabinet interior shall be insulated with 1" thick neoprene coated fiberglass. Cabinet panels shall be easily removable for service to all operating components. A condensate drain for the indoor coil shall be provided.
- G. Controls: The cooling system shall be protected with high pressure static low pressurestats, loss of charge protection, indoor coil frezestats, and current and temperature sensitive overload devices. Each of the devices shall be wired to prevent compressor restart until reset at the thermostat (or unit circuit breaker).
- H. Heat exchanger shall be tubular in design and constructed of corrosion resistance aluminized steel. Heat exchanger shall carry a 5 year warranty and an extended 10 year warranty at additional cost. Burners shall be constructed of aluminum painted cold rolled steel and be of the in shot type.
- I. Heating controls shall consist of a redundant gas valve, intermittent, pilot ignition, remote pilot flame sensor, indoor fan relay, limit switches and centrifugal switch.
- J. Unit electrical connections. Cabinet shall contain suitable openings for routing of all utility connections. The base unit shall contain a terminal strip in the control compartment to allow for terminal connection of room thermostat and field installed accessories.
- K. Roof curb shall be of the same manufacturer as unit and shall include an insulated panel under compressor section to prevent condensation forming on the bottom. Dimensions shall be provided to allow for easy duct location and connection to roof curb prior to unit placement. Curb design shall comply with National Roofing Contractors Association requirements.
- L. Provide circuit to prevent compressor short cycling as a result of a rapid change in thermostat setting. Also, automatically prevents compressor restart for at least 5 minutes after shutdown.

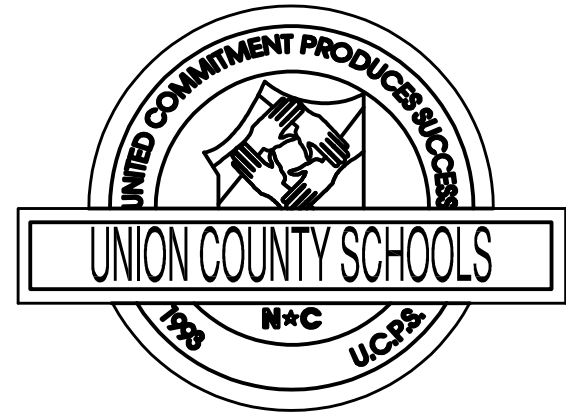
PART 3 EXECUTION

SECTION 23 74 01 PACKAGED AIR CONDITIONING UNIT WITH GAS HEAT

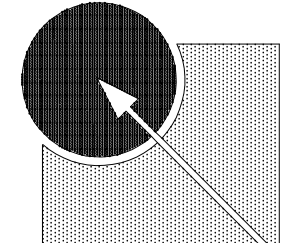
3.1 INSTALLATION

- A. Unit shall be installed in accordance with the manufacturer's recommendations.
- B. Unit shall be installed in fully accessible locations.

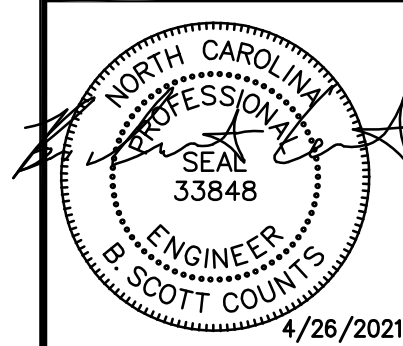
END OF SECTION 23 74 01



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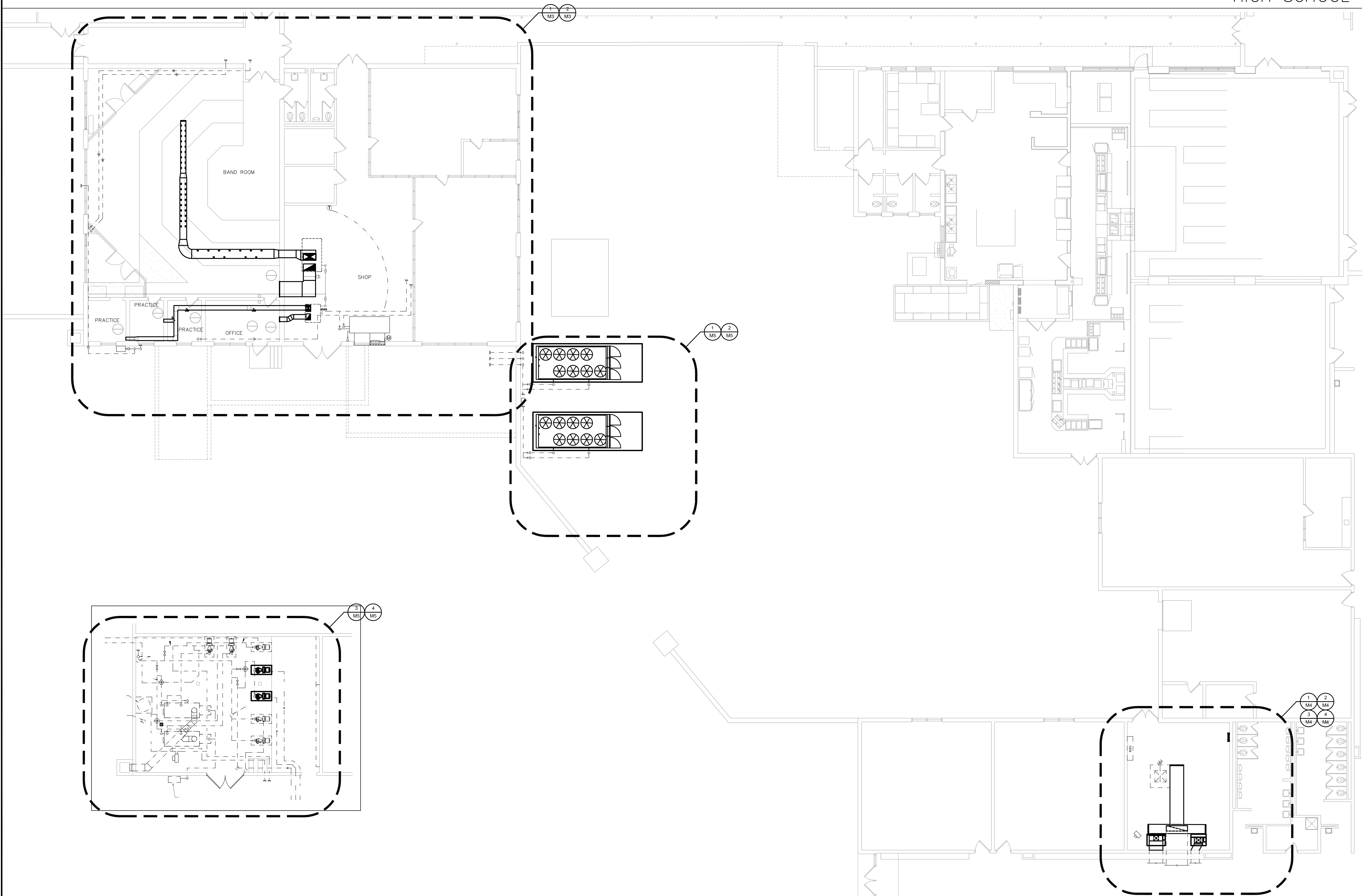


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DATE	4/26/2021		

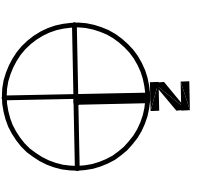
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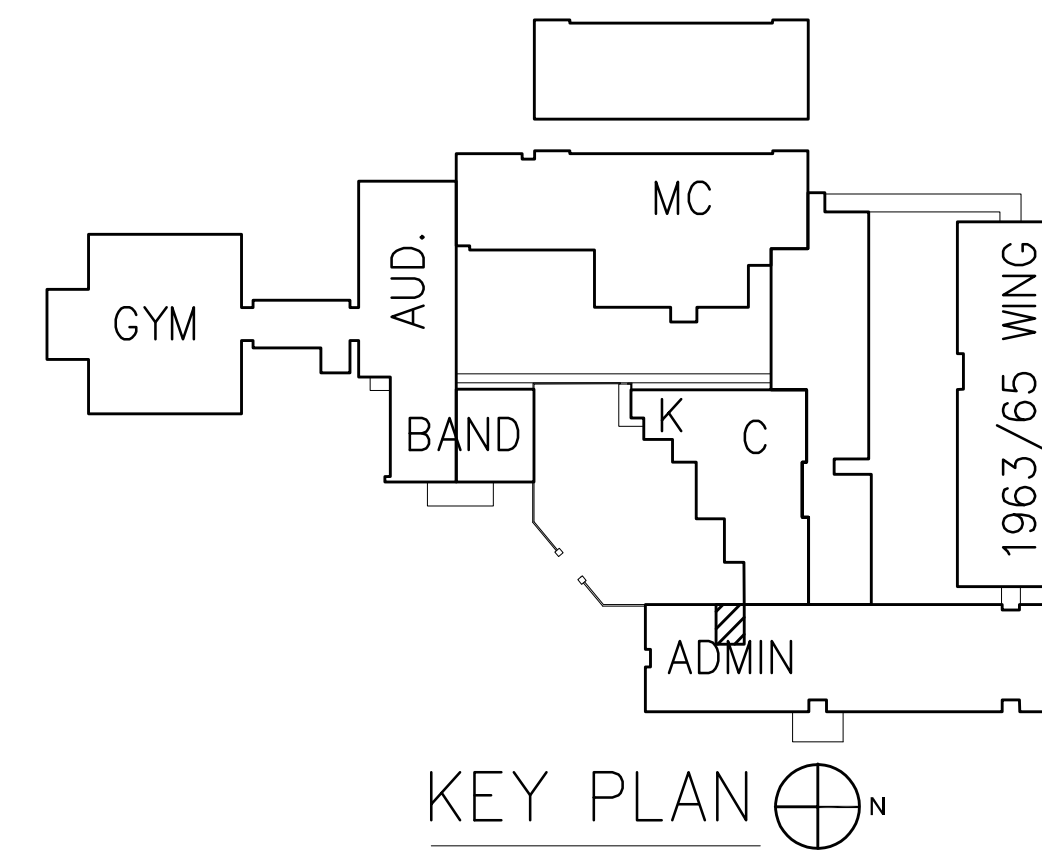
MECHANICAL OVERALL PLAN

SHEET
M2
2 OF 7



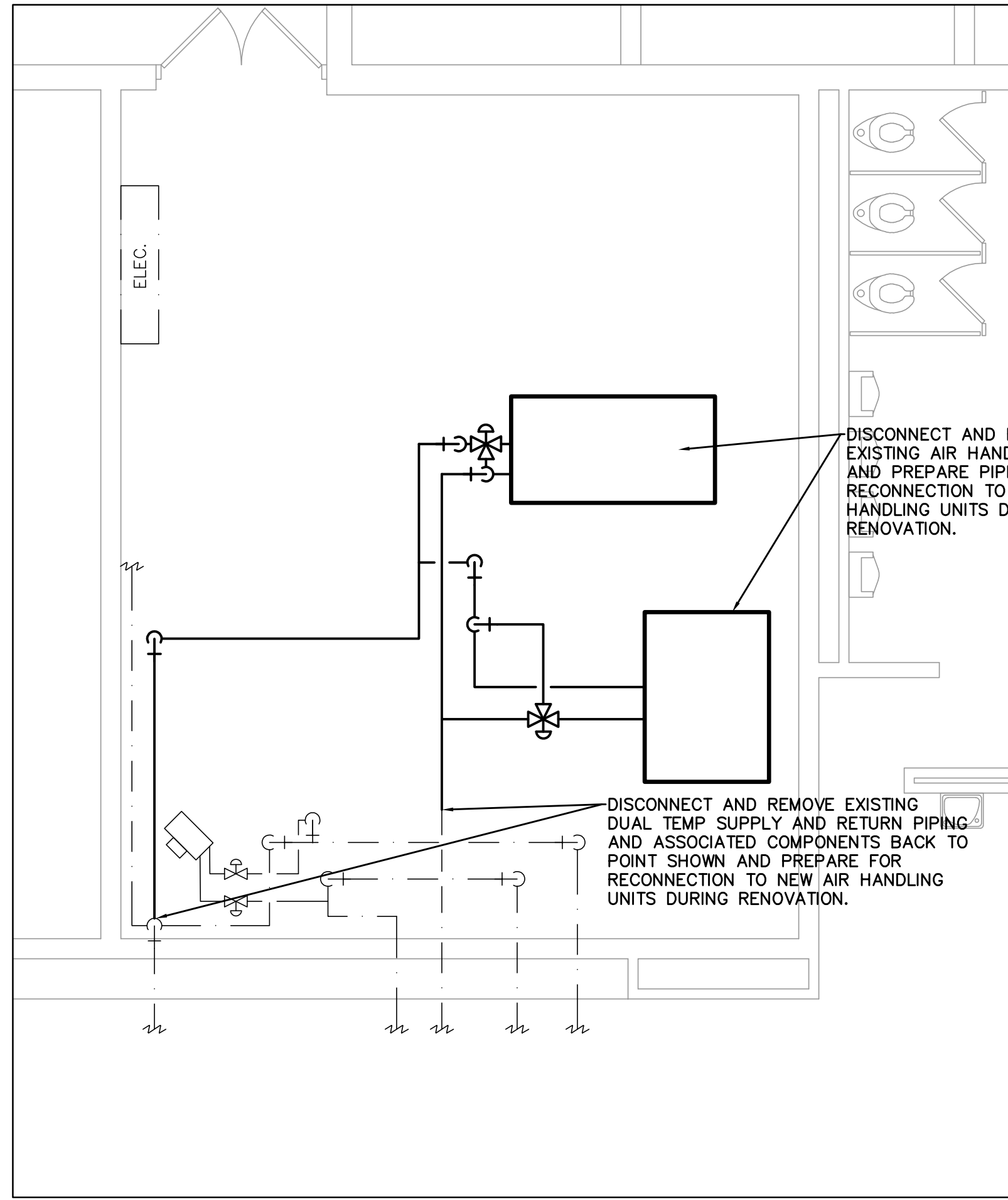
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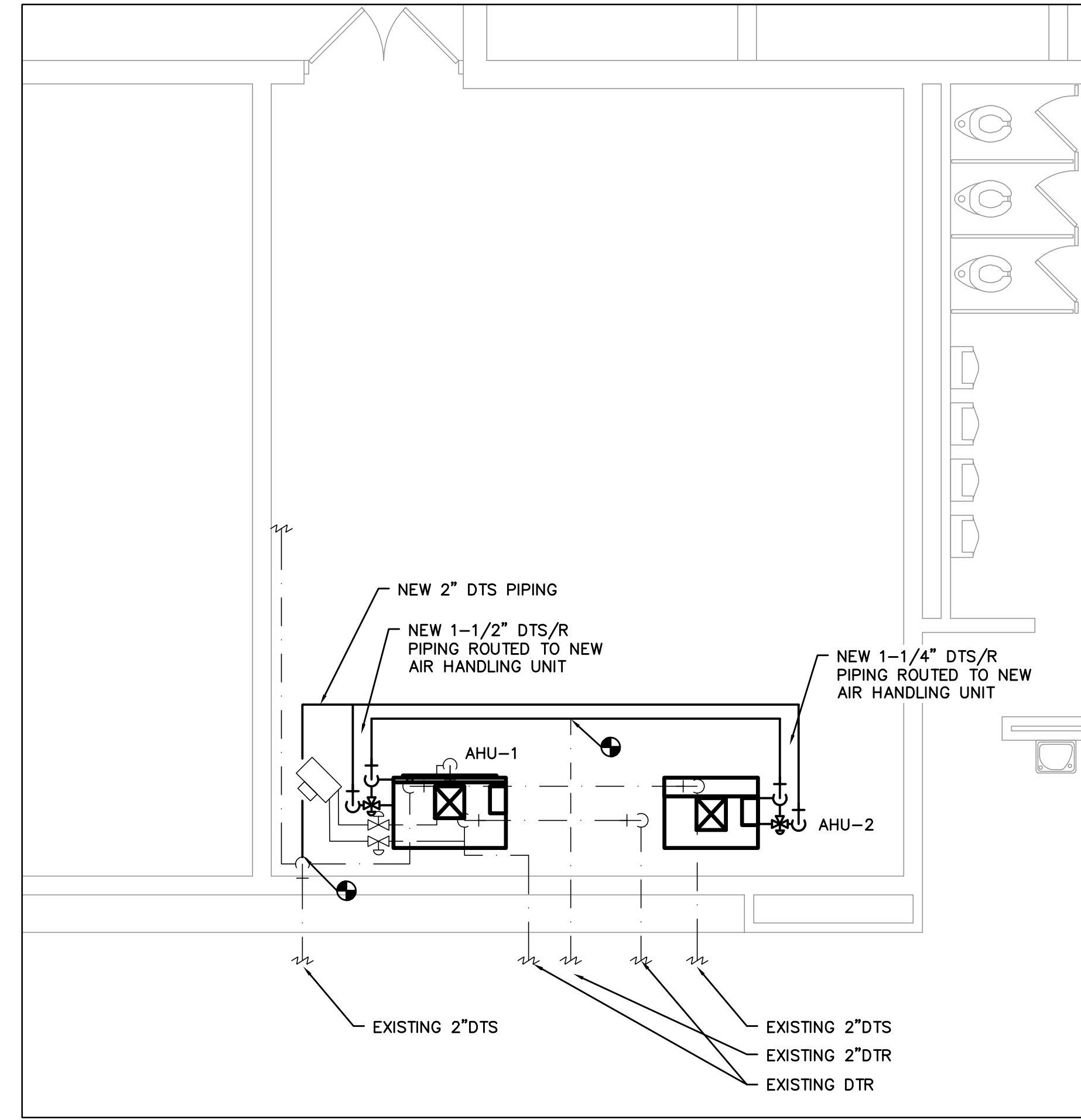


RENOVATION LEGEND	
	NEW EQUIPMENT
	EXISTING
	EXISTING RELOCATED
	EXISTING THERMOSTAT
	CONNECT TO EXISTING

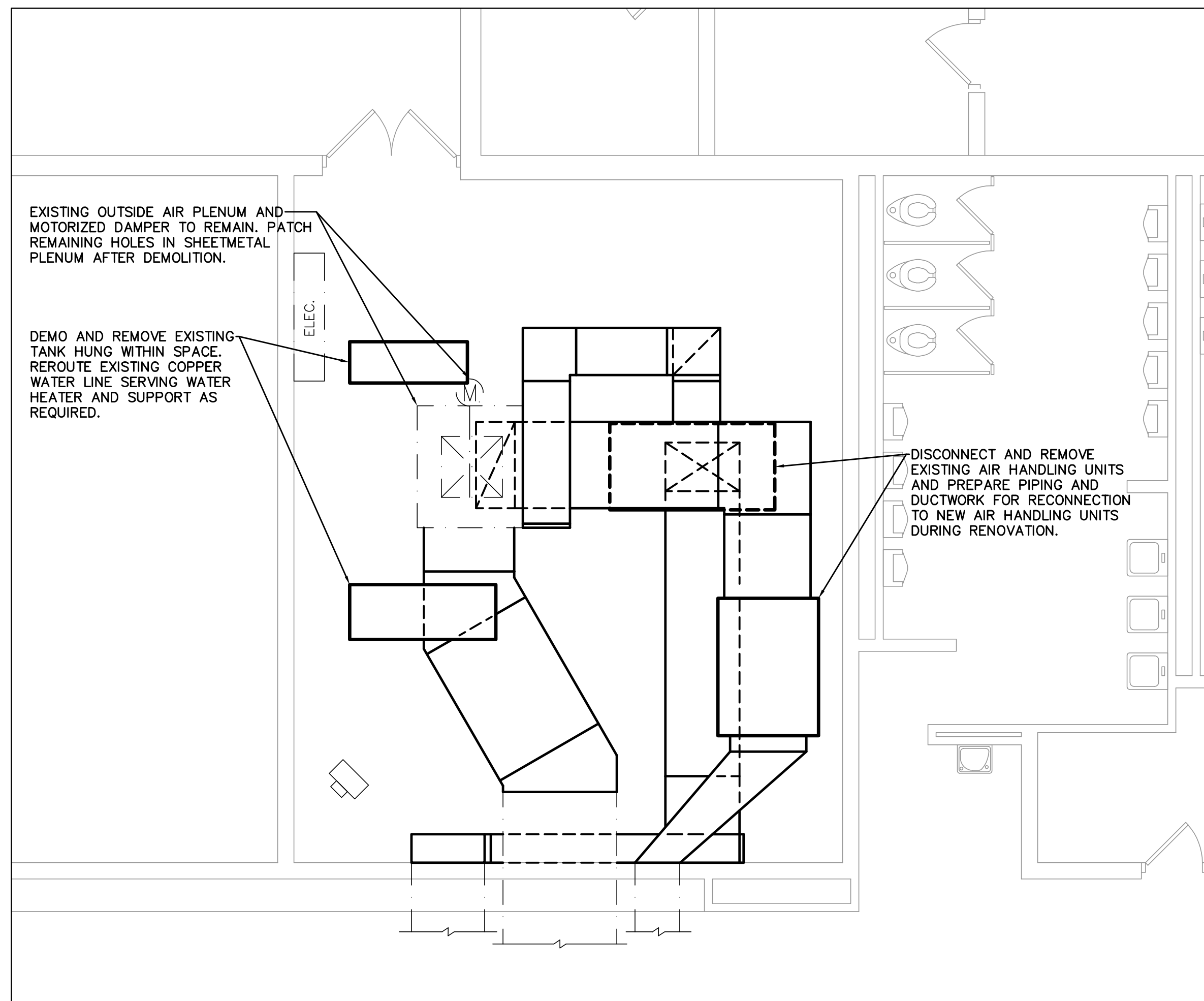
MECHANICAL EQUIPMENT LEGEND	
SYMBOL	DESCRIPTION
LOW PRESSURE DUCTWORK	
	DUCT SECTION—1ST FIGURE WIDTH, 2ND DEPTH
	SQUARE TO ROUND TRANS.
	FLEX DUCTWORK
	ELBOW W/TURNING VANES
	LONG RADIUS ELBOW
	EXHAUST DUCT SECTION
	SUPPLY DUCT SECTION
	RETURN/RELIEF AIR DUCT SECTION
	CONICAL DUCT TAKE-OFF
	FIRE DAMPER "A" OR "B"
MISCELLANEOUS	
	THERMOSTAT (EXISTING)
	DAMPER
	TIE INTO EXISTING AT THIS POINT



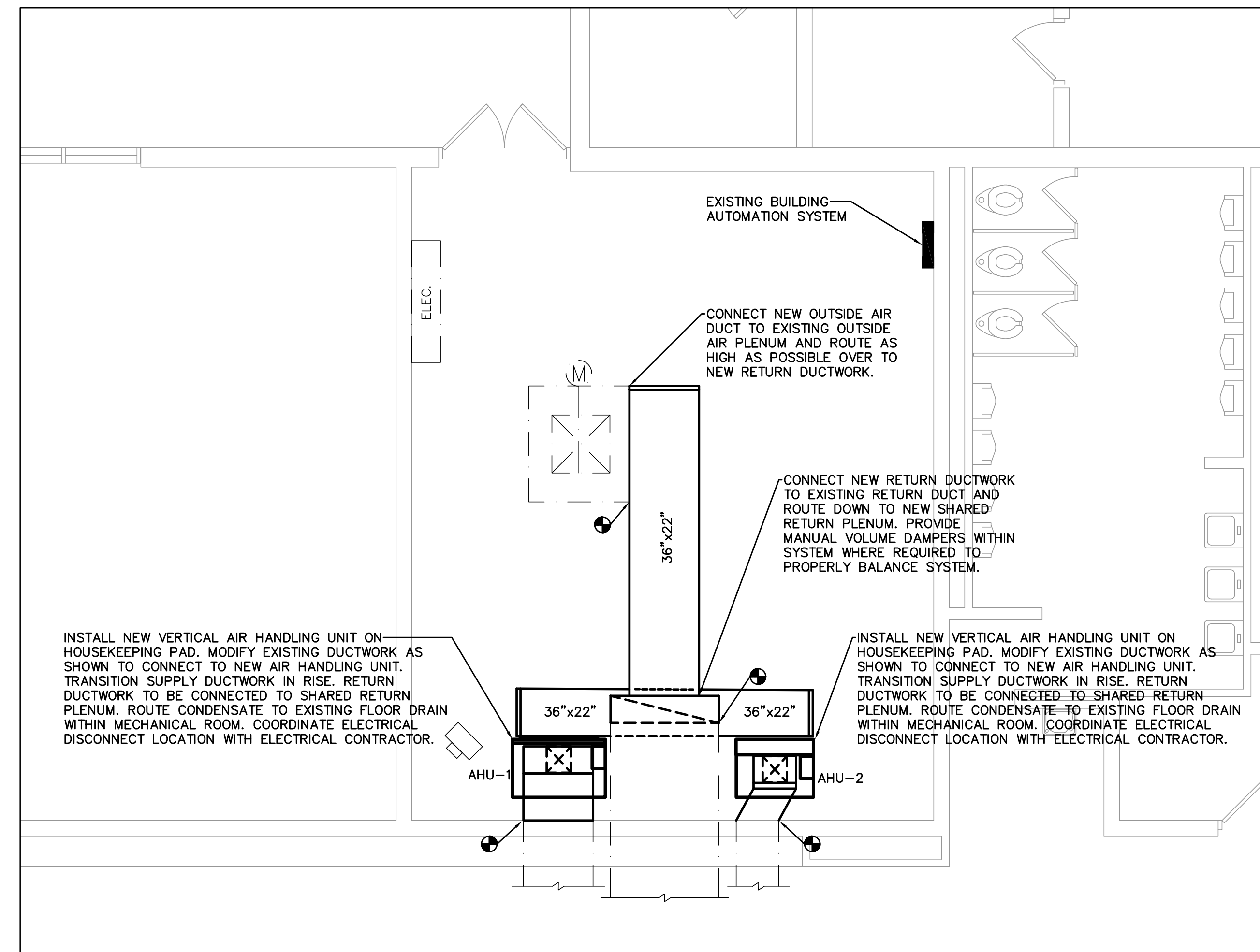
3 ADMIN MECH. RM. PIPING DEMOLITION PLAN
1/4"=1'-0"



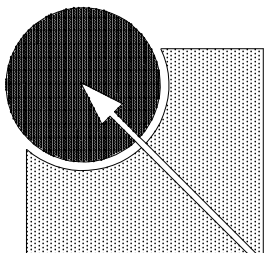
4 ADMIN MECH. RM. PIPING RENOVATION PLAN
1/4"=1'-0"



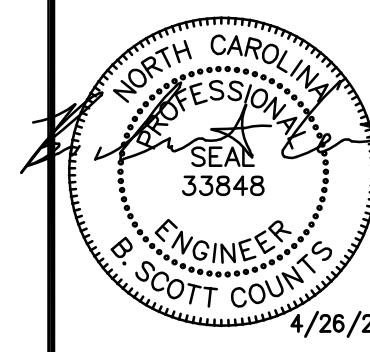
1 ADMIN MECH. RM. DUCTWORK DEMOLITION PLAN
1/4"=1'-0"



2 ADMIN MECH. RM. DUCTWORK RENOVATION PLAN
1/4"=1'-0"



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JOB NUMBER 21-054
JOB TITLE
SHEET TITLE

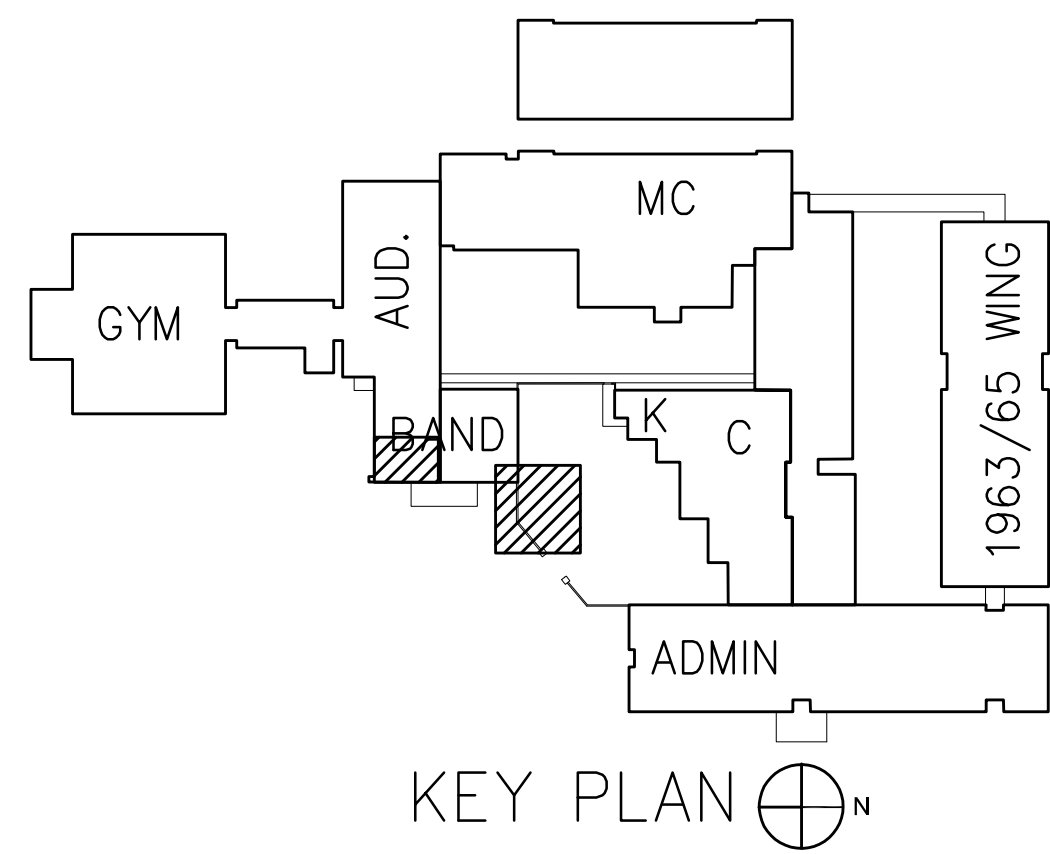
REVISION DATES
21-054
BSC
JOC
4/26/2021

MONROE HIGH SCHOOL
CIP - HVAC IMPROVEMENTS
MECHANICAL ENLARGED PLANS
MECHANICAL ROOM

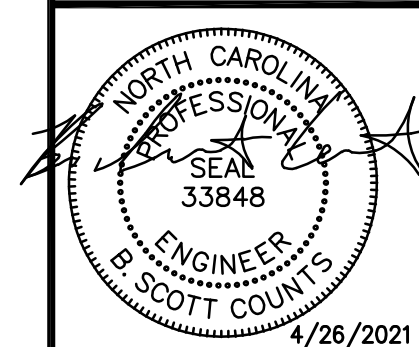
SHEET
M4
4 OF 7

RENOVATION LEGEND	
	NEW EQUIPMENT
	EXISTING
	EXISTING RELOCATED
	EXISTING THERMOSTAT
	CONNECT TO EXISTING

MECHANICAL EQUIPMENT LEGEND	
SYMBOL	DESCRIPTION
SINGLE LINE	DOUBLE LINE
LOW PRESSURE DUCTWORK	
	DUCT SECTION—1ST FIGURE WIDTH, 2ND DEPTH
	SQUARE TO ROUND TRANS.
	FLEX DUCTWORK
	ELBOW W/TURNING VANES
	LONG RADIUS ELBOW
	EXHAUST DUCT SECTION
	SUPPLY DUCT SECTION
	RETURN/RELIEF AIR DUCT SECTION
	CONICAL DUCT TAKE-OFF
	FIRE DAMPER "A" OR "B"
MISCELLANEOUS	
	THERMOSTAT (EXISTING)
	DAMPER
	TIE INTO EXISTING AT THIS POINT



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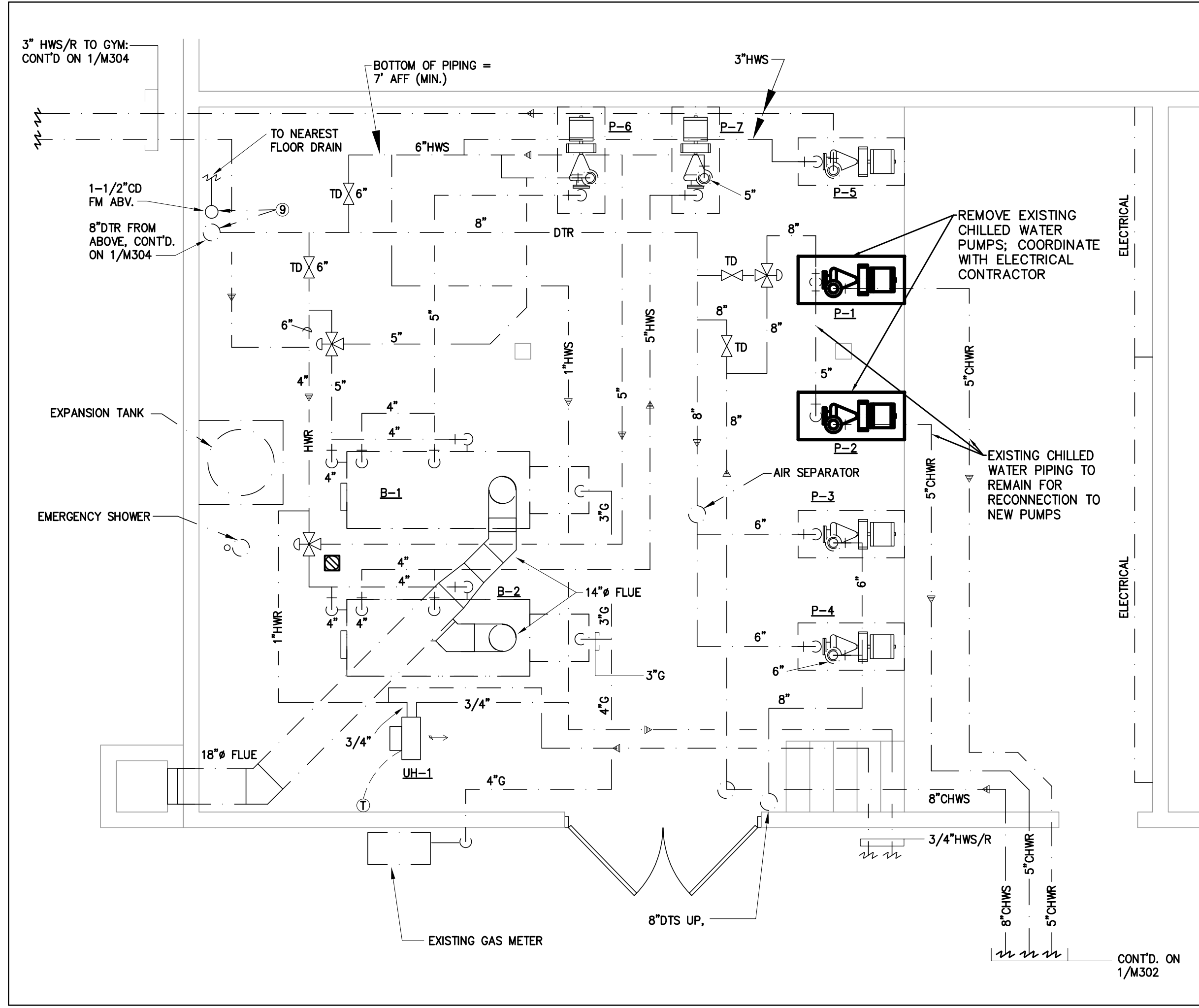
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REVISION DATES

DESIGN BY	BSC
CHECKED BY	JOC
DATE	4/28/2021

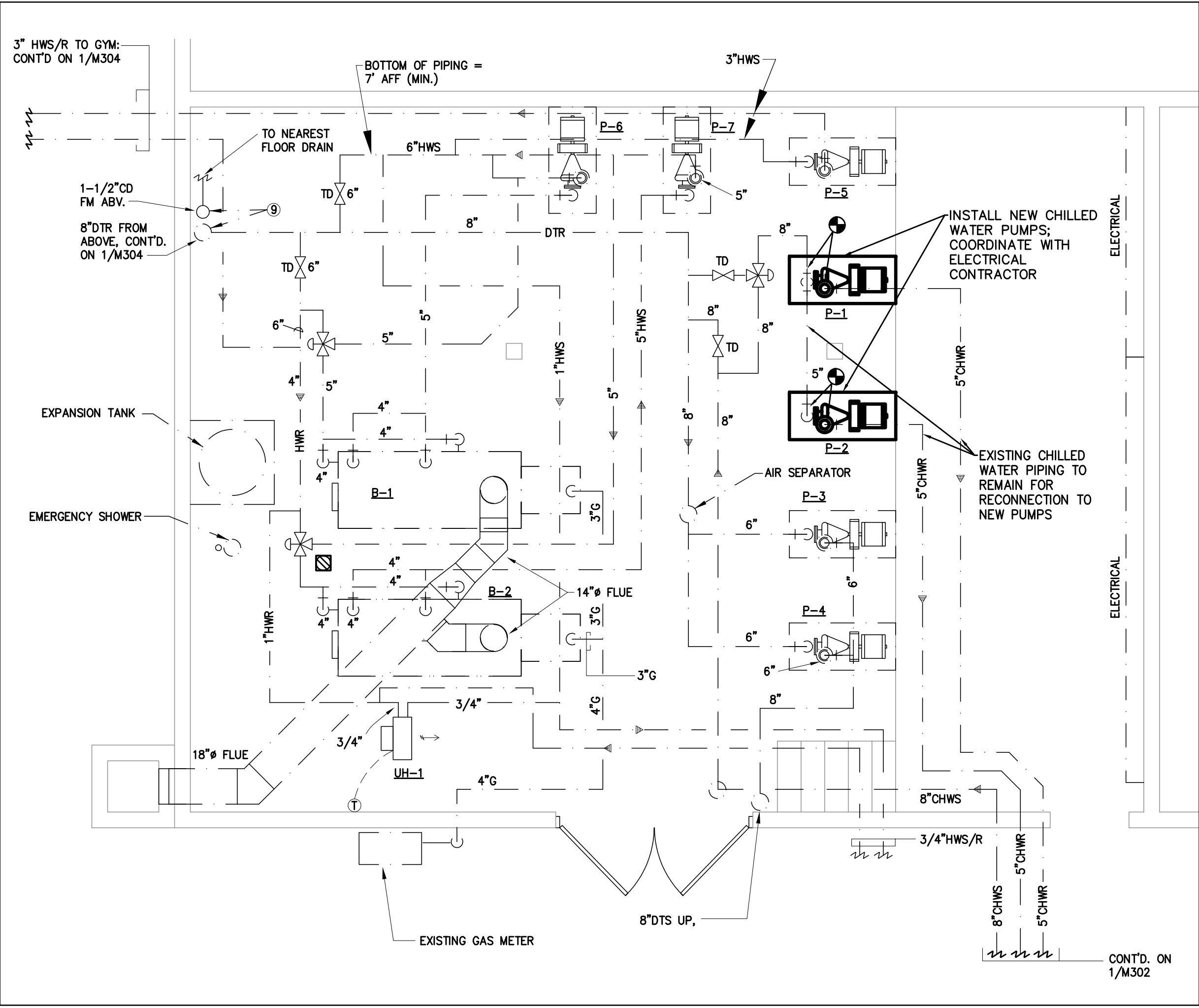
JOB TITLE
MONROE HIGH SCHOOL
CIP - HVAC IMPROVEMENTS

SHEET TITLE
MECHANICAL ENLARGED PLANS
CHILLERS & PUMPS

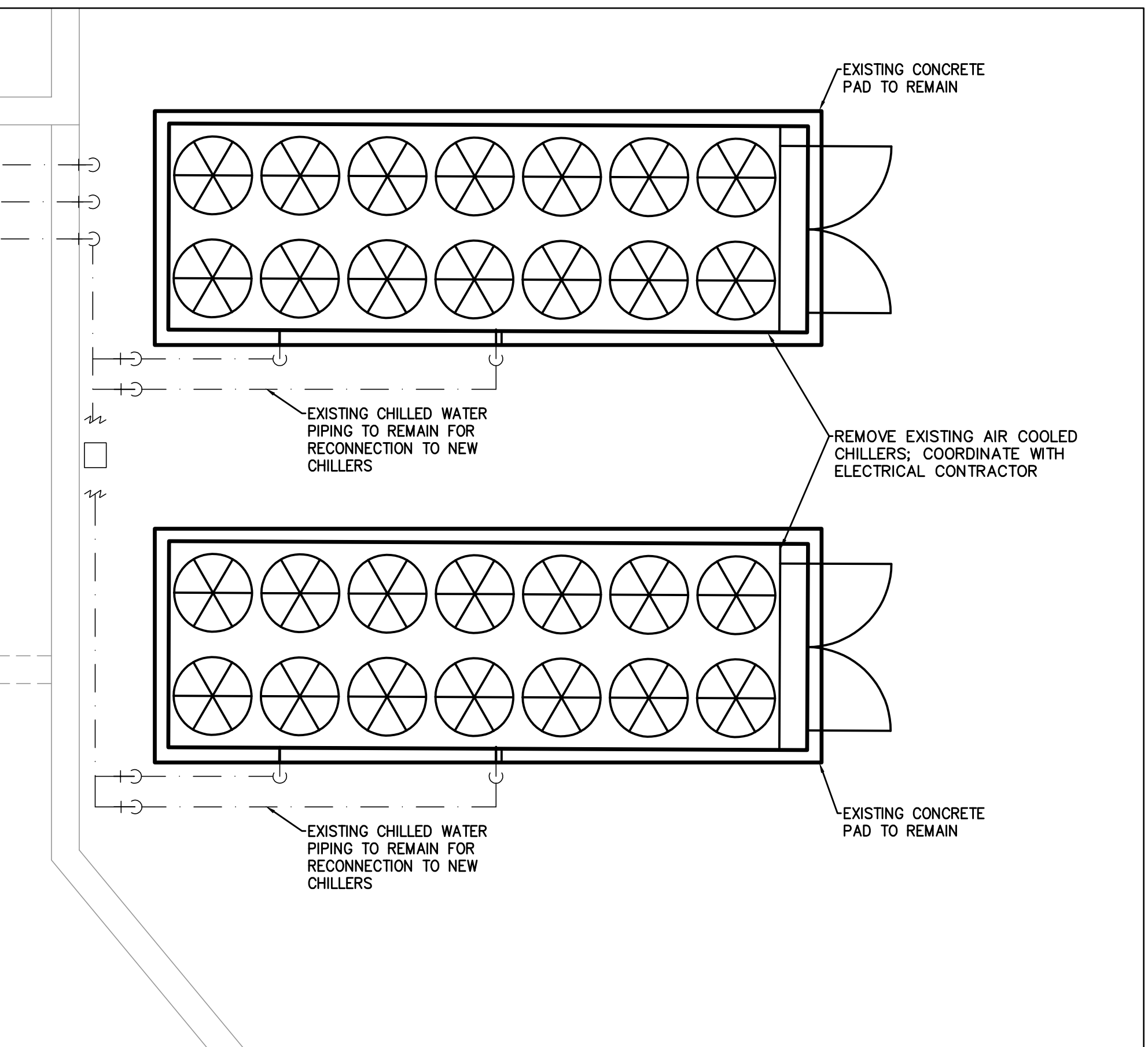
SHEET
M5
5 OF 7



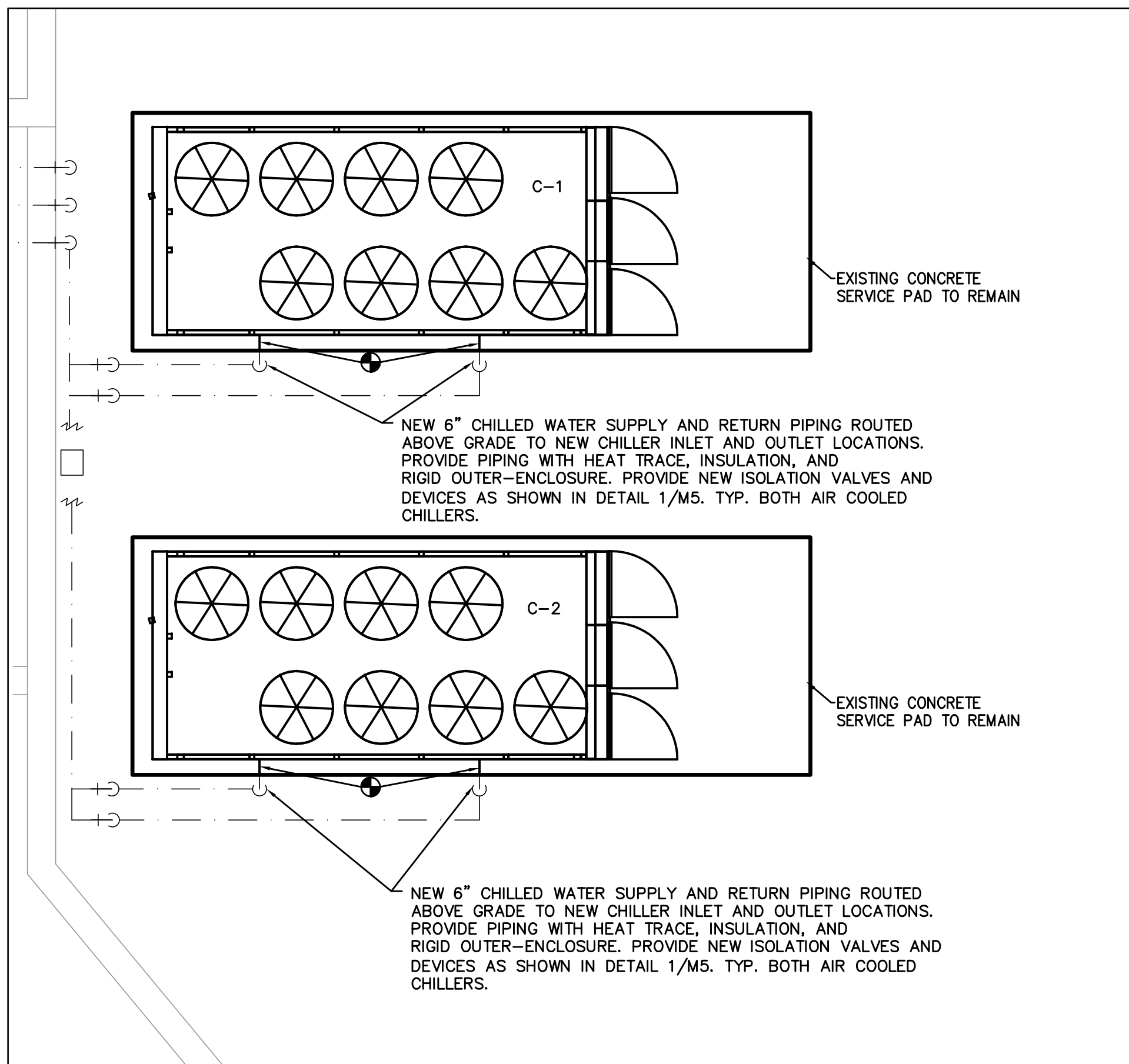
3 BOILER ROOM DEMOLITION PLAN
1/4"=1'-0"



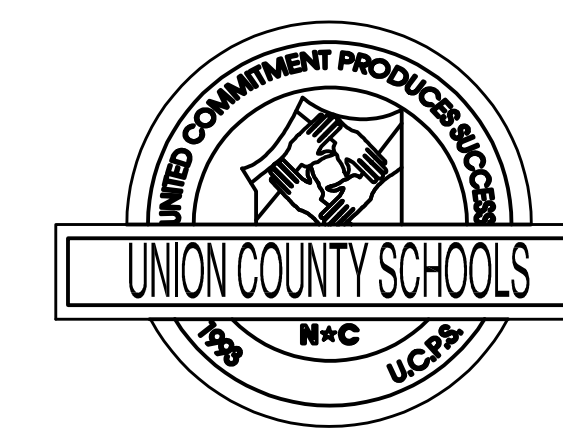
4 BOILER ROOM RENOVATION PLAN
1/4"=1'-0"



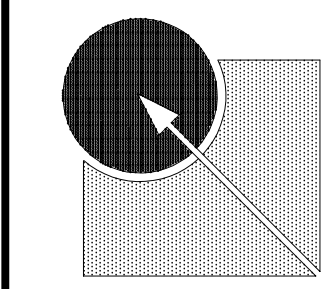
1 AIR-COOLED CHILLER DEMOLITION PLAN
1/4"=1'-0"



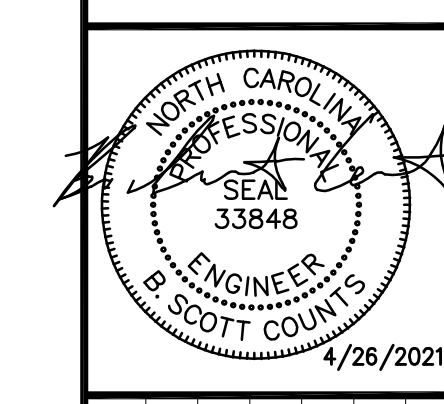
2 AIR-COOLED CHILLER RENOVATION PLAN
1/4"=1'-0"



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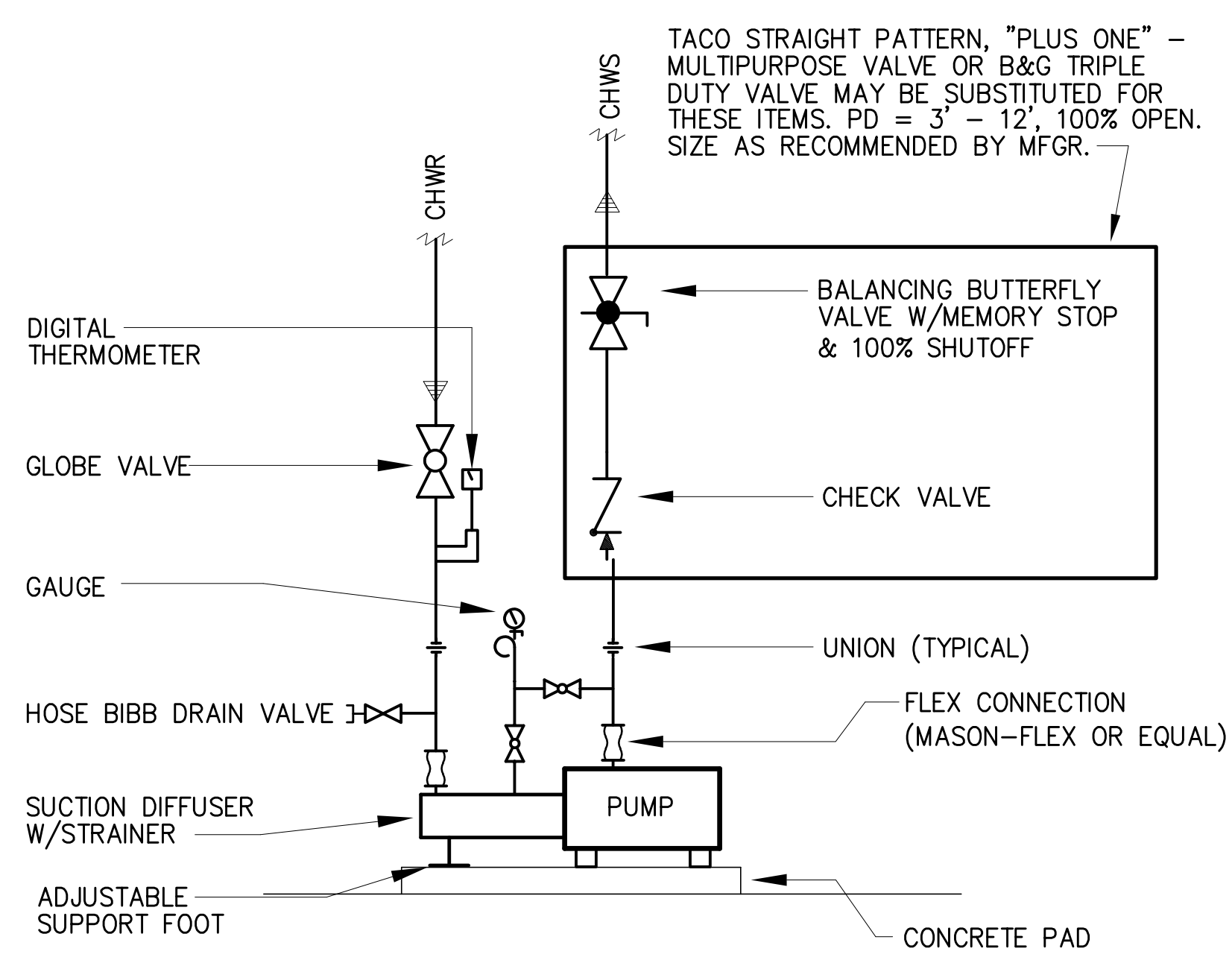
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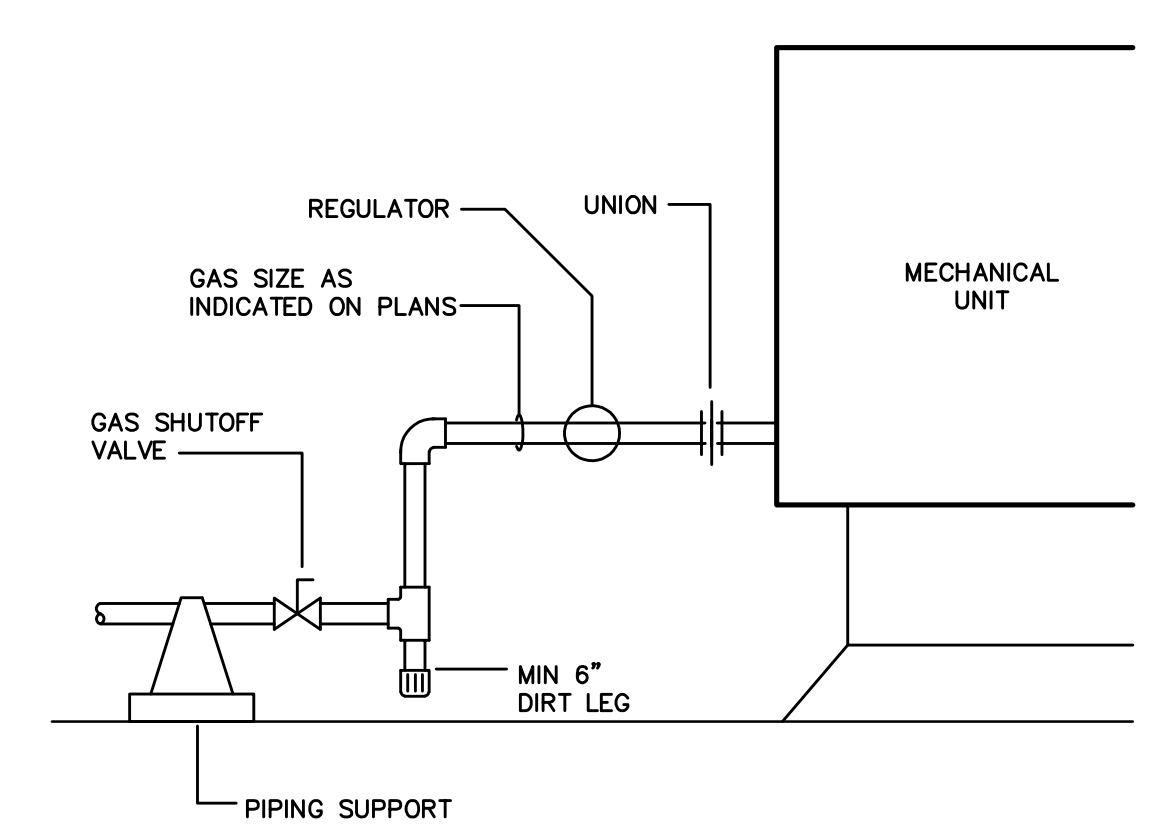
MECHANICAL DETAILS

SHEET

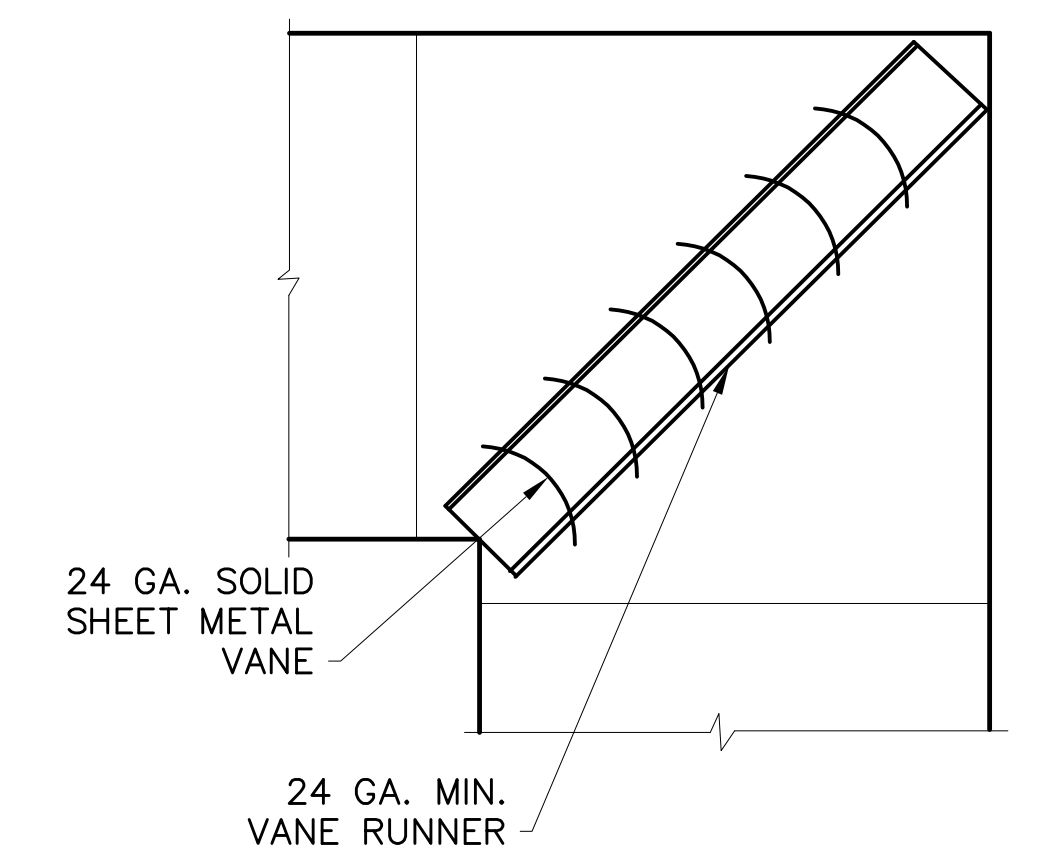
M6
6 OF 7



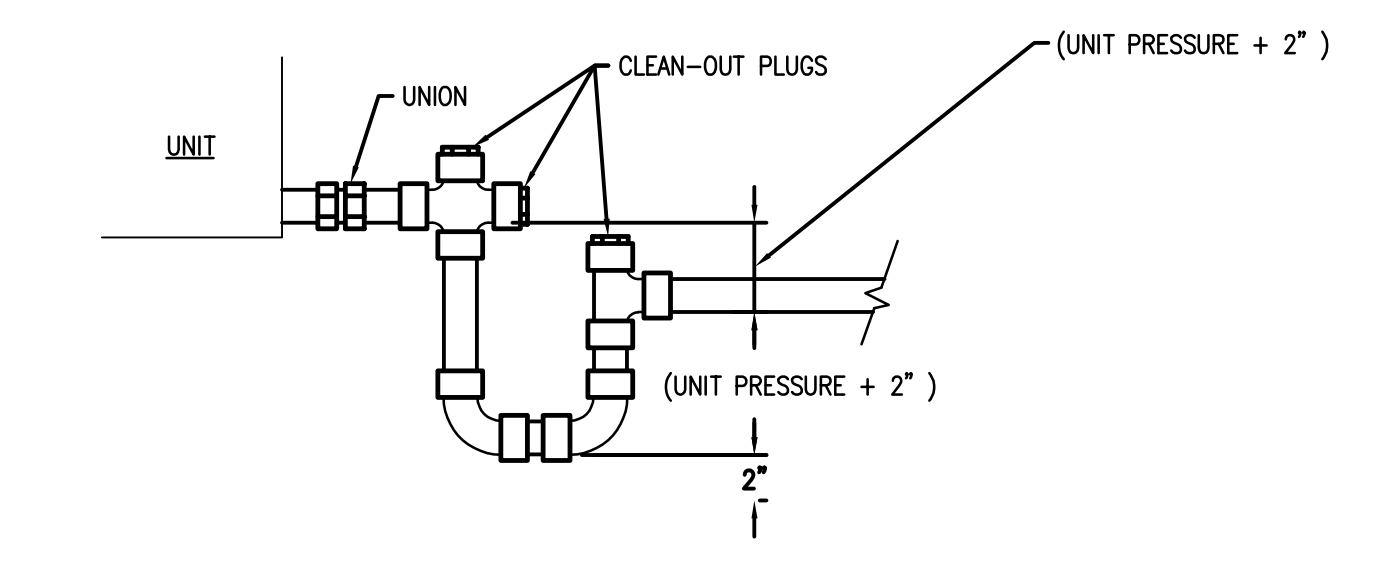
12 PUMP PIPING DETAIL
NTS



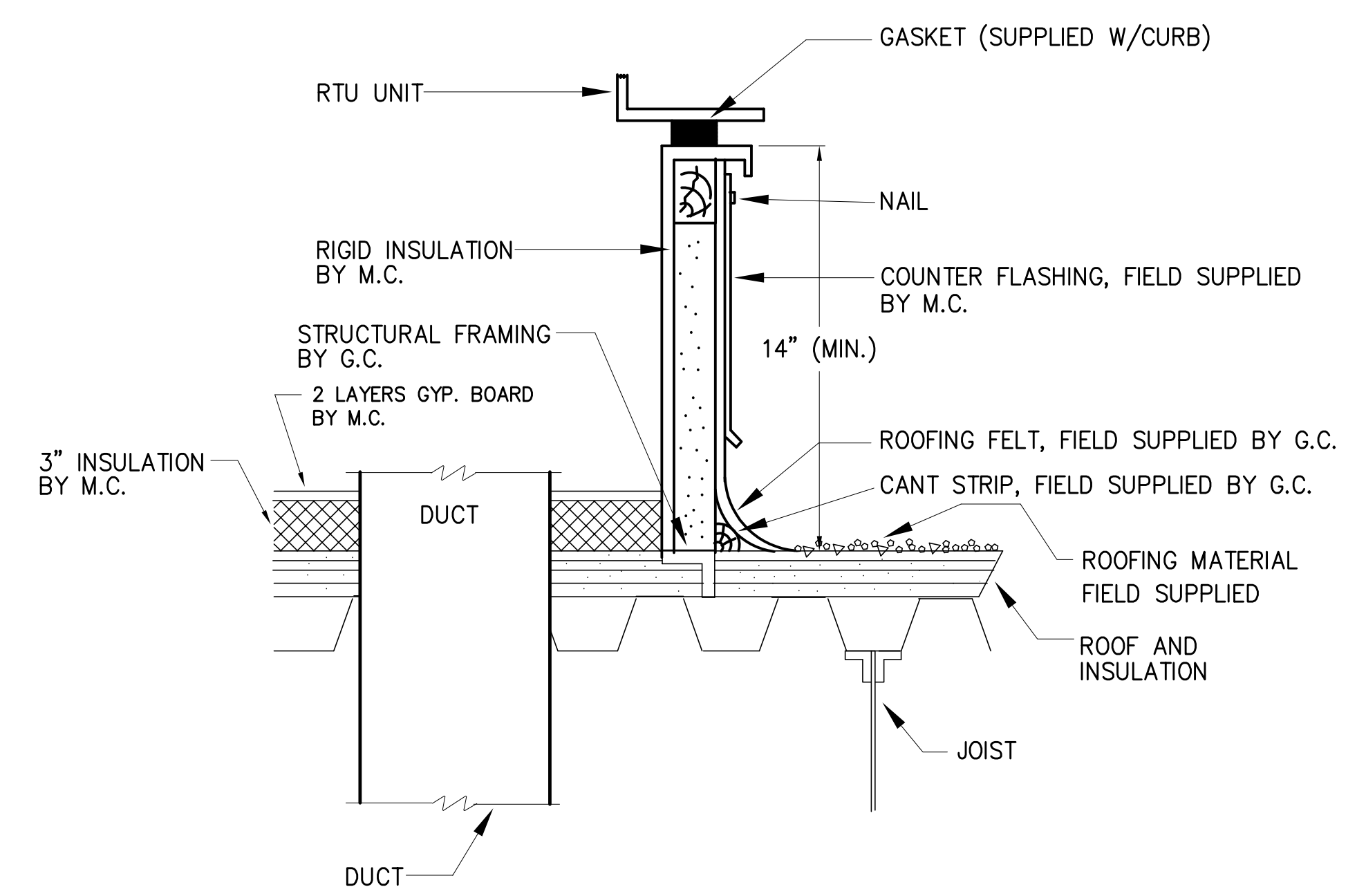
11 GAS PIPING TO UNIT DETAIL
NTS



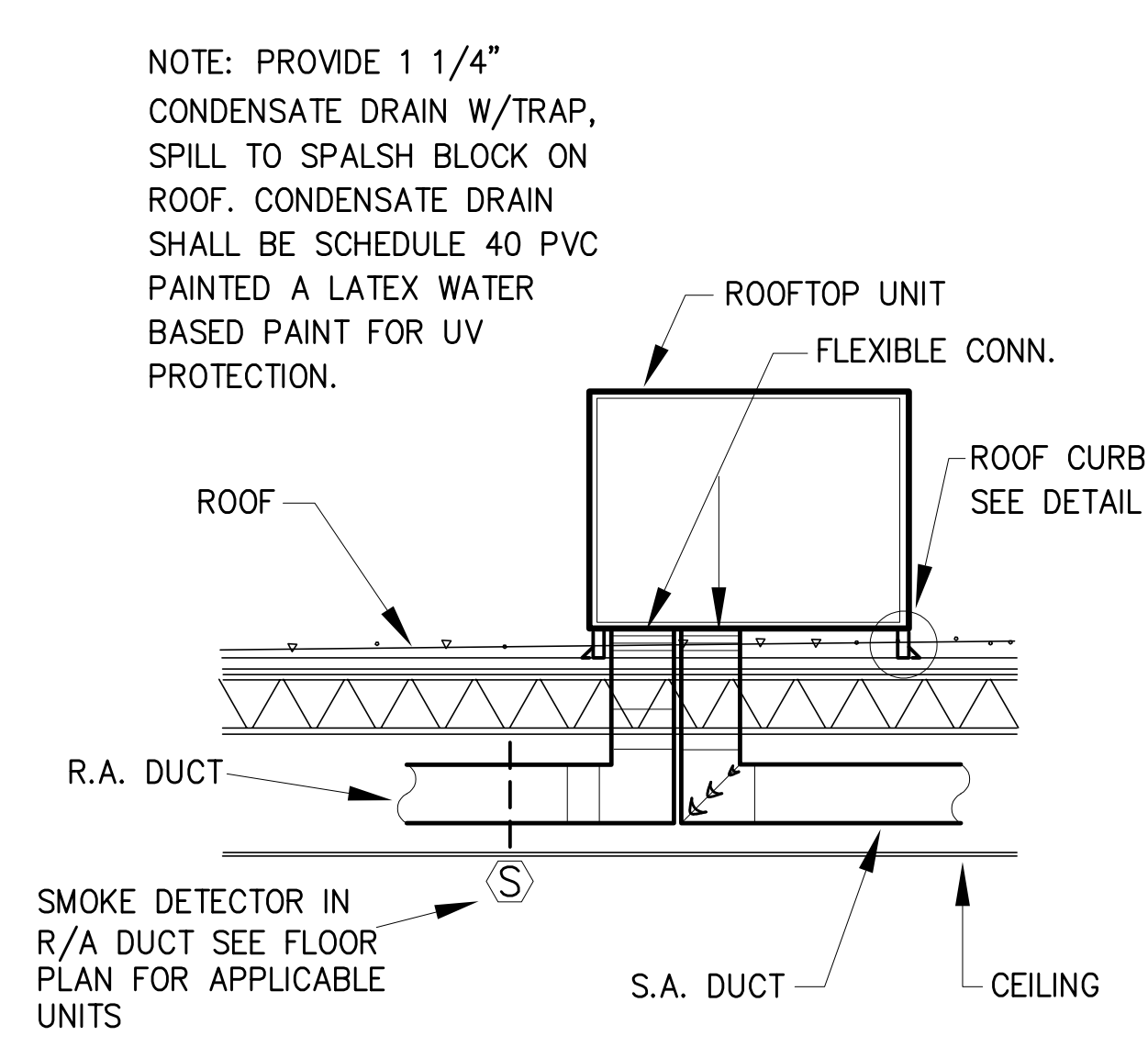
10 TURNING VANE DETAIL
NTS
PERMITTED ONLY WHERE RADIUS
ELL WILL NOT FIT.



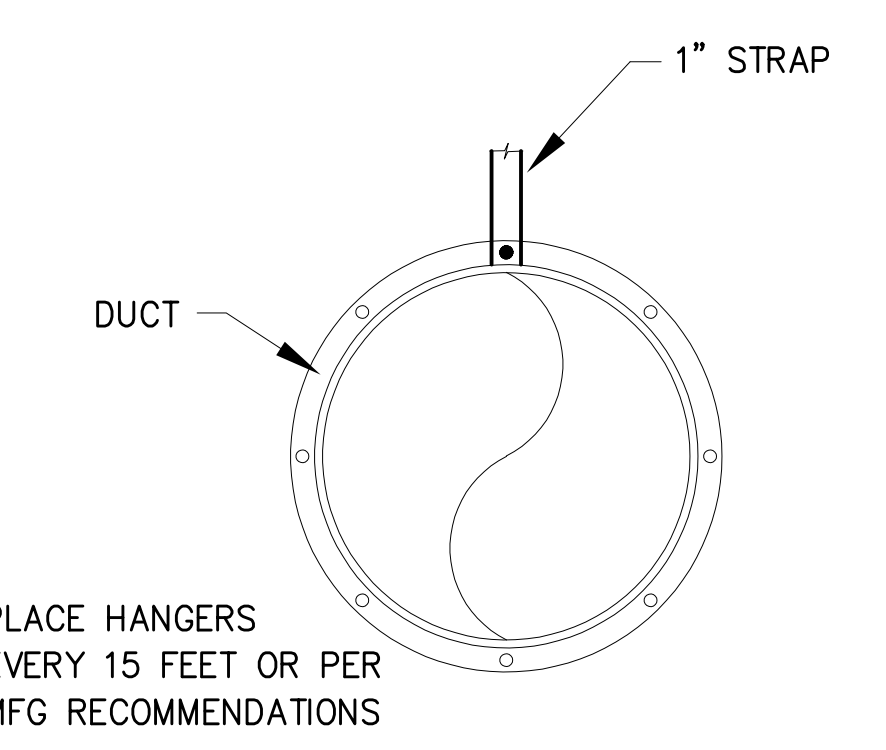
9 CONDENSATE DRAIN DETAIL
NTS
NOTES:
1. CONDENSATE DRAIN SHALL BE PIPED FULL SIZE OF UNIT CONNECTION.
2. CONDENSATE PANS SHALL BE INSTALLED WITH ADEQUATE PITCH TO ENSURE POSITIVE DRAINAGE OF ACCUMULATED CONDENSATE.
3. TRAP CONDENSATE AND DISCHARGE PER PLAN.



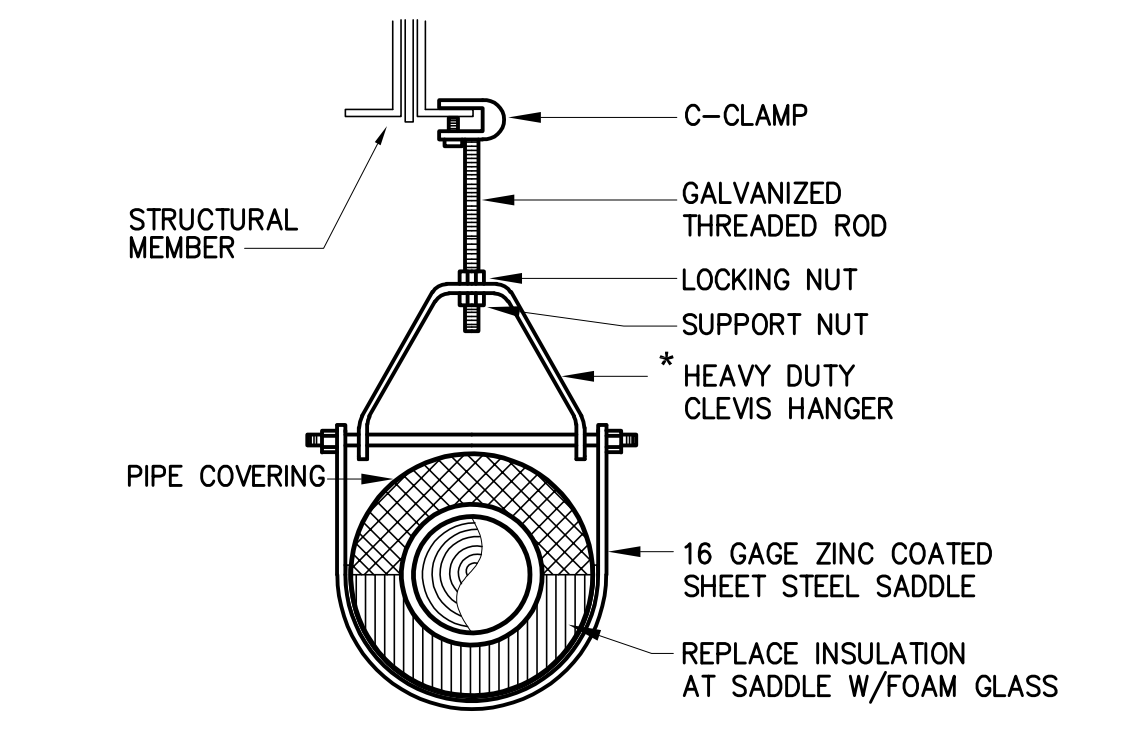
8 ROOFTOP UNIT CURB DETAIL
NTS



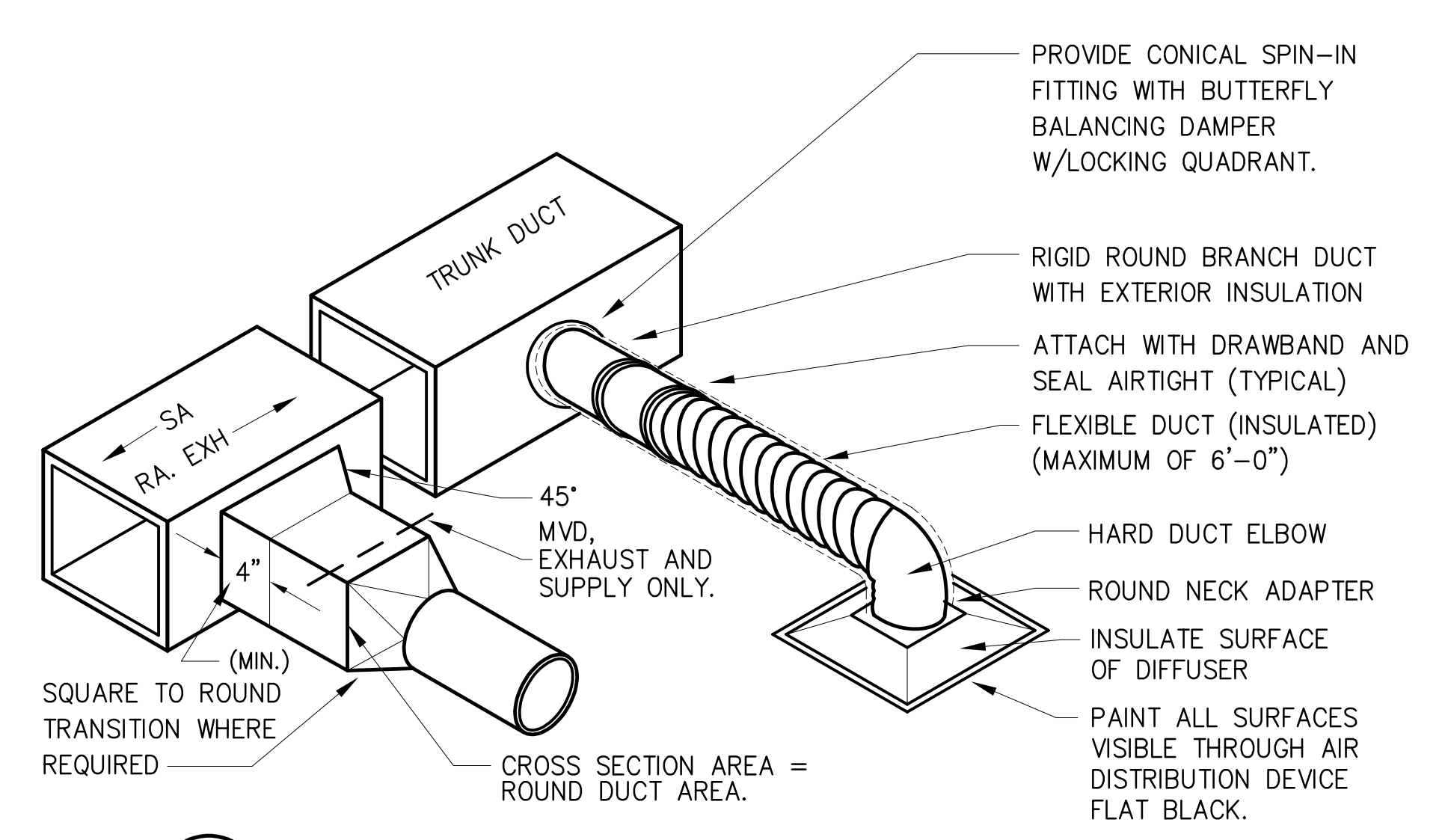
7 SECTION AT RTU DETAIL
NTS
NOTE: PROVIDE 1 1/4" CONDENSATE DRAIN W/TRAP, SPILL TO SPALSH BLOCK ON ROOF. CONDENSATE DRAIN SHALL BE SCHEDULE 40 PVC PAINTED A LATEX WATER BASED PAINT FOR UV PROTECTION.



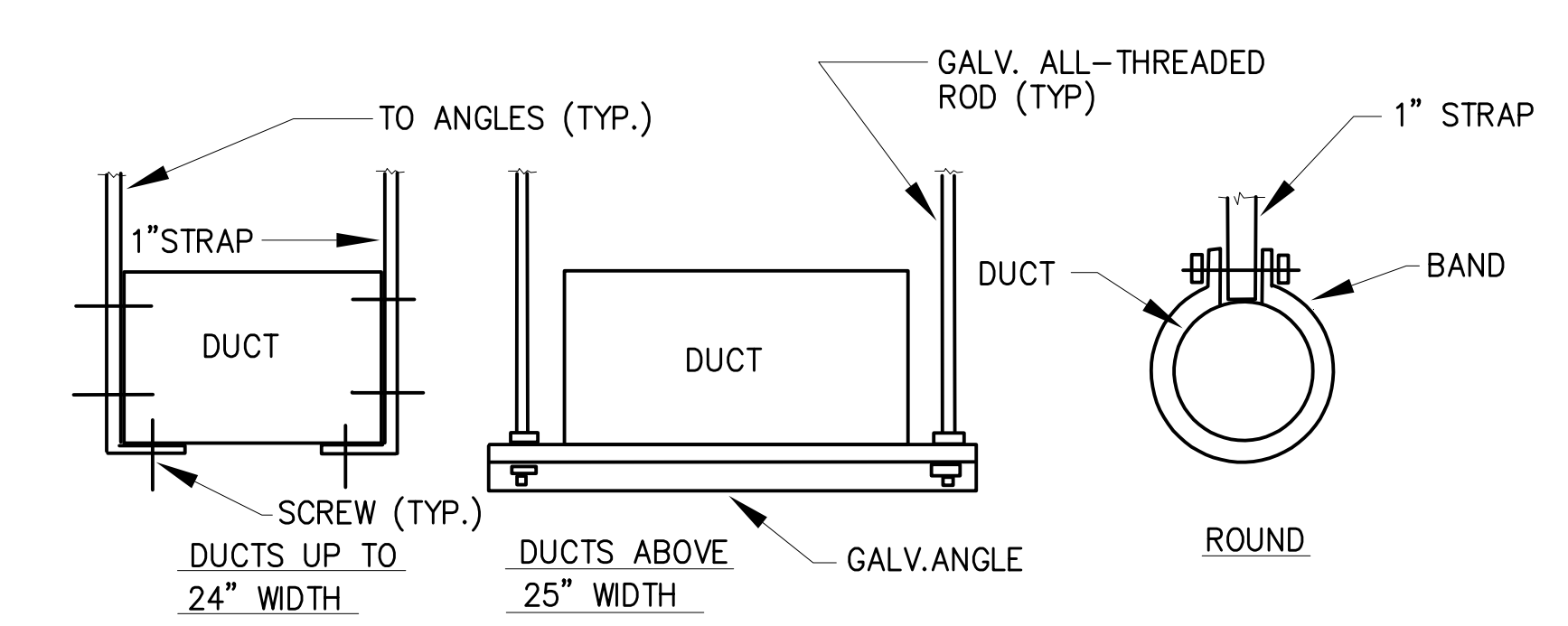
6 ROUND DUCT HANGER DETAIL
NTS
NOTE: PLACE HANGERS EVERY 15 FEET OR PER MFG RECOMMENDATIONS



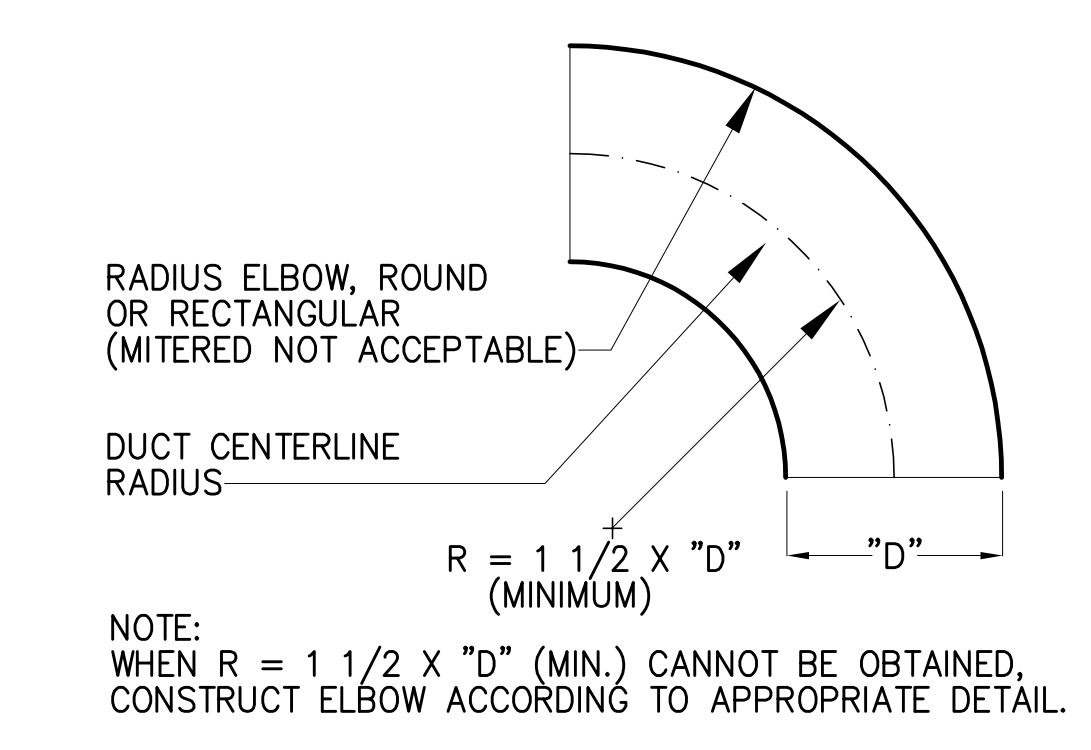
5 PIPE HANGER DETAIL
NTS
* CONTRACTOR OPTION:
MICHIGAN HANGER #403



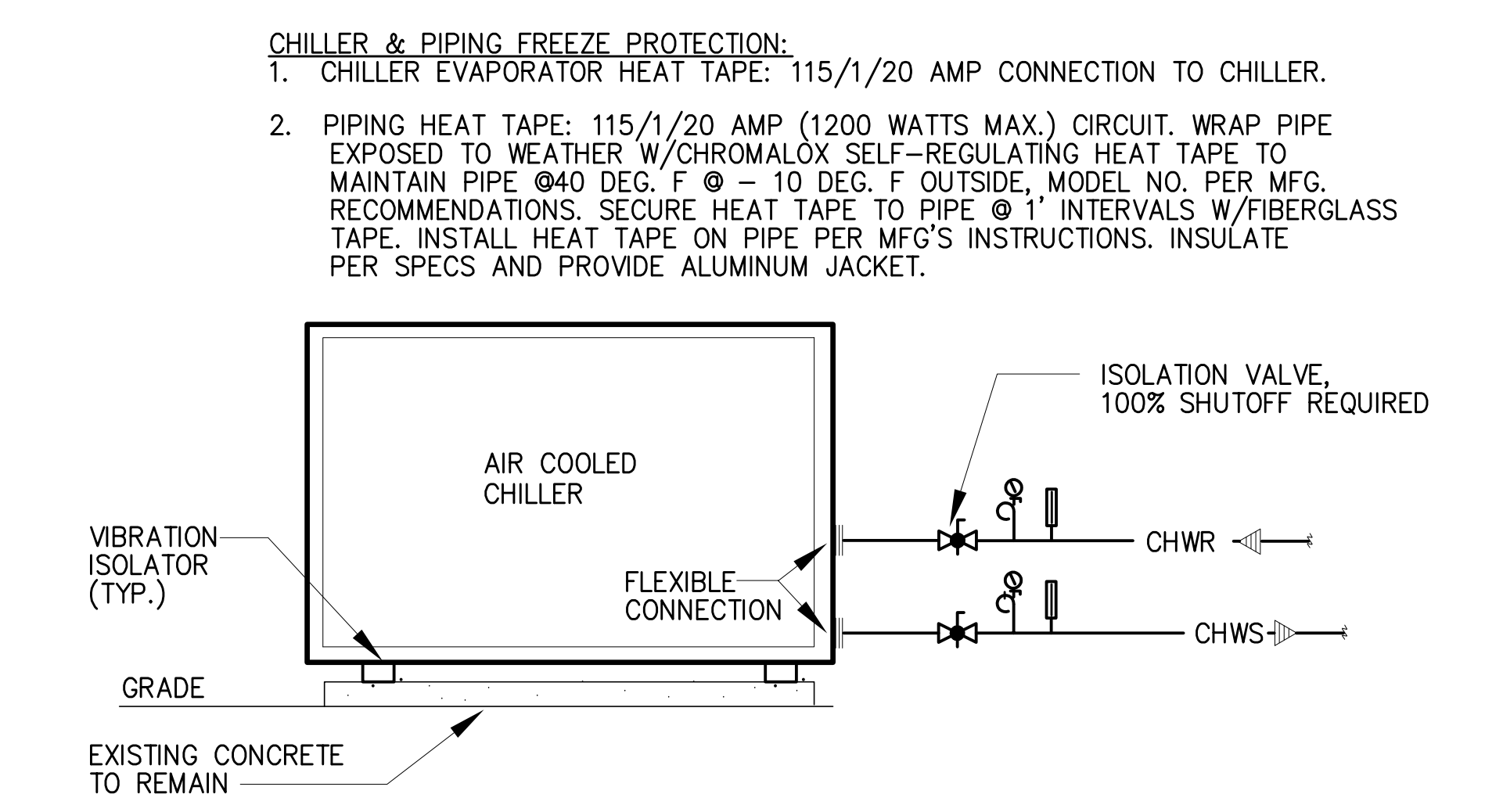
4 DUCT TAKE-OFF DETAIL
NTS



3 DUCTWORK HANGER DETAILS
NTS



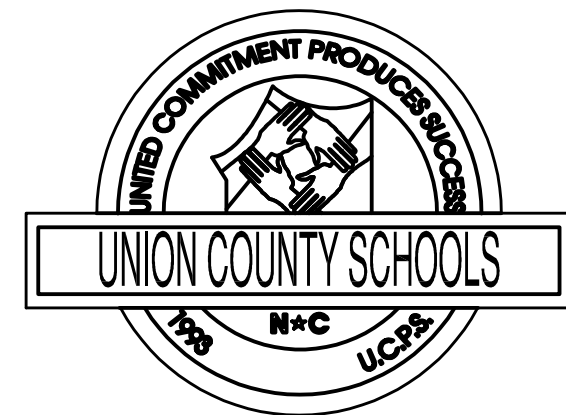
2 RADIUS ELBOW DETAIL
NTS
NOTE: WHEN R = 1 1/2 x 'D' (MIN.) CANNOT BE OBTAINED, CONSTRUCT ELBOW ACCORDING TO APPROPRIATE DETAIL.



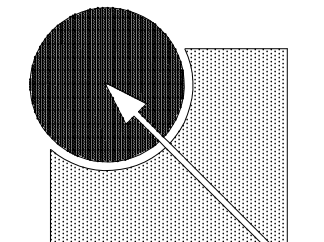
1 AIR COOLED CHILLER PIPING DETAIL
NTS
CHILLER & PIPING FREEZE PROTECTION:
1. CHILLER EVAPORATOR HEAT TAPE: 115/1/20 AMP CONNECTION TO CHILLER.
2. PIPING HEAT TAPE: 115/1/20 AMP (1200 WATTS MAX.) CIRCUIT. WRAP PIPE EXPOSED TO WEATHER W/CHROMALOX SELF-REGULATING HEAT TAPE TO MAINTAIN PIPE @40 DEG. F @ -10 DEG. F OUTSIDE, MODEL NO. PER MFG. RECOMMENDATIONS. SECURE HEAT TAPE TO PIPE @ 1' INTERVALS W/FIBERGLASS TAPE. INSTALL HEAT TAPE ON PIPE PER MFG'S INSTRUCTIONS. INSULATE PER SPECS AND PROVIDE ALUMINUM JACKET.

PIPING & VALVE LEGEND	
SYMBOL	DESCRIPTION
	GATE VALVE
	GLOBE VALVE
	BALL VALVE
	TRIPLE DUTY VALVE
	MULTIPURPOSE VALVE
	PRESSURE REDUCING VALVE
	CHECK VALVE
	BUTTERFLY VALVE
	BALANCING BUTTERFLY VALVE W/100% SHUTOFF & MEMORY STOP
	HOSE END DRAIN VALVE
	REDUCED PRESSURE BACKFLOW PREVENTER
	TEMPERATURE & PRESSURE RELIEF VALVE
	THERMOMETER
	WATER FLOW INDICATOR
	GAUGE COCK AND SNUBBER
	PRESSURE GAUGE
	PIPE UNION
	STRAINER
-CHWS-	CHILLED WATER SUPPLY
-CHWR-	CHILLED WATER RETURN
A.F.F.	ABOVE FINISHED FLOOR
	TIE INTO EXISTING AT THIS POINT
C.I.	CAST IRON
U.N.O.	UNLESS NOTED OTHERWISE

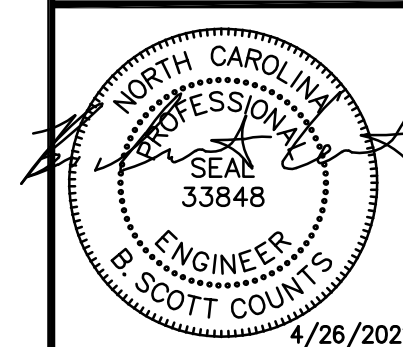
SECOND FLOOR



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JOB NUMBER
21-054

REVISION DATES

BC

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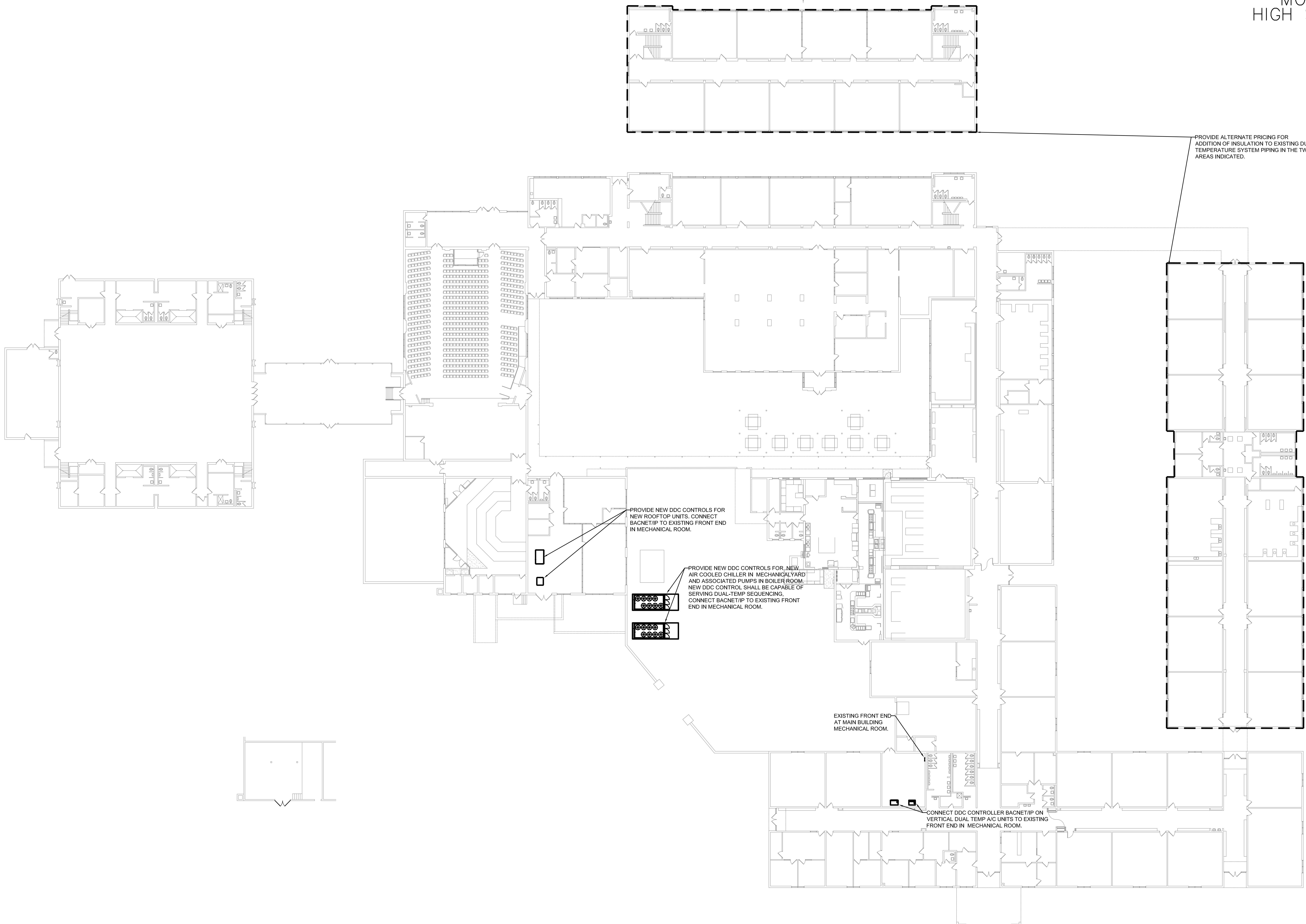
4/26/2021

DESIGNED BY
DATE

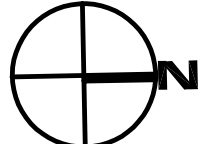
MONROE HIGH SCHOOL
CIP - HVAC IMPROVEMENTS

MECHANICAL CAMPUS PLAN

SHEET
M7
7 OF 7



1 MECHANICAL OVERALL PLAN
NTS



SYMBOL SCHEDULE	
GENERAL SYMBOLS	
SYMBOL	DESCRIPTION
-----	CONDUIT RUN CONCEALED ABOVE CEILINGS OR IN WALLS.
-----	CONDUIT RUN CONCEALED IN OR BELOW FLOORS OR UNDERGROUND.
-----	CONDUIT RUN EXPOSED.
-----	CONDUIT TURNING UP
-----	CONDUIT TURNING DOWN
-----	SQUARE ON CONDUIT SYMBOL INDICATES THAT CIRCUIT CONTINUES BUT NOT SWITCHLEG.
-----	HOMERUN TO PANEL AND CIRCUIT(S) DESIGNATED. ARROW(S) INDICATE QUANTITY OF CIRCUITS.
○	JUNCTION BOX PER N.E.C.
◇	SPECIAL NOTE, NUMERALS IDENTIFY, SEE SCHEDULE.
①	SPECIAL CONNECTION TO A SPECIFIC ITEM OF EQUIPMENT. SEE CONNECTION SCHEDULE.
DISTRIBUTION	
SYMBOL	DESCRIPTION
■	ELECTRICAL PANELBOARD, FLUSH MOUNTED.
■	ELECTRICAL PANELBOARD, SURFACE MOUNTED.
■	CONTROL CABINET, FLUSH OR SURFACE MOUNTED.
■	DISCONNECT SWITCH, NON-FUSIBLE.
■	DISCONNECT SWITCH, FUSIBLE.
→	GROUND CONNECTION.
WIRING DEVICES	
SYMBOL	DESCRIPTION
⊕	DUPLEX RECEPTACLE, 125V, 3-WIRE GROUNDING TYPE.
⊕	DUPLEX GFCI RECEPTACLE, PROVIDE WITH OPERABLE, IN-USE WEATHERPROOF COVER.

ABBREVIATIONS

A ACC AFF AFG AAN C CB CKT CLG DN DW EC EMT ENV EWC FACP FMC G GFI HOA HP HPF HX IG IMC IS JBC KVA KVN FUSE PER NAMEPLATE	AMPERS ARMORED CLAD CABLE ABOVE FINISHED FLOOR ABOVE FINISHED GRADE FIRE ALARM ANNUNCIATOR CABINET CIRCUIT BREAKER CIRCUIT CEILING DOWN DISHWASHER EMPTY CONDUIT ELECTRICAL METALLIC TUBING ELECTRICAL NON-METALLIC TUBING ELECTRIC WATER COOLER FIRE ALARM CONTROL PANEL FLEXIBLE METAL CONDUIT GROUND GROUND FAULT INTERRUPTER HAND OFF AUTOMATIC HORSEPOWER HIGH POWER FACTOR HIGH REACTANCE ISOLATED GROUND INTERMEDIATE METAL CONDUIT INSTANT START JUNCTION BOX KILOVOLT-AMPERES FUSE PER NAMEPLATE	KW LFNC LFMC LVC MCB MCC MLO MTO MTC PBL PBL PRS PRS PWR RCS RMC RPS RS SWB SWB TDB TEL TV TYP V V WG WGP XFM	KILOWATTS LIQUIDTIGHT FLEXIBLE NON-METALLIC CONDUIT LIQUIDTIGHT FLEXIBLE METALLIC CONDUIT LOW VOLTAGE CONTROL CABINET MAIN CIRCUIT BREAKER METAL CLAD CABLE MAIN LUGS ONLY MOUNTED NON-METALLIC CLAD CABLE PULLBOX PANELBOARD PROGRAM RAPID START PROGRAM START POWER RECEPTACLE RIGID METAL CONDUIT RAPID START FIRE ALARM PULL STATION SWITCH SWITCHBOARD TELEPHONE TERMINAL BOARD TELEPHONE TELEVISION TYPICAL VOLTS VAPOR PROOF WALL MOUNTED WEIR GUARD WEATHER PROOF TRANSFORMER
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EQUIPMENT CONNECTION SCHEDULE												
SYM.	EQUIPMENT	LOAD	VOLT/ PHASE	DISCONNECT					CONDUCTORS	RACEWAY		NOTES
				TYPE	RATING	POLES	TRIP/FUSE	ENCL.		TYPE	SIZE	
①	CHILLERS C-1 & C-2	2@270RLA+8@5.4FLA (CKT#1: MCA: 363A, MOCP: 600A; CKT#2: MCA: 355A, MOCP: 600A)	208/3	EXISTING FUSED SWITCHES IN CHILLER YARD					2 SETS OF (3-250MCM, 1#10)	PVC	2-1/2"	◇
②	CHILLER CONTROLS	15A	120/1	TOG	20	1	--	3R	2#12.1#12G	LFMC	1/2"	◇
③	AHU-1	3HP	208/3	VFD FURNISHED BY MC, INSTALLED BY EC					3#12.1#12G	FMC	1/2"	
④	AHU-2	1HP	208/3	VFD FURNISHED BY MC, INSTALLED BY EC					3#12.1#12G	FMC	1/2"	
⑤	PUMPS P-1, P-2	10HP	208/3	VFD FURNISHED BY MC, INSTALLED BY EC					3#8.1#10G	FMC	3/4"	
⑥	RTU-1	15.9RLA+10RLA+ 7.3FLA	208/3	NFDS	60	3	--	3R	3#8.1#10G	LFMC	3/4"	
⑦	RTU-2	30MCA, 30MOCP	208/1	NFDS	30	2	--	3R	2#10.1#10G	LFMC	1/2"	
LEGEND												
DISCONNECT TYPES			DISCONNECT ENCLOSURE TYPES			RACEWAY TYPES			STARTER TYPES			
ETCB = ELECTRONIC-TRIP CIRCUIT BREAKER			1 = NEMA 1 ENCLOSURE			EMT = ELECTRIC METALLIC TUBING			CFMVR = COMBINATION FULL VOLTAGE, NONREVERSING			
FDS = FUSIBLE DISCONNECT SWITCH			3R = NEMA 3R ENCLOSURE			FMC = FLEXIBLE METAL CONDUIT			CONTROL DEVICES			
MOP = MOTOR CIRCUIT PROTECTOR			4 = NEMA 4 ENCLOSURE			IMC = INTERMEDIATE METAL CONDUIT			HOA = HAND-OFF-AUTO			
NFS = NON-FUSIBLE DISCONNECT SWITCH			4X = NEMA 4X ENCLOSURE			LFMC = LIQUID-TIGHT FLEXIBLE METAL CONDUIT			RPL = RED PILOT LIGHT			
ST/DS = COMBINATION STARTER/DISCONNECT SWITCH						PVC = NON-METALLIC PVC CONDUIT			AUX = AUXILIARY CONTACTS (2 N.O., 1 N.C.)			
TMCB = THERMAL-MAGNETIC CIRCUIT BREAKER						RMC = RIGID METAL CONDUIT			CT50 = 50 VA CONTROL TRANSFORMER			
TOG = HP RATED TOGGLE SWITCH			FPN = FUSE PER NAMEPLATE									
NOTES												
ALL ELECTRICAL CHARACTERISTICS SCHEDULED ABOVE ARE BASED ON INFORMATION AVAILABLE AT THE TIME OF DESIGN. ELECTRICAL CONTRACTOR SHALL VERIFY ELECTRICAL CHARACTERISTICS OF ALL EQUIPMENT WITH EQUIPMENT SUPPLIER(S) PRIOR TO ROUGHING, AND SHALL VERIFY EXACT LOCATION AND EXACT TYPE OF CONNECTION. ALL EQUIPMENT SHALL BE PROPERLY AND SECURELY GROUNDED. ANY SIGNIFICANT CHANGES IN LOCATION, ELECTRICAL REQUIREMENTS, OR TYPE OF CONNECTION REQUIRED FOR ANY EQUIPMENT SCHEDULED ABOVE SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER IN WRITING PRIOR TO PROCEEDING.												
CONDUCTORS AND RACEWAY SPECIFIED IN THE ABOVE SCHEDULE ARE FOR FINAL CONNECTION TO UNIT AND SHALL BE EXTENDED FROM THE DISCONNECT SHOWN ON THE FLOOR PLANS TO THE EQUIPMENT TERMINATION BOX.												
CONDUIT AND BOXES REQUIRED FOR EQUIPMENT CONNECTIONS SHALL BE INSTALLED IN SUCH A WAY AS TO NOT COVER UP EQUIPMENT NAMEPLATES, SERVICE AREAS, AIR FLOW AREAS, ETC.												
◇ RECONNECT EXISTING CIRCUIT.												

NOTE: THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING ALL EXISTING CONDITIONS. SUBMISSION OF BIDS IS CONSIDERED VERIFICATION THAT THE CONTRACTOR HAS VISITED THE SITE. NO EXTRAS WILL BE ALLOWED DUE TO LACK OF KNOWLEDGE OF THE EXISTING CONDITIONS.

ELECTRICAL GENERAL REQUIREMENTS

1.1 SCOPE

- Applicable requirements of the General Conditions of the Contract, Amendments, Supplementary General Conditions, and Special Conditions govern work under this Division.
- Work covered by this Division consists of providing all labor, equipment, supplies, and materials, and performing all operations, including trenching, backfilling, cutting, patching, and chasing necessary for the installation of complete electrical systems in strict accordance with these specifications and the applicable drawings.
- Minor details not usually shown or specified, but necessary for the proper installation and operation, shall be included in the work, the same as if herein specified or shown.
- This Contractor is referred to the General and Special Conditions of the contract which shall form a part and be included in this section of the specification and shall be binding on this Contractor.
- Some items of equipment are specified in the singular; however, the Contractor shall provide and install the number of items or equipment as indicated on the drawings, and as required for complete systems.

1.2 RECORD DRAWINGS

- During construction of this project, the Contractor shall maintain one complete set of electrical contract drawings, on which shall be recorded all significant changes. This set of drawings shall be used for no other purpose. Upon completion of the project, the Contractor shall submit these drawings to the Architect/Engineer for approval and presentation to the Owner.

1.3 REGULATIONS AND COMPLIANCE

- The requirements of the North Carolina State Building Code which includes the National Electrical Code, and of all other State and Local codes, ordinances, regulations and interpretations by authorities having jurisdiction are binding upon this Contractor, and nothing contained in, or inferred by, these specifications or the applicable drawings may be construed as waiving those requirements. The latest edition of the National Electrical Code, referred to herein and on the drawings as "N.E.C.", forms a part of these specifications; and under no circumstances may the installation fail to meet the minimum requirements therein.
- This Contractor shall secure and pay for all permits, fees, inspections and licenses required. It is the responsibility of the Contractor to notify the Local Electrical Inspector to schedule the required inspections. Upon completion of the project and prior to his request for final payment he shall present to the Architect/Engineer a certificate of inspection and approval from the inspection authorities.
- All materials and equipment shall bear the approval label, and shall be listed by the Underwriters' Laboratories, Inc.

2.1 GENERAL

- Except where reuse of existing items are specifically indicated or permitted, all materials and equipment shall be new and shall conform with the standards of the National Electrical Manufacturers Association and Underwriters' Laboratories, Inc. in every instance where such a standard has been established for the item involved.
- Materials shall be inspected by the Contractor upon their arrival at the site to be sure they are correct. Material and equipment stored on the site shall be protected against physical damage, dirt and damage caused by precipitation, wind, condensation, excessive humidity, and extremes of temperature. Materials shall be stored in their original cartons when substantial, clean and dry storage facilities provided under this Contract. Conduit, large galvanized boxes, and lighting poles may be stored outdoors on suitable blocks or racks clear of the earth and underground, and painted to drain. Large electrical equipment intended for ultimate installation outdoors may be stored in the weather on suitable blocks or platforms clear of the earth and underground, and with interior legs or spacers welded continuously energized to prevent condensation. Alternate storage provisions may be submitted to the Architect/Engineer for approval prior to the arrival of the material. Under no circumstances shall equipment be stored in the weather under a cover of polyethylene or tarpaulin. The Architect/Engineer will be the sole judge as to the acceptability of storage facilities, and when directed by the Architect/Engineer, improperly stored or damaged material shall be removed from the site and replaced with new material.

- The Contractor shall coordinate the work and equipment of this Division with the work and equipment specified elsewhere in order to assure a complete and satisfactory installation. Work such as excavation, backfill, conduit, flashing, wiring, etc., which is required by the work of this section shall be performed in accordance with the requirements of the applicable section of the specifications.
- It is the intention of these specifications and drawings to call for finished work, tested and ready for operation. Whenever the word "provide" is used, it shall mean "furnish and install complete and ready for use".

3.1 COORDINATION

- The Contractor coordinate the work of all subs and shall furnish any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.
- Where the work will be installed in close proximity to, or may interfere with the work of other trades, the Contractor shall assist in working out space conditions to make a satisfactory adjustment. If so directed by the Engineer, the Contractor shall prepare complete working drawings and sections at a suitable scale not less than 3/8" = 1'-0", clearly showing how his work is to be installed in relation to the work of other trades. If the Contractor installs his work before construction, or so as to cause any interference with the work of any subs, he shall make the necessary changes in his work to correct the condition without extra charge.
- The Contractor shall furnish to other trades, as required, all necessary materials, patterns, setting plans, and shop details for the proper installation of work and for the purpose of coordinating adjacent work.

3.2 EXCAVATION

- Required excavation for installation of all electrical work shall be provided by the Electrical Contractor. Particular care shall be taken not to disturb or damage work of other trades.
- Trenching and shoring shall comply with requirements of North Carolina State Department of Labor's regulations entitled "Safetyguards During Construction", and "Trenching and Shoring".
- In backfilling pipe trenches, approved fill shall first be compacted firm and evenly on both sides of pipe in 6" layers to a depth of 12" over the top of the pipe. Remainder of trench shall be backfilled to established grade in 6" layers. Compact between each layer with a high-frequency vibrator tamper such as Dart Soil Compactor (as manufactured by Dart Manufacturing Company, Denver, Colorado). Fill shall be compacted to density specified in Earthwork Section for the area through which trench is cut. Where compaction is required, the Contractor shall be responsible for the proper installation of work and for the purpose of coordinating adjacent work.

4. EXCESS EARTH SHALL BE DEPOSITED ON THE SITE AS DIRECTED BY THE ARCHITECT/ENGINEER.

- Where excess earth outside of building, the surface shall be finished to match existing surfaces. Any existing work, or work of other trades, which is damaged or disturbed shall be repaired or replaced, and left in good order.

3.3 BELLIES, CUTTING AND PATCHING

- Contractor shall place his own reserves and advise other trades of required chases and openings so they can be properly built in. Where any raceways supported installed under this Contract place the roof, suitable plug pockets shall be provided and coordinated with the roofing contractor as necessary to be acceptable to the Architect. Provide suitable fittings where any raceways or equipment cross egression joints.
- Permitted cutting or patching necessary shall be done by Contractor. Structural members shall not be cut except by written permission of Architect/Engineer.

3.4 PROTECTION AND CLEANUP

- Protect all material and work from damage during construction. Equipment installed in the building prior to its being closed in and dried out shall be protected from the elements in the same manner as previously specified for stored materials. Protect finished surfaces from splattering of mortar, paint, plaster, etc. Do not install device plates, face plates, canopies, flush cabinet trim, or fixtures on walls or ceilings until after painting or cleaning of the surface has been completed, and arrange for such items that are required to be field painted to be painted before being mounted. Repair, clean and touch-up or replace, all damaged material. At the completion of the project, remove all dust from finished surfaces, including lighting fixtures, lenses and lamps.
- The Contractor shall keep premises free of debris resulting from his work.

3.5 PAINTING AND FINISHING

- Substrate finishes shall be provided on all items of electrical equipment and materials which are exposed. This shall consist of either an acceptable finish as manufactured and supplied to the job or application of suitable finishes after installation.
- Where installed in finished areas, exposed equipment and materials shall be supplied with prime coat, and shall be professionally painted or enameled as directed to match or blend with adjacent surfaces.
- In unfinished areas such as equipment rooms, exposed equipment shall be furnished with suitable factory applied finishes (e.g. standard gray enamel finish for panelboards, etc.).

3.6 OBSERVATION

- The project will be observed periodically as construction progresses. The Contractor will be responsible for notifying the Architect at least 72 hours in advance when any work to be covered up is ready for inspection. No work will be covered up until after observation has been completed on such items as piping and insulation, etc.

EQUIPMENT CONNECTIONS AND COORDINATION

1. GENERAL

- Heating, Ventilating, Air Conditioning, Refrigeration and Plumbing Equipment. Unless otherwise indicated, provide all power wiring, including feeders and branch circuits, to the terminals of the equipment, including mounting of motor starters, feeder and branch circuit over-current protection; disconnecting means within sight of each motor and each starter, whether or not specifically indicated on drawings; and Motor Control Centers indicated, complete as indicated and specified.

BASIC MATERIALS AND METHODS

1.1 WIRING METHODS

- Unless otherwise indicated or specified, the Wiring Method for this project shall consist of copper conductors with 600 volt insulation installed in metal raceways.
- The word "Raceway" and the word "Conduit" for abbreviation "C" used herein or on the drawings indicate Rigid Metal Conduit, and where permitted, Intermediate Metal Conduit, Electrical Metallic Tubing, Rigid Nonmetallic Conduit, Flexible Metal Conduit, or Liquidtight Flexible Metal Conduit.
- Reference to "Rigid Conduit" or "RMC" indicates heavy-wall Rigid Metal Conduit only.

- Reference to "IMC" indicates Intermediate Metal Conduit.

- Reference to "PVC" indicates Rigid Nonmetallic Conduit.

- Reference to "EMT" or "Tubing" indicates Electrical Metallic Tubing.

- Reference to "Flex" or "Flexibond" indicates Flexible Metal Conduit, or, where required, Liquidtight Flexible Metal Conduit.

1.2 FASTENINGS METHODS

- Acceptable fastening methods include wood screws and nails on wood construction, toggle bolts on hollow masonry, expansion bolts and lead anchors on brick and concrete, and machine screws on metal surfaces.
 - Explosive fasteners may be used in steel and concrete in accordance with the manufacturer's recommendations.
 - Wire, perforated metal plate, and wooden plugs are not acceptable as fastening material.
 - Materials used shall be good quality, made of zinc or cadmium coated steel or other non-corroding material.
 - Materials, whether exposed or concealed, shall be firmly and adequately held in place. Fastening and support shall afford safety factor of three or higher, and shall be in full compliance with the seismic protection requirements of the N.C. State Building Code.
 - Flanges, raceways, and equipment shall be supported from the structure. Nothing may be supported on suspended ceiling unless definitely noted so on the Drawings or specifically permitted by the Architect/Engineer.
 - Equipment and raceways attached to outside walls, or interior walls subject to permanent moisture, shall be sheathed out with non-corroding material so as to provide 1/4" air space between wall and equipment or raceway.
- ##### 1.3 NAMEPLATES
- Substrate nameplates shall be provided for the identification of electrical equipment including Switchboards, Panelboards, Motor Control Centers, Motor Starters, Safety Switches, and Circuit Breakers.
 - Nameplates shall be of engraved white core plastic laminate, not less than 1/16" thick. For 120/208 volt systems, nameplates shall have white letters on black backgrounds.
 - Engraving shall be of professional quality, with block style letters, minimum 1/16" high.
 - Nameplates shall be attached with sheet metal screws. They shall be sized to allow for installation of screws without obscuring text.

RACEWAYS AND FITTINGS

1.1 MATERIALS AND APPLICATIONS

- Rigid Metal Conduit shall be zinc coated steel or alloy 6063-T42 aluminum with threaded couplings and fittings. Termination at sheet metal enclosures shall consist of double locknuts and insulating bushings. Rigid Steel Conduit shall be used for all exposed and concealed work except where other raceways are indicated or permitted. Aluminum conduit complete with aluminum fittings may be used in lieu of steel conduit except in wet locations, underground, or in poured concrete. Steel and aluminum shall not be mixed in the same run of conduit.
- Intermediate Metal Conduit (IMC) with threaded couplings and fittings may be used for exposed and concealed work in lieu of rigid metal conduit except underground outside the building foundation, or where supporting lighting fixtures, or in hazardous locations, or where exposed to severe impact or injury. Termination at sheet metal enclosures shall consist of double locknuts and insulating bushings. Rigid Steel Conduit shall be used for all exposed and concealed work except where other raceways are indicated or permitted. Aluminum conduit complete with aluminum fittings may be used for exposed work in lieu of rigid metal conduit except outdoors, or above a roof, or where supporting lighting fixtures, or where exposed to severe impact or injury, or in hazardous locations, or less than 10 feet above a floor or platform or other than in electrical, mechanical, or communications closets or equipment rooms.
- Rigid PVC Conduit shall be Schedule 40, UL listed for use with 900C, Conduit run underground or in or in under a poured concrete slab shall be rigid PVC. Vertical elbows and vertical extensions from underground or concrete embedded PVC conduits smaller than 3" trade size may also be of PVC provided that they remain concealed or otherwise protected, but shall be of Rigid Steel Conduit or IMC where permitted) when they stub up into exposed locations or trade size is 3" or larger. An insulating bushing or end bell shall be provided at each termination. Conduit run underground and not under a poured concrete slab shall have installed continuously above a warning tape. Tape shall be 12 inches wide, centered on conduit and located 12 inches below finished grade.
- Flexible Metal Conduit shall be of zinc coated steel of minimum length, and shall be used in lieu of Rigid Metal Conduit for connections to moving or vibrating apparatus, recessed lighting fixtures, dry-type transformers, and motors. Flexible Metal Conduit may be used where rigid connections are impractical due to obstructions or space limitations. Flexible Metal Conduit shall be used in wet, damp, or corrosive locations shall be PVC jacketed liquid-tight complete with liquid-tight connectors.
- Fittings for steel conduit and tubing shall be of zinc coated steel or malleable iron. Insulating bushings of plastic provided for Rigid and Intermediate Metal Conduits shall be rated for 1500C. Bonding bushings shall be steel or malleable iron with non-removable plastic thrusts rated 1500C. EMT fittings shall be of the compression type. Set-screw, union, pressure cast, and die cast fittings are not acceptable. Connectors for IMC, Flexible Metal Conduit and Liquid-tight Flexible Metal Conduit shall be the insulated Rupture type. Connectors for Flexible Metal Conduits shall be of the "Bite-Bite" design.
- Conduit expansion fittings shall be of zinc coated steel or malleable iron and steel conduit, complete with flexible bonding straps. Expansion fittings shall allow longitudinal conduit movement of 4 inches.
- Minimum raceway size shall be 1/2". Other raceway sizes, unless indicated on the drawings, shall be determined by the Contractor in accordance with NEC requirements for type THW insulated conductors, or the actual insulation used if it is thicker than type THW.

2.1 INSTALLATION

- Rigid and Intermediate Metal Conduits shall be made up with full threads, to which a conductive pipe compound (T & B Kopr-Shield or equal) has been applied, and butted in coupling. Terminations at sheet metal enclosures in indoor dry locations shall be made with double locknuts and an insulating bushing. Terminations at sheet metal enclosures in outdoor, damp, and wet locations shall be made with threaded conduit hubs of zinc coated malleable iron.
- Except where run under a concrete slab on grade, underground conduits shall be installed at a minimum of 24" below grade.
- Underground steel conduits, including conduits in gravel or under a concrete slab on grade, shall be protected from corrosion by one of the following means:
 - Concrete encasement with a minimum cover of 3" in all directions.
 - PVC coating of 0.10" minimum thickness, factory bonded to the steel conduit. Robby Industries "Rob-Kote" or approved equal. Provide equal protection at joints and where the coating is damaged in accordance with the manufacturer's recommendations.
 - Conduits painted with two coats of heavy asphaltum or bituminous. Apply coating to clean, dry, full length conduits, each with a coupling on one end, and allow to dry between coats and before installation. Support conduits on saw-horses or racks, clear of earth and moisture, during painting and drying. Touch-up joints and abrasions after assembling, and protect completed conduit runs by booting, or by covering conduits with suitable protective material approved by the Architect/Engineer.
- Installation of PVC Conduit shall be in accordance with the manufacturer's recommendations using solvent welded couplings and fittings. Field bends shall be made with approved heating equipment. Open flames are not permitted. An insulating bushing or end bell shall be provided at each termination.
- Conduits shall be rigidly supported not more than 8 feet on center and shall be concealed within walls, ceilings, and floors, except as indicated or specifically approved by the Architect/Engineer, support at least 8" from flues and steam or hot water pipes; and protected against the entry of dirt, plaster, or trash. Raceways shall be supported independently of suspended ceiling members and suspension wires.
- Exposed EMT shall be provided with additional hangings at elbows and bends, and where necessary to avoid strain at couplings and connectors.
- Supplied conduits, where permitted, shall be run parallel or perpendicular to walls, structural members and ceilings, with right-angle turns conducted by symmetrical bends or cast metal fittings with threaded hubs. Offsets may be used where necessary provided that they are of minimum length.
- Conduits crossing expansion and contraction joints shall cross perpendicular to the joint and shall be provided with expansion fittings. Conduits shall not be embedded in the concrete slabs at the expansion and contraction joints.

CONDUCTORS

1.1 MATERIALS

- Unless otherwise indicated, all wire and cable conductors shall be copper.
 - Conductors shall be not smaller than #12 AWG except that #10 AWG minimum is required for the entire length of 120 volt branch circuits whose distance to the center of the load exceeds 75 feet. #14 AWG may be used for signal and remote control circuits. #16 AWG may be used for low-voltage remote control lighting fixtures or circuits protected by over-current devices rated at 20 amperes or less and contained within flexible metal conduits that do not exceed 6 feet in length. Other conductors smaller than #14 AWG may be used only where specifically indicated on the drawings or specified herein.
 - Conductors #10 AWG and smaller shall be solid, dual rated type THW/THHN.
 - Conductors #8 AWG and larger shall be stranded, dual rated type THW/THHN.
 - Each conductor shall bear easily readable markings along entire length, indicating size and insulation type.
 - Insulation on conductors #10 AWG and smaller shall be suitably colored in manufacture.
 - Conductors in any location subject to abnormal temperature shall be furnished with an insulation type suitable for temperature encountered.
 - Where no indication is made of wire size, the conductor shall be of N.E.C. size to match its overcurrent protective device, but in no case smaller than #12 AWG.
- ##### 2.1 SPLICES, TAPS, AND CONNECTIONS
- Splices in conductors #10 AWG and smaller shall be made with twist-on spring steel devices UL listed as Pressure Cable Connectors, with integral insulating covers rated 750C, at 600 volts.

- Splices in copper conductors #8 AWG and larger shall be made with mechanical devices UL listed as Pressure Cable Connectors and insulated with thermoplastic tape UL listed for use as sole insulation. Tape may be omitted from conductors supplied with securely fastened insulating covers which completely enclose the conductor and the conductors. Insulating covers shall be rated 750C at 600 volts.

2.2 COLOR CODING

- All wiring shall be color coded.
- On 120/208V, 3 phase, 4 wire power systems, conductors shall be color coded Black (Phase A), Red (Phase B), Blue (Phase C), and White (Neutral). On 277/480V, 3 phase, 4 wire systems, conductors shall be color coded Brown (Phase A), Orange (Phase B), Yellow (Phase C), and Gray (Neutral).
- Insulation for grounding conductors on all systems shall be Green.
- Conductors #8 AWG and larger may be identified with two or more bands of proper color plastic tape applied near each splice and termination. Painting of wire will not be acceptable.
- Phase sequence shall be "A", "B", and "C" from left to right, top to bottom or front to back when facing equipment.

2.3 BRANCH CIRCUIT RACEWAY WIRING

- Three-phase circuits shall be limited to one such circuit per raceway. They shall consist of three different phase wires, and a neutral where required.
- A neutral shall not serve more than one circuit. The neutral carrying all or any part of the current of any specific load shall be contained in the same raceway or enclosure with the phase wire or wires also carrying that current.
- Circuits shall be connected to panels as shown in the panel schedules.
- Under the above requirements and with required color coding system no raceway shall contain more than one wire of the same color, except for switch legs and control conductors.
- Conductors supplying lighting outlets may be combined in the same raceways with conductors supplying receptacles, but lighting outlets and receptacle outlets shall not be connected to the same circuits unless specifically indicated on the drawings.

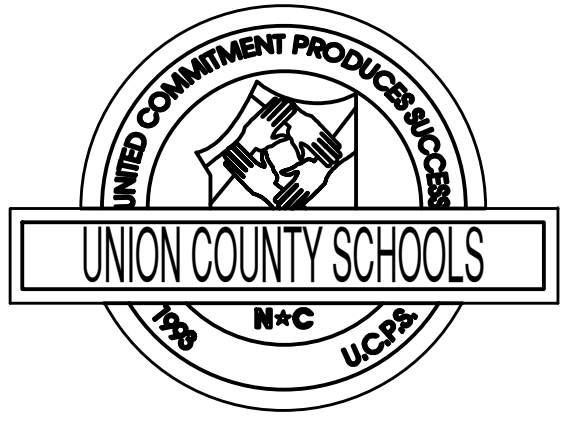
2.4 SERVICE & FEEDER CONDUCTORS

- Unless specifically shown otherwise, each feeder and each set of service conductors shall be installed in a separate raceway.
- Where paralleling of conductors is shown for service or service entrance, it is absolutely required that they be exactly the same length between terminations.
- Where service or feeder conductors are so installed that the conductor markings cannot be read without moving or twisting conductors, they shall be provided with suitable tags indicating the conductor size and insulation.

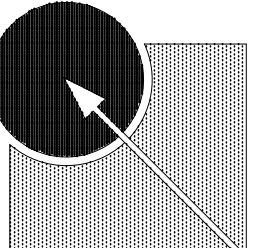
GROUNDING AND BONDING

1.1 SCOPE

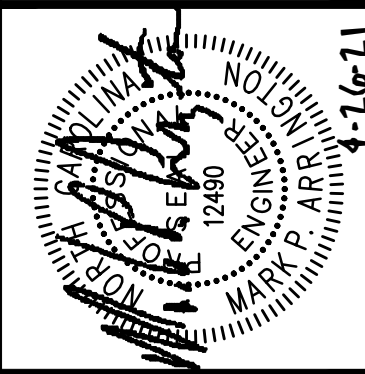
- The electric system neutral, the neutral of each separately derived system, and all non-current-carrying metal parts, raceways, and enclosures shall be permanently and effectively grounded.
 - Grounding and bonding shall be provided in strict accordance with the National Electrical Code, and as specified herein and on the drawings.
 - The Contractor shall note that required grounding conductors and connections are not all shown on the drawings. NEC requirements apply.
- ##### 2.1 MATERIALS AND APPLICATIONS
- Grounding conductors shall be of THWN insulated copper, unless otherwise indicated.
 - Grounding bus bars in distribution equipment shall be bare copper.
 - Clamps for attaching conductors to water pipes and ground rods shall be of bronze. Ground rod clamps shall be UL listed for direct burial.
 - Clamps for attaching conductors to building steel shall be of steel, bronze, or malleable iron.
 - Threaded hubs for bonding metal raceways to the contained grounding electrode conductors and to the water pipe clamps shall be of bronze or malleable iron. Similar hubs shall be used to bond the same raceways to the conductors and



MONROE
HIGH SCHOOL



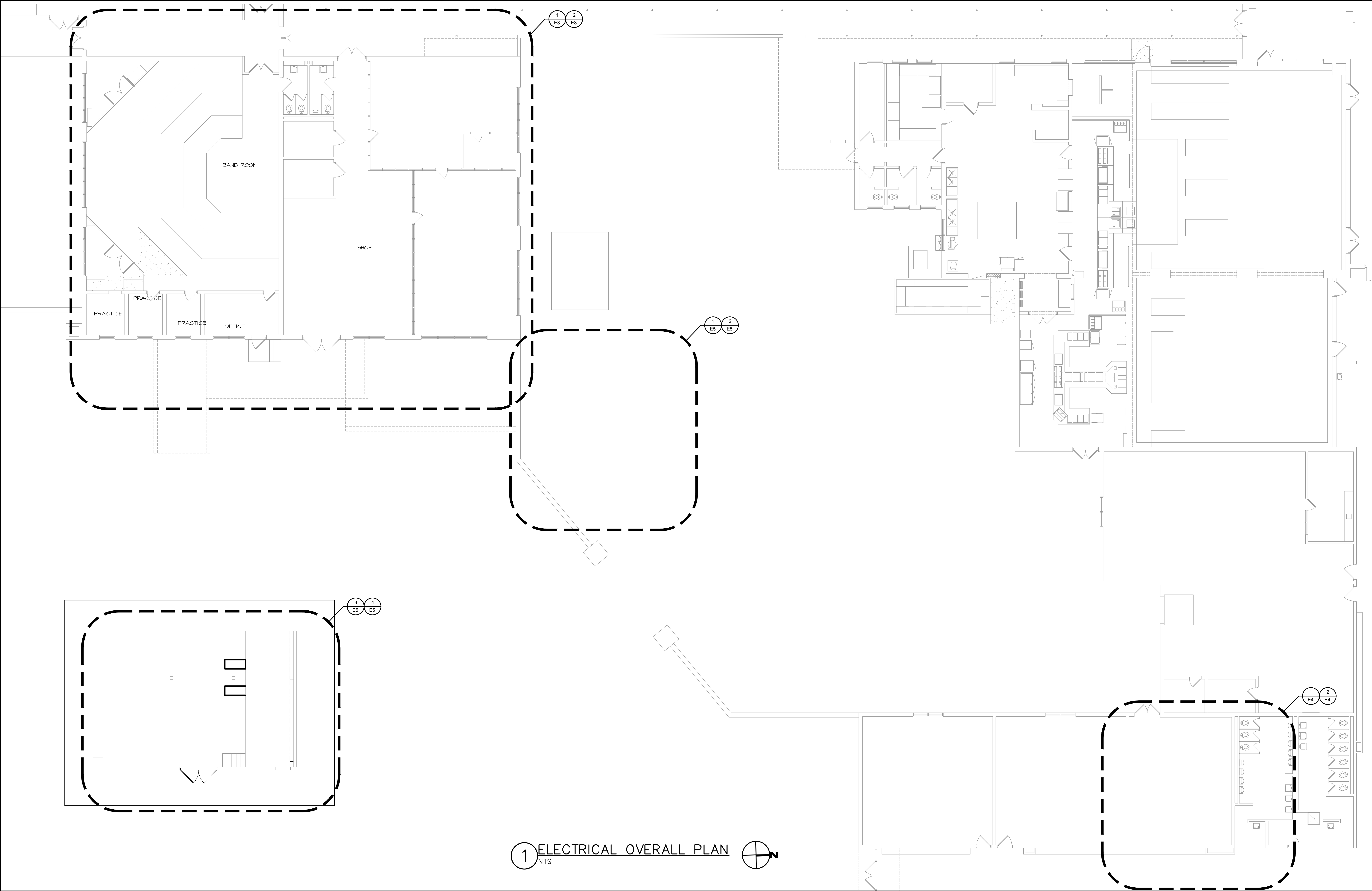
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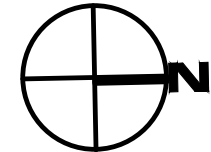
JOB NUMBER	21-054	REVISION DATES
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CHECKED BY	WPA	
DATE	4/26/2021	

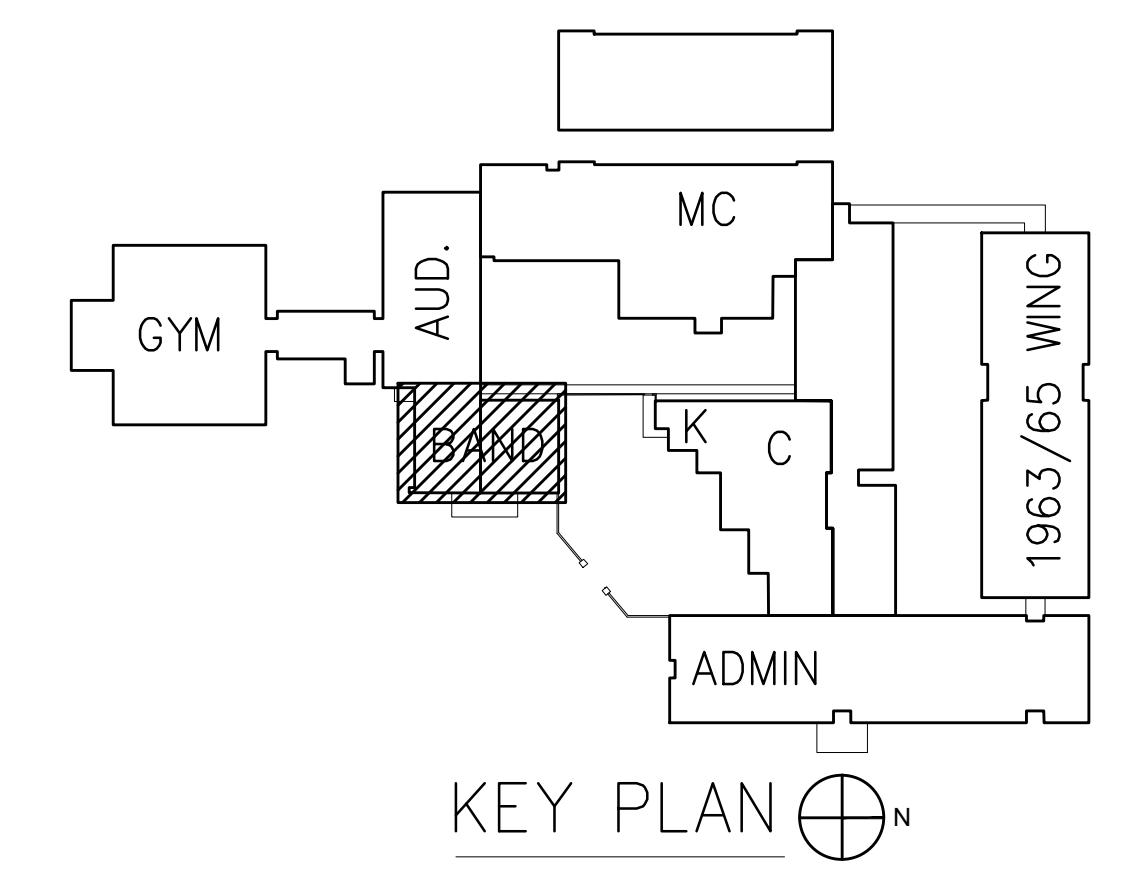
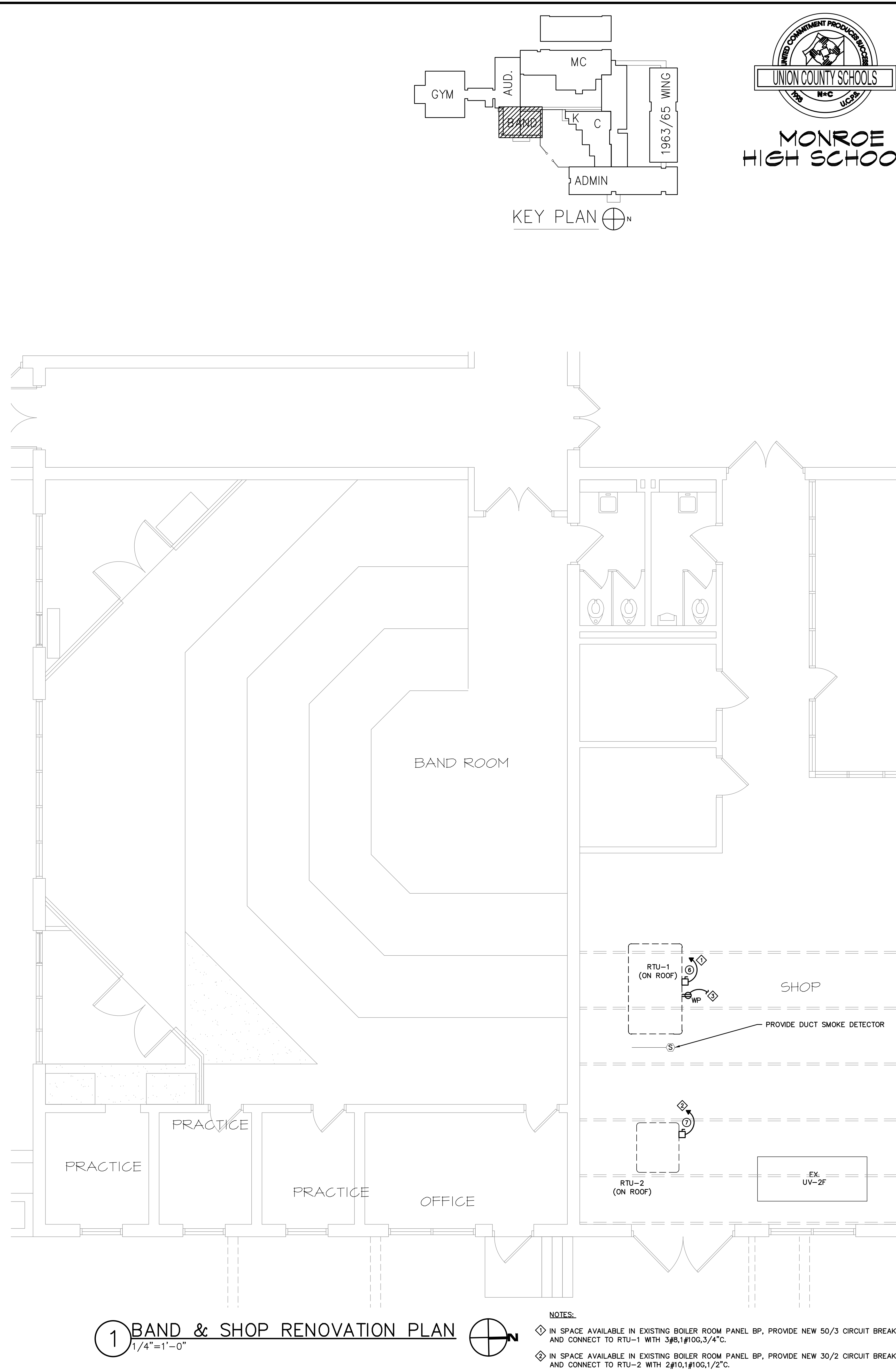
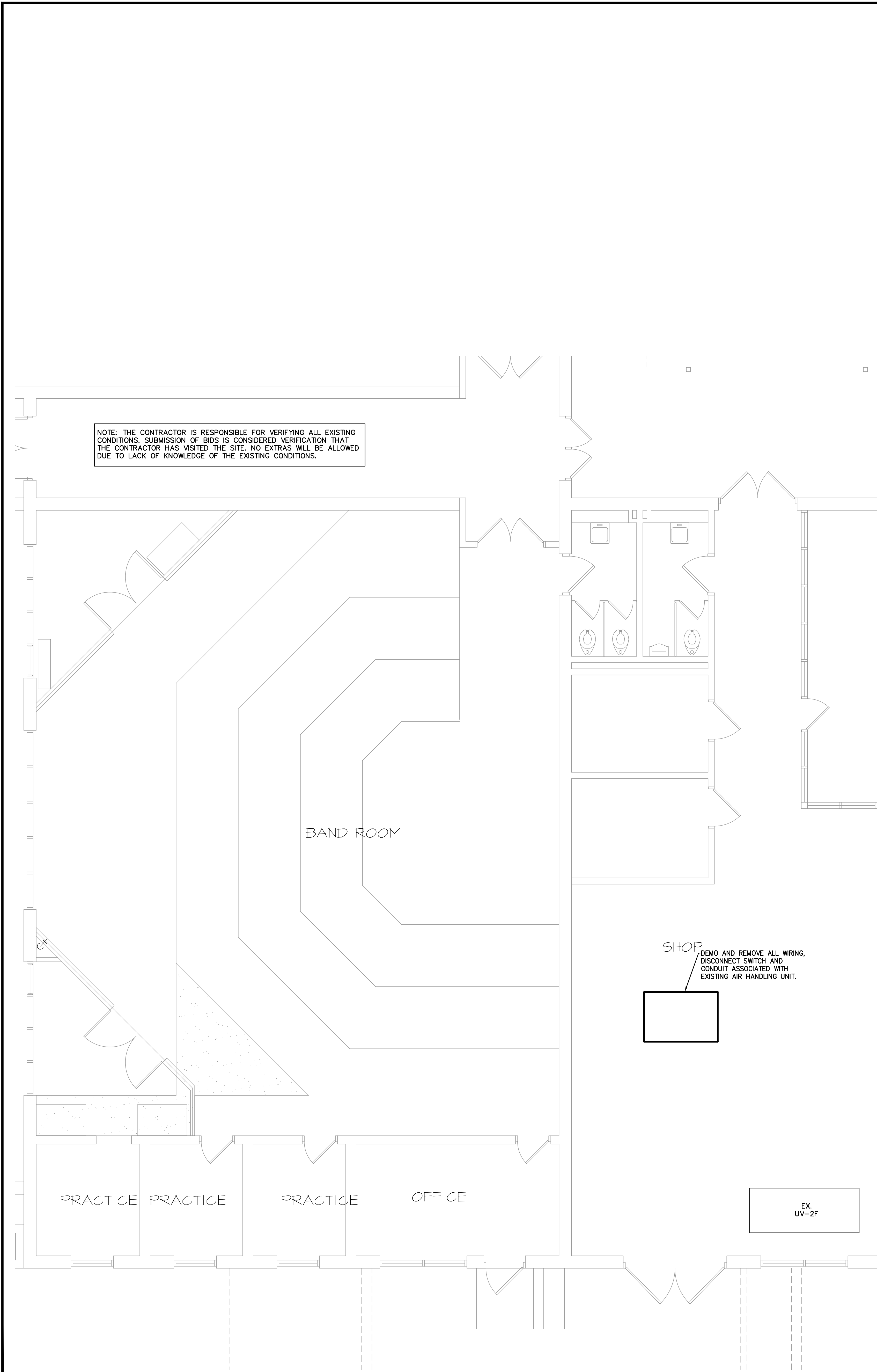
MONROE HIGH SCHOOL
CIP – HVAC IMPROVEMENTS

ELECTRICAL OVERALL PLAN

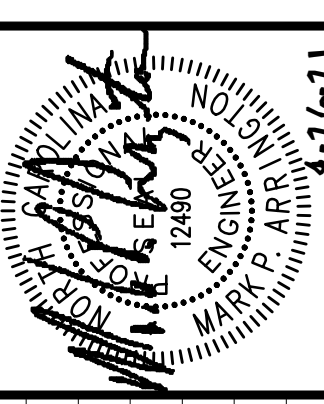


1 ELECTRICAL OVERALL PLAN
NTS





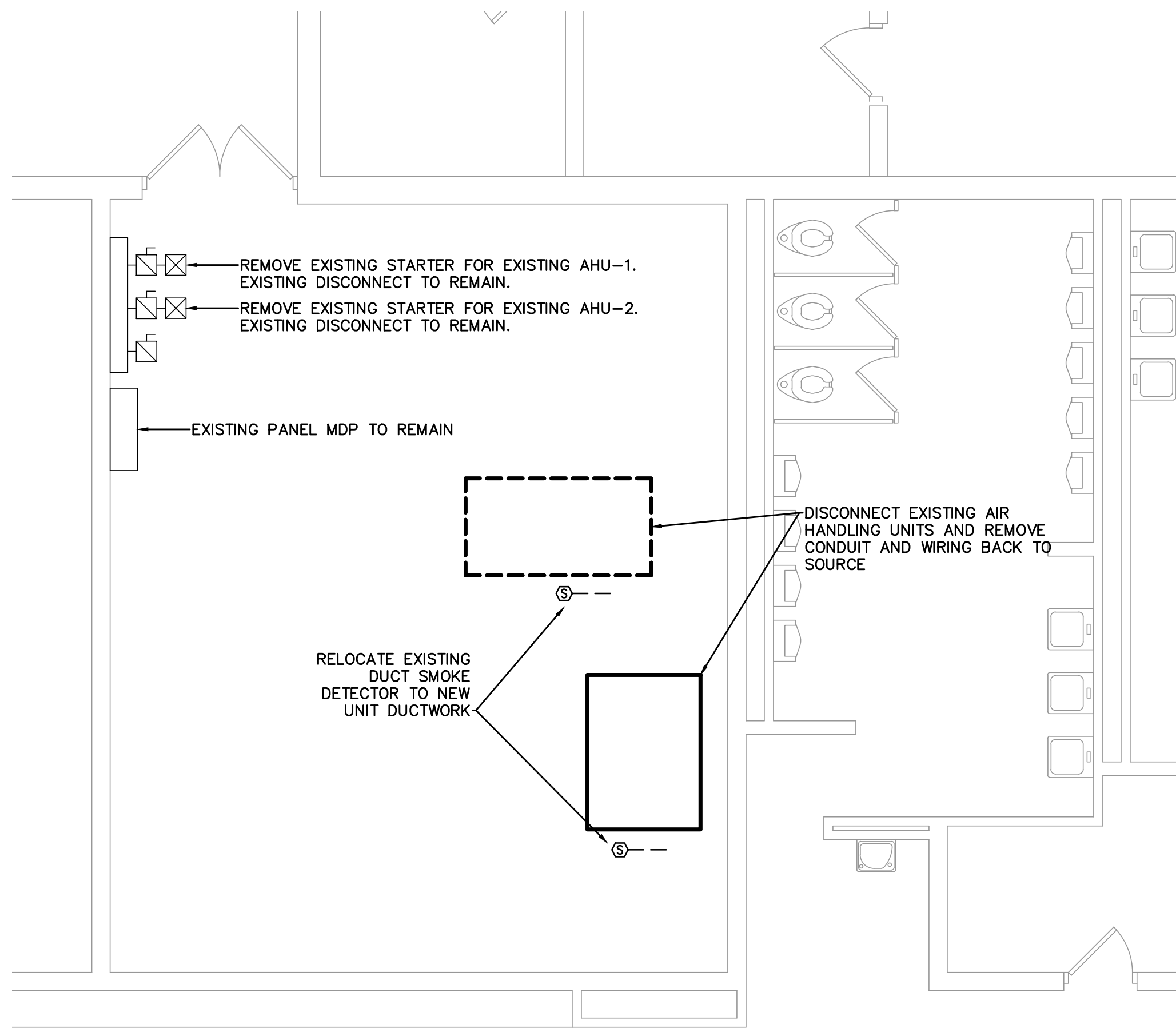
McKNIGHT • SMITH • WARD • GRIFFIN
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PO Box 240826 • 4223 South Boulevard
Charlotte, NC 28224 • 704/527-2112



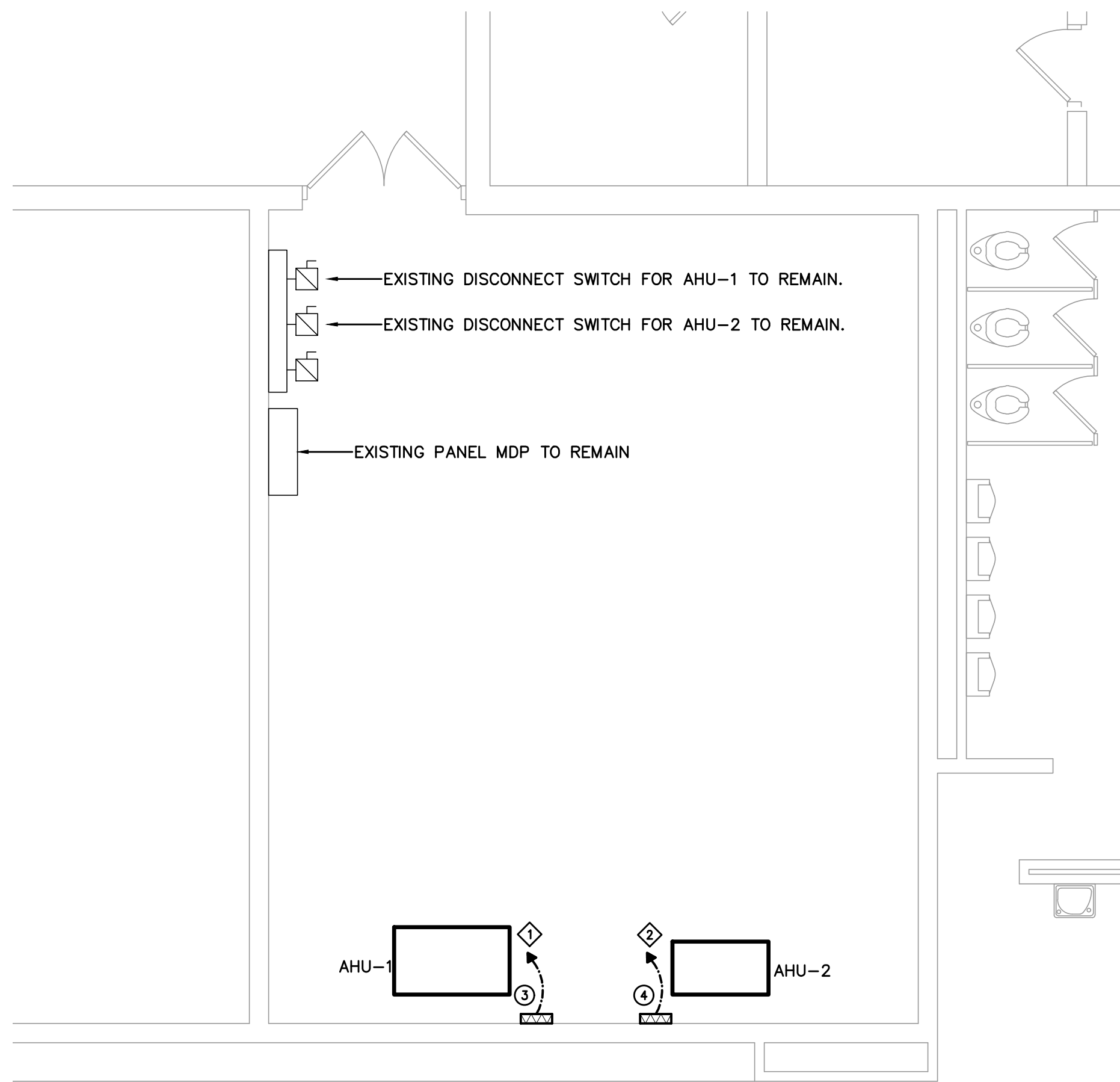
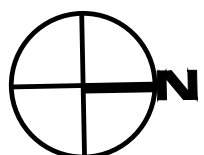
JOB NUMBER	21-054	REVISION DATES
DRAWN BY	MDK	
CHECKED BY	MPA	
DATE	4/26/2021	

MONROE HIGH SCHOOL
CIP - HVAC IMPROVEMENTS

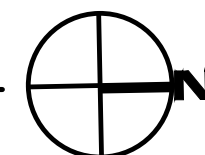
ENLARGED PLANS
BAND ROOM



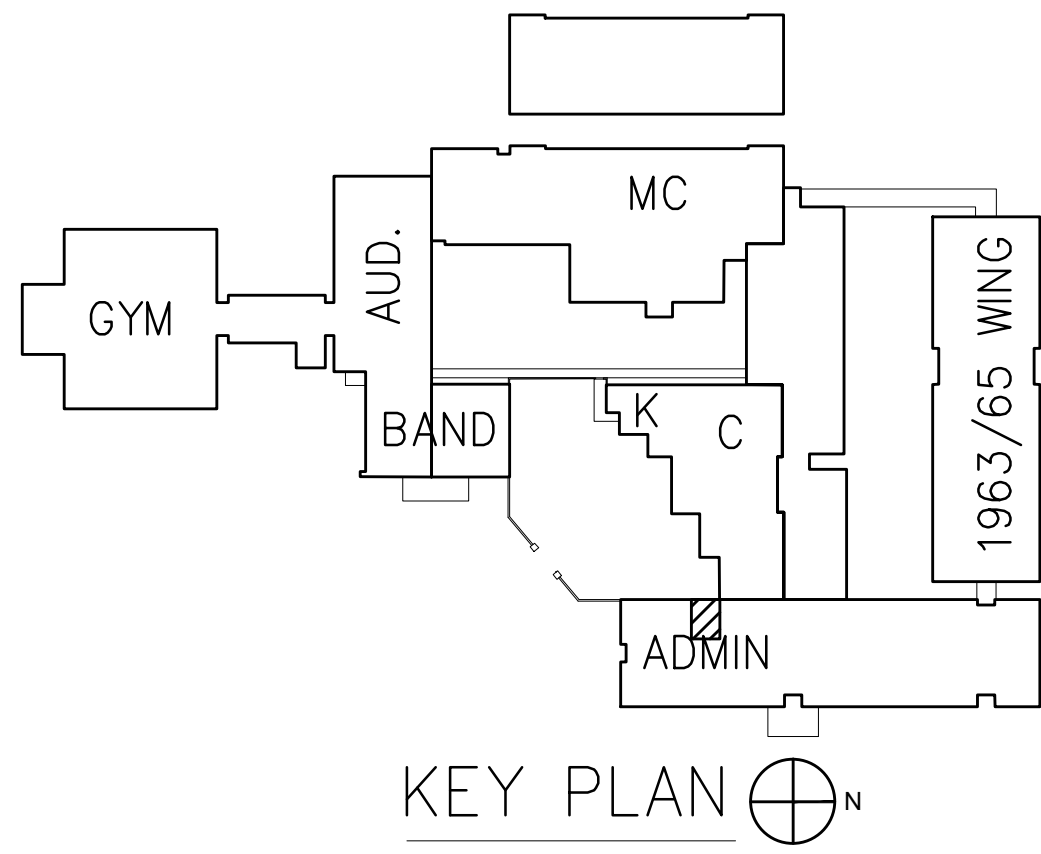
1 ADMIN MECH. RM. DEMOLITION PLAN
1/4"=1'-0"



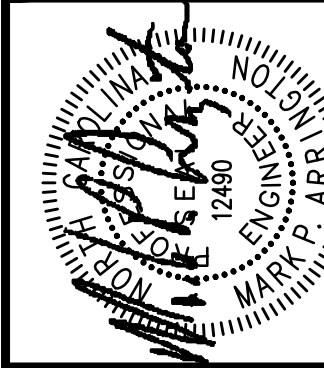
2 ADMIN MECH. RM. RENOVATION PLAN
1/4"=1'-0"



- NOTES:
- CONNECT TO EXISTING DISCONNECT SWITCH FOR AHU-1 WITH 3#12,1#12G,1/2"C. REPLACE EXISTING 10A FUSES (3) IN DISCONNECT SWITCH WITH NEW 15A FUSES.
 - CONNECT TO EXISTING DISCONNECT SWITCH FOR AHU-2 WITH 3#12,1#12G,1/2"C. REPLACE EXISTING 5A FUSES (3) IN DISCONNECT SWITCH WITH NEW 7A FUSES.



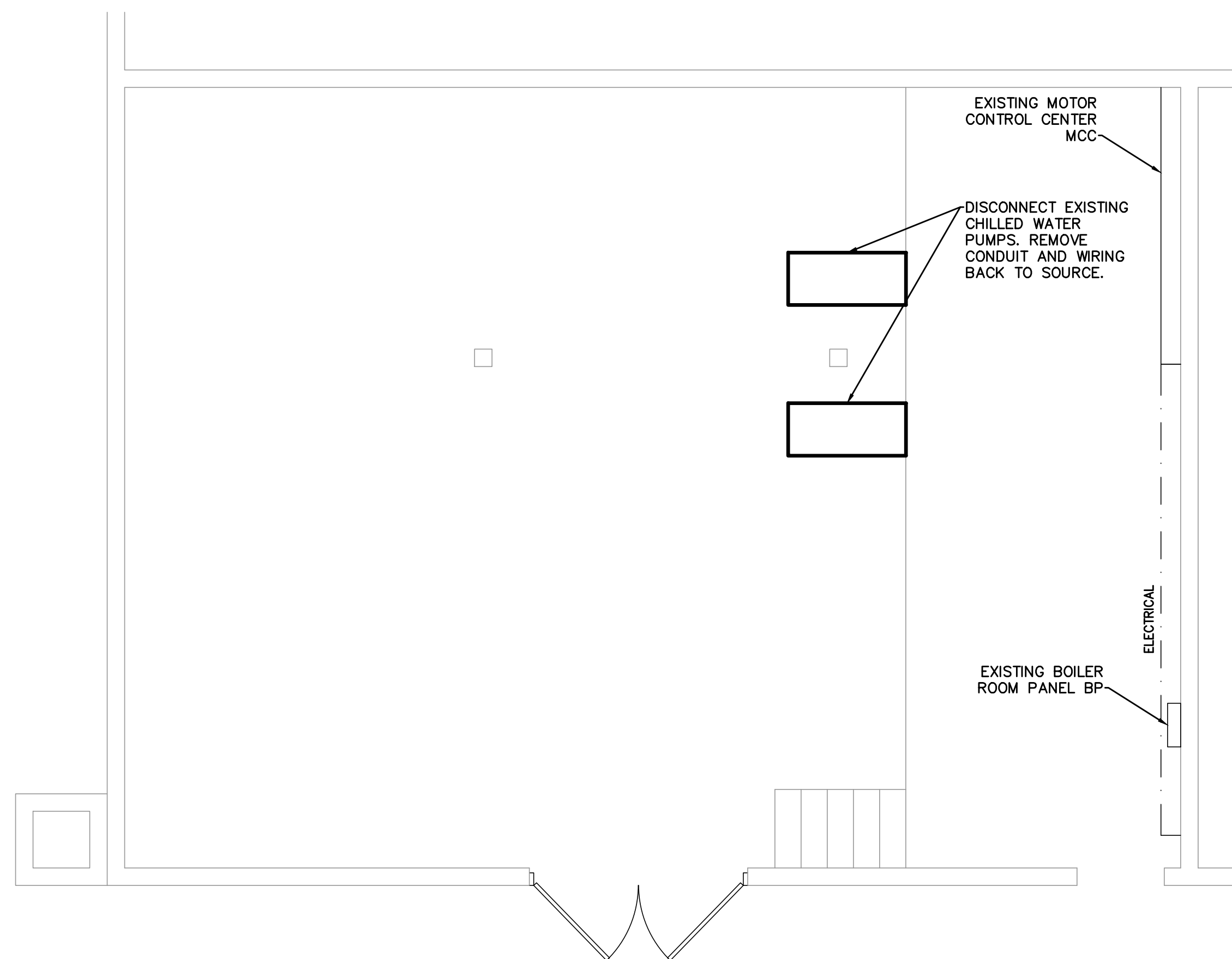
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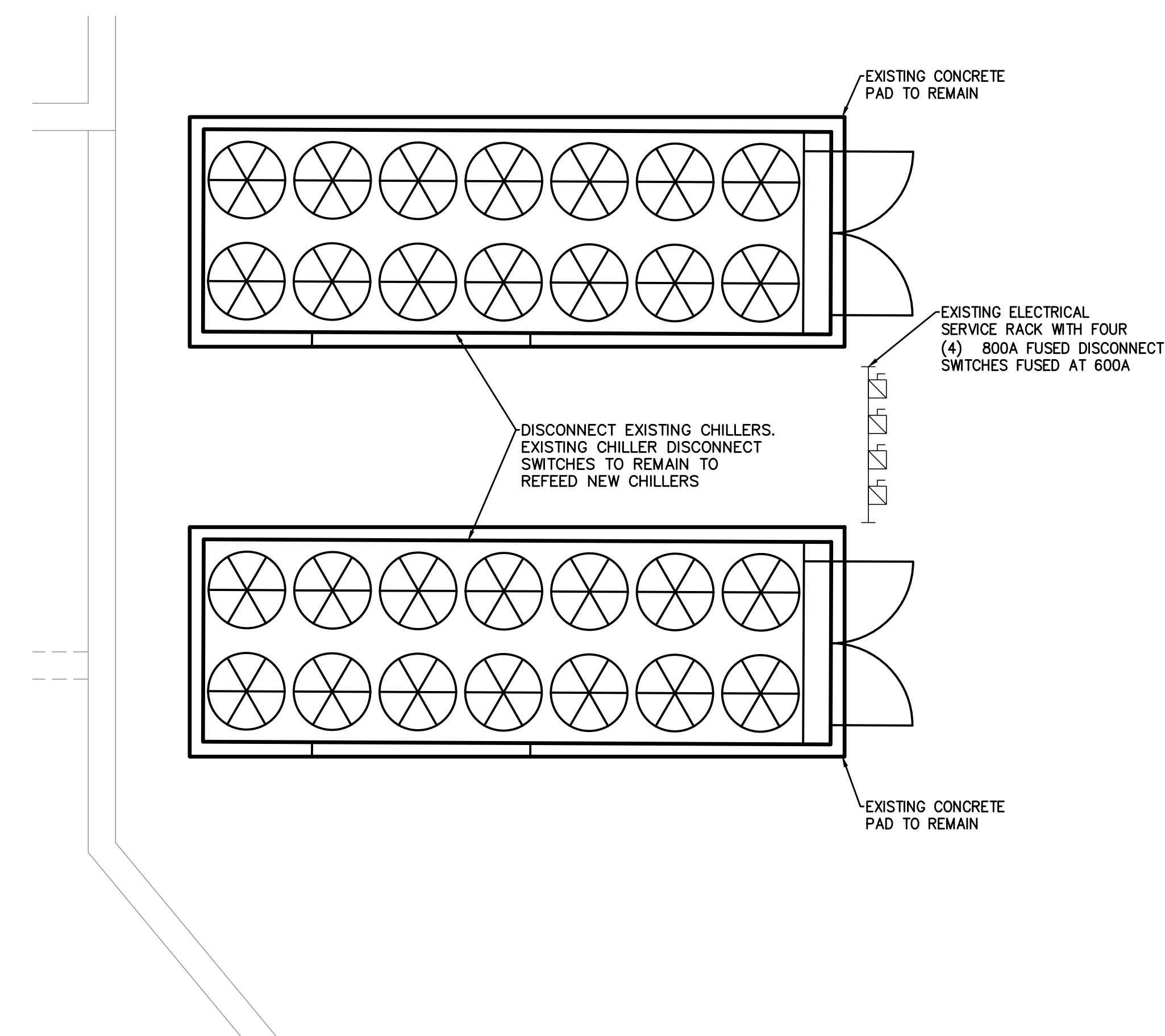
JOB NUMBER	21-054	REVISION DATES
DRAWN BY	MDK	
CHECKED BY	WPA	
DATE	4/26/2021	

JOB TITLE
MONROE HIGH SCHOOL
CIP - HVAC IMPROVEMENTS

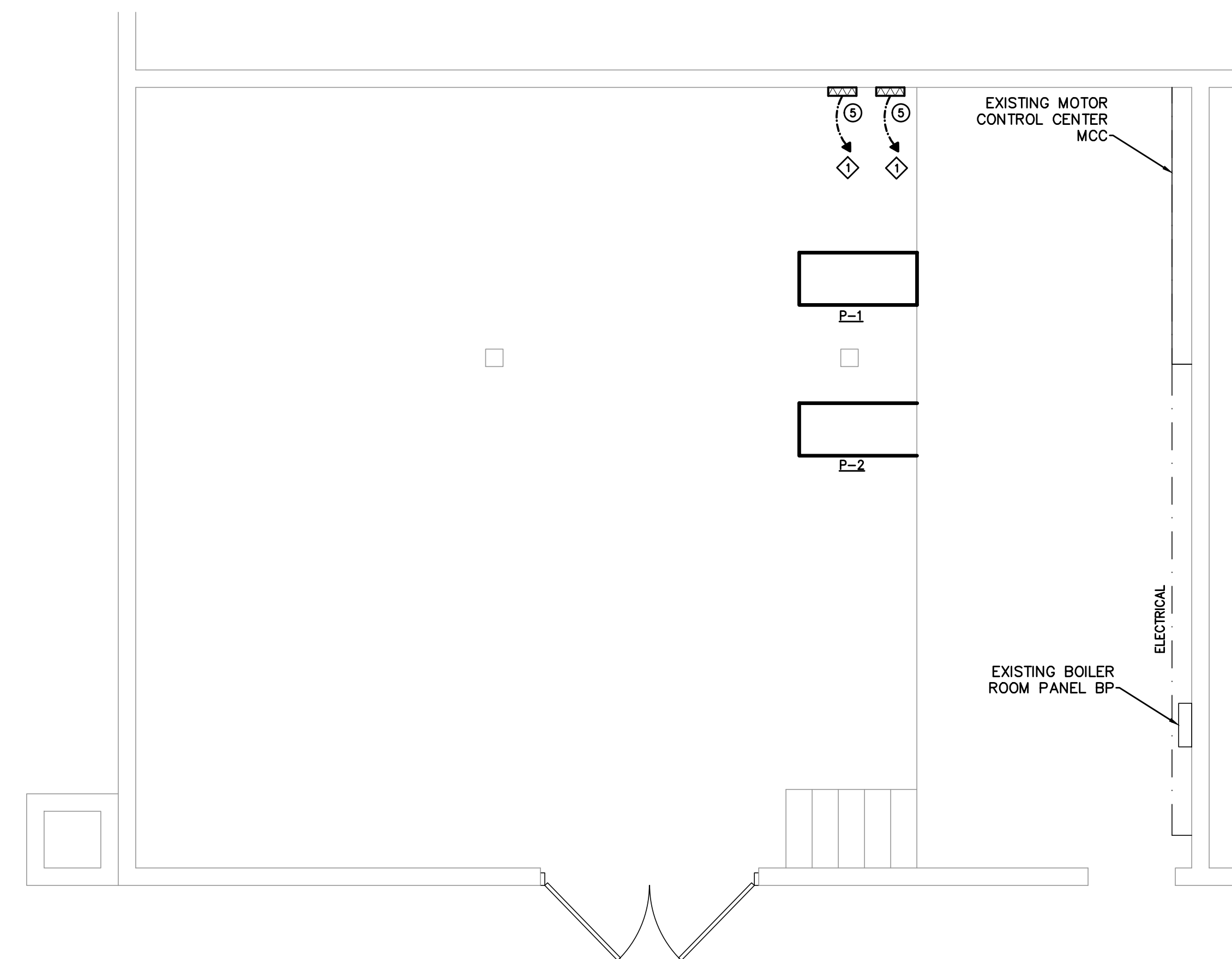
JOB TITLE
ENLARGED PLANS
MECHANICAL ROOM



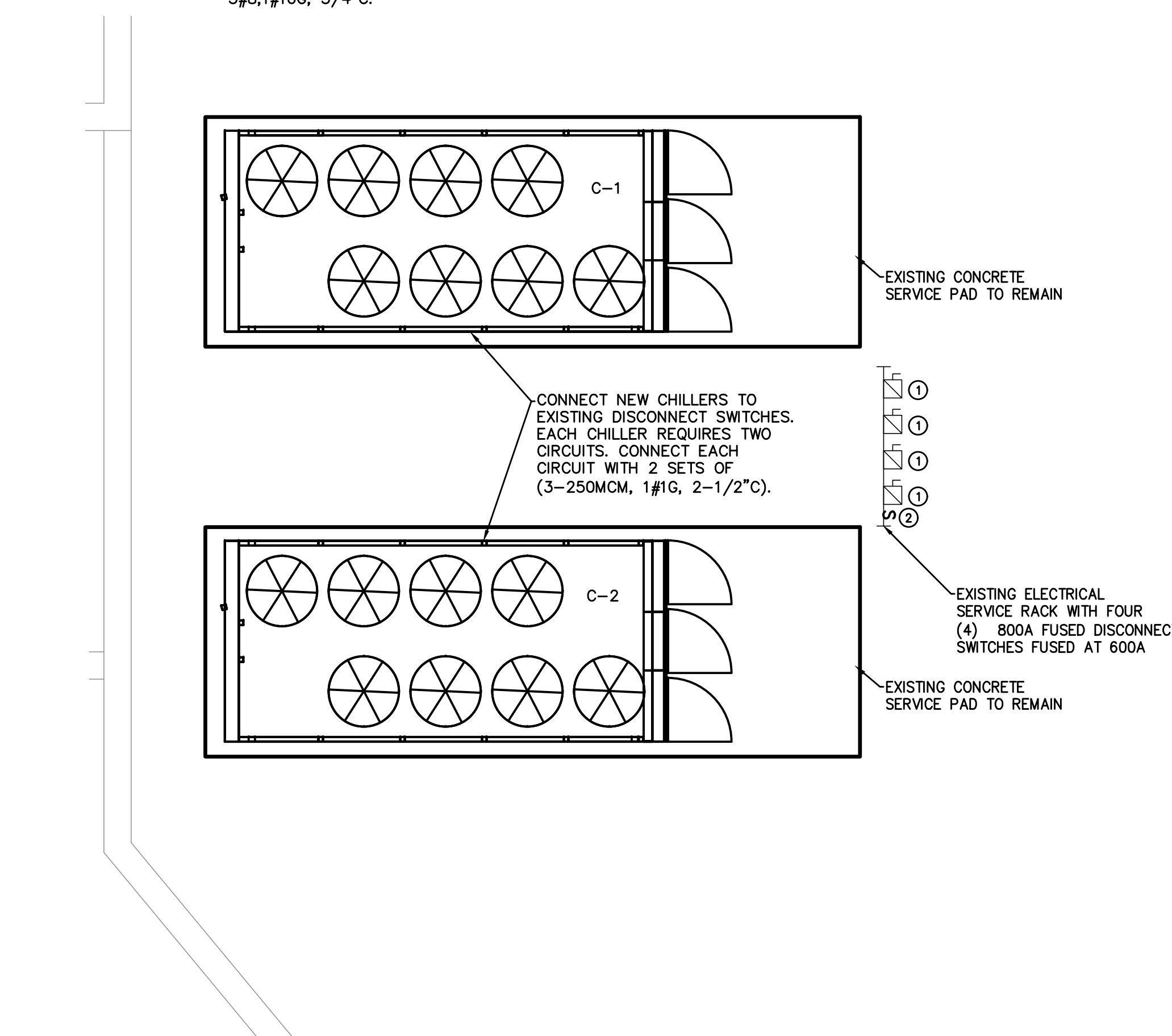
3 BOILER ROOM DEMOLITION PLAN
1/4"=1'-0"



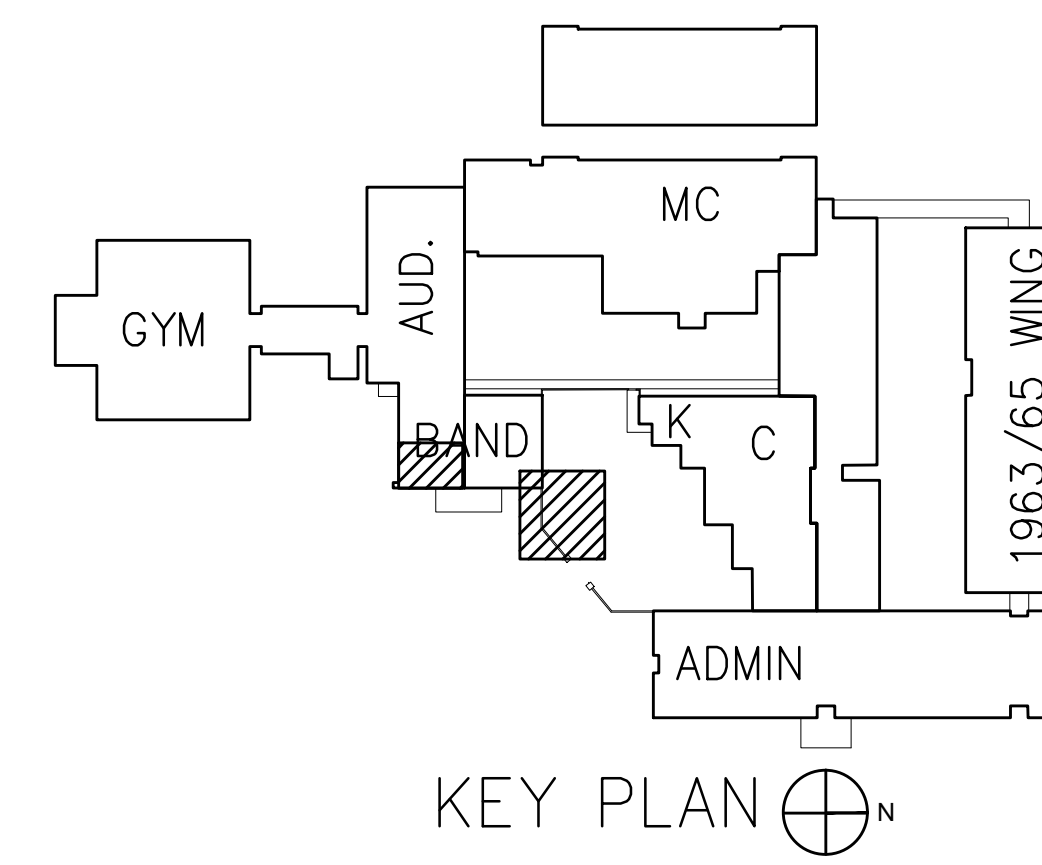
1 CHILLER DEMOLITION PLAN
1/4"=1'-0"



4 BOILER ROOM RENOVATION PLAN
1/4"=1'-0"



2 CHILLER RENOVATION PLAN
1/4"=1'-0"



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JOB NUMBER	21-054	REVISION DATES	
DRAWN BY	WJK		
CHECKED BY	WPA		
DATE	4/26/2021		

MONROE HIGH SCHOOL
CIP - HVAC IMPROVEMENTS

ENLARGED PLANS
CHILLERS & PUMPS

MINORITY BUSINESS CONTRACT PROVISIONS (CONSTRUCTION)

APPLICATION:

The **Guidelines for Recruitment and Selection of Minority Businesses for Participation in State Construction Contracts** are hereby made a part of these contract documents. These guidelines shall apply to all contractors regardless of ownership. Copies of these guidelines may be obtained from the Department of Administration, State Construction Office, (physical address) 301 North Wilmington Street, Suite 450, NC Education Building, Raleigh, North Carolina, 27601-2827, (mail address) 1307 Mail Service Center, Raleigh, North Carolina, 27699-1307, phone (919) 807-4100, Website: <http://www.nc-sco.com>

MINORITY BUSINESS SUBCONTRACT GOALS:

The goals for participation by minority firms as subcontractors on this project have been set at 10%.

The bidder must identify on its bid, the minority businesses that will be utilized on the project with corresponding total dollar value of the bid and affidavit (Affidavit A) listing good faith efforts **or** affidavit (Affidavit B) of self-performance of work, if the bidder will perform work under contract by its own workforce, as required by G.S. 143-128.2(c) and G.S. 143-128.2(f).

The lowest responsible, responsive bidder must provide Affidavit C, that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, which is equal to or more than the applicable goal.

OR

Provide Affidavit D, that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, **with documentation of Good Faith Effort, if the percentage is not equal to the applicable goal.**

OR

Provide Affidavit B, which includes sufficient information for the State to determine that the bidder does not customarily subcontract work on this type project.

The above information must be provided as required. Failure to submit these documents is grounds for rejection of the bid.

MINIMUM COMPLIANCE REQUIREMENTS:

All written statements, affidavits or intentions made by the Bidder shall become a part of the agreement between the Contractor and the State for performance of this contract. Failure to comply with any of these statements, affidavits or intentions, or with the minority business Guidelines shall constitute a breach of the contract. A finding by the State that any information submitted either prior to award of the contract or during the performance of the contract is inaccurate, false or incomplete, shall also constitute a breach of the contract. Any such breach may result in termination of the contract in accordance with the termination provisions contained in the contract. It shall be solely at the option of the State whether to terminate the contract for breach.

In determining whether a contractor has made Good Faith Efforts, the State will evaluate all efforts made by the Contractor and will determine compliance in regard to quantity, intensity, and results of these efforts. Good Faith Efforts include:

- (1) Contacting minority businesses that reasonably could have been expected to submit a quote and that were known to the contractor or available on State or local government maintained lists at least 10 days before the bid or proposal date and notifying them of the nature and scope of the work to be performed.
- (2) Making the construction plans, specifications and requirements available for review by prospective minority businesses, or providing these documents to them at least 10 days before the bid or proposals are due.
- (3) Breaking down or combining elements of work into economically feasible units to facilitate minority participation.
- (4) Working with minority trade, community, or contractor organizations identified by the Office for Historically Underutilized Businesses and included in the bid documents that provide assistance in recruitment of minority businesses.
- (5) Attending any prebid meetings scheduled by the public owner.
- (6) Providing assistance in getting required bonding or insurance or providing alternatives to bonding or insurance for subcontractors.
- (7) Negotiating in good faith with interested minority businesses and not rejecting them as unqualified without sound reasons based on their capabilities. Any rejection of a minority business based on lack of qualification should have the reasons documented in writing.
- (8) Providing assistance to an otherwise qualified minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letters of credit, including waiving credit that is ordinarily required. Assisting minority businesses in obtaining the same unit pricing with the bidder's suppliers in order to help minority businesses in establishing credit.
- (9) Negotiating joint venture and partnership arrangements with minority businesses in order to increase opportunities for minority business participation on a public construction or repair project when possible.
- (10) Providing quick pay agreements and policies to enable minority contractors and suppliers to meet cash-flow demands.

Attach to Bid Attach to Bid Attach to Bid Attach to Bid Attach to Bid Attach to Bid Attach to Bid Attach to Bid

State of North Carolina AFFIDAVIT A – Listing of Good Faith Efforts

County of _____

(Name of Bidder)

Affidavit of _____

I have made a good faith effort to comply under the following areas checked:

Bidders must earn at least 50 points from the good faith efforts listed for their bid to be considered responsive. (1 NC Administrative Code 30 I.0101)

- ☐ **1 – (10 pts)** Contacted minority businesses that reasonably could have been expected to submit a quote and that were known to the contractor, or available on State or local government maintained lists, at least 10 days before the bid date and notified them of the nature and scope of the work to be performed.
- ☐ **2 --(10 pts)** Made the construction plans, specifications and requirements available for review by prospective minority businesses, or providing these documents to them at least 10 days before the bids are due.
- ☐ **3 – (15 pts)** Broken down or combined elements of work into economically feasible units to facilitate minority participation.
- ☐ **4 – (10 pts)** Worked with minority trade, community, or contractor organizations identified by the Office of Historically Underutilized Businesses and included in the bid documents that provide assistance in recruitment of minority businesses.
- ☐ **5 – (10 pts)** Attended prebid meetings scheduled by the public owner.
- ☐ **6 – (20 pts)** Provided assistance in getting required bonding or insurance or provided alternatives to bonding or insurance for subcontractors.
- ☐ **7 – (15 pts)** Negotiated in good faith with interested minority businesses and did not reject them as unqualified without sound reasons based on their capabilities. Any rejection of a minority business based on lack of qualification should have the reasons documented in writing.
- ☐ **8 – (25 pts)** Provided assistance to an otherwise qualified minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letters of credit, including waiving credit that is ordinarily required. Assisted minority businesses in obtaining the same unit pricing with the bidder's suppliers in order to help minority businesses in establishing credit.
- ☐ **9 – (20 pts)** Negotiated joint venture and partnership arrangements with minority businesses in order to increase opportunities for minority business participation on a public construction or repair project when possible.
- ☐ **10 - (20 pts)** Provided quick pay agreements and policies to enable minority contractors and suppliers to meet cash-flow demands.

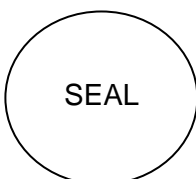
The undersigned, if apparent low bidder, will enter into a formal agreement with the firms listed in the Identification of Minority Business Participation schedule conditional upon scope of contract to be executed with the Owner. Substitution of contractors must be in accordance with GS143-128.2(d) Failure to abide by this statutory provision will constitute a breach of the contract.

The undersigned hereby certifies that he or she has read the terms of the minority business commitment and is authorized to bind the bidder to the commitment herein set forth.

Date: _____ Name of Authorized Officer: _____

Signature: _____

Title: _____



State of _____, County of _____

Subscribed and sworn to before me this _____ day of _____ 20____

Notary Public _____

My commission expires _____

Attach to Bid Attach to Bid Attach to Bid Attach to Bid Attach to Bid Attach to Bid Attach to Bid Attach to Bid

**State of North Carolina --AFFIDAVIT B-- Intent to Perform Contract
with Own Workforce.**

County of _____

Affidavit of _____

(Name of Bidder)

I hereby certify that it is our intent to perform 100% of the work required for the _____

_____contract.

(Name of Project)

In making this certification, the Bidder states that the Bidder does not customarily subcontract elements of this type project, and normally performs and has the capability to perform and will perform all elements of the work on this project with his/her own current work forces; and

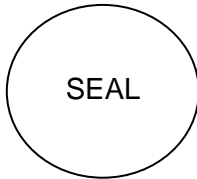
The Bidder agrees to provide any additional information or documentation requested by the owner in support of the above statement. The Bidder agrees to make a Good Faith Effort to utilize minority suppliers where possible.

The undersigned hereby certifies that he or she has read this certification and is authorized to bind the Bidder to the commitments herein contained.

Date: _____ Name of Authorized Officer: _____

Signature: _____

Title: _____



State of _____, County of _____

Subscribed and sworn to before me this _____ day of _____ 20____

Notary Public _____

My commission expires _____

Attach to Bid Attach to Bid Attach to Bid Attach to Bid Attach to Bid Attach to Bid Attach to Bid Attach to Bid

Identification of HUB Certified/ Minority Business Participation

I, _____,
(Name of Bidder)

do hereby certify that on this project, we will use the following HUB Certified/ minority business as construction subcontractors, vendors, suppliers or providers of professional services.

Firm Name, Address and Phone #	Work Type	*Minority Category	**HUB Certified (Y/N)

*Minority categories: Black, African American (B), Hispanic (H), Asian American (A) American Indian (I), Female (F) Socially and Economically Disadvantaged (D)

** HUB Certification with the state HUB Office required to be counted toward state participation goals.

The total value of minority business contracting will be (\$)_____.

Do not submit with bid Do not submit with bid Do not submit with bid Do not submit with bid

State of North Carolina - AFFIDAVIT C - Portion of the Work to be Performed by HUB Certified/Minority Businesses

County of _____

(Note this form is to be submitted only by the apparent lowest responsible, responsive bidder.)

If the portion of the work to be executed by HUB certified/minority businesses as defined in GS143-128.2(g) and 128.4(a),(b),(e) is equal to or greater than 10% of the bidders total contract price, then the bidder must complete this affidavit.

This affidavit shall be provided by the apparent lowest responsible, responsive bidder within **72 hours** after notification of being low bidder.

Affidavit of _____ I do hereby certify that on the _____
(Name of Bidder)

(Project Name)
Project ID# _____ Amount of Bid \$ _____

I will expend a minimum of _____% of the total dollar amount of the contract with minority business enterprises. Minority businesses will be employed as construction subcontractors, vendors, suppliers or providers of professional services. Such work will be subcontracted to the following firms listed below.

Attach additional sheets if required

Name and Phone Number	*Minority Category	**HUB Certified Y/N	Work Description	Dollar Value

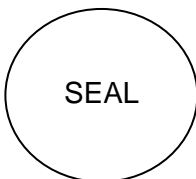
*Minority categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**) Socially and Economically Disadvantaged (**D**)

**** HUB Certification with the state HUB Office required to be counted toward state participation goals.**

Pursuant to GS143-128.2(d), the undersigned will enter into a formal agreement with Minority Firms for work listed in this schedule conditional upon execution of a contract with the Owner. Failure to fulfill this commitment may constitute a breach of the contract.

The undersigned hereby certifies that he or she has read the terms of this commitment and is authorized to bind the bidder to the commitment herein set forth.

Date: _____ Name of Authorized Officer: _____



Signature: _____

Title: _____

State of _____, County of _____

Subscribed and sworn to before me this _____ day of _____ 20____

Notary Public _____

My commission expires _____

Do not submit with the bid Do not submit with the bid Do not submit with the bid Do not submit with the bid Do not submit with the bid

State of North Carolina AFFIDAVIT D – Good Faith Efforts

County of _____

(Note this form is to be submitted only by the apparent lowest responsible, responsive bidder.)

If the goal of 10% participation by HUB Certified/ minority business **is not** achieved, the Bidder shall provide the following documentation to the Owner of his good faith efforts:

Affidavit of _____ I do hereby certify that on the
(Name of Bidder)

(Project Name)
Project ID# _____ Amount of Bid \$ _____

I will expend a minimum of _____% of the total dollar amount of the contract with HUB certified/ minority business enterprises. Minority businesses will be employed as construction subcontractors, vendors, suppliers or providers of professional services. Such work will be subcontracted to the following firms listed below. (Attach additional sheets if required)

Name and Phone Number	*Minority Category	**HUB Certified Y/N	Work Description	Dollar Value

*Minority categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**) Socially and Economically Disadvantaged (**D**)

**** HUB Certification with the state HUB Office required to be counted toward state participation goals.**

Examples of documentation that may be required to demonstrate the Bidder's good faith efforts to meet the goals set forth in these provisions include, but are not necessarily limited to, the following:

- Copies of solicitations for quotes to at least three (3) minority business firms from the source list provided by the State for each subcontract to be let under this contract (if 3 or more firms are shown on the source list). Each solicitation shall contain a specific description of the work to be subcontracted, location where bid documents can be reviewed, representative of the Prime Bidder to contact, and location, date and time when quotes must be received.
- Copies of quotes or responses received from each firm responding to the solicitation.
- A telephone log of follow-up calls to each firm sent a solicitation.
- For subcontracts where a minority business firm is not considered the lowest responsible sub-bidder, copies of quotes received from all firms submitting quotes for that particular subcontract.
- Documentation of any contacts or correspondence to minority business, community, or contractor organizations in an attempt to meet the goal.
- Copy of pre-bid roster
- Letter documenting efforts to provide assistance in obtaining required bonding or insurance for minority business.
- Letter detailing reasons for rejection of minority business due to lack of qualification.
- Letter documenting proposed assistance offered to minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letter of credit, including waiving credit that is ordinarily required.

Failure to provide the documentation as listed in these provisions may result in rejection of the bid and award to the next lowest responsible and responsive bidder.

Pursuant to GS143-128.2(d), the undersigned will enter into a formal agreement with Minority Firms for work listed in this schedule conditional upon execution of a contract with the Owner. Failure to fulfill this commitment may constitute a breach of the contract.

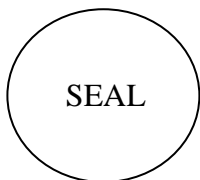
Do not submit with the bid Do not submit with the bid Do not submit with the bid Do not submit with the bid Do not submit with the bid

The undersigned hereby certifies that he or she has read the terms of this commitment and is authorized to bind the bidder to the commitment herein set forth.

Date: _____ Name of Authorized Officer: _____

Signature: _____

Title: _____



State of _____, County of _____

Subscribed and sworn to before me this _____ day of _____ 20____

Notary Public _____

My commission expires _____

APPENDIX E**MBE DOCUMENTATION FOR CONTRACT PAYMENTS**

Prime Contractor/Architect: _____

Address & Phone: _____

Project Name: _____

Pay Application #: _____ Period: _____

The following is a list of payments made to Minority Business Enterprises on this project for the above-mentioned period.

MBE FIRM NAME	* INDICATE TYPE OF MBE	AMOUNT PAID THIS MONTH	TOTAL PAYMENTS TO DATE	TOTAL AMOUNT COMMITTED

*Minority categories: Black, African American (B), Hispanic (H), Asian American (A), American Indian (I), Female (F), Social and Economically Disadvantage (D)

Date: _____ Approved/Certified By: _____

Name

Title_____
Signature***SUBMIT WITH EACH PAY REQUEST & FINAL PAYMENT***



201 Venus Street
Monroe, NC 28112
704-296-9898
704-289-9182
ucps.k12.nc.us

Purchasing and Contract

ADDENDUM 1

PROJECT: Monroe High School
BID DUE DATE: 3:00 p.m., June 1, 2016

Contractor shall fulfill all requirements contained in bid documents, including additions, revisions noted below.

Contractor information is required to be submitted with bid. See attached form.
See Narrative and Revised Drawings by Mcknight Smith Ward Griffin Engineers.

END OF ADDENDUM

Bid No. 1-97336074Title: Monroe High School HVAC RenovationsOFFEROR: Superior Mechanical Services, Inc.STREET ADDRESS: 607 Industrial Avenue, Greensboro, NC 27406PRINT NAME: James R. FieldsTITLE: PresidentSIGNATURE: 

Subcontractors planned for this project:

1. Company Name: Industrial & Commercial Insulation
Street Address: 118 Sullivan St., Greensboro, NC 27405
Telephone No: 336-274-1605
Trade: Insulation
2. Company Name: Elrod Electrical
Street Address: 207 SW Gate Dr., Suite E, Greensboro, NC 27407
Telephone No: 336-852-7776
Trade: Electrical
3. Company Name: Control Stop
Street Address: 3416 Carolina Ave., Charlotte, NC 28208
Telephone No: 704-248-2376
Trade: Controls
4. Company Name: Lay Heating & Air
Street Address: 809 Post St., Greensboro, NC, 27405
Telephone No: 336-274-6323
Trade: Ductwork

Monroe High School
Addendum #1
May 3, 2021

1. There are no approved requests for substitutions at this time.
2. M1 MECHANICAL SCHEDULES
 - a. Air Cooled Chiller Schedule
 - i. Add note #11, Provide Manufacturer's Hail Guards and Security Guards
 - b. Air Cooled Chiller Schedule
 - i. Note #6, Provide Screw Compressors only. Substitution of scroll compressors and plate heat exchangers shall not be accepted.
 - ii. Note #10, provide router for Bacnet over IP integration into existing campus BAS.
 - c. Air Cooled Chiller Schedule
 - i. Add Note #12, Provide Low Sound Option to include insulation on suction and discharge piping and compressor to provide a minimum 5 dB sound level reduction.
 - d. Packaged RTU with Gas Heat Schedule
 - i. RTU-2, Remarks, remove note 7, hot gas reheat is not an option for 2-ton packaged unit.
 - e. Packaged RTU with Gas Heat Schedule
 - i. Revise note 1 as follows: Models by Trane. Refer to Approved Manufacturer's List for Approved Equals.
 - f. Approved Manufacturer Listing
 - i. DDC Controls Manufacturer's change to refer to spec section 230900
 - ii. Remove reference to JCI/York for Air Cooled Chillers, Modular Air Handling Units, Packaged Rooftop Units
 - iii. Remove line items for spiral ductwork and wall louvers
3. M3 MECHANICAL ENLARGED PLANS BAND ROOM
 - a. Roof warranty note: The contractor is responsible for contracting with the owner's existing roofing contractor to meet the requirements of the existing roofing warranty. Contact AAR, warranty number RO-073969, contact number is 800.428.4442.
 - b. Asbestos removal note: UCPS is not aware of asbestos-containing materials in the project area. If Contractor becomes suspicious of ACM, they are to immediately stop and contact the assigned UCPS Project Manager for direction. If needed abatement shall be handled by owner.
 - c. Extend return duct from RTU-2 through Office and into each adjacent practice room. Two new wall openings will be required in existing CMU walls.
 - d. Extend 6" supply ducts from fabric duct in to each storage room.
 - e. Include a \$5,000 allowance for structural engineer to review and provide details as required for RTU support.
 - f. Include a \$5,000 allowance for re-routing existing electrical conduits to coordinate with new RTU and ductwork installation.
4. M5 MECHANICAL ENLARGED PLANS CHILLERS & PUMPS

- a. Owner shall recover refrigerant from existing chillers. Contractor shall provide Owner a minimum of one week's notice prior to chiller demolition.
- b. Remove and replace existing chilled water piping exposed above grade from chiller back to isolation valve. Provide new heat trace, and other devices as shown on details.

5. M6 MECHANICAL DETAILS

- a. Detail 1 and 12 have been revised to clarify point of connection to existing piping.

6. M7 MECHANICAL CAMPUS PLAN

- a. Contractor shall remove existing ceiling tiles and store for reinstallation. After insulation is performed, Contractor shall leave the area exposed until an inspection has been performed by Engineer and/or Owner. When approved, Contractor shall reinstall the ceiling tiles. Any missing or damaged tiles beyond Contractor's control will be furnished by Owner.

7. SPECIFICATION SECTION 23 09 00 BUILDING AUTOMATION SYSTEM (BAS)

- a. Revise section 2.1.A as follows:

2.1 SCOPE OF WORK

- A. The required system will be Tridium based **and shall be a minor renovation to the existing Tridium based BAS system located in the mechanical room.**

8. SPECIFICATION SECTION 23 09 00 BUILDING AUTOMATION SYSTEM (BAS)

- a. Revise section 2.1.C as follows:

C. APPROVED MANUFACTURER/INSTALLERS

1. Facility Systems Services Inc
2. Platinum Building Automation
3. Environmental Controls
4. Carolina Air Solutions
5. ~~Carrier~~
6. ~~Hoffman/HBT~~
7. ~~Johnson/JCI~~
8. Schneider Electric
9. ~~Trane~~

9. SPECIFICATION SECTION 23 09 00 BUILDING AUTOMATION SYSTEM (BAS)

- a. Revise section 2.2.F as follows:

- F. ~~BACnet MS/TP, BACnet IP, LonTalk FTT-10A, and WebServices~~ shall be native to the NSCs. There shall not be a need to provide multiple NSCs to support all the network protocols, nor should there be a need to supply additional software to allow all three protocols to be natively supported. A sub-network of SDCUs using the BACnet IP ~~MS/TP, LonTalk FTT-10A, and/or Modbus RTU~~ protocol shall connect the local, stand-alone controllers with Ethernet-level Network Server Controllers/IP Routers.

10. SPECIFICATION SECTION 23 09 00 BUILDING AUTOMATION SYSTEM (BAS)

- a. Revise section 4.1 to remove Dual Temperature Pumps, Hot Water System, Fan Coil Units, Unit Ventilators, Fans, and Variable Speed Pumping

11. SPECIFICATION SECTION 23 30 00 AIR DISTRIBUTION

- b. Add sections 2.11 and 3.5 for Fabric Ductwork as follows.

2.11 FABRIC AIR DISPERSION SYSTEM:

A. Air diffusers shall be constructed of a woven fire retardant fabric complying with the following physical characteristics:

1. Fabric Construction. 100% Flame Retardant and retreated with a machine washable anti-microbial agent from the manufacturer.
2. Weight. 6.75 oz./yd² per ASTM D3776
3. Color. (Standard: blue, white, tan, red, green, gray, black or Custom)
4. Air Permeability: 2 (+2/-1) cfm/Ft² per ASTM D737, Frazier
5. Temperature Range: 0 degrees F to 180 degrees F
6. Fire Retardancy. Classified by Underwriters Laboratories in accordance with the flame spread/smoke developed requirements of NFPA 90-A and ICC AC 167.
7. Antimicrobial agent shall be proven 99% effective after 10 laundry cycles per AATCC Test Method 100.
8. Duct shall maintain round shape at no airflow.

B. Systems Fabrication Requirements.

1. Air dispersion accomplished by linear vent and permeable fabric, linear vent to consist of many 3/16" diameter open orifices rather than a mesh style vent to reduce maintenance requirements of mesh style vents.
2. Size of and location of linear vents to be specified and approved by manufacturer.
3. Inlet connection to metal duct via fabric draw band with anchor patches as supplied by manufacturer. Anchor patches to be secured to metal duct via. Zip screw fastener – supplied by contractor.
4. Inlet connection includes zipper for easy removal/maintenance.
5. Lengths to include required zippers as specified by manufacturer.
6. System to include Adjustable Flow Devices to balance turbulence, airflow and distribution as needed. Flow restriction device shall include ability to adjust the airflow resistance from 0.06 – 0.60 in w.g. static pressure.
7. End cap includes zipper for easy maintenance.
8. Fabric system shall include connectors to accommodate suspension system listed below.
9. Any deviation from a straight run shall be made using a gored elbow or an efficiency tee. Normal 90 degree elbows are 5 gores and the radius of the elbow is 1.5 times the diameter of the duct.

C. Design Parameters.

1. Use fabric diffusers only for positive pressure air distribution components of the mechanical ventilation system.
2. Do not use fabric diffusers in concealed locations.
3. Fabric diffusers shall be designed from 0.25" water gage minimum to 3.0" maximum, with 0.5" as the standard.
4. Fabric air diffusers shall be limited to design temperatures between 0 degrees F and 180 degrees F (-17.8 degrees C and 82 degrees C).
5. Design CFM, static pressure and diffuser length shall be designed or approved by the manufacturer.

D. Suspension Hardware.

1. Tension Cable. System shall be installed using a tension cable system including a double strands (2 Row) of cable located 3" above the 10 and 2 o'clock locations of the system. Hardware to include cable, eyebolts, cable clamps and turnbuckle(s) as required. System attachment shall be made using nylon snap clips spaced 24 inches. Component options include:
 - a. Standard Galvanized Steel Cable
 - b. Standard Stainless Steel Cable
 - c. Heavy Weight Stainless Steel Cable

d. **Plastic Coated Stainless Steel Cable**

3.5 INSTALLATION OF FABRIC AIR DISPERSION SYSTEM

- A. **Install chosen suspension system in accordance with the requirements of the manufacturer. Instructions for installation shall be provided by the manufacturer with product.**
- B. **Clean air handling unit and ductwork prior to the system unit-by-unit as it is installed. Clean external surfaces of foreign substance, which may cause corrosive deterioration of facing.**
- C. **Temporary Closure. At ends of ducts, which are not connected to equipment or distribution, devices at time of ductwork installation, cover with polyethylene film or other covering, which will keep the system clean until installation is completed.**
- D. **If systems become soiled during installation, they should be removed and cleaned following the manufacturers standard terms of laundry.**

12. SPECIFICATION SECTION 23 64 00 AIR COOLED WATER CHILLERS

c. **Revise section 2.3 for Compressors as follows:**

2.3 COMPRESSORS

- A. **Construct semi-hermetic **direct drive** rotary screw compressors with heat treated forged steel or ductile iron shafts, aluminum alloy connecting rods, automotive type pistons, rings to prevent gas leakage, discharge valves, and sealing surface immersed in oil. Rotors shall be of high grade steel alloy. **Substitution of scroll compressors shall not be allowed.****

13. SPECIFICATION SECTION 23 64 00 AIR COOLED WATER CHILLERS

d. **Revise section 2.4 for Evaporator as follows:**

2.4 EVAPORATOR

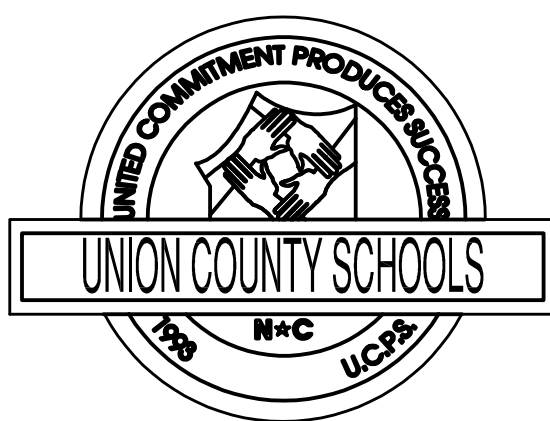
- A. **Provide a shell and tube heat exchanger. Substitution of plate heat exchangers shall not be allowed.**

14. SPECIFICATION SECTION 23 64 00 AIR COOLED WATER CHILLERS

e. **Revise section 2.8 for Controls as follows:**

2.8 CONTROLS

- H. **BAS interface – BACNET only, contractor shall provide router compatible with chiller manufacturer as required to allow for IP.**



MONROE HIGH SCHOOL

APPROVED MANUFACTURER LISTING	
THE FOLLOWING MANUFACTURER'S LISTING (ALPHABETICALLY ORDERED) IS PROVIDED FOR BIDDING PURPOSES AND DOES NOT IMPLY OR PROVIDE A GUARANTEE OF SUBMITTAL APPROVAL. ALL ITEMS SUBMITTED SHALL MEET OR EXCEED THE MINIMUM SPECIFIED DESIGN AND QUALITY CRITERIA IN THIS SET OF CONSTRUCTION DOCUMENTS. ANY BIDDER THAT INTENDS TO SUBMIT USING A MANUFACTURER NOT LISTED BELOW MAY REQUEST A PRIOR APPROVAL IN ACCORDANCE WITH THE ENTIRETY OF THE PROJECT BID DOCUMENTS, REFER TO THE ARCHITECT'S GENERAL CONDITIONS AND BIDDING REQUIREMENTS.	
THE BIDDER IS RESPONSIBLE FOR INCLUDING ALL COSTS ASSOCIATED WITH SUBSTITUTED EQUIPMENT, INCLUDING BUT NOT LIMITED TO, CODE AND MANUFACTURER'S REQUIRED MAINTENANCE AND ACCESS CLEARANCE, COORDINATION WITH ALL OTHER BUILDING TRADES, AND INSTALLATION OF DUCTWORK, PIPING, ETC. BIDDER SHALL BEAR RESPONSIBILITY FOR ALL ASSOCIATED COSTS AND ADDITIONAL COSTS RESULTING FROM SUBSTITUTED ITEMS SHALL NOT BE CONSIDERED FOR APPROVAL AFTER BIDS ARE AWARDED.	

ITEM	MANUFACTURER'S
AIR COOLED CHILLERS	CARRIER, DAIKIN-MCQUAY, TRANE
AIR DISTRIBUTION	CARNES, METAL-AIRE, NAILOR, PRICE, TITUS, TUTTLE & BAILEY
BIPOLAR IONIZATION	PLASMA AIR, GLOBAL PLASMA SOLUTIONS
DDC CONTROLS	REFER TO SPEC SECTION 23.0900
FIRE DAMPERS	GREENHECK, NAILOR, RUSKIN, POTTORFF
MODULAR AIR HANDLING UNITS	CARRIER, DAIKIN-MCQUAY, TRANE
PACKAGED ROOFTOP UNITS	CARRIER, DAIKIN-MCQUAY, TRANE
PUMPS & HYDRONIC EQUIPMENT	ARMSTRONG, BELL & GOSSETT, GRUNDFOS, TACO

PUMP SCHEDULE											
UNIT TAG	SERVICE	GPM	HEAD (ft.)	RPM	EFF. (%)	HP	VOLTS	PHS.	TYPE	MFR. & MODEL NO.	RMKS.
P-1	CHILLER CIRCULATION	350	61	1684	73	10	208	3	ES	B&G SERIES e-1510 3BD	1-5
P-2	CHILLER CIRCULATION	350	61	1684	73	10	208	3	ES	B&G SERIES e-1510 3BD	1-5


- REFER TO APPROVE MANUFACTURER'S LIST FOR APPROVED EQUALS.
- TYPES: IL = INLINE, ES = END SUCTION.
- PROVIDE SHAFT BRUSH RINGS ON MOTOR.
- IMPELLERS SHALL BE TRIMMED IN FIELD PER NC ENERGY CODE REQUIREMENTS.
- PROVIDE PREMIUM EFFICIENCY INVERTER-DUTY MOTOR AND VARIABLE FREQUENCY DRIVE (VFD FOR SOFT-START).
- MECHANICAL CONTRACTOR SHALL COORDINATE EXISTING MOTOR VOLTAGE AND PHASE WITH ELECTRICAL CONTRACTOR.

MECHANICAL SYSTEMS, SERVICE SYSTEMS AND EQUIPMENT METHOD OF COMPLIANCE	
Prescriptive	Energy Cost Budget
Thermal Zone: Union County (3A)	
Exterior Design Conditions	
Winter Dry Bulb:	20
Summer Dry Bulb:	94
Interior Design Conditions	
Winter Dry Bulb:	70
Summer Dry Bulb:	75
Relative Humidity:	50%
Building Heating Load: 95,900 BTUH	
Building Cooling Load: 105,600 BTUH	
Mechanical Space Conditioning System	
Unitary	
Description of Unit:	Packaged AC with Gas Heat
Heating Efficiency:	Refer to HVAC Equipment Schedules
Cooling Efficiency:	Refer to HVAC Equipment Schedules
Heat Output of Unit:	Refer to HVAC Equipment Schedules
Cooling Output of Unit:	Refer to HVAC Equipment Schedules
List Equipment Efficiencies:	
Equipment Schedules with Motors (Mechanical Systems)	
Motor Horsepower:	Comply w/ 2018 NC Energy Code
Number of Phases:	Comply w/ 2018 NC Energy Code
Minimum Efficiency:	Comply w/ 2018 NC Energy Code
Motor Type:	Comply w/ 2018 NC Energy Code
Number of Poles:	Comply w/ 2018 NC Energy Code
Designer Statement:	
To the best of my knowledge and belief, the design of this building complies with the 2018 North Carolina Energy Code. The requirements of Section C406 is met through the Subsection C406.3 (Reduced Lighting Power Density).	

OUTSIDE AIR CALCULATION												
ZONE NAME	CLASSIFICATION	AREA (SQFT)	OCC. DENSITY (#/1000 SQFT)	# PEOPLE	CFM/PERSON (Rp)	CFM/SQFT (Rz)	ZONE EFF. (Ez)	OA REQUIRED	RTU CFM	RTU OA %	ZONE SUPPLIED OA (CFM)	REMARKS
RTU-5									3000	14.0%		
BAND ROOM	MUSIC/THEATRE/DANCE	1952	--	20 *	10	0.06	0.8	396.4	3000	14.0%	420.0	
TOTAL OA REQUIRED:								396.4	TOTAL OA SUPPLIED:		420.0	
RTU-6									700	12.0%		
OFFICES	OFFICES	520	--	4 *	5	0.06	0.8	64	700	12.0%	84.0	
TOTAL OA REQUIRED:								64	TOTAL OA SUPPLIED:		84.0	
REMARKS												
1. CALCULATION PERFORMED IN ACCORDANCE WITH THE ASHRAE 62.1 - 2013.												
2. *** NEXT TO # OF PEOPLE INDICATES ACTUAL PEOPLE COUNT IN SPACE												

PACKAGED RTU WITH GAS HEAT SCHEDULE																															
Unit Tag	Nom. Tons	SEER	AFUE %	CFM	O.A. Min.	ESP	Fan Motor					Cooling Performance					Heating Performance					Electrical Data							Model	Weight (lbs.)	Remarks
							HP	Volts				EAT DB/WB	MBH Net Total	MBH Net Sens.	EAT	INPUT MBH	OUTPUT MBH	Fan No.	FLA	No.	Compressor LRA	RLA	MCA	MOCP	Volts	Phase					
RTU-1	7.5	14.5	80	3000	420	0.75	2.75	208				80/67	88.7	69.2	60	120	96	1	7.3	2	---	15.9/10.0	42	50	208	3	YHC092F3	1295	1-4, 6, 7		
RTU-2	2	14	80	700	84	0.75	1/3	208				80/67	24.6	-	60	60	48	1	-	1	-		30	30	208	1	4YCC4024	450	1-5		

- MODEL NUMBERS BASED ON TRANE. REFER TO APPROVED MANUFACTURERS LIST FOR ALTERNATES.
- SINGLE POINT ELECTRICAL CONNECTION.
- NETWORK THERMOSTAT BRAND MODEL RP32HE-IP 7-DAY PROGRAMMABLE ETHERNET THERMOSTAT WITH HUMIDITY CONTROL. MOUNTED IN LOCKABLE METAL PROTECTIVE CASE.
- MANUFACTURER'S 14" HIGH ROOF CURB.
- OUTSIDE AIR INTAKE HOOD WITH MANUAL VOLUME DAMPER. PER 2018 NCECC, ECONOMIZER IS NOT REQUIRED FOR SYSTEMS LESS THAN 65,000 BTUH.
- OUTSIDE AIR INTAKE HOOD WITH MOTORIZED VOLUME DAMPER FOR AIR INTAKE ECONOMIZER.
- PROVIDE UNIT WITH HOT GAS REHEAT.

AIR COOLED CHILLER SCHEDULE																										
UNIT TAG	REFRIGERANT		PERFORMANCE									ELECTRICAL DATA											GENERAL			
	TYPE	CHARGE (LBS.)	TONS	IPLV EER	FULL LOAD EER	EVAPORATOR					AMB. TEMP (F)	UNIT				COMPRESSORS				CONDENSER FANS			MFGR. & MODEL NO.	RMKS		
						EWI (F)	LWT (F)	GPM	PD (FT)	FOUL FACTOR		VOLT	PHS.	MCA CKT #1	MOP CKT #1	MCA CKT #2	MOP CKT #2	QTY.	RLA CKT #1	RLA CKT #1	RLA CKT #2	RLA CKT #2			QTY.	RLA (EA.)
C-1	R-410A	330.00	140.0	13.7	9.8	54.0	44.0	335.0	11.3	0.0001	95	208	3	363	600	359	600	2	270	600	270	600	8	5.4	TRANE RTAC140	1-13
C-2	R-410A	330	140.0	13.7	9.8	54.0	44.0	335.0	11.3	0.0001	95	208	3	363	600	359	600	2	270	600	270	600	8	5.4	TRANE RTAC140	1-13
																										

- MODELS BY TRANE. REFER TO APPROVED MANUFACTURERS LIST FOR APPROVED EQUALS.
- FOULING FACTOR = 0.0001 ARI 590-81, OR 0.00025 ARI 590-86.
- ONE 208V/3 ELECTRICAL CONNECTION FOR UNIT POWER & CONTROLS
- SEE ELECTRICAL NOTES BY MFR.
- LOW AMBIENT TEMPERATURE CONTROL
- SCREW COMPRESSORS ONLY. SUBSTITUTION OF SCROLL COMPRESSORS AND PLATE HEAT EXCHANGER NOT ACCEPTED.
- PROVIDE FACTORY INSTALLED SOUND ATTENUATION FOR SUCTON AND DISCHARGE PIPING AS REQUIRED FOR MAX SOUND POWER OF 94 DBA AND MAX. SOUND PRESSURE OF 67 DBA AT 30 FEET.

- DISCONNECT BY ELECTRICAL CONTRACTOR.
- VARIABLE FLOW COMPATIBLE DOWN TO 40% FLOW.
- NEW CONTROLS SHALL BE COMPATIBLE WITH EXISTING DDC BAS. PROVIDE ROUTER FOR BACNET OVER IP INTEGRATION INTO EXISTING BAS.
- PROVIDE MANUFACTURER'S HAIL GAURDS AND SECURITY GAURDS
- PROVIDE LOW SOUND OPTION.
- SOUND ATTENUATION FOR SUCTON AND DISCHARGE PIPING AND COMPRESSOR TO REDUCE SOUND LEVEL BY 5 DB.

AIR HANDLING UNIT SCHEDULE (DUAL TEMP)																											
UNIT TAG	AREA SERVED	UNIT TYPE	CFM		ESP (IN.)	FAN				EAT (F) DB/WB	LAT (F) DB/WB	COOLING PERFORMANCE						HEATING PERFORMANCE						UNIT WEIGHT (pounds)	TRANE MODEL NO.	REMARKS	
			SA	OA		BHP	HP	MOTOR VOLTS	PHS			MBH (GROSS)		GPM	EWT (F)	WTR (F)	MAX. PD		EWT/ LWT(F)	MAX. WATER PD(FT.)	HEAT COIL						
												TOTAL	SENS.				WATER (FT.)	AIR (IN.)			CFM	EAT/ LAT (F)	GPM				MX. AIR PD (in.)
AHU-1	ADMIN INTERIOR	CAV	3,400		0.80	2.29	3	208	3			116.03	86.81	23.1	45	55.0		0.64				450	BCVD090	---			
AHU-2	ADMIN EXTERIOR	CAV	2,000		0.80	0.99	1	208	3			62.24	48.81	12.4	45	55.0		0.57				300	BCVD054	---			

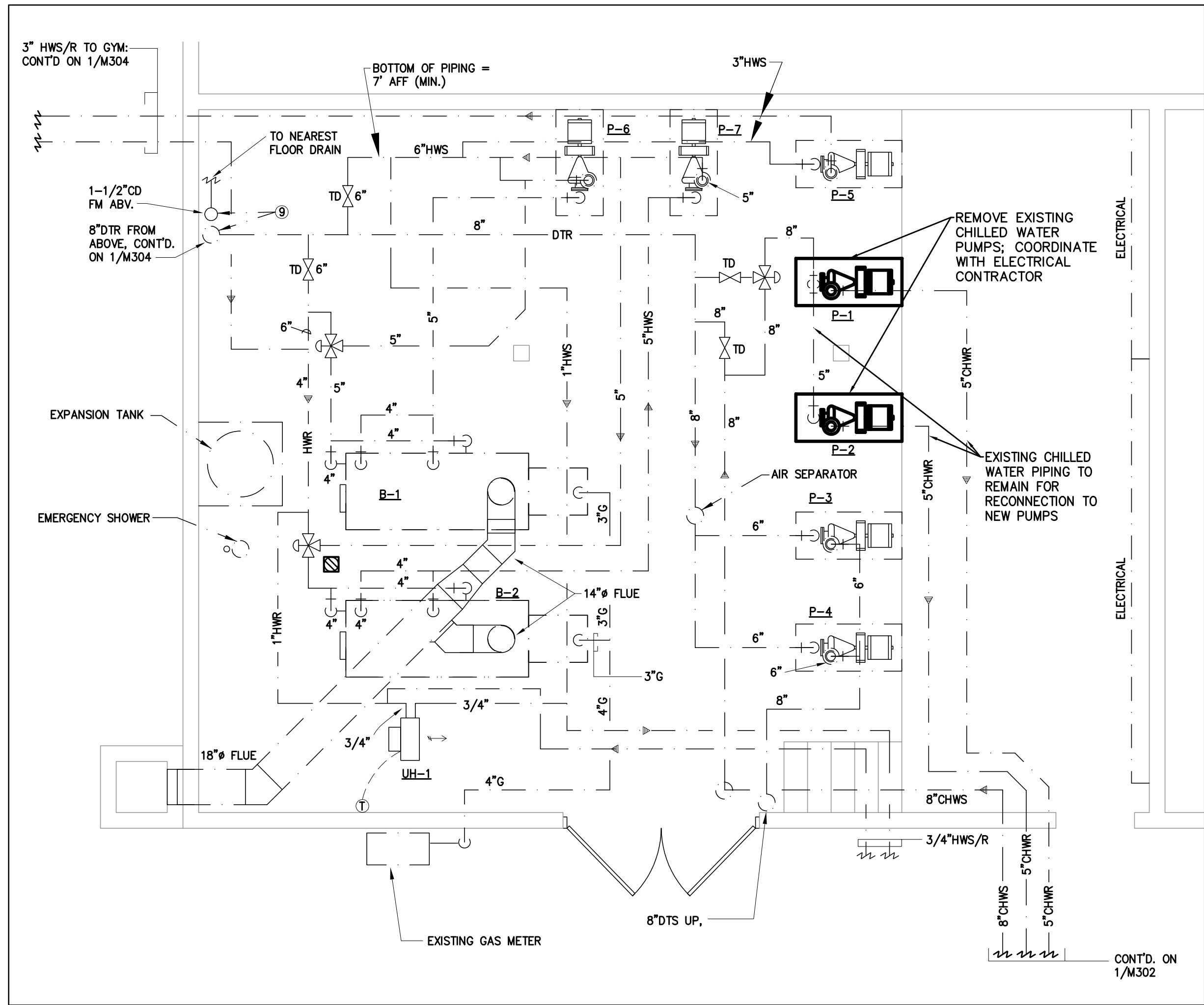
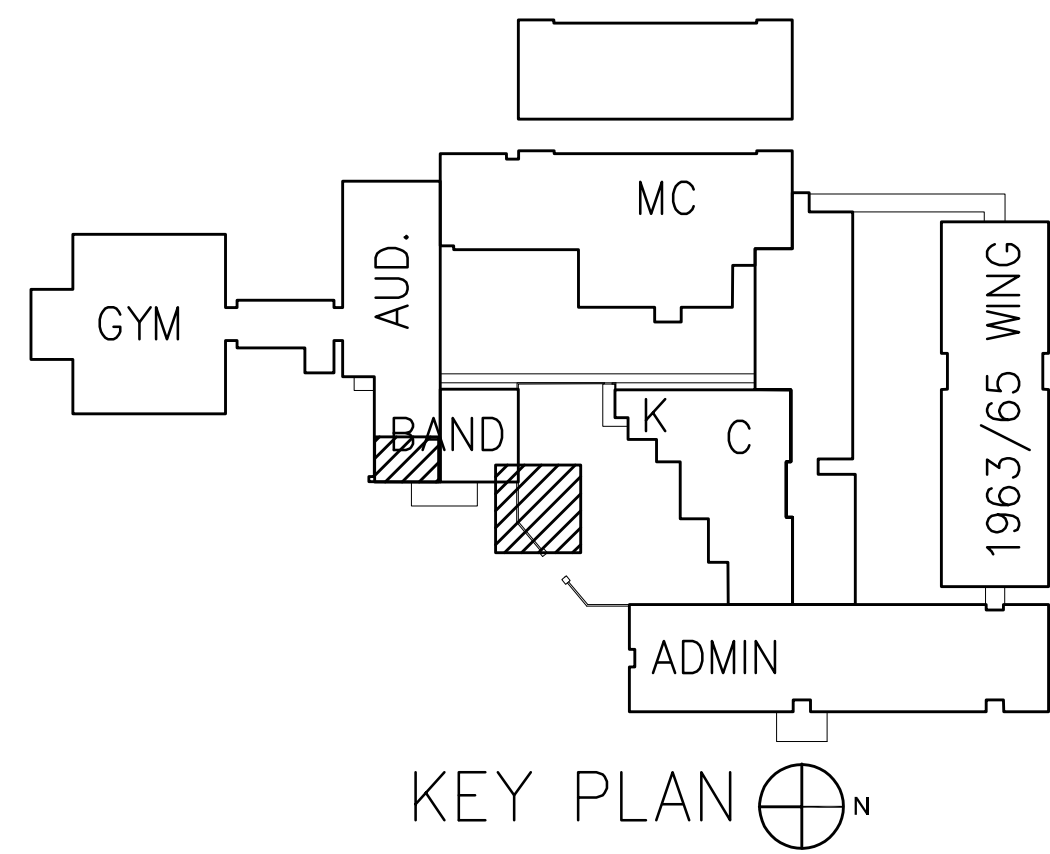
- REFER TO APPROV. MANU. LIST FOR EQUALS. SEE DETAILS FOR UNIT ARRANGE-MENTS. COILS SELECTED ON A 0.0 FOULING FACTOR. VIB. ISOL. TO BE SEISMIC RATED IF CALLED FOR ELSEWHERE IN PLANS. CONTROL VA. MAX. PD = 12'. CNTRL. VA. SHALL SEAT AGAINST MAX. SYSTEM PRESS. MC SHALL VERIFY SERVICE CLEARANCES FOR SUBSTITUTIONS. B) OA MIN. = BLDG. PRESSURIZATION MIN., OA MAX = CODE, C) VAV = VARIABLE AIR VOLUME
- WALL MTD. TSTAT(S). ABBREVIATIONS: FMB = FLTR. MXNG. BOX.
- MFR'S FAN DATA INCLUDES FAN CASING. ESP IN SCHEDULE INCLUDES ALL PRESSURE DROPS EXTERNAL TO UNIT. UNIT PD INCLUDES ALL ITEMS INTERNAL TO UNIT: CLEAN FILTERS (VAV = DIRTY), COILS, ETC. TSP = ESP+UNIT PD. FILTER CASING PRESSURE DROP INCLUDED IN FILTER PRESSURE DROP.
- QUANTITY OF DUCT MOUNTED SMOKE DETECTORS ASSOCIATED WITH UNIT.
- FILTERS: 2" PLEATED MERV 13 FILTERS
- STAINLESS STEEL IAQ DRAIN PAN.
- ECONOMIZER CYCLE.
- 2-WAY CHW VALVE, 2-WAY HW VALVE.
- 2-WAY CHW VALVE, 3-WAY HW VALVE.
- VARIABLE FREQUENCY DRIVE.
- PROVIDE ON-OFF SWITCH FOR UV LIGHTS. M.C. SHALL PROVIDE & INSTALL AFTERMARKET UV LIGHTS.
- AIR FLOW MONITORING STATION ON OUTSIDE AIR INTAKE OF UNIT.
- HOT WATER TEMPERATURE RISE = 30 DEG F.
- UNITS SHALL BE SHIPPED SPLIT IN A SUCH A MANNER TO ALLOW THEM TO BE HOISTED THROUGH A 40" WIDE X 78" LONG CEILING ACCESS PANEL. TOP OF UNIT SHALL FACE UP WHILE BEING HOISTED THROUGH ACCESS OPENING. EQUIPMENT NOT ABLE TO BE HOISTED THROUGH DESCRIBED OPENING IS NOT ACCEPTABLE.
- PIPE SIZES: 2" CHW, 1" HW, 1.5" COND. DR.

GRILLE & DIFFUSER SCHEDULE									
SYM	TYPE	USE	CFM RANGE	NECK SIZE	OVER-ALL SIZE	FINISH	FRAME	PRICE MODEL NO	REMARKS
A--	LOUVER FACE	SUPPLY 4-WAY	SEE PLANS & RMK 5	RMK 5	RMK 4	OFF WHITE	RMK 3	SMDA	1-6
B--	PERF. RETURN/ EXHAUST	SEE PLANS & RMK 6	SEE PLANS & RMK 7	RMK 7	RMK 4	OFF WHITE	RMK 3	PDDR	1-4, 7-10
C-	SIDEWALL SUPPLY	SEE PLANS	SEE PLANS	RMK 4	RMK 12	SEE PLANS	520D		1-4, 9, 11-13
D-	SIDEWALL RETURN/ EXHAUST	SEE PLANS	SEE PLANS	RMK 4	RMK 12	SEE PLANS	530		1-4, 9, 12, 13

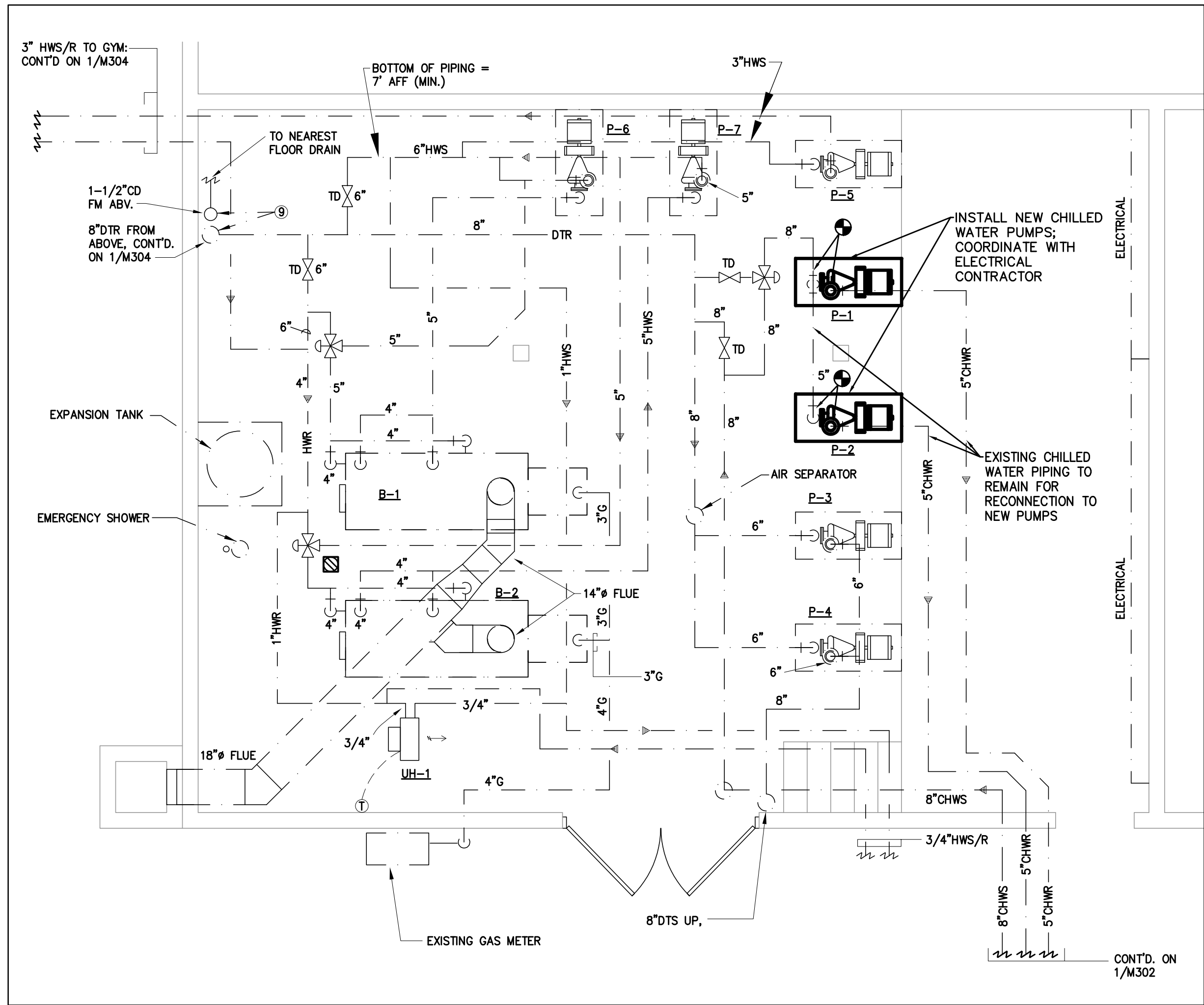
- REMARKS
- REFER TO APPROVE MANUFACTURER'S LIST FOR APPROVED EQUALS
 - SCHEDULE IS GENERAL, SOME MAY NOT BE USED. PAINT ALL INSIDE VISIBLE SURFACES FLAT BLACK.
 - SYMBOL EXPLANATION:
XXX/CFM = SYMBOL, FRAME (RMK 3), NECK (RMK 5, 7)/CFM
 - FRAME TYPES:
S = FLUSH SURF. MTD.. E = DUCT MOUNTED: V-BEVELED
PLASTER FRAME FOR DROP SURF. (TYPE "A" DIFFUSER)
CEILING MOUNTING. D = DROPPED FRAME
NOTE: VERIFY FRAME/CEILING COMPATIBILITY.
 - OVERALL SIZE: LAY-IN = 2'x2', OTHER GRILLES = NECK + 2" +/-.
 - LOUVER FACE SUPPLY NECK SIZES
- | NO. | ROUND NK SIZE | CFM | NO. | SQUARE NK SIZE | CFM |
|-----|---------------|-----|-----|----------------|------|
| A | 6" | 90 | H | 6x6 | 125 |
| B | 8" | 175 | I | 9x9 | 280 |
| C | 10" | 300 | J | 12x12 | 500 |
| D | 12" | 400 | K | 15x15 | 780 |
| E | 14" | 535 | L | 18x18 | 1125 |
| F | 16" | 700 | M | 21x21 | 1530 |
| G | 18" | 885 | N | 24x24 | 2000 |
- NOTE: VERIFY CFM/ NECK SIZE.
- ADJUSTABLE: HORIZONTAL/VERTICAL - "PIANO HINGE" DEVICE.
- Z, "B" & "I" EXH/RETURN NECK SIZES ("E" = SQ. NK. ONLY)
- | NO. | ROUND NK SIZE | CFM | NO. | SQUARE NK SIZE | CFM |
|-----|---------------|-----|-----|----------------|------|
| A | 6" | 100 | G | 8x8 | 220 |
| B | 8" | 175 | H | 10x10 | 345 |
| C | 10" | 275 | I | 12x12 | 500 |
| D | 12" | 400 | J | 14x14 | 680 |
| E | 14" | 535 | K | 16x16 | 885 |
| F | 16" | 700 | L | 18x18 | 1125 |
- NOTE: VERIFY CFM/ NECK SIZE.
- | NO. | ROUND NK SIZE | CFM | NO. | SQUARE NK SIZE | CFM |
|-----|---------------|-----|-----|----------------|------|
| A | 6" | 100 | G | 8x8 | 220 |
| B | 8" | 175 | H | 10x10 | 345 |
| C | 10" | 275 | I | 12x12 | 500 |
| D | 12" | 400 | J | 14x14 | 680 |
| E | 14" | 535 | K | 16x16 | 885 |
| F | 16" | 700 | L | 18x18 | 1125 |
- NOTE: VERIFY CFM/ NECK SIZE.
- | NO. | ROUND NK SIZE | CFM | NO. | SQUARE NK SIZE | CFM |
|-----|---------------|-----|-----|----------------|------|
| A | 6" | 100 | G | 8x8 | 220 |
| B | 8" | 175 | H | 10x10 | 345 |
| C | 10" | 275 | I | 12x12 | 500 |
| D | 12" | 400 | J | 14x14 | 680 |
| E | 14" | 535 | K | 16x16 | 885 |
| F | 16" | 700 | L | 18x18 | 1125 |
- NOTE: VERIFY CFM/ NECK SIZE.
- | NO. | ROUND NK SIZE | CFM | NO. | SQUARE NK SIZE | CFM |
|-----|---------------|-----|-----|----------------|------|
| A | 6" | 100 | G | 8x8 | 220 |
| B | 8" | 175 | H | 10x10 | 345 |
| C | 10" | 275 | I | 12x12 | 500 |
| D | 12" | 400 | J | 14x14 | 680 |
| E | 14" | 535 | K | 16x16 | 885 |
| F | 16" | 700 | L | 18x18 | 1125 |
- NOTE: VERIFY CFM/ NECK SIZE.
- | NO. | ROUND NK SIZE | CFM | NO. | SQUARE NK SIZE | CFM |
|-----|---------------|-----|-----|----------------|------|
| A | 6" | 100 | G | 8x8 | 220 |
| B | 8" | 175 | H | 10x10 | 345 |
| C | 10" | 275 | I | 12x12 | 500 |
| D | 12" | 400 | J | 14x14 | 680 |
| E | 14" | 535 | K | 16x16 | 885 |
| F | 16" | 700 | L | 18x18 | 1125 |
- NOTE: VERIFY CFM/ NECK SIZE.
- | NO. | ROUND NK SIZE | CFM | NO. | SQUARE NK SIZE | CFM |
|-----|---------------|-----|-----|----------------|------|
| A | 6" | 100 | G | 8x8 | 220 |
| B | 8" | 175 | H | 10x10 | 345 |
| C | 10" | 275 | I | 12x12 | 500 |
| D | 12" | 400 | J | 14x14 | 680 |
| E | 14" | 535 | K | 16x16 | 885 |
| F | 16" | 700 | L | 18x18 | 1125 |
- NOTE: VERIFY CFM/ NECK SIZE.
- | NO. | ROUND NK SIZE | CFM | NO. | SQUARE NK SIZE | CFM |
|-----|---------------|-----|-----|----------------|------|
| A | 6" | 100 | G | 8x8 | 220 |
| B | 8" | 175 | H | 10x10 | 345 |
| C | 10" | 275 | I | 12x12 | 500 |
| D | 12" | 400 | J | 14x14 | 680 |
| E | 14" | 535 | K | 16x16 | 885 |
| F | 16" | 700 | L | 18x18 | 1125 |
- NOTE: VERIFY CFM/ NECK SIZE.
- | NO. | ROUND NK SIZE | CFM | NO. | SQUARE NK SIZE | CFM |
|-----|---------------|-----|-----|----------------|-----|
| A | 6" | 100 | G | 8x8 | 220 |
| B | 8" | 175 | H | 10x10 | 345 |

RENOVATION LEGEND	
	NEW EQUIPMENT
	EXISTING
	EXISTING RELOCATED
	EXISTING THERMOSTAT
	CONNECT TO EXISTING

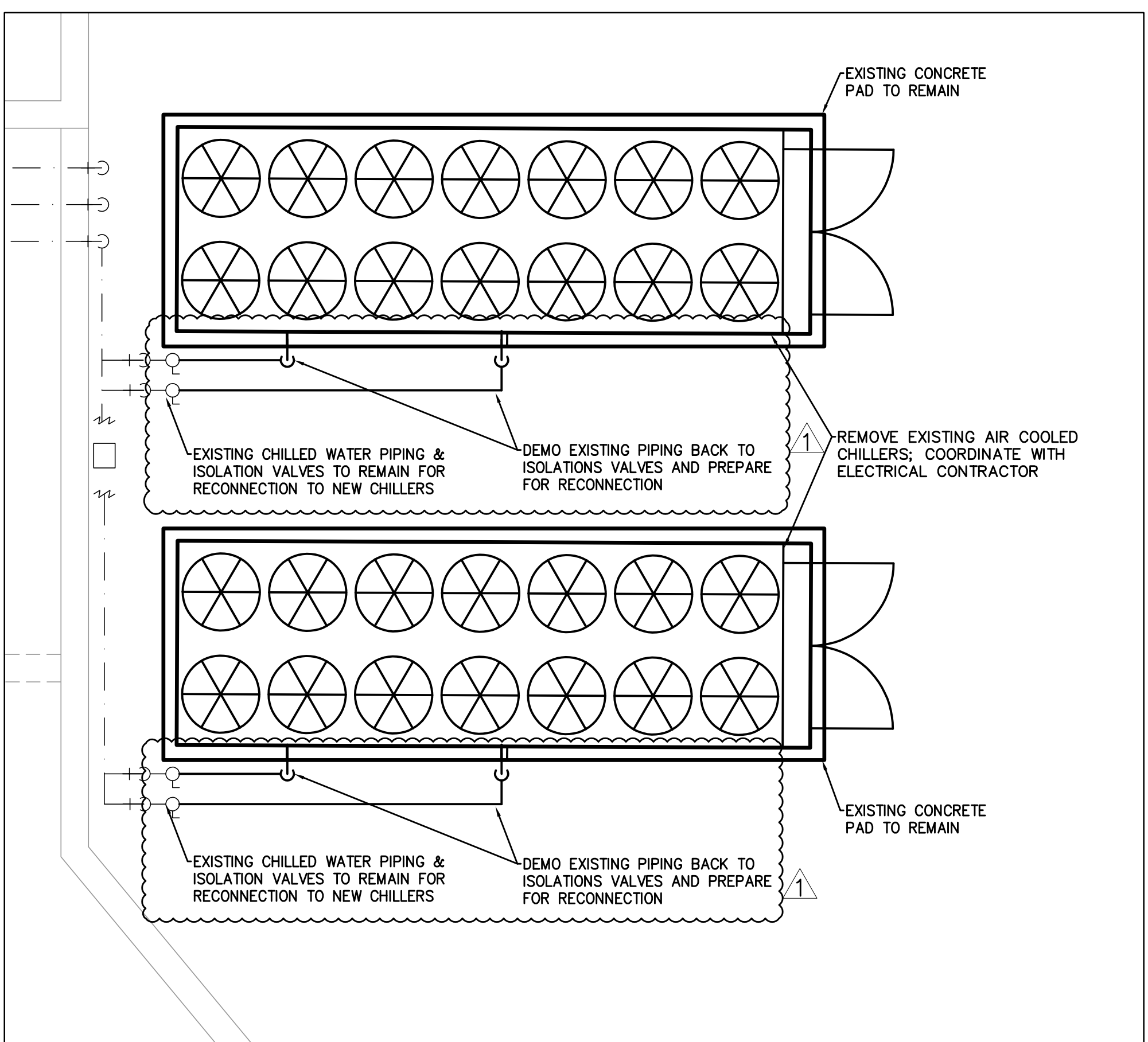
MECHANICAL EQUIPMENT LEGEND	
SYMBOL	DESCRIPTION
SINGLE LINE	DOUBLE LINE
LOW PRESSURE DUCTWORK	
	DUCT SECTION—1ST FIGURE WIDTH, 2ND DEPTH
	SQUARE TO ROUND TRANS.
	FLEX DUCTWORK
	ELBOW W/TURNING VANES
	LONG RADIUS ELBOW
	EXHAUST DUCT SECTION
	SUPPLY DUCT SECTION
	RETURN/RELIEF AIR DUCT SECTION
	CONICAL DUCT TAKE-OFF
	FIRE DAMPER "A" OR "B"
MISCELLANEOUS	
	THERMOSTAT (EXISTING)
	DAMPER
	TIE INTO EXISTING AT THIS POINT



3 BOILER ROOM DEMOLITION PLAN
1/4"=1'-0"

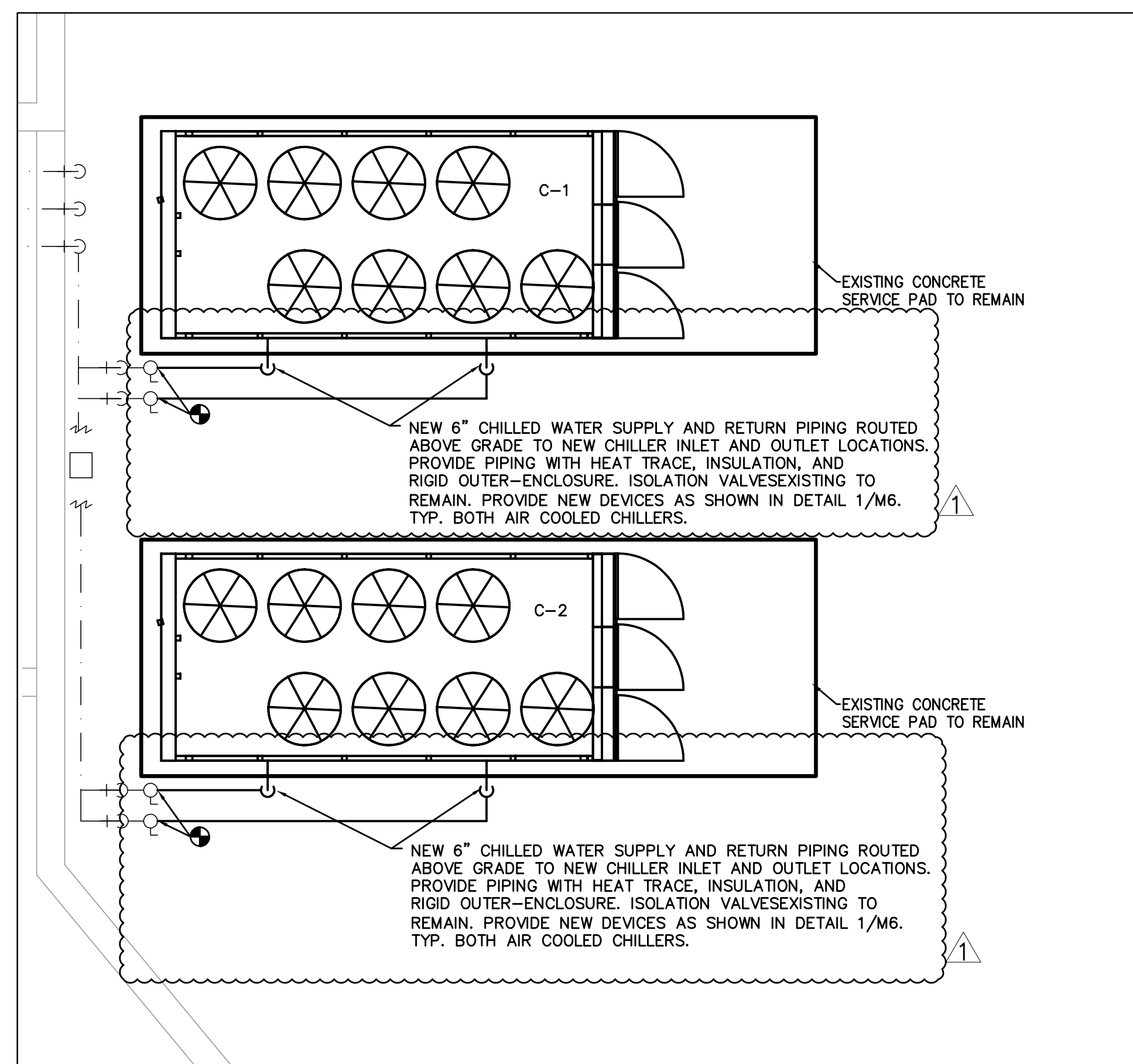


4 BOILER ROOM RENOVATION PLAN
1/4"=1'-0"

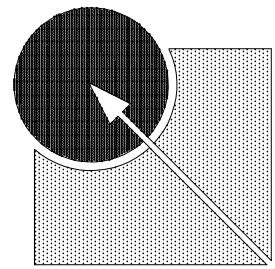


1 AIR-COOLED CHILLER DEMOLITION PLAN
1/4"=1'-0"

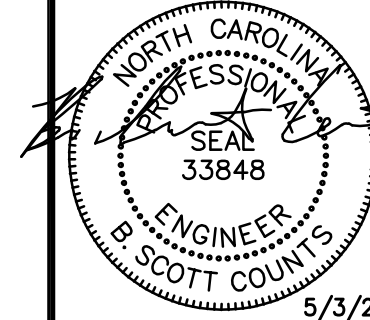
REFRIGERANT RECOVERY NOTE:
OWNER IS RESPONSIBLE FOR RECOVERY OF
REFRIGERANT FROM EXISTING CHILLERS.
CONTRACTOR SHALL PROVIDE OWNER A MINIMUM OF
ONE WEEK NOTICE PRIOR TO CHILLER DEMOLITION.



2 AIR-COOLED CHILLER RENOVATION PLAN
1/4"=1'-0"



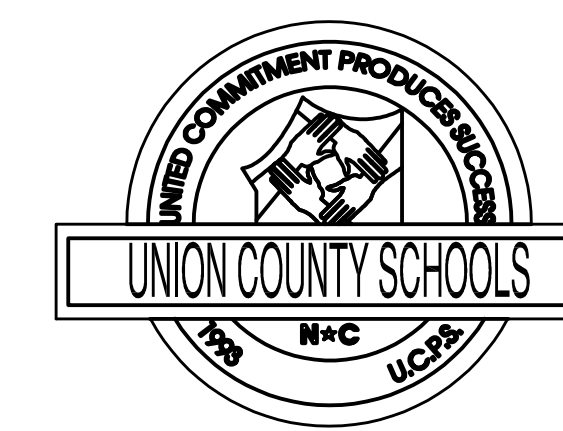
McKNIGHT • SMITH • WARD • GRIFFIN
ENGINEERS, INCORPORATED
PO Box 240826 • 4223 South Boulevard
Charlotte, NC 28224 • 704/527-2112



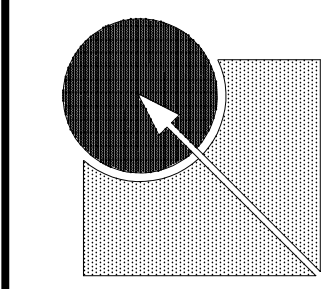
JOB NUMBER	REVISION DATES	ADDITION #	DATE
21-054	BSC	JOC	5/3/2021
DESIGNED BY	DATE		
CHECKED BY			

MONROE HIGH SCHOOL
CIP - HVAC IMPROVEMENTS

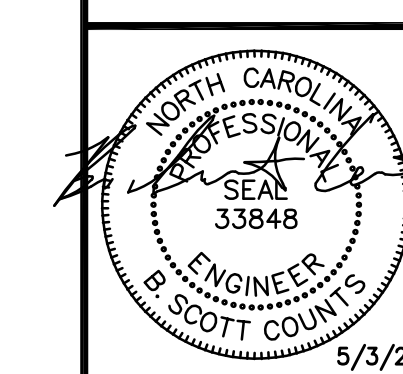
MECHANICAL ENLARGED PLANS
CHILLERS & PUMPS



MONROE
HIGH SCHOOL



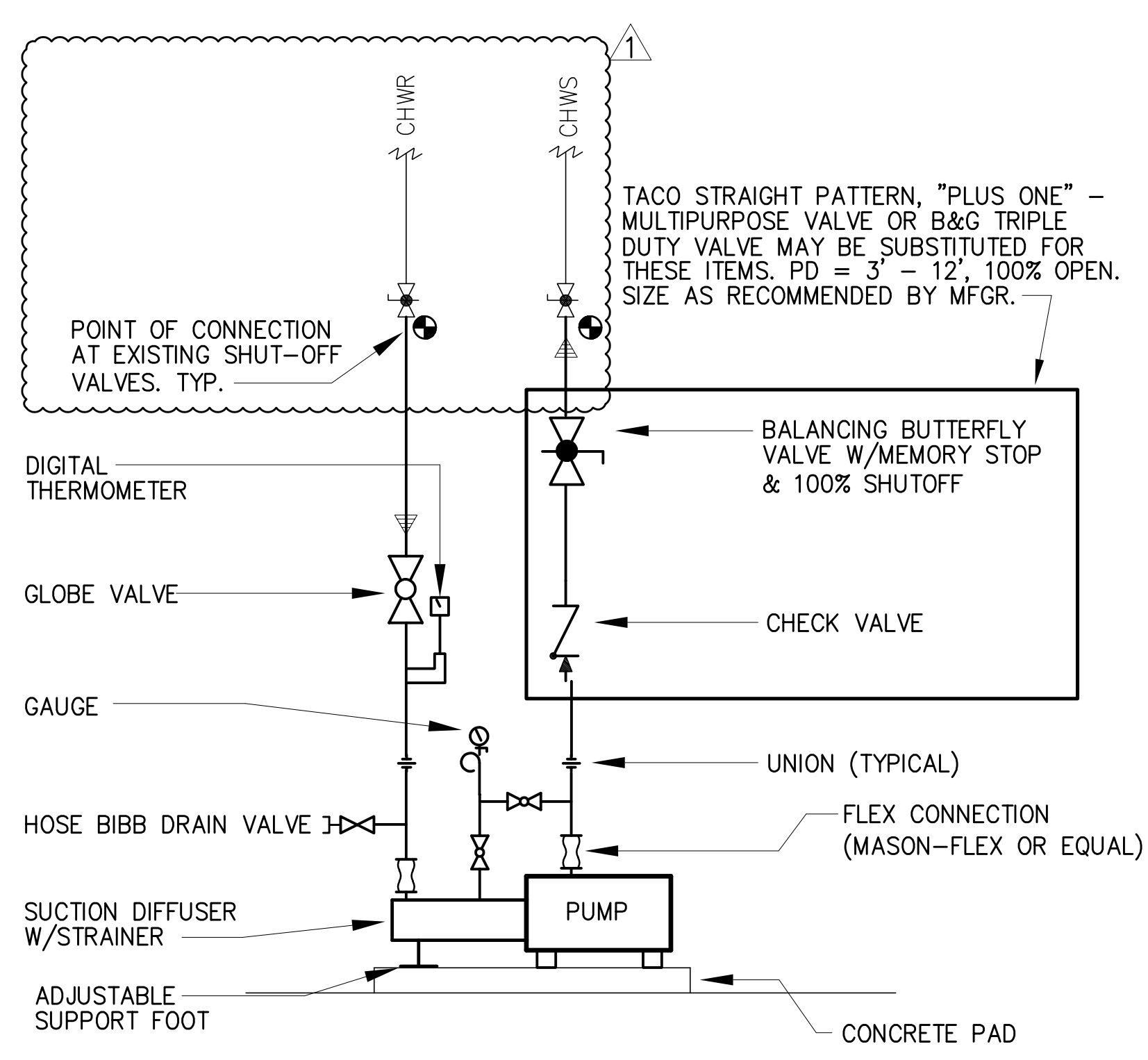
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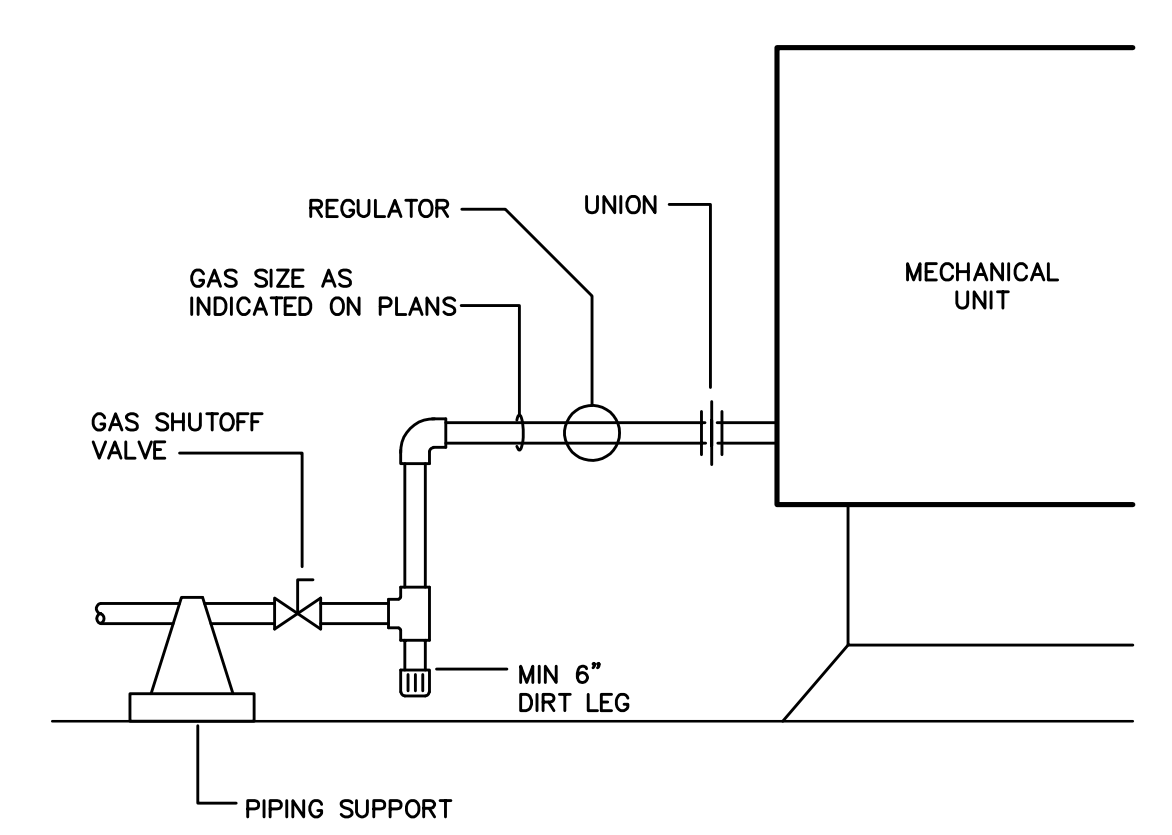
REVISION DATES	21-054	REVISION DATES	21-054
DESIGN BY	BSC	DESIGN BY	BSC
CHECKED BY	JCC	CHECKED BY	JCC
DATE	5/3/2021	DATE	5/3/2021

MONROE HIGH SCHOOL
CIP - HVAC IMPROVEMENTS

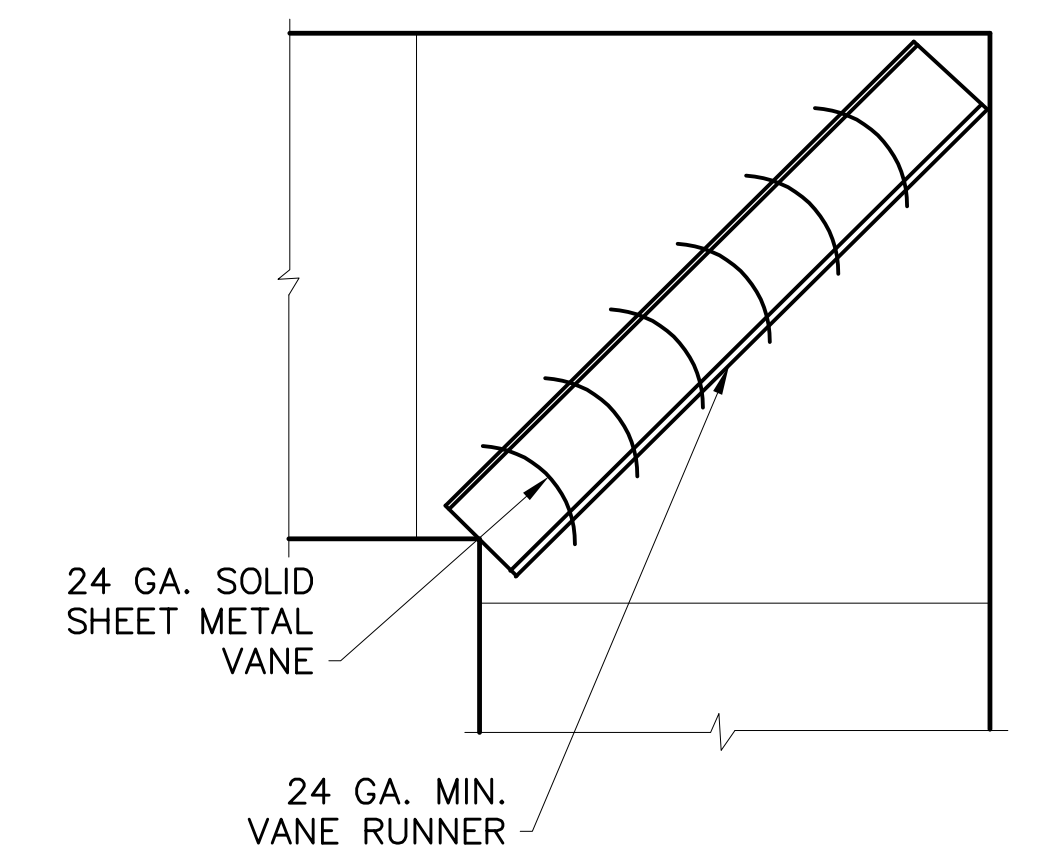
MECHANICAL DETAILS



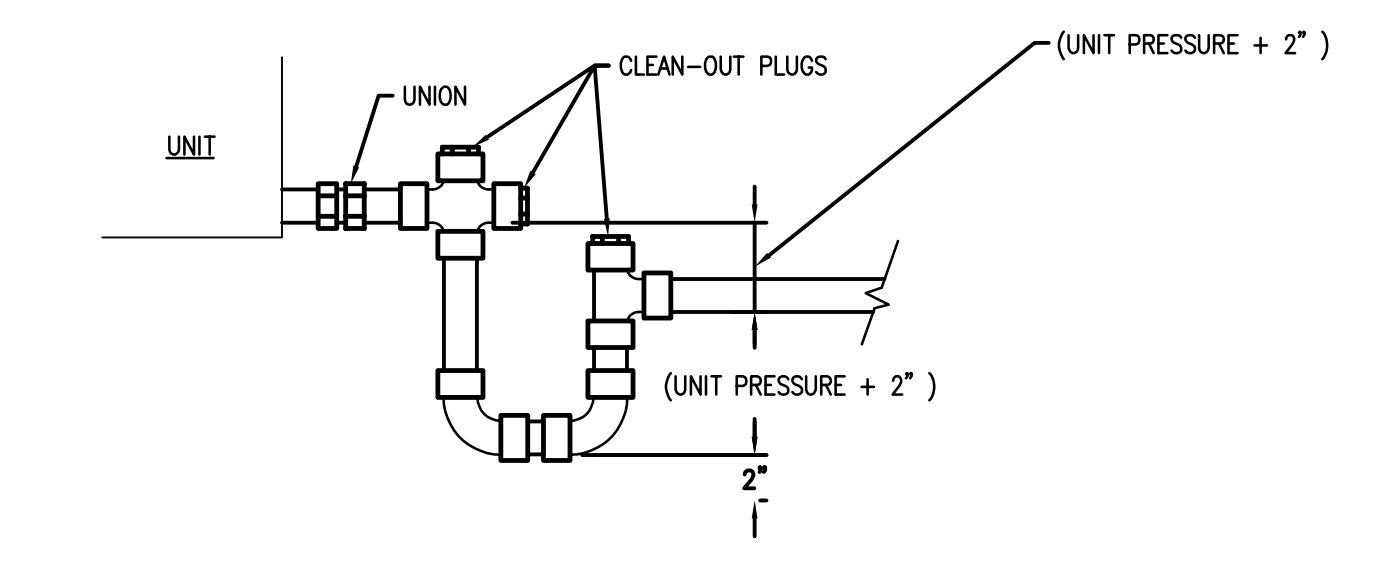
12 PUMP PIPING DETAIL
NTS



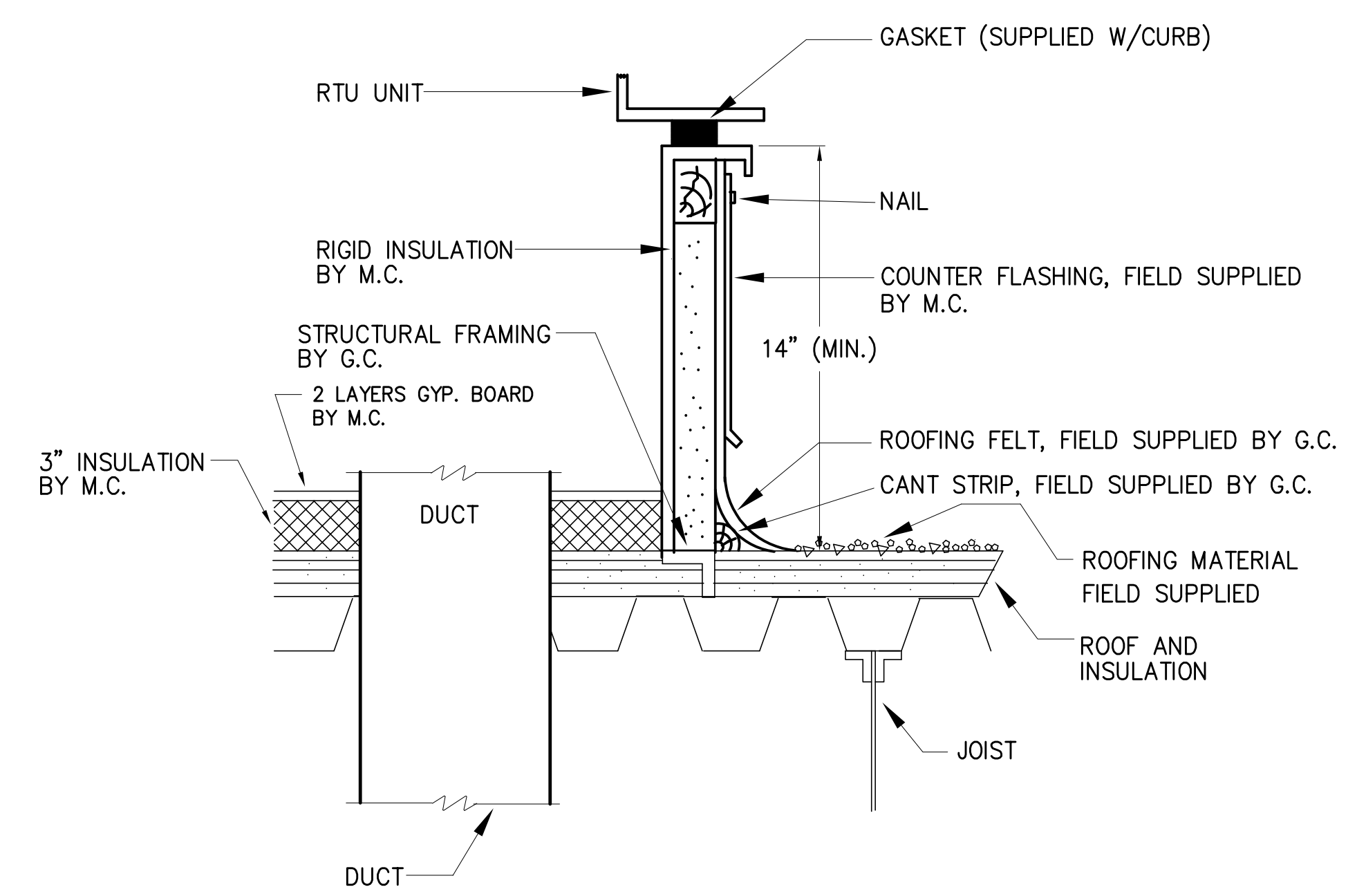
11 GAS PIPING TO UNIT DETAIL
NTS



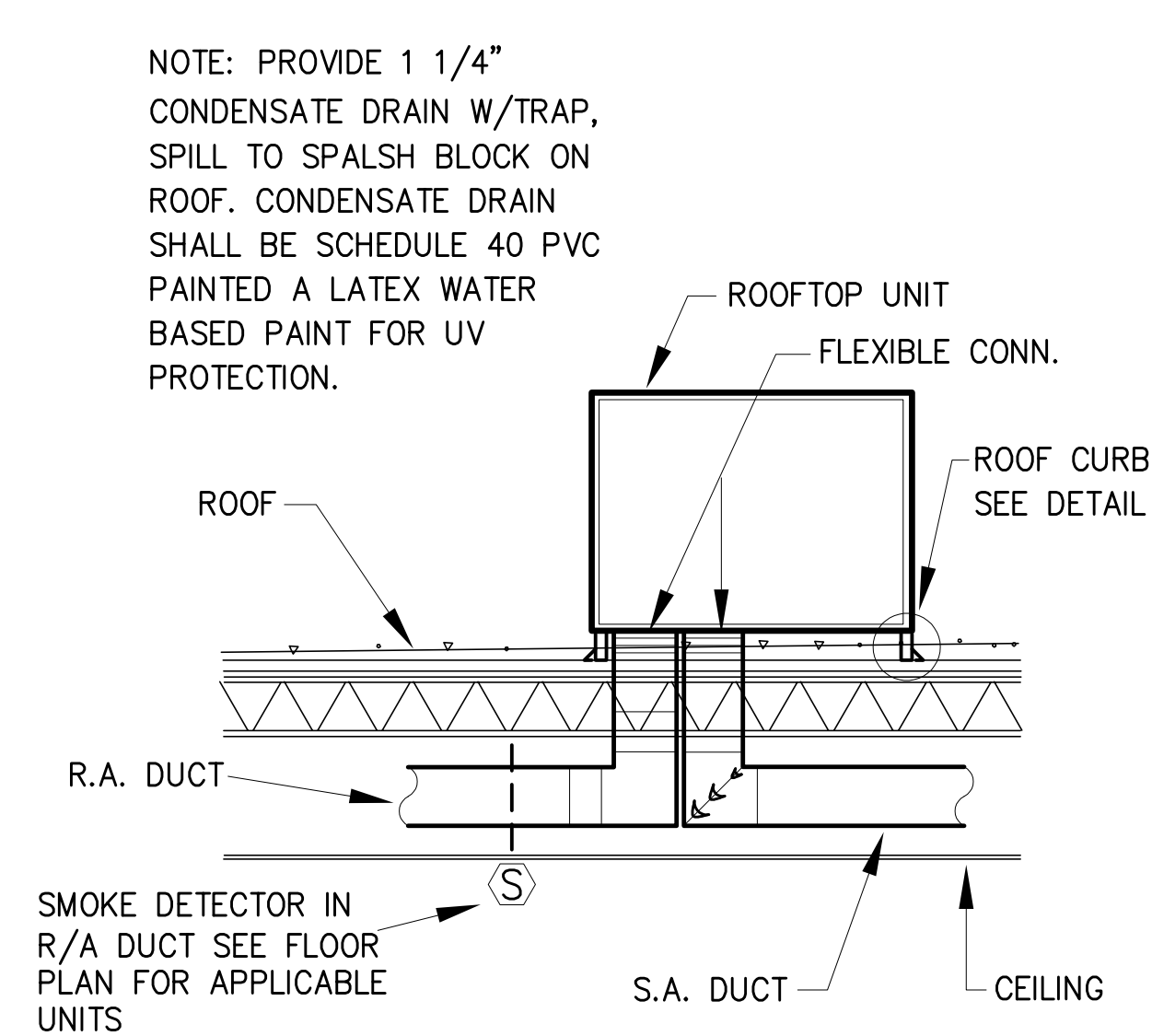
10 TURNING VANE DETAIL
NTS
PERMITTED ONLY WHERE RADIUS
ELL WILL NOT FIT.



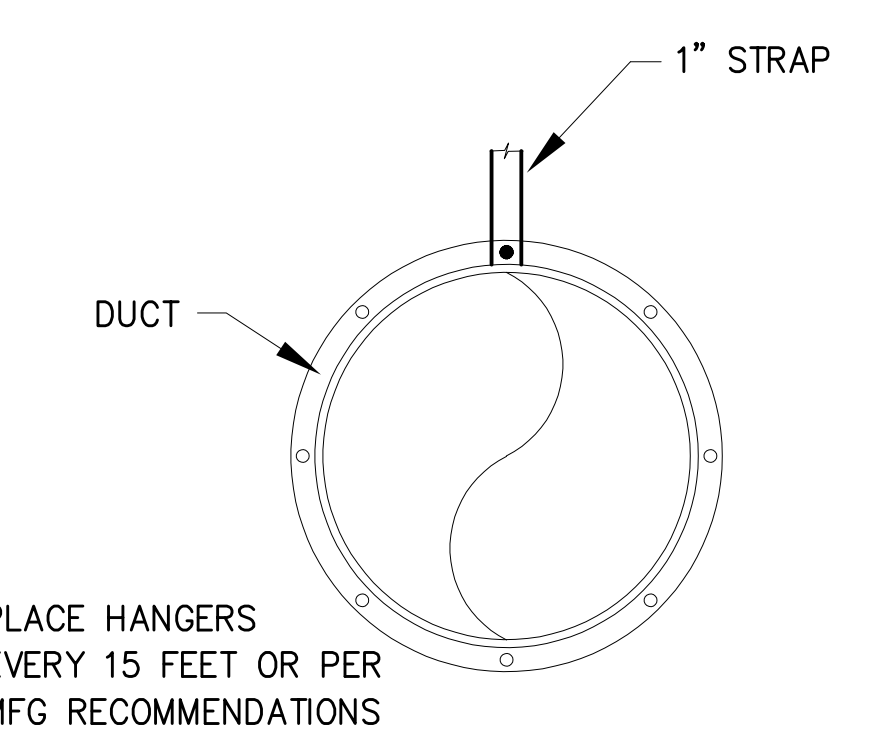
9 CONDENSATE DRAIN DETAIL
NTS
NOTES:
1. CONDENSATE DRAIN SHALL BE PIPED FULL SIZE OF UNIT CONNECTION.
2. CONDENSATE PANS SHALL BE INSTALLED WITH ADEQUATE PITCH TO
ENSURE POSITIVE DRAINAGE OF ACCUMULATED CONDENSATE.
3. TRAP CONDENSATE AND DISCHARGE PER PLAN.



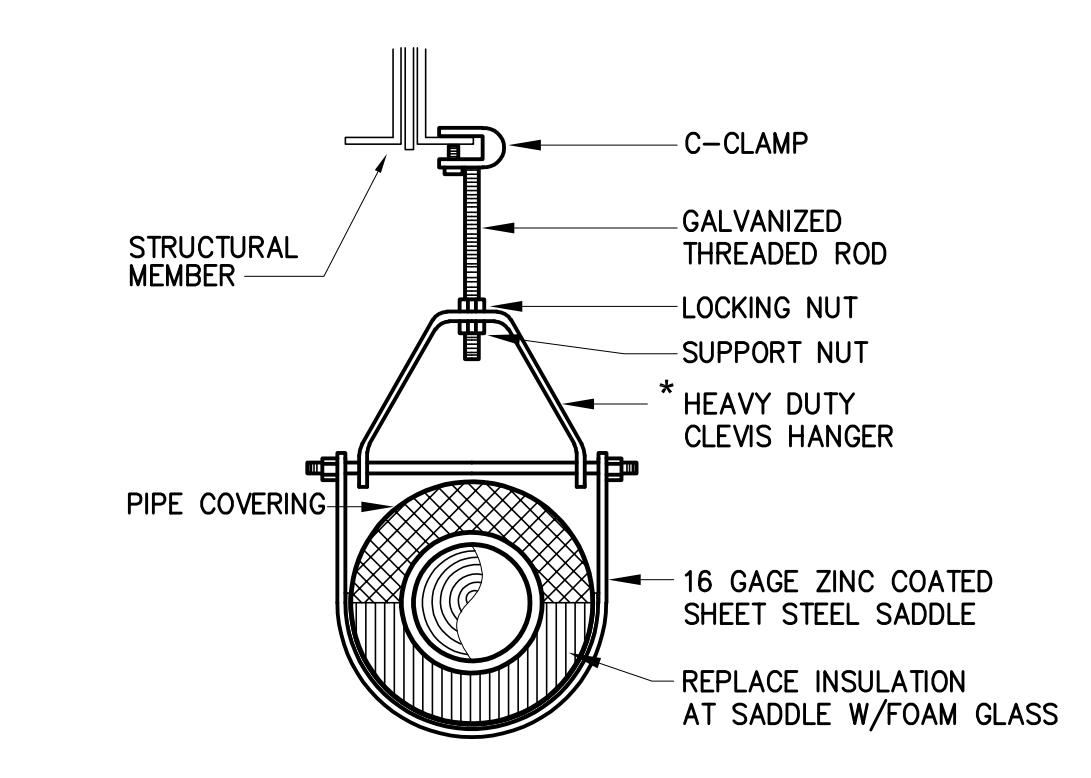
8 ROOFTOP UNIT CURB DETAIL
NTS



7 SECTION AT RTU DETAIL
NTS

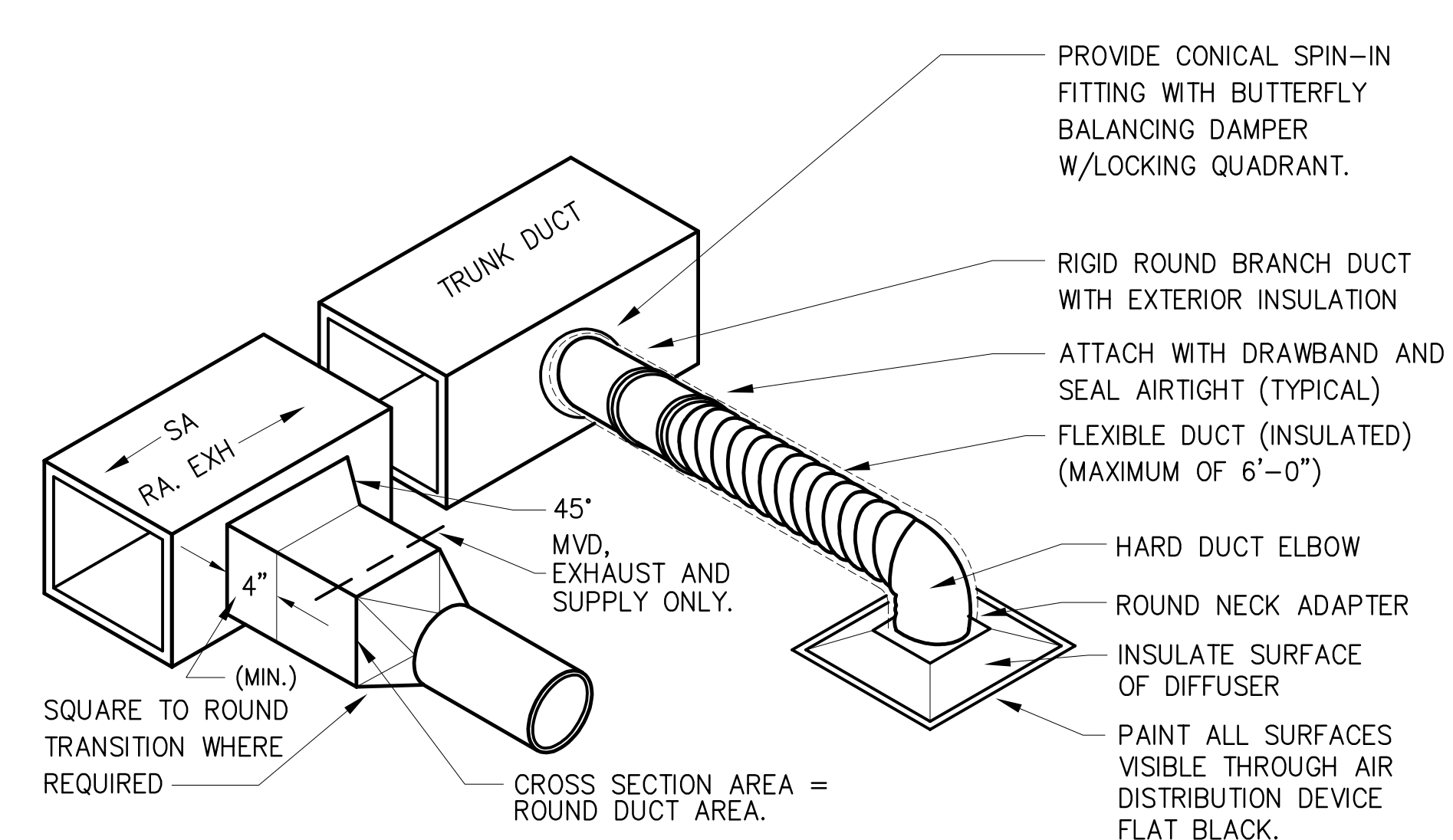


6 ROUND DUCT HANGER DETAIL
NTS
NOTE: PLACE HANGERS
EVERY 15 FEET OR PER
MFG RECOMMENDATIONS

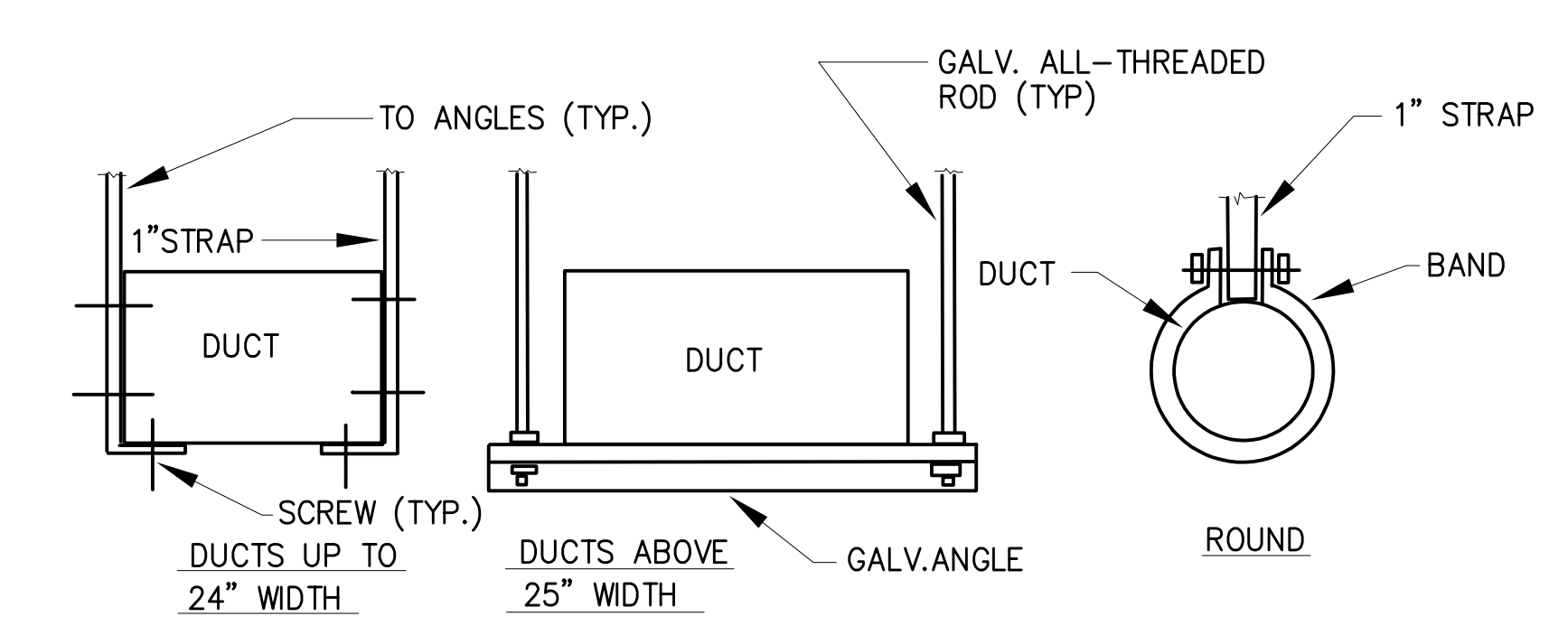


5 PIPE HANGER DETAIL
NTS
* CONTRACTOR OPTION:
MICHIGAN HANGER #403

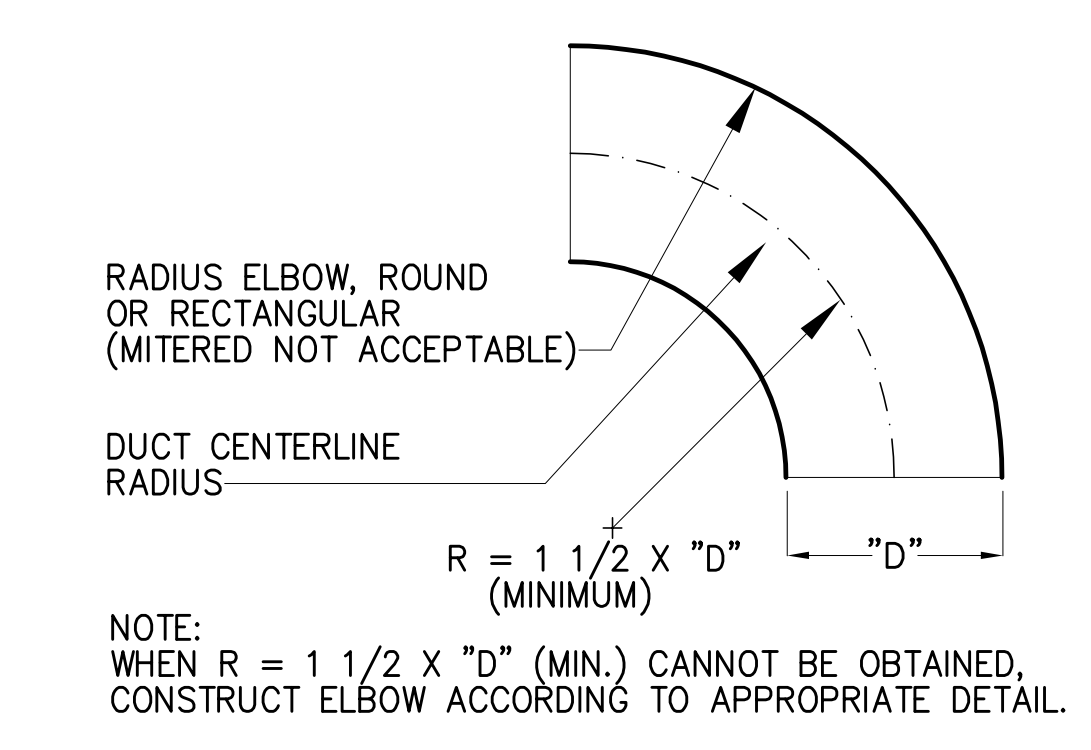
PIPING & VALVE LEGEND	
SYMBOL	DESCRIPTION
	GATE VALVE
	GLOBE VALVE
	BALL VALVE
	TRIPLE DUTY VALVE
	MULTIPURPOSE VALVE
	PRESSURE REDUCING VALVE
	CHECK VALVE
	BUTTERFLY VALVE
	BALANCING BUTTERFLY VALVE W/100% SHUTOFF & MEMORY STOP
	HOSE END DRAIN VALVE
	REDUCED PRESSURE BACKFLOW PREVENTER
	TEMPERATURE & PRESSURE RELIEF VALVE
	THERMOMETER
	WATER FLOW INDICATOR
	GAUGE COCK AND SNUBBER
	PRESSURE GAUGE
	PIPE UNION
	STRAINER
	-CHWS- CHILLED WATER SUPPLY
	-CHWR- CHILLED WATER RETURN
	A.F.F. ABOVE FINISHED FLOOR
	TIE INTO EXISTING AT THIS POINT
	C.I. CAST IRON
	U.N.O. UNLESS NOTED OTHERWISE



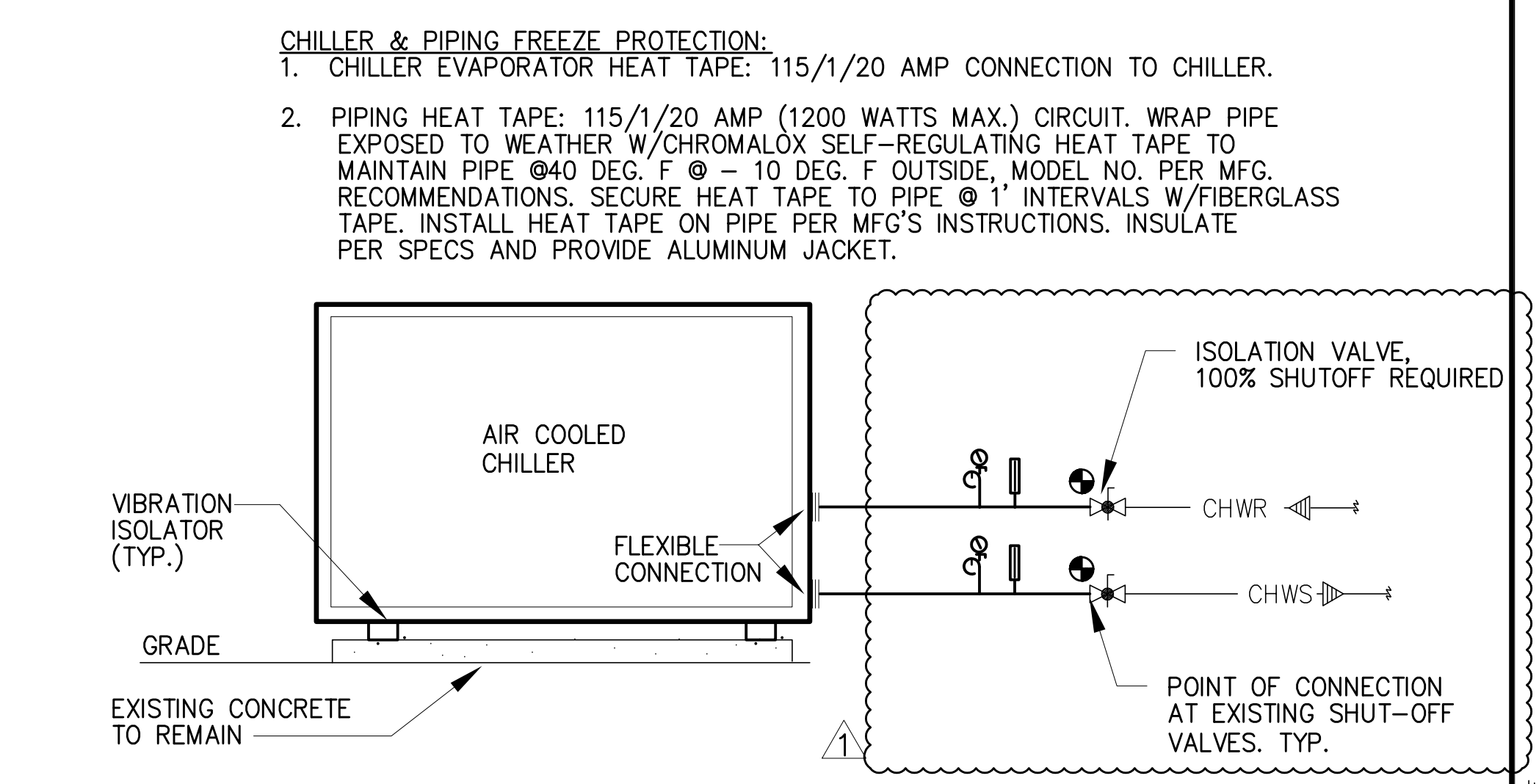
4 DUCT TAKE-OFF DETAIL
NTS



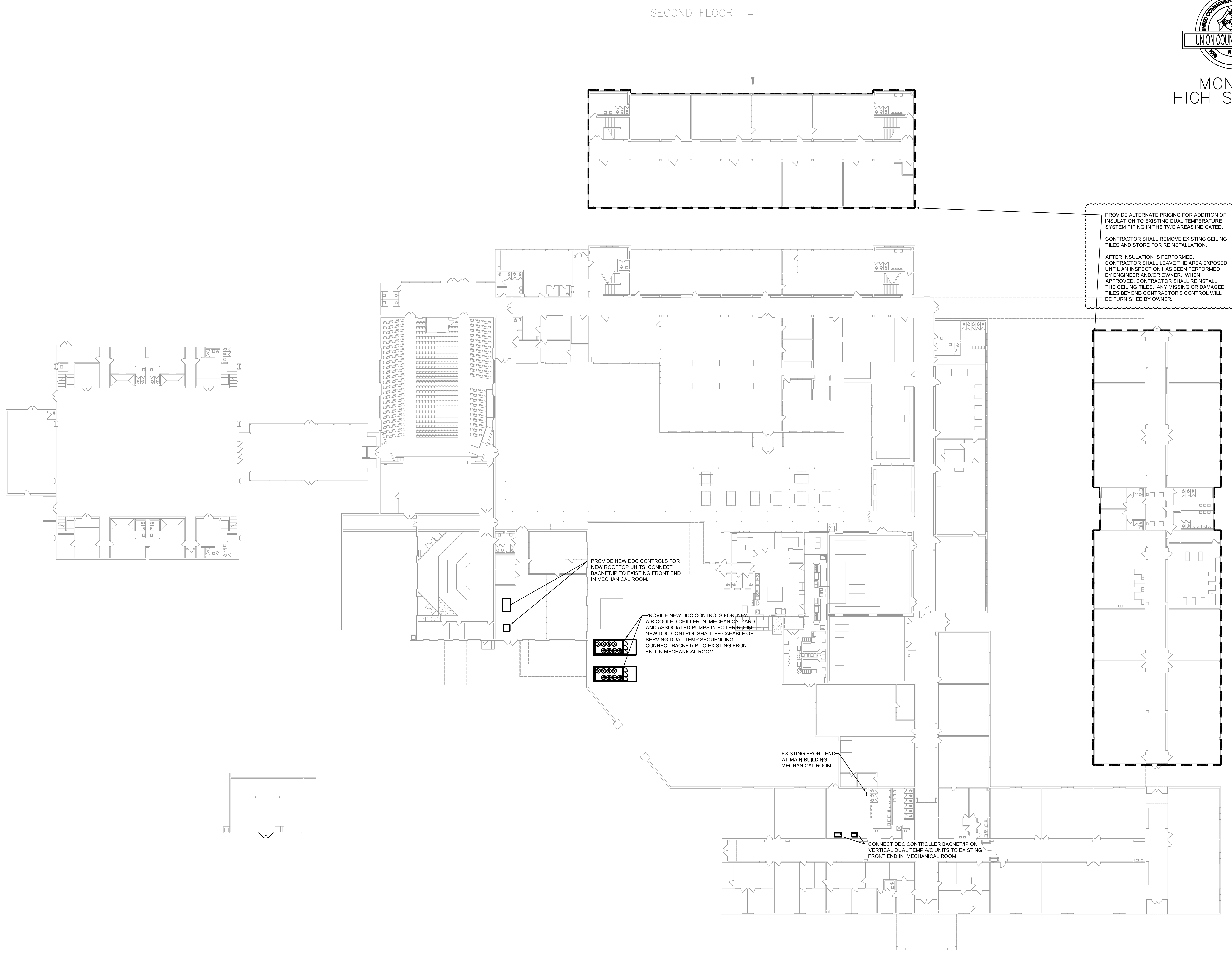
3 DUCTWORK HANGER DETAILS
NTS



2 RADIUS ELBOW DETAIL
NTS
NOTE: WHEN R = 1 1/2 X "D" (MIN.) CANNOT BE OBTAINED,
CONSTRUCT ELBOW ACCORDING TO APPROPRIATE DETAIL.



1 AIR COOLED CHILLER PIPING DETAIL
NTS



1 MECHANICAL OVERALL PLAN
NTS



PROVIDE ALTERNATE PRICING FOR ADDITION OF INSULATION TO EXISTING DUAL TEMPERATURE SYSTEM PIPING IN THE TWO AREAS INDICATED.

CONTRACTOR SHALL REMOVE EXISTING CEILING TILES AND STORE FOR REINSTALLATION.

AFTER INSULATION IS PERFORMED, CONTRACTOR SHALL LEAVE THE AREA EXPOSED UNTIL AN INSPECTION HAS BEEN PERFORMED BY ENGINEER AND/OR OWNER. WHEN APPROVED, CONTRACTOR SHALL REINSTALL THE CEILING TILES. ANY MISSING OR DAMAGED TILES BEYOND CONTRACTOR'S CONTROL WILL BE FURNISHED BY OWNER.

PROVIDE NEW DDC CONTROLS FOR NEW ROOFTOP UNITS. CONNECT BACNET/IP TO EXISTING FRONT END IN MECHANICAL ROOM.

PROVIDE NEW DDC CONTROLS FOR NEW AIR COOLED CHILLER IN MECHANICAL YARD AND ASSOCIATED PUMPS IN BOILER ROOM. NEW DDC CONTROL SHALL BE CAPABLE OF SERVING DUAL-TEMP SEQUENCING. CONNECT BACNET/IP TO EXISTING FRONT END IN MECHANICAL ROOM.

EXISTING FRONT END AT MAIN BUILDING MECHANICAL ROOM.

CONNECT DDC CONTROLLER BACNET/IP ON VERTICAL DUAL TEMP A/C UNITS TO EXISTING FRONT END IN MECHANICAL ROOM.

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PROFESSIONAL SEAL
5/3/21
ENGINEER
B. SCOTT COWLEY
5/3/2021

JOB NUMBER
21-054

JOB TITLE
MONROE HIGH SCHOOL
CIP - HVAC IMPROVEMENTS

SHEET
M7
7 OF 7

REVISION DATES
21-054
BSC
JOC
5/3/2021

ADDENDUM # - 05/03/21

PART 1 GENERAL**1.1 WORK INCLUDED**

- A. Direct Digital Controls (DDC)
- B. Programming and Graphics
- C. Controllers (Global, Standalone, Application Specific)
- D. Communications
- E. Sensors
- F. Valves and actuators
- G. Electrical appurtenances and wiring systems
- H. Sequence of Operation

1.2 RELATED WORK

- A. Section 23 05 00 -Mechanical General Requirements
- B. Electrical Contract Documents

1.3 SHOP DRAWINGS

- A. System Architecture
- B. Wiring diagrams
- C. Valves and actuators
- D. System schematics for all mechanical systems
- E. Material lists with part numbers and quantities, as appropriate
- F. Technical/Product data sheets for each piece of equipment
- G. Sequence of Operation for each system
- H. As-built drawings of installed system

1.4 SUBMITTALS

- A. Submit Shop Drawings of the complete Building Automation System (DDC System) for review and approval.
- B. Drawings shall be submitted on standard sheet size format (8-1/2" x 11", 11" x 17", or 24" x 36").
- C. Drawings shall be bound within a standard 3-ring binder, cover, or other suitable permanent binder. For projects in which the controls submittals will be less than one-half inch thick, the submittal documents may be securely stapled in the upper left hand corner provided the cover sheet and back sheet are printed on card stock (heavy bond paper).
- D. Submit five (5) copies of submittal drawings for review by the Owner.
- E. At completion, furnish as-built drawings in bound form and on CD.
- F. Submit documentation for all DDC programming in graphical form (AutoCAD or Visio format, or equal) as a part of the as-built documentation.

SECTION 23 09 00 BUILDING AUTOMATION SYSTEM (BAS)

- G. Submit manufacturer's operating instruction manual for the DDC control system for use in owner training.
- H. Submit Certificate of Training upon completion of all scheduled training of the owner's operating personnel.

1.5 CODES AND REFERENCE STANDARDS

- A. The latest edition of the following standards and codes in effect and amended as of the date of the supplier's proposal, and any subsections thereof as applicable, shall govern the design and selection of equipment and material supplied.
 - 1. NFPA 70 - National Electrical Code (NEC)
 - 2. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers (Handbooks)
 - 3. ANSI/ASHRAE Standard 135 (1995) – BACnet: A Data Communication Protocol for Building Automation and Control Networks
 - 4. UL 916 - Standard for Energy Management Equipment
 - 5. FCC – Part 15, Subpart J
 - 6. City, County, State and Federal regulations and codes in effect as of the date of the Contract

1.6 PERMITS

- A. Except as otherwise indicated, the system supplier shall secure and pay for all permits, inspections, and certifications required for his work and arrange for all necessary approvals by the governing authorities.

1.7 QUALITY ASSURANCE

- A. Responsibility: The supplier of the HVAC digital logic control system shall be responsible for inspection and Quality Assurance (QA) for all materials and workmanship furnished by him.
- B. Component Testing: Maximum reliability shall be achieved through extensive use of high quality, pre-tested components. The manufacturer prior to shipment shall individually test each and every controller, sensor, and all other DDC components.
- C. Tools, Testing and Calibration Equipment: The control system supplier shall provide all tools, testing, and calibration equipment necessary to ensure reliability and accuracy of the control system.
- D. Authorized Representative: The systems control contractor shall have been in business a minimum of three years and be the authorized representative for the manufacturer of the BACnet components.

1.8 WARRANTY

- A. The DDC control system installed under this Specification shall be free from defects in material and workmanship under normal use and service for a period of twelve (12) months after final acceptance by the Owner. If within the twelve (12) month warranty period, any equipment, software, or labor is found to be defective in workmanship or materials, it shall be replaced free of charge by the Controls system installer. Warranty service shall be available to the job site during normal working hours.

1.9 PREVENTATIVE MAINTENANCE

- A. The DDC control system installed as part of this project shall include a preventative maintenance schedule including two four hour inspections per building twice within the first year of operation. The **owner** desires one service company to have responsibility for maintaining the entire campus-wide automation system. Therefore, the successful bidder shall be responsible for conducting similar inspections at all campus buildings with DDC controls.

1.10 CONTROL AND INTERLOCK WIRING

- A. All electrical work required under this section of specifications shall comply with the latest National Electrical Code. Control system power supply shall be served by a separate breaker and fused in control center for secondary protection.

SECTION 23 09 00 BUILDING AUTOMATION SYSTEM (BAS)

- B. The mechanical contractor shall furnish and turn over to the electrical contractor, motor starters for mounting and power connections through starter to motor. Disconnect switches, when required, shall be furnished by electrical contractor.
- C. All control wiring shall be run in rigid conduit below grade or, on outdoor installation. Galvanized EMT may be run in dry wall construction, above ceilings, or in equipment rooms where permitted by electrical specifications.
- D. Control wiring shall be color-coded #16 TFF of TFFN wire with 600 volt insulation. Run all wiring between terminal points without changing color. Color code of control wiring shall be as indicated on control wiring diagram. Multi-conductor thermostat cable will not be acceptable.

PART 2 PRODUCTS**2.1 SCOPE OF WORK**

- A. The required system will be Tridium based **and shall be a minor renovation to the existing Tridium based BAS system located in the mechanical room.** All equipment will consist of approved products specified below. Contractor to provide needed quantities of product specified below based on jobsite visit and plans provided. All Graphics, Alarms, Trending and Scheduling shall be added to existing FX server and match existing layout and function of other schools unless approved in writing by UCPS.
 - 1. Contractor to provide job documentation, including System Layout, Comm bus layout, sequence of operation, point to point controller diagrams and all product data sheets. The documentation is to be provided via 3 hard copies and also placed on FX server to be access via system graphics.
 - 2. All Products to be warrantied for a period of 3 years from the date of purchase, all labor to be warrantied 1 year from Job Completion and Sign-off.
 - 3. System to be BACNET/IP based, all controllers need to be connected via UCPS Ethernet network. Contractor to provide switches listed below. UCPS will install and setup switches in existing IT closets located on campus. All Ethernet cable for HVAC equipment will be Cat-6 and orange in color. The Contractor will pull CAT-6 cable via existing cable tray from field controllers to new switches.
- B. APPROVED PRODUCTS
 - 1. VG-20 Controllers for Fan Coils
 - 2. VG-32 Controllers for Chillers, Boilers, Air Handling Units, and Roof Top Units.
 - 3. VC-20 Expansion Controllers for Chillers, Boilers, Air Handling Units
 - 4. A/CP-S Room Sensors
 - 5. EX3300-48 48 Port switch (1 Per Wing)
 - 6. FX-7021 Jace (Located in Mechanical Room and will be provided by UCPS)
 - 7. A/10K-CP-6 Duct Temp Sensors for Fan Coils
 - 8. RIXGA CT Switches for Fan Coil Fan Status (Fan Coils, Air Handling Units, Chillers, Boilers)
 - 9. PA Series JCI UL Listed Control Panels (if needed) Chiller, Boiler Plant
 - 10. A/10K-CP Immersion Sensors Chillers, Boilers

C. APPROVED MANUFACTURER'/INSTALLERS

- 1. Facility Systems Services Inc
- 2. Platinum Building Automation
- 3. Environmental Controls
- 4. Carolina Air Solutions
- 5. ~~Carrier~~
- 6. ~~Hoffman/HBT~~
- 7. ~~Johnson/JCI~~
- 8. Schneider Electric
- 9. ~~Trane~~

2.2 SYSTEM REQUIREMENTS

- A. The Building Automation System (BAS) shall consist of Network Server/Controllers (NSCs), a family of Standalone Digital Control Units (SDCUs), Administration and Programming Workstations (APWs), and Web-based Operator Workstations (WOWs). The BAS shall provide control, alarm detection, scheduling, reporting and information management for the entire facility, and Wide Area Network (WAN) if applicable.

SECTION 23 09 00 BUILDING AUTOMATION SYSTEM (BAS)

- B. An Enterprise Level BAS shall consist of an Enterprise Server, which enables multiple NSCs (including all graphics, alarms, schedules, trends, programming, and configuration) to be accessible from a single Workstation simultaneously for operations and engineering tasks.
- C. The Enterprise Level BAS shall be able to host up to 250 servers, or NSCs, beneath it.
- D. For Enterprise reporting capability and robust reporting capability outside of the trend chart and listing ability of the Workstation, a Reports Server shall be installed on a Microsoft Windows based computer. The Reports Server can be installed on the same computer as the Enterprise Server.
- E. The system shall be designed with a top-level 10/100bT Ethernet network, using the BACnet/IP.
- F. ~~BACnet MS/TP, BACnet IP, LonTalk FTT-10A, and WebServices~~ shall be native to the NSCs. There shall not be a need to provide multiple NSCs to support all the network protocols, nor should there be a need to supply additional software to allow all three protocols to be natively supported. A sub-network of SDCUs using the ~~BACnet IP MS/TP, LonTalk FTT-10A, and/or Modbus RTU~~ protocol shall connect the local, stand-alone controllers with Ethernet-level Network Server Controllers/IP Routers.
- G. The TCP/IP layer connects all of the buildings on a single Wide Area Network (WAN) isolated behind the campus firewall. Fixed IP addresses for connections to the campus WAN shall be used for each device that connects to the WAN.
- H. Fieldbus Level with Standalone Digital Control Units (SDCUs)
- I. The fieldbus layer shall be support all of the following types of SDCUs:
 - J. BACnet SDCU requirements: The system shall consist of one or more BACnet MS/TP field buses managed by the Network Server Controller. Minimum speed shall be 76.8kbps. The field bus layer consists of an RS485, token passing bus that supports up to 127 Standalone Digital Control Units (SDCUs) for operation of HVAC and lighting equipment. These devices shall conform to BACnet standard 135-2007. The NSCs shall be capable of at least two BACnet MS/TP field buses for a total capability of 254 SDCUs per NSC.
 - K. NETWORK 8000 SDCU requirements: The system shall consist of one or more ASD or LCM field buses managed by the Network Server Controller. The field bus layer shall consist of up to 128 ASD SDCUs or 31 LCM SDCUs for operation of HVAC, power metering, and lighting equipment.
 - M. I/NET SDCU requirements: The system shall consist of one or more controller LANs and subLANs managed by the Network Server Controller. The network shall consist of up to 100,000 I/NET points capable through numerous links and devices for operation of HVAC, power metering, and lighting equipment.
- N. The BAS shall be capable of being segmented, through software, into multiple local area networks (LANs) distributed over a wide area network (WAN). Workstations can manage a single LAN (or building), and/or the entire system with all portions of that LAN maintaining its own, current database.
- O. All NSCs, Workstation(s) and Servers shall be capable of residing directly on the owner's Ethernet TCP/IP LAN/WAN with no required gateways. Furthermore, the NSC's, Workstation(s), and Server(s) shall be capable of using standard, commercially available, off-the-shelf Ethernet infrastructure components such as routers, switches and hubs. With this design the owner may utilize the investment of an existing or new enterprise network or structured cabling system. This also allows the option of the maintenance of the LAN/WAN to be performed by the owner's Information Systems Department as all devices utilize standard TCP/IP components.
- P. The BAS system shall be scalable and expandable at all levels of the system using the same software interface, and the same TCP/IP level and fieldbus level controllers. Systems that require replacement of either the workstation software or field controllers in order to expand the system shall not be acceptable.
- Q. Web-based operation shall be supported directly by the NSCs and require no additional software, other than a Java supported network browser.
- R. The system shall be capable of using graphical and/or line application programming language for the Network Server Controllers.

2.3 SENSORS, TRANSMITTERS AND THERMOSTATS

SECTION 23 09 00 BUILDING AUTOMATION SYSTEM (BAS)

- A. Temperature Sensors: Thermistor type with an accuracy of plus or minus 0.40 degree F over the entire control range. Sensors for pipe installations shall be immersion type, brass well, and thermistor with integral lead wire. Sensors for duct application shall be insertion probe type, stainless steel probe, integral handibox, and thermistor with integral lead wire. Space temperature sensors shall be compatible with the unit controller and shall be provided in a decorative metal or plastic enclosure. Space temperature sensors shall be provided with setpoint adjustment (lever or slide type), and override pushbutton, and connection port for field service tool. Outdoor temperature sensors shall be mounted inside a protective weather and sun shield.
- B. Space Temperature Sensor: Wall mounted room controller with integral digital display and user function keys to control room temperature setpoints, select fan speeds (where appropriate), view room and outside air temperatures, view room setpoints or discharge temperature, or initiate after-hours operation of the associated terminal unit or system. The controller shall also be capable of functioning as a field service tool to allow maintenance personnel to observe and adjust all control parameters resident in the terminal unit controller. These control parameters shall also be adjustable from the global controller. Sensor shall be standard two-wire connection and have a thermistor, housed in a decorative plastic enclosure.
- C. Humidity Sensors: Thin-film capacitive type sensor with on-board nonvolatile memory, accuracy to plus or minus two percent (2%) at 0 to 90% RH, 12 - 30 VDC input voltage, analog output (0 - 10 VDC or 4 - 20mA output). Operating range shall be 0 to 100% RH and 32 to 140 degree F. Duct mounted type sensors shall have a stainless steel insertion element, sealed to prohibit corrosion. Sensors shall be selected for wall, duct or outdoor type installation as appropriate.
- D. Current Switches (Type 1): For proving fan or pump operational status, provide split-core type current status switches with adjustable setpoint and solid state internal circuitry. Current switch shall have induced power, trip point set adjustment to plus or minus 1% over a range of 1 to 135 amps, trip and power LED, and field adjustable to indicate both On-Off conditions and loss of load (broken belt, etc.). Units shall have a five-year manufacturer's warranty. Current switches shall be Hawkeye Series H-908 by Veris Industries, or approved equal.
- E. Low Temperature Sensors: For sensing low temperatures in air handling units, provide SPST type switch, 35 to 45 degree F range, manual reset, vapor charged twenty foot long sensing element, and 120 volt electrical power connection.

2.4 MISCELLANEOUS MATERIALS

- A. Panels: All enclosures for DDC controllers and devices shall be fabricated in accordance with UL Standards from code gauge steel. Enclosures shall be provided with a continuous hinge on the door and a flush latching mechanism. Enclosures shall be shop painted with standard grade enamel coating. Back panels shall be furnished when required to facilitate installation of boards or accessories. All enclosures installed outdoors shall be constructed to NEMA 3R standards. All controllers shall be installed within an approved enclosure unless the controller will be installed within the control cabinet section of the equipment that it is intended to control. Enclosures shall facilitate the mounting of gauges, switches, pilot lights, and the like, on the face panel when required. Control devices that are mounted on the face of the panel shall be identified with engraved nameplates.
- B. Power Transformers: Step-down power transformers shall be provided for all DDC controllers and associated accessory devices as required. Transformers shall be sized and selected to accommodate all connected accessory items. Transformers shall be UL Listed Class 2 type with 120 VAC primary, 24 VAC secondary.
- C. Relays: Miscellaneous control relays shall be provided as required to energize or control equipment and devices within the control system. Relays shall be located as close as practical to the controlled device (motor, motor starter, etc.). Where approved by NEC, relays may be installed within starters and equipment control panels where space is available. Relays installed outside of the controlled device shall be provided with a NEMA enclosure suitable for the location where installed.
- D. Wiring: All wiring shall be installed raceways. Control wiring shall not be installed in power circuit conduits.
 - 1. Provide all interlock and control wiring. Provide wiring as required by functions as specified and as recommended by equipment and device manufacturers to achieve the specified control functions.
 - 2. Low voltage conductors shall be stranded bare or tinned-copper with premium grade polymer alloy insulation. For shielded cable, furnish multi-conductor of overall polyester supported aluminum foil with stranded tinned copper drain wire to facilitate grounding. Coaxial shield shall be copper braided type.

SECTION 23 09 00 BUILDING AUTOMATION SYSTEM (BAS)

Provide shielded cable where recommended by the equipment or device manufacturer, grounded in strict accordance with the manufacture's recommendations.

3. Low voltage wiring shall be UL Listed type for the intended application. Non-plenum type cable shall be UL Type CM and /or CMR. Plenum type cable shall be UL type CMP and /or CL3P for approved plenum installations.

2.5 DIRECT DIGITAL CONTROL SYSTEM

- A. The Direct Digital Control (DDC) System shall consist of native BACnet type global controller(s) and standalone or application specific unitary controller(s) configured as a distributed communications network composed of one or more levels of BACnet compliant local area networks (LAN). No gateways shall be used except when required to interface with specific equipment furnished by another manufacturer (e.g.: chiller controllers, packaged equipment controllers, etc.). The intent of the distributed control strategy is to install the controllers in close proximity to the equipment being controlled, and to distribute the processing to each standalone DDC panel. In the event of a communications failure of the BACnet LAN, the controllers shall be capable of operating in standalone mode. All devices (global controllers, standalone controllers, programmable controllers, etc.) shall be UL Listed, FCC approved, and BACnet compliant.
- B. Furnish a totally native BACnet -based system based on distributed logic control in accordance with this specification section. The existing operator's terminal, all global controllers, logic controllers, and all input/output devices shall communicate using the protocols and local area network (LAN) standards as defined by ANSI/ASHRAE Standard 135-1995, BACnet. All DDC controllers, including unitary controllers, shall be native BACnet devices. In general, no gateways shall be used except when required to interface with specific equipment furnished by another manufacturer. Scope of work will include, but not be limited to, the following:
 1. Provide all necessary BACnet compliant hardware and software to meet the system's functional specifications. Provide Protocol Implementation Conformance Statement (PICS) for every controller in the system, including unitary controllers. All direct digital logic hardware is to comply with BACnet.
 2. Prepare individual hardware layouts, interconnection drawings, and software configuration from project design data.
 3. Implement the detailed design for all system-standard analog and binary objects, distributed control and system databases, graphic displays, logs, and management reports based on control descriptions, logic drawings, configuration data, and bid documents.
 4. Design, provide, and install all equipment enclosures, panels, data communication network cables needed, and all associated hardware.
 5. Provide and install all interconnecting cables between supplied enclosures, logic controllers, and input/output devices.
 6. Provide and install all interconnecting cables between all operator's terminals and peripheral devices (such as printers, etc.) supplied under this contract.
 7. Provide complete manufacturer's product data for all items that are supplied. Include vendor name of every item supplied.
 8. Provide qualified supervisory personnel and technicians at the job site to assist in all phases of system installation, startup, and commissioning.
 9. Provide for operator training as described in this Section.
 10. Provide "as-built" documentation, operator's terminal software, diagrams, and all other associated project operational documentation (such as technical manuals) on approved media, the sum total of which accurately represents the final system.
 11. Provide new dampers, valves, actuators, sensors, controllers, and the like. No used components shall be provided as any part or piece of the installed system.

2.6 SYSTEM DESCRIPTION

- A. General Requirements
 1. A distributed logic control system complete with Direct Digital Control (DDC) and Direct Analog Control (DAC) software shall be provided. System shall be totally based on ANSI/ASHRAE Standard 135 – 1995, BACnet or LON. This system is to control all mechanical equipment, including all unitary equipment such as packaged air conditioning units, and all air handling units, boilers, chillers, and any other listed equipment on this project using native BACnet -compliant components.
 2. The entire processing system shall be in complete compliance with the BACnet standard. The system shall use BACnet protocols and LAN types throughout and exclusively. Non-BACnet compliant or proprietary equipment or systems (including gateways, except as specified previously) shall not be acceptable and are specifically prohibited.

SECTION 23 09 00 BUILDING AUTOMATION SYSTEM (BAS)

3. All logic controllers for terminal units, air handlers, central mechanical equipment, and Microsoft Windows-based operator's terminal(s) shall communicate and share data, utilizing only BACnet communication protocols.
 4. All logic controllers shall be fully programmable. Programmable controllers for every terminal unit, air handler, all central plant equipment, and any other piece of controlled equipment shall be provided. Programming tools shall be provided as part of the operator workstation for every controller supplied for the project.
 5. The Controls Contractor shall assume complete responsibility for the entire controls system as a single source. He shall certify that he has factory-trained personnel on staff under his direct employ on a daily basis. These employees shall be qualified to engineer, program, debug, and service all portions of the BACnet based logic control system. This shall include operator's terminal, global controllers, routers, programmable controllers, terminal unit controllers, sensors and all other components of the system.
- B. Trendlog Information
1. DDC system shall be capable of periodically monitoring the values or status of selected feedback or control data from the system global controller(s) or field controllers, and archiving this information on the operator's terminal. Archived files shall be appended with new sample data, allowing samples to be accumulated over a user defined period. Systems that overwrite previously archived data samples shall not be allowed, unless limited file size is specified. Samples in a trendlog shall be available for viewing at the operator's terminal. Displays of trendlog data shall be in spreadsheet format. Operator shall be capable of scrolling through all trendlog data. System shall automatically open archive files as needed to display archived data when the operator scrolls through the data vertically. All trendlog information displays shall be shown in standard engineering units.
 2. Software shall be included that is capable of graphing the trend logged object data. Software shall be capable of creating two-axis (x, y) graphs that display up to six object types at the same time in different colors. Graphs shall show object type values relative to time.
 3. Operator shall be able to change trendlog setup information. This shall include the data points and status information being trendlogged as well as the interval at which the information is to be logged. All trendlog functions shall be password protected. The operator shall be capable of viewing or setting up a trendlog for any prompted or read-only item.
 4. The system shall provide a means for the operator to directly export data to a comma-delimited file format for use in third-party software spreadsheets or other database programs. The system operation shall not be affected in any way by this data exchange.
- C. Energy Log Information
1. DDC system shall periodically gather energy log data stored in field terminal controllers and archive this information on the operator terminal's hard disk. Archive data shall be appended with the new data and allow data to be accumulated over several years. Systems that overwrite archived data shall not be allowed unless limited file size is specified. System shall automatically open archive files as needed to display archived data when the operator scrolls through the data. All energy log information shall be displayed in standard engineering units.
 2. System software shall be capable of graphing the Energy Log data. Software shall be capable of creating graphs in two-axis (x, y) format that shows recorded data relative to time. All data shall be stored in comma-delimited file format for direct use by third party software spreadsheets or other database programs. System operation shall not be affected by on-line access to the energy information.
 3. Operator shall be able to modify the energy log setup information. This shall include which meters are to be logged, meter pulse value, and what types of energy units are being logged. All energy meters monitored by the system shall be capable of being logged. All energy logging operations shall be password protected.
 4. Provide capability for the operator to export to a comma-delimited file format all energy-logged data for use by third party software spreadsheets or other database programs. System operation shall not be affected by on-line access to the energy information.
- D. Configuration/Setup
1. Provide means for the operator to display and change the system configuration. This shall include, but not be limited to: system time, day of the week, date of daylight savings time set forward/back, printer termination, port addresses, modem port and speed, and the like. Items shall be modified utilizing easily understood terminology by means of simple mouse/cursor key movements.
- E. Programming Tools
1. Operator's Terminal shall include programming tools for all controllers supplied. If a new software package is proposed it is the contractor's responsibility to load all programming tools/ engineering software

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on all of the owner's existing operator terminals and laptops, as well as provide all connectors for connection to field devices with portable terminals. All controllers shall be programmed using graphical tools that allow the user to connect function blocks on screen that provide sequencing of all control logic. Function blocks shall be represented by graphical displays that are easily identified and distinct from different types of blocks. Graphical programming that uses simple rectangles and squares is not acceptable.

2. User shall be able to pick graphical function block from the menu and place on screen. Programming tools shall place lines connecting appropriate function blocks together automatically. Provide zoom in and zoom out capabilities. Function blocks shall be downloaded to controller without any reentry of data.
3. Programming tools shall include a test mode. Test mode shall show user the real-time data on top of graphical display of selected function blocks. Data shall be updated real-time with no interaction by the user. Function blocks shall be animated to show status of data inputs and outputs. Animation shall show change of status on logic devices and countdown of timer devices in graphical format.

2.7 GLOBAL BUILDING CONTROLLERS (GBCs)

- A. The controls contractor shall supply one or more global controller as part of this contract. Number of global controllers required is dependent on the type and quantity of DDC devices.
- B. The Global Building Controller shall provide the interface between the LAN and the field control devices, and provide global supervisory control functions over the control devices connected to the GBC. It shall be capable of executing application control programs to provide:
 1. Calendar functions
 2. Scheduling
 3. Trending
 4. Alarm monitoring and routing
 5. Time synchronization
 6. Integration of LonWorks controller data and BACnet controller data
 7. The GBC must provide the following hardware features as a minimum:
 - a. One Ethernet Port - 10 Mbps
 - b. One RS-232 port
 - c. One BACnet MS/TP Port
 - d. Battery Backup
 - e. Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
 - f. The GBC must be capable of operation over a temperature range of 0 to 55°C
 - g. The GBC must be capable of withstanding storage temperatures of between 0 and 70°C.
 - h. The GBC must be capable of operation over a humidity range of 5 to 95% RH, non-condensing.
 - i. The GBC shall provide multiple user access to the system and support for ODBC or SQL. A database resident on the GBC shall be an ODBC-compliant database or must provide an ODBC data access mechanism to read and write data stored within it.
 - j. Event Alarm Notification and actions
 - k. The GBC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
 - l. The GBC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up telephone connection, or wide-area network.
 - m. Alarm generation shall be selectable for annunciation type and acknowledgement requirements.
 8. Provide for the creation of a minimum of eight alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.
 9. Provide timed (schedule) routing of alarms by class, object, group, or node.
 10. Provide alarm generation from binary object "runtime" and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.
 11. Control equipment and network failures shall be treated as alarms and annunciated.
 12. Alarms shall be annunciated in any of the following manners as defined by the user:
 13. Screen message text
 14. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
 - a. Day of week
 - b. Time of day
 - c. Recipient
 15. Pagers via paging services that initiate a page on receipt of email message
 16. Graphic with flashing alarm object(s)

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17. Printed message, routed directly to a dedicated alarm printer
18. Audio messages
19. The following shall be recorded by the NAC for each alarm (at a minimum):
 - a. Time and date
 - b. Location (building, floor, zone, office number, etc.)
 - c. Equipment (air handler #, accessway, etc.)
 - d. Acknowledge time, date, and user who issued acknowledgement.
 - e. Number of occurrences since last acknowledgement.
20. Alarm actions may be initiated by user defined programmable objects created for that purpose.
21. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
22. A log of all alarms shall be maintained by the GBC and/or a server (if configured in the system) and shall be available for review by the user.
23. Provide a "query" feature to allow review of specific alarms by user defined parameters.
24. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.
25. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

C. DATA COLLECTION AND STORAGE

1. The GBC shall have the ability to collect data for any property of any object and store this data for future use.
2. The data collection shall be performed by log objects, resident in the GBC that shall have, at a minimum, the following configurable properties:
3. Designating the log as interval or deviation.
4. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
5. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
6. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
7. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.
8. All log data shall be stored in a relational database in the NAC and the data shall be accessed from a server (if the system is so configured) or a standard Web Browser.
9. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.
10. All log data shall be available to the user in the following data formats:
11. HTML
12. XML
13. Plain Text
14. Comma or tab separated values
15. Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable.
16. The GBC shall have the ability to archive it's log data either locally (to itself), or remotely to a server or other GBC on the network. Provide the ability to configure the following archiving properties, at a minimum:
17. Archive on time of day
18. Archive on user-defined number of data stores in the log (buffer size)
19. Archive when log has reached it's user-defined capacity of data stores
20. Provide ability to clear logs once archived

D. AUDIT LOG

1. Provide and maintain an Audit Log that tracks all activities performed on the NAC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached it's user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network, or to a server. For each log entry, provide the following data:
2. Time and date
3. User ID
4. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

E. DATABASE BACKUP AND STORAGE

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1. The NAC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.
2. Copies of the current database and, at the most recently saved database shall be stored in the NAC. The age of the most recently saved database is dependent on the user-defined database save interval.
3. The NAC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

PART 3 EXECUTION**3.1 TRAINING**

- A. The Controls Contractor shall provide complete on-site training for the Owner's designated operating personnel. Training shall include all functional aspects of the control system and all modes of system operation. System modes include occupied/unoccupied, heating/cooling, economizer, startup/shutdown, energy management, and alarm event operations. Training of Owner's operating personnel shall include a minimum of eight (8) hours of system instruction, conducted during one or two site visits for a combined total of eight hours of instruction. Additional instruction time may be requested by the Owner for an additional fee if needed for training additional personnel or if more instruction is requested. Training is not intended to include in-depth instruction in system programming.
- B. Training shall be conducted during normal working hours, Monday through Friday, at the project site. When applicable, the training may be conducted at the Owner's central energy management office in addition to training on site.
- C. Contractor shall furnish one (1) copy of the system Operator's Manual to the Owner. This manual should be delivered to the Owner at the time of training. This manual is in addition to the system As-built documents which are intended to show wiring configurations and sensor locations.

PART 4 SEQUENCE**4.1 SEQUENCE OF OPERATION****~~A. DUAL TEMPERATURE PUMPS~~**

- ~~1. Dual temperature water is provided to the primary loops through two pumps in parallel. The pumps shall be energized when the building is in occupied mode or on any call for heating or cooling. Pumps shall operate anytime outside air temperature is below 32F.~~
 - ~~2. Upon initiation, the lead pump (alternated weekly), shall provide water to the building. Delta T across the pump exceeds 10F in cooling mode and 20F in heating mode for 30 minutes, the lag pump shall be brought on line.~~
 - ~~3. Set point in heating mode shall be per the following reset schedule.~~

Outside Air	Hot Water Supply
20 Deg. F.	160 Deg. F.
60 Deg. F.	100 Deg. F.
 - ~~4. Both pumps shall remain in simultaneous operation until the next time event change.~~
 - ~~5. The system shall enter heating mode when the outdoor temperature is less than 50F for two hours. System shall remain in heating mode until outdoor temperature exceeds 55F for two hours.~~
 - ~~6. The system shall enter cooling mode when the outdoor temperature exceeds 60F for two hours. System shall remain in cooling mode until outdoor temperature is less than 55F for two hours.~~
 - ~~7. Changeover valves shall modulate during transition from one setting to the other in order to prevent shocking boiler/chiller.~~
 - ~~8. Dual temp system points list.~~
 - ~~a. Water supply temperature~~
 - ~~b. Water return temperature~~
 - ~~c. Outside air temperature.~~
 - ~~d. Primary pump start/stop/status.~~
 - ~~e. Secondary pump start/stop/status.~~
- ~~B. Hot Water System~~
- ~~1. Hot water is provided to the building by gas-fired boilers and secondary pumps.~~
 - ~~2. Pumps shall be energized through the BAS whenever the dual temperature loop enters heating mode. Upon proof of flow the boilers will be energized.~~

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- ~~3. Upon proof of flow, the boilers and secondary pumps shall be energized. The boilers shall operate under its internal control to provide 180F water. The three way changeover valve shall modulate to maintain the loop temperature noted above.~~
- ~~4. The hot water supply and return temperatures shall be monitored and alarmed at the DDC. Each boiler shall be energized from the DDC with a status contact monitored and alarmed.~~
- ~~5. Boiler system points list.~~
 - ~~a. Hot water supply temperature (each boiler).~~
 - ~~b. Hot water return temperature (each boiler).~~
 - ~~c. Pump start/stop/status.~~

C. Chilled Water System

1. Chilled water is provided to the building by one or two chillers as shown on the plans. Each chiller shall have a dedicated secondary pump.
2. Secondary pumps shall be energized through the BAS upon a call for cooling or dehumidification. Upon proof of flow, the chiller shall be energized. The chiller shall operate under its own controls to provide 44F chilled water to the loop.
3. Where two chillers are provided, they shall alternate weekly. The lead chiller shall operate until the delta T across the chiller exceeds 10F for 30 minutes. At that point the lag chiller shall be energized. When the delta T across both chillers falls below 4F for 30 minutes, the lag chiller shall de-energize. The lag chiller shall also de-energize upon entering un occupied mode.
4. Chiller system points list with local display at chiller and at the BMS.
 - a. Chilled water supply temperature (secondary loop)
 - b. Chilled water return temperature (secondary loop).
 - c. Pump start/stop/status.

D. Fan Coil Units

- ~~1. A programmable controller capable of stand alone operation will control the unit. The unit will be started via pre determined optimum start through the Building Automation System (BAS). The unit will be de-energized in accordance with time schedules through the BAS.~~
- ~~2. Occupied Mode: In occupied mode, the supply fan will be indexed on and will run continuously. In unoccupied mode, the fan shall cycle on as required to maintain space set points.~~
- ~~3. Temperature Control: The unit shall index mode based on dual temperature system setting. In cooling mode, on a rise in space temperature above the setpoint, the controller will modulate the chilled water valve open to the coil. On a drop in space temperature, the chilled water valve will modulate closed. In heating mode, on a drop in space temperature below the heating set point, the controller will modulate the valve open to the coil. On a rise in space temperature, the reverse will occur. Unique temperature set points shall be provided for occupied and unoccupied mode.~~
- ~~4. Fan coil point list.~~
 - ~~a. Fan start/stop/status.~~
 - ~~b. Discharge air temperature.~~
 - ~~c. Control valve outputs.~~
 - ~~d. Space temperature~~

E. Unit Ventilators

- ~~1. A programmable controller capable of stand alone operation will control the unit. The unit will be started via pre determined optimum start through the Building Automation System (BAS). The unit will be de-energized in accordance with time schedules through the BAS.~~
- ~~2. Occupied Mode: In occupied mode, the supply fan will be indexed on and will run continuously. In unoccupied mode, the fan shall cycle on as required to maintain space set points.~~
- ~~3. Temperature Control: The unit shall index mode based on dual temperature system setting. In cooling mode, on a rise in space temperature above the setpoint, the controller will modulate the chilled water valve open to the coil and the face and bypass damper shall modulate to maintain temperature set point. On a drop in space temperature, the chilled water valve will modulate closed. In heating mode, on a drop in space temperature below the heating set point, the controller will modulate the valve open to the coil. On a rise in space temperature, the reverse will occur. In heating mode the face and bypass dampers shall be fully open to th coil. Unique temperature set points shall be provided for occupied and unoccupied mode.~~
- ~~4. Fan coil point list.~~
 - ~~a. Fan start/stop/status.~~
 - ~~b. Discharge air temperature.~~
 - ~~c. Face and bypass damper output~~
 - ~~d. Control valve outputs.~~

SECTION 23 09 00 BUILDING AUTOMATION SYSTEM (BAS)~~_____ e. Space temperature~~**F. Existing Constant Volume Air Handling Units**

1. A programmable controller capable of stand-alone operation will control the unit. The unit will be started via pre-determined optimum start through the Building Automation System (BAS). The unit will be de-energized in accordance with time schedules through the BAS. The unit is a constant volume unit with dual temperature coil.
2. Occupied Mode: In occupied mode, the supply fan will be indexed on and will run continuously. In unoccupied mode, the fan shall cycle on as required to maintain space set points. In occupied mode the outside air damper shall modulate to minimum position. In unoccupied mode the damper shall remain closed.
3. Temperature Control: The unit control valve shall modulate as required to maintain space heating or cooling setpoint.
4. AHU point list.
 - a. Fan start/stop/status.
 - b. Discharge air temperature.
 - c. Control valve outputs.
 - d. Space temperature.
 - e. Outside air damper position

G. Packaged Unitary Equipment

1. A programmable controller capable of stand-alone operation will control the unit. The unit will be started via pre-determined optimum start through the Building Automation System (BAS). The unit will be de-energized in accordance with time schedules through the BAS.
2. Occupied Mode: In occupied mode, the supply fan will be indexed on and will run continuously. In unoccupied mode, the fan shall cycle on as required to maintain space set points. In occupied mode the outside air damper shall modulate to minimum position. In unoccupied mode the damper shall remain closed.
3. Temperature Control: The unit components shall modulate as required to maintain space heating or cooling setpoint.
4. Points list.
 - a. Start/stop/status.
 - b. Discharge air temperature.
 - c. Space temperature.

H. ~~Fans shall be started and stopped through the building automation system.~~**I. Other**

1. ~~Provide emergency switch at entrance of Boiler Room that shall upon activation shutdown all burners within the Boiler Room.~~
2. All points (unit start/stop, temperature settings, etc.) shall be viewable and adjustable through the building graphics.
3. Main page shall have a holiday setting that will enable the owner to put the entire building in "unoccupied" mode.
4. Provide morning warmup/cooldown mode. In warmup mode all fans shall be off. All outside air dampers shall remain closed. All units shall operate in heating mode until space temperature setpoints are achieved.
5. In unoccupied mode, units shall operate to maintain setback space setpoints.

J. Variable Speed Pumping

1. ~~For each energy plant, primary pumps shall be provided with a variable speed drive.~~
2. ~~Provide two differential pressure sensors in for each system. Locations shall be determined during construction.~~
3. ~~Pump speed shall vary to maintain differential pressure of both sensors as required.~~
4. ~~Point list.~~
 - ~~a. Drive speed~~
 - ~~b. Differential pressure (each location)~~

END OF SECTION 23 09 00

SECTION 23 30 00 AIR DISTRIBUTION

PART 1 GENERAL**1.1 SCOPE**

- A. Furnish and install all sheet metal work shown or called for including ductwork and connections to fans and equipment.
- B. Ductwork shall be provided and installed as shown on the drawings. All details of ductwork are not indicated, and necessary bends, offsets and transformation must be furnished whether shown or not.
- C. The provisions of Section 23 05 00 apply to all the work in this Section.

1.2 SUBMITTALS

- A. Submit the following in accordance with Section 23 07 00.
 - 1. Manufacturer's cuts.
 - 2. Certified capacity ratings.
 - 3. Installation instructions.

1.3 RELATED DOCUMENTS

- A. Section 23 07 00 - Insulation.

PART 2 PRODUCTS**2.1 GENERAL**

- A. All ductwork, plenums and casings shall be constructed of sheet metal, as herein specified. All sheet metal construction shall conform to the pressure classification shown on the contract drawings, or herein specified and shall be in accordance with the construction and installation details in Chapter 19 of the 2012 ASHRAE Systems and Equipment Handbook or the appropriate SMACNA Standards.
- B. Duct sizes on drawings represent gross sheet metal dimensions. Allowance has been made, where applicable, for duct liner.

2.2 LOW PRESSURE DUCTWORK

- A. Low pressure ductwork shall be constructed of zinc coated sheet steel and shall conform to the 1st Edition of SMACNA HVAC Duct Construction Standards -Metal and Flexible, 1985, as follows:
 - 1. Rectangular Duct
 - a. 1" w.g. pressure class - Table 1-4.
 - 2. Round Duct
 - a. 2" w.g. pressure class - Table 3-2.

2.3 GENERAL EXHAUST DUCTWORK

- A. Unless otherwise noted, all exhaust ductwork shall be constructed the same as specified for low pressure ductwork.

2.4 FLEXIBLE DUCTWORK

- A. Flexible air duct for connections between medium pressure duct and terminals units and between low pressure duct to diffusers shall be equal to Thermaflex M-KE. Duct shall be listed by Underwriter's Laboratories under UL 181 standards as Class 1 flexible air duct material and shall comply with NFPA Standards 90A and 90B. Duct shall be rated to operate at pressures up to 6" w.g. for sizes 10" and 4" w.g. for sizes 12" and above. Maximum length of flexible air duct shall be 6 feet.
- B. Duct shall be a factory fabricated assembly composed of a polymeric liner duct bonded permanently to a coated spring steel wire helix and supporting a fiberglass insulating blanket. Outer vapor barrier shall be of fiberglass reinforced film laminate. Connections shall be made with Thermaflex, or equal, duct straps.

2.5 INSTRUMENT TEST HOLES

- A. Ventlock No. 699 with gasket. Provide a minimum of one in each zone supply duct.

2.6 TURNING VANES

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- A. Turning vanes and Deflector Controls, Barber-Colman, Carnes Corporation, Kruger or Titus in length up to 18"; Aero-Dyne Duro-Dyne, or Airsan double thickness about 24" in length, installed in rails.

2.7 FLEXIBLE CONNECTIONS

- A. Flexible duct connections shall be provided where ductwork connects to equipment; ventifabrics or Duro-Dyne 28 ounce minimum waterproof and fire retardant woven glass fabric double coated with neoprene, approved by UL. Maximum length of flexible connections shall be 10 inches.

2.8 MANUAL AND MOTOR OPERATED DAMPERS

- A. American Warming and Ventilating Company Type DAA-P-50, opposed blade, constructed with 15 gauge steel blades. Manual dampers shall be provided with Ventlock No. 637 hand operated locking quadrants located outside of ducts. Locking quadrants shall be elevated 1-1/2" for insulation. Manual dampers 18" x 10" or smaller may be single blade type construction of 16 gauge galvanized sheet metal. Dampers of Ruskin, Krueger, Louvers and Dampers, or Advanced Air, Inc. will be acceptable.

2.9 SPLITTER DAMPERS

- A. Install where shown and at duct splits; provide with Ventlock No. 690 self-locking device; constructed of 16 gauge galvanized steel with hemmed leading edge and reinforced at hinged side.

2.10 GRILLES, REGISTERS AND DIFFUSERS

- A. Grilles, registers and diffusers shall be of the type, size and design as shown on the drawings and/or as specified below. Grilles within the same room or areas shall be of the same type and style to provide architectural uniformity.
- B. Each supply, return and exhaust device shall be of the proper design as indicated to handle quantities of air within the space with maximum diffusion and without objectionable air movement or noise level.
- C. Each supply outlet and register shall have a volume damper control operable from the front of the device with removable key. Where indicated on the drawings, all side wall registers shall be equipped with deflectors.

2.11 FABRIC AIR DISPERSION SYSTEM:

- A. **Air diffusers shall be constructed of a woven fire retardant fabric complying with the following physical characteristics:**
 - 1. **Fabric Construction. 100% Flame Retardant and retreated with a machine washable anti-microbial agent from the manufacturer.**
 - 2. **Weight. 6.75 oz./yd² per ASTM D3776**
 - 3. **Color. (Standard: blue, white, tan, red, green, gray, black or Custom)**
 - 4. **Air Permeability: 2 (+2/-1) cfm/Ft² per ASTM D737, Frazier**
 - 5. **Temperature Range: 0 degrees F to 180 degrees F**
 - 6. **Fire Retardancy. Classified by Underwriters Laboratories in accordance with the flame spread/smoke developed requirements of NFPA 90-A and ICC AC 167.**
 - 7. **Antimicrobial agent shall be proven 99% effective after 10 laundry cycles per AATCC Test Method 100.**
 - 8. **Duct shall maintain round shape at no airflow.**
- B. **Systems Fabrication Requirements.**
 - 1. **Air dispersion accomplished by linear vent and permeable fabric, linear vent to consist of many 3/16" diameter open orifices rather than a mesh style vent to reduce maintenance requirements of mesh style vents.**
 - 2. **Size of and location of linear vents to be specified and approved by manufacturer.**
 - 3. **Inlet connection to metal duct via fabric draw band with anchor patches as supplied by manufacturer. Anchor patches to be secured to metal duct via. Zip screw fastener – supplied by contractor.**
 - 4. **Inlet connection includes zipper for easy removal/maintenance.**
 - 5. **Lengths to include required zippers as specified by manufacturer.**
 - 6. **System to include Adjustable Flow Devices to balance turbulence, airflow and distribution as needed. Flow restriction device shall include ability to adjust the airflow resistance from 0.06 – 0.60 in w.g. static pressure.**
 - 7. **End cap includes zipper for easy maintenance.**

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8. Fabric system shall include connectors to accommodate suspension system listed below.
9. Any deviation from a straight run shall be made using a gored elbow or an efficiency tee. Normal 90 degree elbows are 5 gores and the radius of the elbow is 1.5 times the diameter of the duct.

C. Design Parameters.

1. Use fabric diffusers only for positive pressure air distribution components of the mechanical ventilation system.
2. Do not use fabric diffusers in concealed locations.
3. Fabric diffusers shall be designed from 0.25" water gage minimum to 3.0" maximum, with 0.5" as the standard.
4. Fabric air diffusers shall be limited to design temperatures between 0 degrees F and 180 degrees F (-17.8 degrees C and 82 degrees C).
5. Design CFM, static pressure and diffuser length shall be designed or approved by the manufacturer.

D. Suspension Hardware.

1. Tension Cable. System shall be installed using a tension cable system including a double strands (2 Row) of cable located 3" above the 10 and 2 o'clock locations of the system. Hardware to include cable, eyebolts, cable clamps and turnbuckle(s) as required. System attachment shall be made using nylon snap clips spaced 24 inches. Component options include:
 - a. Standard Galvanized Steel Cable
 - b. Standard Stainless Steel Cable
 - c. Heavy Weight Stainless Steel Cable
 - d. Plastic Coated Stainless Steel Cable

PART 3 EXECUTION**3.1 DUCTWORK**

- A. All ductwork shall be provided in a neat workmanlike manner. The ducts shall be properly braced and reinforced. All slip joints shall be made in the direction of flow. All ducts shall be true to the dimension indicated and shall be straight and smooth on the inside with neatly finished airtight joints. The ducts shall be securely anchored into the building construction in an approved manner and shall be completely free from vibration under all conditions of operation. All supply, return fresh-air and exhaust systems shall be completely balanced.
- B. No duct transformation shall be of a ratio less than four to one and where possible, shall be of a ratio of six to one. No less than three vertical splitters shall be provided where these ratios cannot be met. No elbow shall have a throat center line radius of less than one and one-half times the duct width at the turn. All turns of less than this amount in rectangular duct shall be provided with duct turning vanes of standard design. Splitters or multi-blade volume dampers, where indicated, shall be provided in all branch.
- C. Turning vanes shall be provided at all tees and square elbows. Turning vanes shall be factory fabricated and designed in accordance with the SMACNA or ASHRAE Guide for formed vanes. The first set of turning vanes on the leaving side of fans shall be of the acoustical type to aid in the elimination of unit noise with the exception of room fan coil units.
- D. Splitter dampers and volume extractors shall be provided in all low velocity ductwork for proper air distribution. Each damper shall be provided, lubricated bearings at both ends of the shafts, adjustments quadrant, and locking devices and shall be constructed of galvanized iron or steel sheet one gauge heavier than the duct in which they are installed. Access doors shall be located at all splitter dampers.
- E. Handholes of not less than 6" x 6" shall be provided at all points where access is required. Manholes of not less than 18" x 24" shall be provided at all points where it is necessary to clean or remove parts of equipment. All access doors and handholes shall be rubber gasketed insulated type with frame and latches.
- F. Install access doors at each fire damper and smoke detector. Label all access doors.
- G. All ductwork must be sealed in accordance with Seal Class C as defined in SMACNA HVAC Duct Construction Standards - Metal and Flexible, 1985.
- H. All joints and seams in ductwork exposed to weather shall be sealed watertight with a suitable non-aging sealer.

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3.2 DUCT HANGERS AND SUPPORTS

- A. Duct hangers and supports shall conform to those shown in Tables 4-1 and 4-2 of SMACNA HVAC Ductwork 1985, 1st Edition.

3.3 WALL PENETRATIONS

- A. Where ducts pass through non-rated walls and is exposed to view the duct shall be finished with suitable metal collar.
- B. Where ducts pass through one hour fire walls, provide not less than 1/2" clearance between the duct and combustible material. Seal the clearance space with non-combustible material retained, and the duct secured in place by steel collars of a gauge equivalent to that of the duct and fastened to both the duct and the enclosure.
- C. Where fire dampers are shown or required, dampers shall be installed per manufacturer's UL listing.

3.4 CLEANING DUCT SYSTEMS

- A. Before fan systems are put in operation, vacuum clean inside of air units, plenums and apparatus housing. Filters are to be installed before moving air through duct systems.

3.5 INSTALLATION OF FABRIC AIR DISPERSION SYSTEM

- A. **Install chosen suspension system in accordance with the requirements of the manufacturer. Instructions for installation shall be provided by the manufacturer with product.**
- B. **Clean air handling unit and ductwork prior to the system unit-by-unit as it is installed. Clean external surfaces of foreign substance, which may cause corrosive deterioration of facing.**
- C. **Temporary Closure. At ends of ducts, which are not connected to equipment or distribution, devices at time of ductwork installation, cover with polyethylene film or other covering, which will keep the system clean until installation is completed.**
- D. **If systems become soiled during installation, they should be removed and cleaned following the manufacturers standard terms of laundry.**

END OF SECTION 23 30 00

SECTION 23 64 00 AIR COOLED WATER CHILLERS

PART 1 GENERAL**1.1 SCOPE**

- A. The Provisions of Section 23 05 00 apply to all the work in this section.
- B. The Contractor shall furnish and install air cooled water chillers as shown as scheduled on the contract documents. The chillers shall be installed in accordance with this specification and perform at the specified conditions as scheduled.

1.2 SECTION INCLUDES

- A. Chiller package.
- B. Charge of refrigerant and oil.
- C. Controls and control connections.
- D. Chilled water connections.
- E. Starters.
- F. Electrical power connections.

1.3 REFERENCES

- A. ANSI/ARI 590 - Reciprocating Water - Chilling Packages.
- B. ANSI/ARI 550 - Centrifugal or Rotary Water Chilling Packages.
- C. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.
- D. ANSI/ASHRAE 90A - Energy Conservation in New Building Design.
- E. ANSI/ASME SEC 8 - Boiler and Pressure Vessel Code
- F. ANSI/NEMA MG 1 - Motors and Generators.
- G. ANSI/UL 465 - Central Cooling Air Conditioners.
- H. ANSI/UL 984 - Safety Standard for Hermetic Motor Compressors.
- I. ANSI/AFBMA 9-1978 - Load Ratings and Fatigue Life for Ball Bearings. Bearings must have life of not less than 200,000 hours.
- J. California Administrative Code - Title 24
- K. ASTM B117 - Standard Method of Salt Spray (Fog) Testing
- L. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- M. ASTM A525 - Zinc (Hot-Dip Galvanized) Coatings on Sheet Steel Products
- N. ASTM D1654 - Evaluation of Painted or Coated Specimens, Subjected to Corrosive Environments

1.4 SUBMITTALS

- A. Submit drawings indicating components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate accessories where required for complete system.
- B. Submit product data indicating rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.
- C. Submit manufacturer's installation instructions.

SECTION 23 64 00 AIR COOLED WATER CHILLERS

1.5 REGULATORY REQUIREMENTS

- A. Conform to ANSI/ARI 590 code for testing and rating of reciprocating water chillers or conform to ANSI/ARI 550 code for testing and rating of centrifugal and rotary chillers.
- B. Conform to ANSI/UL 465 code for construction of water chillers and provide UL label. In the event the unit is not UL approved, the manufacturer shall, at his expense, provide for a field inspection by an UL representative to verify conformance to UL standards. If necessary, contractor shall perform modifications to the unit to comply with UL, as directed by the UL representative.
- C. Conform to ANSI/ASME SEC 8 Boiler and Pressure Vessel Code for construction and testing of water chillers.
- D. Conform to ANSI/ASHRAE 15 code for construction and operation of water chillers.

1.6 STORAGE AND HANDLING

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Protect units from physical damage. Factory coil shipping covers shall be kept in place until installation.

1.7 WARRANTY

- A. Provide a five year warranty on parts, labor and refrigerant. Warranty begins at beneficial occupancy.

PART 2 PRODUCTS**2.1 APPROVED MANUFACTURES**

- A. Trane
- B. Carrier
- C. Daikin
- D. Substitutions: Prior approval required as indicated under the general and/or supplemental conditions of these specifications.

2.2 GENERAL UNIT DESCRIPTION

- A. Provide factory assembled and tested outdoor air cooled liquid chillers consisting of scroll or helical rotary compressors, condenser, evaporator, thermal or electronic expansion valve, refrigeration accessories, starter, and control panel. Construction and ratings shall be in accordance with ANSI/ARI 550 or ANSI/ARI 590.

2.3 COMPRESSORS

- A. Construct semi-hermetic **direct drive** rotary screw compressors with heat treated forged steel or ductile iron shafts, aluminum alloy connecting rods, automotive type pistons, rings to prevent gas leakage, discharge valves, and sealing surface immersed in oil. Rotors shall be of high grade steel alloy. **Substitution of scroll compressors shall not be allowed.**
- B. Statically and dynamically balance rotating parts.
- C. Provide oil pump lubrication system with oil charging valve and oil filter to ensure adequate lubrication during starting, stopping, and normal operation.
- D. Provide compressor with automatic capacity reduction equipment consisting of suction valve unloaders or capacity control slide valve (rotary). Use lifting mechanism operated by solenoid valve. Compressor must start unloaded for soft start on motors.
- E. Provide constant speed rpm compressor motor, suction gas cooled with solid state sensor and electronic winding overheating protection, designed for across-the-line or star delta starting. Furnish with starter.

SECTION 23 64 00 AIR COOLED WATER CHILLERS

- F. Provide crankcase heater to evaporate refrigerant returning to crankcase during shut down. Energize heater when compressor is not operating.

2.4 EVAPORATOR

- A. **Provide a shell and tube heat exchanger. Substitution of plate heat exchangers shall not be allowed.**
- B. Design, test, and stamp refrigerant side for 300 psig (2068 kPa) working pressure and water side for 215 psig (1482 kPa) working pressure, in accordance with ANSI/ASME SEC 8.
- C. Insulate with 0.75 inch minimum thick flexible elastomeric rubber closed cell insulation with maximum K value of 0.26. Provide heat tape to protect evaporator to -20 degrees F.
- D. Provide water drain connection, vent and fittings for factory installed leaving water temperature control and low temperature cutout sensors.
- E. Water connections shall be victaulic.
- F. Low ambient temperature protection: Ambient freeze temperature down to 0°F.

2.5 CONDENSER AND FANS

- A. Construct condenser coils microchannel. Provide sub-cooling circuits. Air test under water to 506 psig (3488kPa).
- B. Provide vertical discharge direct driven propeller type condenser fans with fan guard on discharge. Entire fan assembly shall be statically and dynamically balanced and fan assembly shall be either painted or zinc coated steel. Fan guard shall be either PVC, chrome or zinc coated.
- C. Provide fan motors with permanently lubricated ball bearings and built-in thermal overload protection.

2.6 ENCLOSURES

- A. House components in 12 gauge galvanized steel frame and mounted on welded structural steel base. Hot-dip galvanized steel frame coating shall be Underwriters laboratories Inc. (UL) recognized as G90-U, UL guide number DTHW2.
- B. Unit panels, and control panels shall be finished with a baked on powder paint. Paint system shall meet the requirements for outdoor equipment of Federal Government Agencies.
- C. Mount starters with full opening access doors.
- D. Condenser coils shall be protected with ½" steel painted louvered panels covering the complete condensing coil. Guards shall provide coil protection from outside objects and louvered profile for coils. Access guard shall be maximum 4" square heavy wire mesh covers the service area beneath the condenser coils protecting the unit components from outside access.

2.7 REFRIGERANT CIRCUIT

- A. All units shall have 2 independent refrigeration circuits, each with a separate single compressor for standby operation. No manifolded compressors will be accepted.
- B. Provide for each refrigerant circuit:
 - 1. Liquid line shutoff valve.
 - 2. Filter dryer (replaceable core type).
 - 3. Liquid line sight glass and moisture indicator.
 - 4. Electronic or thermal expansion valve sized for maximum operating pressure.
 - 5. Charging valve.
 - 6. Discharge and oil line check valve.
 - 7. Compressor discharge service valve.
 - 8. High side pressure relief valve.
 - 9. Full operating charge of refrigerant and oil.
 - 10. Unit factory leak tested at 200 psig.

SECTION 23 64 00 AIR COOLED WATER CHILLERS

- C. Capacity Modulation: Provide capacity modulation by either slide valve or unloader valves. Unit shall be capable of operation down to 10 %. In the event a manufacturer can not provide unit with modulation down to 10% Hot Gas Bypass must be provided.

2.8 CONTROLS

- A. On chiller, mount weatherproof control panel, containing starters, power and control wiring, factory wired with terminal block power connection. Provide primary and secondary fused control power transformer and a single 115 volt single phase connection for evaporator heat tape.
- B. Provide wye-delta starter.
- C. Provide the following safety controls with indicating lights or diagnostic readouts.
1. Low chilled water temperature protection.
 2. High refrigerant pressure - each compressor.
 3. Low oil flow protection- each compressor.
 4. Loss of chilled water flow.
 5. Contact for remote mounted emergency shut-down.
 6. Loss of refrigerant charge protection.
 7. Motor current and motor temperature overload.
 8. Phase reversal/unbalance/single phasing (30% current imbalance threshold)
 9. Over/under voltage.
 10. Failure of water temperature sensor used by controller.
- D. Provide the following operating controls:
1. 8 or more step leaving chilled water temperature controller which cycles compressors and activates cylinder unloaders or slide valve based on PI algorithms. If manufacturer is unable to provide at least 8 steps of unloading providing hot gas by pass shall be required.
 2. Five minute solid state anti-recycle timer to prevent compressor from short cycling. If 10 minute solid state anti recycle timer is provided, hot gas bypass shall be provided to insure accurate temperature control in light load applications.
 3. Load limit thermostat to limit compressor loading on high return water temperature to prevent nuisance tripouts.
 4. Low ambient controls for operation down to 15 degrees F or lower.
 5. High ambient unloader pressurestat that unloads compressors to keep head pressure under control and help prevent high pressure nuisance tripouts on days when outside ambient is above design.
 6. Compressor current sensing unloader unit that unloads compressors to help prevent current overload nuisance tripouts.
 7. Auto lead lag functions that constantly evens out running hours and compressor starts automatically. If contractor can not provide this function then cycle counter and hour meter shall be provided so owner can be instructed by the contractor on how to manually change lead lag on compressors and even out compressor starts and running hours.
 8. Condenser fan sequencing which automatically cycles fans in response to ambient and expansion valve pressure differential thereby optimizing unit efficiency.
 9. Chiller shall have automatic restart/reset after voltage sag/interruption.
- E. Provide pre-piped gauge board with pressure gauges for suction and discharge refrigerant pressures or digital display of pressures on microprocessor.
- F. Provide ammeters for each compressor or digital display of % RLA on microprocessor.
- G. Provide remote mounted alarm and display panel with a minimum of the following features:
1. Leaving chiller water temperature setpoint adjustment
 2. Display diagnostics
 3. Display ambient, entering and leaving water temperatures.
 4. Display active chilled water setpoint.
 5. Display parts failures:
 - a. Water temperature and ambient temperature sensors
 - b. Motor contactors
 - c. Unit Controller
 - d. Condenser and evaporator refrigerant temperature sensors.
- H. **BAS interface – BACNET only, contractor shall provide router compatible with chiller manufacturer as required to allow for IP.**

SECTION 23 64 00 AIR COOLED WATER CHILLERS

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Align chiller package on steel or concrete foundations.
- C. Install units on vibration isolators.
- D. Connect to electrical service.
- E. Connect to chilled water piping.
- F. Arrange piping for easy dismantling to permit tube cleaning.
- G. Provide flexible connections at each chiller.

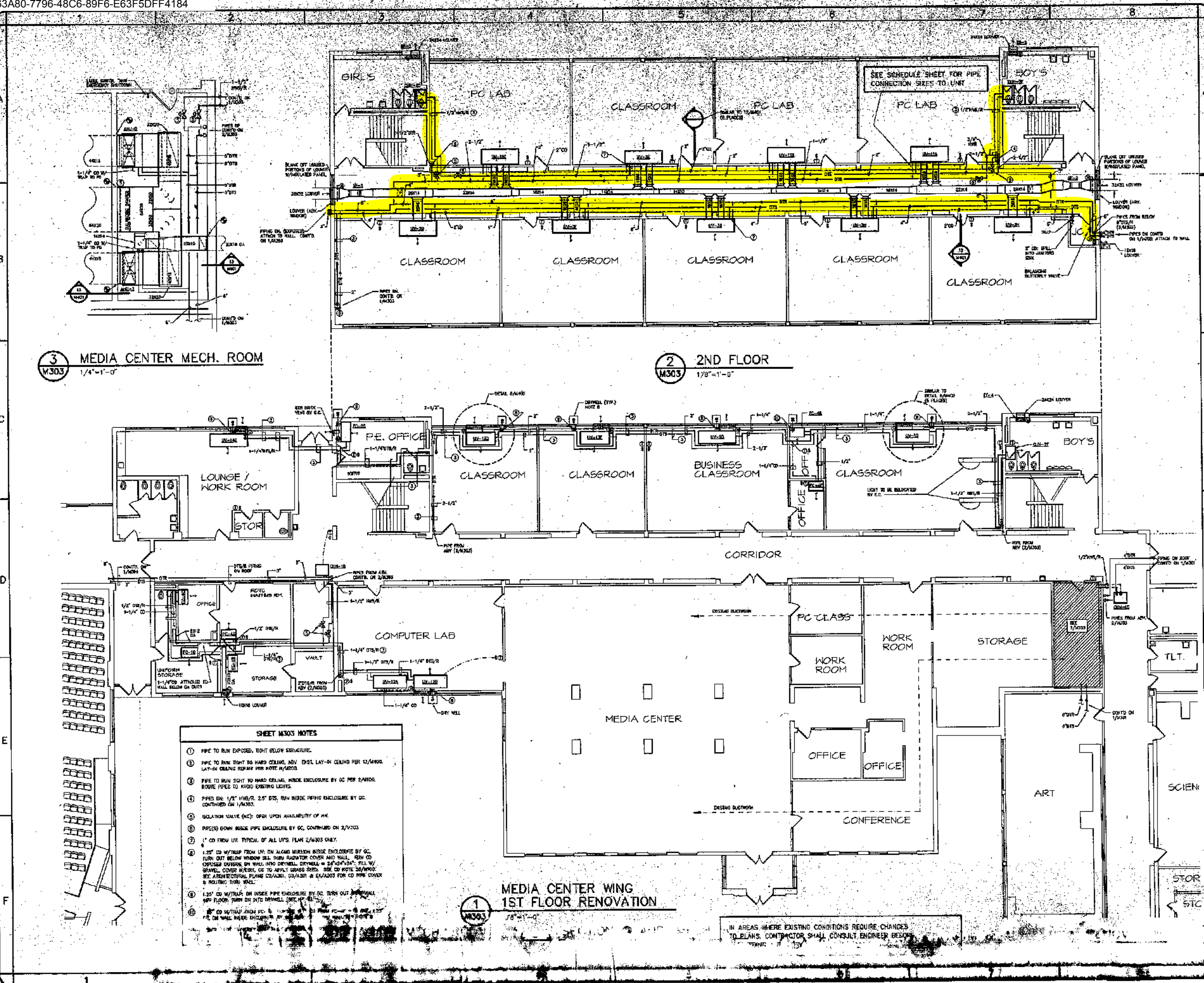
3.2 MANUFACTURER'S FIELD SERVICES

- A. Supply service of factory trained representative for a period of 3 days to supervise testing, dehydration and charging of machine, start-up, and instruction on operation and maintenance to Owner.
- B. Supply initial charge of refrigerant and oil.

END OF SECTION 23 64 00

Monroe High School
Addendum #2
May 5, 2021

1. In lieu of multiple allowances, Contractor shall provide a single allowance of \$10,000 to cover unforeseen circumstances. The original cost proposal form indicated a \$5,000 allowance on pages 4 and 5 of the Invitation for Bid and Exhibit 1. This should be acknowledged on the Cost Proposal/Execution of Proposal under Addenda Acknowledgment Addendum 2.
2. Reference following pages to illustrate piping insulation scope of work referenced on sheet M7.



UNION COUNTY SCHOOLS

MONROE HIGH SCHOOL

FINAL DRAWINGS. NOT ISSUED FOR CONSTRUCTION.

MCKNIGHT SMITH WARD & GRIFFIN

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ARCHITECTS

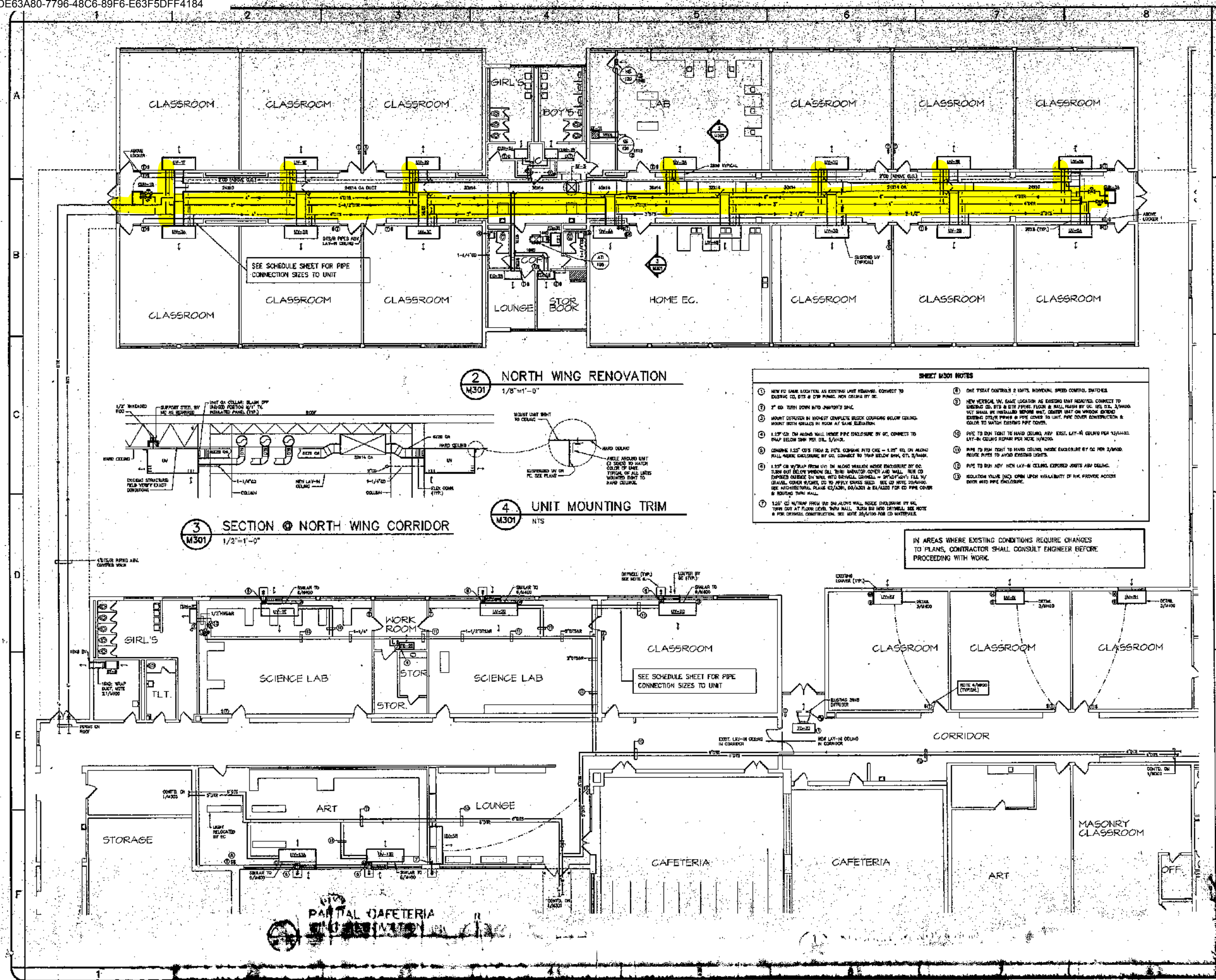
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SUITE 200
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704/375-2112

SHREVE: 215 EAST NORTON STREET
SUITE 100
SHREVE, LA 70578-0215
704/634-0264

1/3/00

RELEASE DATE

SHEET 7 OF 10



2 NORTH WING RENOVATION
1/8" = 1'-0"

3 SECTION @ NORTH WING CORRIDOR
1/2" = 1'-0"

4 UNIT MOUNTING TRIM
NTS

- SHEET M301 NOTES**
- 1. NEW FC DASH LOCATED AS EXISTING UNIT REMOVED. CONNECT TO EXISTING CO. B7S & DTP ALONG NEW CEILING BY EC.
 - 2. 2" OD TURN DOWN INTO SHUTTER SINK.
 - 3. MOUNT DEFENDER IN HIGHEST COMPLETE BLOCK CORRESPONDING BELOW CEILING. MOUNT BOTH GRILLS IN ROOM AT SAME ELEVATION.
 - 4. 1.5" OD IN ALONG WALL INSIDE PIPE ENCLOSURE BY EC. CONNECT TO PUMP BELOW SHIP FOR OIL 5/4" HX.
 - 5. CHANGE 1.5" ODS FROM 2 PPS. CORRESPOND TO ONE - 1.5" OD IN ALONG WALL INSIDE ENCLOSURE BY EC. CONNECT TO PUMP BELOW SHIP, 5/4" HX.
 - 6. 1.5" OD IN WALL FROM UIC IN ALONG WALL INSIDE ENCLOSURE BY EC. TURN OUT BELOW WINDOW ALL TURN SHUTTER COVER AND WALL. RUN CO EXPOSED OUTSIDE IN WALL INTO DRYWALL CORNELL - 3/4" ODS. FULL 1/2" DRYWALL CORNELL. DO TO APPLY CORNELL. SEE CO NOTE 2/4/80. SEE ARCHITECTURAL PLANS 2/4/80, 2/4/80 & 2/4/80 FOR CO PIPE COVER & ROUTING TRIM WALL.
 - 7. 1.5" OD IN WALL FROM UIC IN ALONG WALL INSIDE ENCLOSURE BY EC. TURN OUT AT FLOOR LEVEL. TURN WALL. TURN IN INTO DRYWALL. SEE NOTE 2/4/80 FOR CORNELL CONSTRUCTION. SEE NOTE 2/4/80 FOR CO MATERIALS.
 - 8. ONE TREAT CONTROLS 2 UNITS. INDIVIDUAL SPEED CONTROL SWITCHES.
 - 9. NEW VERTICAL UN. SAME LOCATION AS EXISTING UNIT REMOVED. CONNECT TO EXISTING CO. B7S & DTP FLOOR. IN WALL. PUMP BY EC. USE 2 1/4" HX. 2 1/4" HX. NOT SHALL BE INSTALLED BEFORE UNIT. COAST UNIT ON WINDOW EXPOSED EXISTING DTP/PPS & PIPE COVER TO UNIT. PIPE COVER CONSTRUCTION & COLOR TO MATCH EXISTING PIPE COVER.
 - 10. PIPE TO RUN TOIT TO HANG CEILING. ANY EXIST. LAY-IN CEILING PER 1/2" HX. LAY-IN CEILING. PUMP FOR HX. HX.
 - 11. PIPE TO RUN TOIT TO HANG CEILING. INSIDE ENCLOSURE BY EC PER 2/4/80. INSIDE PUMP TO LAY-IN EXISTING LIGHTS.
 - 12. PIPE TO RUN ANY NEW LAY-IN CEILING EXPOSED JOINTS ANY CEILING.
 - 13. ISOLATION VALVE (NOT OPEN UNLESS AVAILABILITY OF HX. PROVIDE ACCESS DECK INTO PIPE ENCLOSURE).

IN AREAS WHERE EXISTING CONDITIONS REQUIRE CHANGES TO PLANS, CONTRACTOR SHALL CONSULT ENGINEER BEFORE PROCEEDING WITH WORK.

REVISIONS

NO.	DATE	DESCRIPTION

UNION COUNTY SCHOOLS

MONROE HIGH SCHOOL

FINAL DRAWINGS:
NOT ISSUED FOR
CONSTRUCTION.

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1/3/80
RELEASE DATE

1 of 10



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 704-283-2371

 ucps.k12.nc.us

Purchasing and Contract

PROJECT SCHEDULE

Exhibit 2

Project: Monroe High School-HVAC Renovation

Areas listed below are to be completed by August 10, 2021.

Band Room
Administration Area
Duct Work

Remaining areas to be completed no later than December 31, 2021.

Contractor shall work closely with the assigned UCPS Project Coordinator to ensure no disruption to school activities.



Growing Possibilities...

PROJECT: Monroe High School-HVAC Renovation

REFERENCE NUMBER: 1-97336074

BID OPENING: 3:30 p.m., May 6, 2021

BID EXPIRATION: July 5, 2022

BID TABULATION

#	CONTRACTOR	BID AMOUNT (INCLUDES \$10,000 ALLOWANCE FUNDS)	COMPLETION	ALTERNATE (ADDITIONAL HVAC INSULATION IN SEPARATE AREA OF BUILDING)	COMPLETION
1	American Mechanical Denver, NC	\$525,000.00	120 CCD	\$555,000.00	120 CCD
2	Superior Mechanical Services, Inc. Greensboro, NC	\$477,000.00	200 CCD	No Bid	No Bid