RFB NO. 318015

CONSTRUCTION DOCUMENTS
PROJECT MANUAL

DANE COUNTY DEPARTMENT OF PUBLIC WORKS,
HIGHWAY AND TRANSPORTATION

PUBLIC WORKS ENGINEERING DIVISION
1919 ALLIANT ENERGY CENTER WAY
MADISON, WISCONSIN 53713

REQUEST FOR BIDS NO. 318015 (REBID)
FEN OAK HEAT PUMP REPLACEMENT
LYMAN F. ANDERSON AGRICULTURE & CONSERVATION CENTER
5201 FEN OAK DRIVE
MADISON, WISCONSIN

Due Date / Time: **TUESDAY, JANUARY 15, 2019 / 2:00 P.M.**

Location: **PUBLIC WORKS OFFICE**

Performance / Payment Bond: **100% OF CONTRACT AMOUNT**

Bid Deposit: **5% OF BID AMOUNT**

FOR INFORMATION ON THIS REQUEST FOR BIDS, PLEASE CONTACT:

TODD DRAPER, PROJECT MANAGER
TELEPHONE NO.: 608/267-0119
FAX NO.: 608/267-1533
E-MAIL: DRAPER@COUNTYOFDANE.COM

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LEGAL NOTICE

INVITATION TO BID

Dane County Dept. of Public Works, Hwy & Transp., 1919 Alliant Energy Center Way, Madison, WI 53713, will receive sealed Bids until:

2:00 P.M., TUESDAY, JANUARY 15, 2019

RFB NO. 318015 (REBID)

FEN OAK HEAT PUMP REPLACEMENT

LYMAN F. ANDERSON AGRICULTURE & CONSERVATION CENTER

5201 FEN OAK DRIVE

MADISON, WI

Dane County is inviting Bids for construction services. The project consists of the removal and replacement of HVAC equipment. Only firms with capabilities, experience & expertise with similar projects should obtain this Request for Bids document & submit Bids.

Request for Bids document may be obtained after **2:00 p.m. on November 20, 2018** by downloading it from bids-pwht.countyofdane.com. Please call Todd Draper, Project Manager, at 608/267-0119, or our office at 608/266-4018, with any questions or for additional information.

All Bidders must be pre-qualified as a Best Value Contractor before award of Contract. Complete Pre-qualification Application for Contractors at countyofdane.com/pwht/BVC_Application.aspx or obtain one by calling 608/266-4029.

A pre-bid facility tour will be held December 11, 2018 at 9:00 a.m. at the Lyman F. Anderson Agriculture & Conservation Center, starting in the first floor lobby. Bidders are strongly encouraged to attend this tour.

PUBLISH: **NOVEMBER 20 & NOVEMBER 27, 2018 - WISCONSIN STATE JOURNAL**
NOVEMBER 20 & NOVEMBER 27, 2018 - THE DAILY REPORTER

INSTRUCTIONS TO BIDDERS

TABLE OF CONTENTS

1. GENERAL

A. Before submitting Bid, bidder shall thoroughly examine all Construction Documents. Successful Bidder shall be required to provide all the Work that is shown on Drawings, set forth in Specifications, or reasonably implied as necessary to complete Contract for this project.

B. Bidder shall visit site to become acquainted with adjacent areas, means of approach to site, conditions of actual site and facilities for delivering, storing, placing, and handling of materials and equipment.

C. Pre-bid meeting is scheduled on December 11, 2019 at 9:00 a.m. at the Lyman F. Anderson Agriculture & Conservation Center, 5201 Fen Oak Drive, Madison, in the first floor lobby. Attendance by all bidders is optional, however bidders and subcontractors are strongly encouraged to attend.

D. Failure to visit site or failure to examine any and all Construction Documents will in no way relieve successful Bidder from necessity of furnishing any necessary materials or equipment, or performing any work, that may be required to complete the Work in accordance with Drawings and Specifications. Neglect of above requirements will not be accepted as reason for delay in the Work or additional compensation.

2. DRAWINGS AND SPECIFICATIONS

A. Drawings and Specifications that form part of this Contract, as stated in Article 1 of General Conditions of Contact, are enumerated in Document Index of these Construction Documents.

B. Complete sets of Drawings and Specifications for all trades will be available to all Bidders, irrespective of category of work to be bid on, in order that all Bidders may be familiar with work of other trades as they affect their bid.

3. INTERPRETATION

A. No verbal explanation or instructions will be given in regard to meaning of Drawings or Specifications before Bid Due Date. Bidders shall bring inadequacies, omissions or conflicts to Owner or Architect / Engineer's attention at least ten (10) calendar days before Bid Due Date. Prompt clarification will be available to all bidders by Addendum.

B. Failure to so request clarification or interpretation of Drawings and Specifications will not relieve successful Bidder of responsibility. Signing of Contract will be considered as implicitly denoting that Contractor has thorough understanding of scope of the Work and comprehension of Construction Documents.

C. Owner , Consultant / Engineer will not be responsible for verbal instructions.

4. QUALIFICATIONS OF BIDDER (CONTRACTOR AND SUBCONTRACTOR)

A. Before award of Contract can be approved, Owner shall be satisfied that Bidder involved meets following requirements:

1. Has completed at least one (1) project of at least fifty percent (50%) of size or value of Division of work being bid and type of work completed is similar to that being bid. If greater magnitude of experience is deemed necessary, other than size or value of work, such requirements will be described in appropriate section of Specifications.

2. Maintains permanent place of business.

3. Can be bonded for terms of proposed Contract.

4. Has record of satisfactorily completing past projects and supplies list of no more than three (3) most recent, similar projects, with architect or engineer's and owner's names, addresses and telephone numbers for each project. Submit to Public Works Project Engineer within three (3) business days after Bid Due Date. Criteria which will be considered in determining satisfactory completion of projects by bidder will include:

    a. Completed contracts in accordance with drawings and specifications.
    b. Diligently pursued execution of work and completed contracts according to established time schedule unless Owner grants extensions.
    c. Fulfilled guarantee requirements of construction documents.
    d. Is not presently on ineligible list maintained by County's Department of Administration for noncompliance with equal employment opportunities and affirmative action requirements.
    e. Authorized to conduct business in Wisconsin. By submitting Bid, bidder warrants that it has: complied with all necessary requirements to do business in State of Wisconsin; that persons executing contract on its behalf are authorized to do so; and, if corporation, that name and address of bidder's registered agent are as set forth in Contract. Bidder shall notify Owner immediately, in writing, of any change in its registered agent, their address, and bidder's legal status. For partnership, term "registered agent" shall mean general partner.

B. County's Public Works Project Engineer will make such investigations as are deemed necessary to determine ability of bidder to perform the Work, and bidder shall furnish to

County's Public Works Project Engineer or designee all such information and data for this purpose as County's Public Works Project Engineer may request. Owner reserves right to reject Bid if evidence submitted by, or investigation of, bidder fails to satisfy Owner that bidder is responsible and qualified to carry out obligations of Contract and to complete the Work contemplated therein.

5. BID GUARANTEE

A. Bank certified check, cashier's check or Bid Bond, payable to County in amount not less than five percent (5%) of maximum bid, shall accompany each Bid as guarantee that if Bid is accepted, Bidder will execute and return proposed Contract and Performance and Payment Bonds within ten (10) business days after being notified of acceptance of Bid. Company issuing bonds must be licensed to do business in Wisconsin.

B. Any bid, which is not accompanied by bid guarantee, will be considered "No Bid" and will not be read at Bid Due Date.

C. If successful Bidder so delivers Contract, Certificate of Insurance, and Performance and Payment Bonds, check will be returned to Bidder. In case Bidder fails to deliver such Contract, insurance, and bond, amount of bid guarantee will be forfeited to County as liquidated damages.

D. All checks tendered as bid guarantee, except those of three (3) lowest qualified, responsible bidders, will be returned to their makers within three (3) business days after Bid Due Date. All such retained checks will be returned immediately upon signing of Contract and Performance and Payment Bonds by successful Bidder.

6. WITHDRAWAL OF BIDS

A. Bids may be withdrawn by written request received from bidder or authorized representative thereof prior to time fixed for Bid Due Date, without prejudice to right of bidder to file new Bid. Withdrawn Bids will be returned unopened. Negligence on part of bidder in preparing their Bid confers no right for withdrawal of Bid after it has been opened.

B. No Bid may be withdrawn for period of sixty (60) calendar days after Bid Due Date.

C. If Bid contains error, omission or mistake, bidder may limit liability to amount of bidder's guarantee by giving written Notice of Intent not to execute Contract to Owner within seventy-two (72) hours of Bid Due Date.

7. CONTRACT FORM

A. Sample copy of contract that successful Bidder will be required to enter into is included in these Construction Documents and bidders are required to familiarize themselves with all conditions contained therein.

8. CONTRACT INTERESTS BY COUNTY PUBLIC OFFICIALS

A. In accordance with Wisconsin Statute 946.13, county official may not bid for or enter into any contract involving receipts or disbursements of more than $15,000.00 in a year, in which they have private pecuniary interest, direct or indirect if at same time they are authorized to take official action with respect to making of this Contract. Any contract entered into in violation of this Statute is void and County incurs no liability thereon. This subsection does not affect application and enforcement of Wisconsin Statute 946.13 by state prosecutors in criminal courts of this state.

9. EMERGING SMALL BUSINESS PROVISIONS

A. **Emerging Small Business Definition.** For purposes of this provision, ESB is defined as:

1. Independent business concern that has been in business minimum of one year;

2. Business located in State of Wisconsin;

3. Business comprised of less than twenty-five (25) employees;

4. Business must not have gross sales in excess of three million dollars ($3,000,000.00) over past three years; and

5. Business does not have history of failing to complete projects.

B. **Emerging Small Business (ESB) Involvement.** Bidder shall make good faith effort to award minimum of ten percent (10%) of the Work to ESBs. Bidder shall submit report to Dane County Contract Compliance Officer within ten (10) business days of Bid Due Date demonstrating such efforts. Good faith efforts means significant contact with ESBs for purposes of soliciting bids from them. Failure to make or demonstrate good faith efforts will be grounds for disqualification.

C. **Emerging Small Business Report.** Emerging Small Business Enterprise Report is to be submitted by Bidder in separate envelope marked "Emerging Small Business Report". This report is due by 2:00 p.m. following specified ten (10) business days after Bid Due Date. Bidder who fails to submit Emerging Small Business Report shall be deemed not responsive.

D. **ESB Goal.** Goal of this project is ten percent (10%) ESB participation. ESB utilizations are shown as percentage of total Bid. If Bidder meets or exceeds specified goal, Bidder is only required to submit Form A - Certification, and Form B - Involvement. Goal shall be met if Bidder qualifies as ESB.

E. **Report Contents.** Following award of Contract, Bidder shall submit copies of executed contracts for all Emerging Small Businesses. Emerging Small Business Report shall consist of these:

1. Form A - Certification;

2. Form B - Involvement;

3. Form C - Contacts;

4. Form D - Certification Statement (if appropriate); and

5. Supportive documentation (i.e., copies of correspondence, telephone logs, copies of advertisements).

F. ESB Listing. Bidders may solicit bids from this ESB listing: pdf.countyofdane.com/commissions/2013-2015_Targeted_Business_Directory.pdf.

G. **ESB Certification.** All contractors, subcontractors and suppliers seeking ESB certification must complete and submit Emerging Small Business Report to Dane County Contract Compliance Program.

H. **Certification Statement.** If ESB firm has not been certified by County as ESB prior to submittal of this Bid, ESB Report cannot be used to fulfill ESB goal for this project unless

firm provides “Form D - Certification Statement”. Certification statement must be completed and signed by ESB firm.

I. **Questions.** Questions concerning Emerging Small Business provisions shall be directed to:

Dane County Contract Compliance Officer
City-County Building, Room 421
210 Martin Luther King, Jr. Blvd.
Madison, WI 53703
608/266-5623

J. **Substituting ESBs.** In event of any significant changes in subcontract arrangements or if need arises to substitute ESBs, Bidder shall report such proposed changes to Contract Compliance Officer to making any official changes and request authorization to substitute ESB firm. Bidder further agrees to make every possible effort to replace ESB firm with another qualified ESB firm.

K. **Good Faith Efforts.** Good faith efforts can be demonstrated by meeting all of these obligations:

1. Selecting portions of the Work to be performed by ESBs in order to increase likelihood of meeting ESB goal including, where appropriate, breaking down Contract into smaller units to facilitate ESB participation.

2. Advertising in general circulation, trade associations and women / minority focus media concerning subcontracting opportunities.

3. Providing written notices to reasonable number of specific ESBs that their interest in Contract was being solicited in sufficient time to allow ESBs to participate effectively.

4. Following up on initial solicitations of interest by contacting ESBs within five (5) business days prior to Bid Due Date to determine with certainty whether ESB were interested, to allow ESBs to prepare bids.

5. Providing interested ESB with adequate information about Drawings, Specifications and requirements of Contract.

6. Using services of available minority, women and small business organizations and other organizations that provide assistance in recruitment of MBEs / WBEs / ESBs.

7. Negotiating in good faith with interested ESBs, not rejecting ESBs as unqualified without sound reason based on thorough investigation of their capabilities.

8. Submitting required project reports and accompanying documents to County’s Contract Compliance Officer within twenty-four (24) hours after Bid Due Date.

L. **Appeals Disqualification of Bid.** Bidder who is disqualified may appeal to Public Works & Transportation Committee and Equal Opportunity Commission.

10. METHOD OF AWARD - RESERVATIONS

A. Following will be basis of award of Contract, providing cost does not exceed amount of funds then estimated by County as available to finance Contract(s):

1. Lowest dollar amount submitted by qualified responsible bidder on Base Bid for all work comprising project, combined with such additive Owner accepted alternates.

2. Owner reserves right to reject all bids or any bid, to waive any informality in any bid, and to accept any bid that will best serve interests of County.

3. Unit Prices and Informational Bids will not be considered in establishing low bidder.

11. SECURITY FOR PERFORMANCE AND PAYMENTS

A. Simultaneous with delivery of signed Contract, Bidder shall be required to furnish Performance and Payment Bonds as specified in Article 29 of General Conditions of Contract, "Contract Security". Surety Company shall be licensed to do business in Wisconsin. Performance and Payment Bonds must be dated same date or subsequent to date of Contract. Performance and Payment Bonds must emulate information in Sample Performance and Payment Bonds in Construction Documents.

B. Provide certified copy of power of attorney from Surety Company showing that agent who signs Bond has power of attorney to sign for Surety Company. Secretary or Assistant Secretary of company must sign this certification, not attorney-in-fact. Certification must bear same or later date as Bond. Power of Attorney must emulate model power of attorney information detailed in Sample Performance and Payment Bonds.

C. If Bidder is partnership or joint venture, State certified list, providing names of individuals constituting partnership or joint venture must be furnished. Contract itself may be signed by one partner of partnership, or one partner of each firm comprising joint venture, but Performance and Payment Bonds must be signed by all partners.

D. If Bidder is corporation, it is necessary that current certified copy of resolution or other official act of directors of corporation be submitted showing that person who signs Contract is authorized to sign contracts for corporation. It is also necessary that corporate seal be affixed to resolution, contract, and performance and payment bonds. If your corporation has no seal, it is required that above documents include statement or notation to effect that corporation has no seal.

12. TAXES

A. Wisconsin Statute 77.54 (9m) allows building materials that become part of local unit government facilities to be exempt from sales & use tax. Vendors & materials suppliers may not charge Bidders sales & use tax on these purchases. This does not include highways, streets or roads. Any other Sales, Consumer, Use & other similar taxes or fees required by law shall be included in Bid.

B. In accordance with Wisconsin Statute 71.80(16)(a),successful nonresident bidder, whether incorporated or not, and not otherwise regularly engaged in business in this state, shall file surety bond with State of Wisconsin Department of Revenue payable to Department of Revenue, to guarantee payment of income taxes, required unemployment compensation contributions, sales and use taxes and income taxes withheld from wages of employees, together with any penalties and interest thereon. Amount of bond shall be three percent (3%) of Contract or subcontract price on all contracts of $50,000 or more.

13. SUBMISSION OF BIDS

A. All Bids shall be submitted on standard Bid Form bound herein and only Bids that are made on this Bid Form will be considered. Entire Bid Form and other supporting documents, if

any, shall be removed or copied from Construction Documents, filled out, and submitted in manner specified hereinafter. Submit completed Bid Bond with Bid as well.

B. No bids for any subdivision or any sub-classification of this Work, except as indicated, will be accepted. Any conditional Bid, amendment to Bid Form or appended item thereto, or inclusion of any correspondence, written or printed matter, or details of any nature other than that specifically called for, which would alter any essential provision of Construction Documents, or require consideration of unsolicited material or data in determining award of Contract, will disqualify Bid. Telecommunication alterations to Bid will not be accepted.

C. Bidders must submit single Bid for all the Work.

D. Bid amounts shall be inserted in words and in figures in spaces provided on Bid Form; in case of conflict, written word amounts will govern.

E. Addenda issued after Bid Letting shall become part of Construction Documents. Bidders shall acknowledge receipt of such addenda in appropriate space provided on Bid Form. Bid may be rejected if receipt of any particular addendum applicable to award of Contract has not been acknowledged on Bid Form.

F. Bids shall be signed, placed in envelope, sealed and delivered before due time to place designated in Invitation to Bid, and identified with project name, bid number, location, category of work being bid upon, Bid Due Date, name and address of bidder.

G. Bidder shall be responsible for sealed Bid being delivered to place designated for Bid Due Date on or before date and time specified. Bids received after time of closing will be rejected and returned to bidder unopened.

H. Bid will be considered invalid and will be rejected if bidder has not signed it.

I. Faxed or emailed Bids will not be accepted.

J. Bidder's organization shall submit completed with Bid, Fair Labor Practices Certification form, included in these Construction Documents.

14. SUBCONTRACTOR LISTING

A. Bidders shall be required to submit list of major subcontractors for General Construction, Plumbing, HVAC, and Electrical work proposed for this project to include committed prices for each subcontractor. List shall be placed in separate sealed envelope that must be clearly identified as "Major Subcontractor List", for named project and name of Bidder submitting it. County must receive envelope no later than date by which successful Bidder is required to submit his or her signed Contract, as established in Construction Documents.

15. ALTERNATE BIDS

A. Bidder shall carefully read requests for Alternate Bids, and thoroughly examine Drawings and Specifications to determine extent various changes and conditions will affect Bid.

B. Space is provided in Bid Form for requested Alternate Bids. Failure to submit bid for any requested Alternate Bids may result in rejection of entire Bid.

C. Bidder shall state amount to be added / subtracted to Base Bid for providing alternates, including all incidentals, omissions, additions, and adjustments as may be necessary or required by such changes. If there is no difference in price, Bidder shall state, "No Change".

D. Descriptions of requested Alternate Bids are as set forth in Construction Documents.

16. INFORMATIONAL BIDS

A. Not Applicable.

17. UNIT PRICES

A. Not Applicable..

18. COMMENCEMENT AND COMPLETION

A. Successful Bidder shall commence work when schedule and weather permit, but no later than stated in Bid Form. Contractor shall pursue the Work regularly and continuously at reasonable rate to insure completion of the Work within time stated in Bid.

B. Should it be found impossible to complete the Work on or before time specified for completion, written request may be submitted for extension of time setting forth reasons believed to justify granting of such request. Refer to Article 20 of General Conditions of Contract, titled "Time for Completion".

19. WORK BY OWNER

A. Not Applicable.

20. SPECIAL HAZARDS COVERAGE

A. Not Applicable.

FORM A

DANE COUNTY
EMERGING SMALL BUSINESS REPORT - CERTIFICATION

In accordance with General Conditions of Contract, submit this Emerging Small Business Report within ten (10) days after Bid Due Date.

PROJECT NAME: _____

_____

BID NO.: _____ BID DUE DATE: _____

BIDDER INFORMATION

COMPANY NAME: _____

ADDRESS: _____

_____

TELEPHONE NO.: _____

CONTACT PERSON: _____

EMAIL ADDRESS: _____

FORM B

DANE COUNTY (Copy this Form as necessary to provide complete information)
EMERGING SMALL BUSINESS REPORT - INVOLVEMENT

COMPANY NAME: _____

PROJECT NAME: _____

BID NO.: _____ BID DUE DATE: _____

ESB NAME: _____

CONTACT PERSON: _____

ADDRESS: _____

_____

PHONE NO & EMAIL.: _____

_____

Indicate percentage of financial commitment to this ESB: _____% Amount: $_____

ESB NAME: _____

CONTACT PERSON: _____

ADDRESS: _____

_____

PHONE NO & EMAIL.: _____

_____

Indicate percentage of financial commitment to this ESB: _____% Amount: $_____

FORM C

DANE COUNTY
(Copy this Form as necessary to provide complete information)
EMERGING SMALL BUSINESS REPORT - CONTACTS

COMPANY NAME: _____

PROJECT NAME: _____

BID NO.: _____ BID DUE DATE: _____

	ESB FIRM NAME CONTACTED	DATE	PERSON CONTACTED	DID ESB BID?	ACC-EPT BID?	REASON FOR REJECTION
1)						
2)						
3)						
4)						
5)						
6)						
7)						
8)						

FORM D

DANE COUNTY
EMERGING SMALL BUSINESS REPORT - CERTIFICATION STATEMENT

I, _____ , _____ of
Name Title

_____ certify to best of my knowledge and
Company

belief that this business meets Emerging Small Business definition as indicated in Article 9 and that information contained in this Emerging Small Business Report is true and correct.

_____ _____
Bidder's Signature Date

Name of Bidding Firm: _____

BID FORM

BID NO. 318015
PROJECT: FEN OAK HEAT PUMP REPLACEMENT
LYMAN F. ANDERSON AGRICULTURE & CONSERVATION CENTER

TO: DANE COUNTY DEPARTMENT OF PUBLIC WORKS, HIGHWAY & TRANSPORTATION PROJECT MANAGER
1919 ALLIANT ENERGY CENTER WAY
MADISON, WISCONSIN 53713

NOTE: WISCONSIN STATUTE 77.54 (9M) ALLOWS FOR NO SALES & USE TAX ON THE PURCHASE OF MATERIALS FOR COUNTY PUBLIC WORKS PROJECTS.

BASE BID - LUMP SUM:
The project consists of the removal and replacement of HVAC equipment. The undersigned, having examined the site where the Work is to be executed and having become familiar with local conditions affecting the cost of the Work and having carefully examined the Drawings and Specifications, all other Construction Documents and Addenda thereto prepared by Dane County Department of Public Works, Highway & Transportation hereby agrees to provide all [design expertise,]labor, materials, equipment and services necessary for the complete and satisfactory execution of the entire Work, as specified in the Construction Documents, for the Base Bid stipulated sum of:

_____ and _____ /100 Dollars
Written Price

$_____
Numeric Price

ALTERNATE BID 1 – LUMP SUM
Price for providing ECM Motor. (Base Bid is to provide PSC motor)

_____ and _____ /100 Dollars
Written Price

$_____
Numeric Price (circle: Add or Deduct)

ALTERNATE BID 2 – LUMP SUM
Price to remove existing pump disconnects, prepare existing inline pump shaft for grounding ring installation, provide differential pressure sensor, new VFD for existing pump, install shaft grounding rings on existing Bell & Gossett 4x9.5 (8.25BF) inline pumps, provide new Distech controls to reside in existing JCI control panel, new Distech controls to reside in Niagara/Distech control panel, 2-way solonoid valve (Base Bid is for no solonoid valve.

_____ and _____ /100 Dollars
Written Price

$_____
Numeric Price (circle: Add or Deduct)

ALTERNATE BID 3 – LUMP SUM
Price to provide 1" bypass between heat pump supply and return piping, new heat pump water return temperature sensor/well, new Distech controls to reside in Niagara/Distech control panel, Variable Frequency Drive

_____ and _____ /100 Dollars
Written Price

$_____
Numeric Price (circle: Add or Deduct)

Receipt of the following addenda and inclusion of their provisions in this Bid is hereby acknowledged:

Addendum No(s). _____ through _____

Dated _____

Dane County Department of Administration must have this project completed by October 18, 2019. Assuming this Work can be started by March 18, 2019, what dates can you commence and complete this job?

Commencement Date: _____ Completion Date: _____
(final, not substantial)

I hereby certify that all statements herein are made on behalf of:

_____
(Name of Corporation, Partnership or Person submitting Bid)

Select one of the following:
1. A corporation organized and existing under the laws of the State of _____, or

2. A partnership consisting of _____, or

3. A person conducting business as _____;

Of the City, Village, or Town of _____ of the State of _____.

I have examined and carefully prepared this Bid from the associated Construction Documents and have checked the same in detail before submitting this Bid; that I have full authority to make such statements and submit this Bid in (its) (their) (my) behalf; and that the said statements are true and correct. In signing this Bid, we also certify that we have not, either directly or indirectly, entered into any agreement or participated in any collusion or otherwise taken any action in restraint of free competition; that no attempt has been made to induce any other person or firm to submit or not to submit a Bid; that this Bid has been independently arrived at without collusion with any other bidder, competitor, or potential competitor; that this Bid has not been knowingly disclosed prior to the Bids Due Date to another bidder or competitor; that the above statement is accurate under penalty of perjury.

The undersigned further agrees to honor the Base Bid and the Alternate Bid(s) for sixty (60) calendar days from date of Award of Contract.

SIGNATURE: _____

(Bid is invalid without signature)

Print Name: _____ Date: _____

Title: _____

Address: _____

Telephone No.: _____ Fax No.: _____

Email Address: _____

Contact Person: _____

THIS PAGE IS FOR BIDDERS' REFERENCE AND NEED NOT BE SUBMITTED WITH BID FORM.

BID CHECK LIST:
These items **must** be included with Bid:
☐ Bid Form ☐ Bid Bond ☐ Fair Labor Practices Certification

BIDDERS SHOULD BE AWARE OF THE FOLLOWING:

DANE COUNTY VENDOR REGISTRATION PROGRAM

Any person bidding on any County contract must be registered with the Dane County Purchasing Division & pay an annual registration fee. A contract will not be awarded to an unregistered vendor. Obtain a *Vendor Registration Form* by calling 608/266-4131 or complete a new form or renewal online at:
www.danepurchasing.com/registration

DANE COUNTY BEST VALUE CONTRACTING PRE-QUALIFICATION

Contractors must be pre-qualified as a Best Value Contractor with the Dane County Public Works Engineering Division before the award of contract. Obtain a *Best Value Contracting Application* by calling 608/266-4018 or complete one online at:
www.countyofdane.com/pwht/BVC_Application.aspx

EQUAL BENEFITS REQUIREMENT

By submitting a Bid, the contractor acknowledges that a condition of this contract is to provide equal benefits as required by Dane County Code of Ordinances Chapter 25.13. Contractor shall provide equal benefits as required by that Ordinance to all required employees during the term of the contract. Equal Benefits Compliance Payment Certification shall be submitted with final pay request. For more information:
www.danepurchasing.com/partner_benefit.aspx

COUNTY OF DANE

PUBLIC WORKS CONSTRUCTION CONTRACT

Contract No. _____ Bid No. 318015

Authority: 2018 RES -_____

THIS CONTRACT, made and entered into as of the date by which authorized representatives of both parties have affixed their signatures, by and between the County of Dane (hereafter referred to as "COUNTY") and _____ (hereafter, "CONTRACTOR"), and

W I T N E S S E T H :

WHEREAS, COUNTY, whose address is c/o Assistant Public Works Director, 1919 Alliant Energy Center Way, Madison, WI 53713, desires to have CONTRACTOR provide Fen Oak Heat Pump Replacement at the Lyman F. Anderson Agriculture & Conservation Center including Alternate Bids (if applicable)] ("the Project"); and

WHEREAS, CONTRACTOR, whose address is _____ _____ is able and willing to construct the Project, in accordance with the Construction Documents;

NOW, THEREFORE, in consideration of the above premises and the mutual covenants of the parties hereinafter set forth, the receipt and sufficiency of which is acknowledged by each party for itself, COUNTY and CONTRACTOR do agree as follows:

1. CONTRACTOR agrees to construct, for the price of $_____ the Project and at the CONTRACTOR'S own proper cost and expense to furnish all materials, supplies, machinery, equipment, tools, superintendence labor, insurance, and other accessories and services necessary to complete the Project in accordance with the conditions and prices stated in the Bid Form, General Conditions of Contract, the drawings which include all maps, plats, plans, and other drawings and printed or written explanatory matter thereof, and the specifications therefore as prepared by JDR Engineering, Inc. (hereinafter referred to as "the Architect / Engineer"), and as enumerated in the Project Manual Table of Contents, all of which are made a part hereof and collectively evidence and constitute the Contract.

2. COUNTY agrees to pay the CONTRACTOR in current funds for the performance of the Contract subject to additions and deductions, as provided in the General Conditions of Contract, and to make payments on account thereof as provided in Article entitled, "Payments to Contractor" of the General Conditions of Contract.

3. During the term of this Contract, CONTRACTOR agrees to take affirmative action to ensure equal employment opportunities. The CONTRACTOR agrees in accordance with Wisconsin Statute 111.321 and Chapter 19 of the Dane County Code of Ordinances not to discriminate on the basis of age, race, ethnicity, religion, color, gender, disability, marital status, sexual orientation, national origin, cultural differences, ancestry, physical appearance, arrest record or conviction record, military participation or membership in the national guard, state defense force or any other reserve component of the military forces of the United States, or political beliefs. Such equal opportunity shall include, but not be limited to, the following: employment,

upgrading, demotion, transfer, recruitment, advertising, layoff, termination, training, rates of pay, and any other form of compensation. CONTRACTOR agrees to post in conspicuous places, available to all employees and applicants for employment, notices setting forth the provisions of this paragraph.

4. CONTRACTOR shall file an Affirmative Action Plan with the Dane County Contract Compliance Officer in accord with Chapter 19 of the Dane County Code of Ordinances. CONTRACTOR must file such plan within fifteen (15) business days of the effective date of this Contract. During the term of this Contract CONTRACTOR shall also provide copies of all announcements of employment opportunities to COUNTY'S Contract Compliance Office, and shall report annually the number of persons, by race, ethnicity, gender, and disability status, which apply for employment and, similarly classified, the number hired and number rejected.

5. During the term of this Contract, all solicitations for employment placed on CONTRACTOR'S behalf shall include a statement to the effect that CONTRACTOR is an "Equal Opportunity Employer".

6. CONTRACTOR agrees to furnish all information and reports required by COUNTY'S Contract Compliance Officer as the same relate to affirmative action and nondiscrimination, which may include any books, records, or accounts deemed appropriate to determine compliance with Chapter 19, Dane County Code of Ordinances, and the provisions of this Contract.

7. This Contract is intended to be a Contract solely between the parties hereto and for their benefit only. No part of this Contract shall be construed to add to, supplement, amend, abridge or repeal existing rights, benefits or privileges of any third party or parties including, but not limited to, employees of either of the parties.

8. The entire agreement of the parties is contained herein and this Contract supersedes any and all oral agreements and negotiations between the parties relating to the subject matter hereof. The parties expressly agree that the express terms of this Contract shall not be amended in any fashion except in writing, executed by both parties.

9. CONTRACTOR must be pre-qualified as a Best Value Contractor with Dane County Public Works Engineering Division before award of Contract. Subcontractors must be pre-qualified ten (10) business days prior to commencing Work under this Contract.

IN WITNESS WHEREOF, COUNTY and CONTRACTOR, by their respective authorized agents, have caused this Contract and its Schedules to be executed, effective as of the date by which all parties hereto have affixed their respective signatures, as indicated below.

* * * * * * *

FOR CONTRACTOR:

Signature Date

Printed or Typed Name and Title

Signature Date

Printed or Typed Name and Title

NOTE: If CONTRACTOR is a corporation, Secretary should attest. In accordance with IRS Regulations, unincorporated entities are required to provide either their Social Security or Employer Number in order to receive payment for services rendered.

* * * * * * *

This Contract is not valid or effectual for any purpose until approved by the appropriate authority designated below, and no work is authorized until the CONTRACTOR has been given notice to proceed by COUNTY'S Assistant Public Works Director.

FOR COUNTY:

Joseph T. Parisi, County Executive Date

Scott McDonell, County Clerk Date

GENERAL CONDITIONS OF CONTRACT

TABLE OF CONTENTS

1. CONSTRUCTION DOCUMENTS

A. Construction Documents, listed in Table of Contents of this Specification volume shall form part of this Contract and provisions of Construction Documents shall be as binding upon parties as if they were fully set forth in Contract itself.

B. These shall also be considered as part of Construction Documents: Addenda, including additions and modifications incorporated in such addenda before execution of Contract; requests for information; construction bulletins; change orders; and written interpretations by Architect / Engineer or Public Works Project Manager that are made after execution of Contract.

C. Construction Documents are complementary, and what is required by one shall be as binding as if required by all. Intent of Construction Documents is to include all labor, materials and equipment necessary for proper execution of the Work.

2. DEFINITIONS

A. These terms as used in this Contract are respectively defined as follows:
   1. All uses of term "County" in Construction Documents shall mean Dane County.
   2. All uses of term "Department" in Construction Documents shall mean Department of Public Works, Highway & Transportation, which is a unit of Dane County government. Department is County agency overseeing Contract with Contractor.
   3. Public Works Project Manager is appointed by and responsible to Department. Public Works Project Manager has authority to act on behalf of Department and will sign change orders, payment requests and other administrative matters related to projects.
   4. Public Works Project Manager is responsible for supervision, administration and management of field operations involved in construction phase of this Work.
   5. Term "Work" includes all labor, equipment and materials necessary to produce project required by Construction Documents.
   6. Term "Substantial Completion" is date when project or specified area of project is certified by Architect / Engineer that construction is sufficiently completed, in accordance with Construction Documents, and as modified by any subsequent changes agreed to by parties, so that County may occupy project or specified area of project for use for which it was intended subject to permit approval for occupancy.
   7. Contractor is person, firm, or corporation with whom County makes Contract. Though multiple contracts may be involved, Construction Documents treat them throughout as if each were of singular number.

3. ADDITIONAL INSTRUCTIONS AND DRAWINGS

A. Contractor may be furnished additional instructions and detail drawings as necessary to carry out the Work included in Contract. Additional drawings and instructions thus supplied to Contractor will coordinate with Construction Documents and will be so prepared that they can be reasonably interpreted as part thereof. Contractor shall carry out the Work in accordance with additional detail drawings and instructions.

4. SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

A. Unless otherwise specified, Contractor shall submit three (3) copies of all Shop Drawings for each submission, until receiving final approval. After final approval, provide five (5) additional copies for distribution and such other copies as may be required.

B. Contractor shall submit, on an on-going basis and as directed, Product Data such as brochures that shall contain catalog cuts and specifications of all furnished mechanical and electrical equipment. After Architect / Engineer's approval, one (1) copy shall remain in Architect / Engineer's file, one (1) kept at Department's office and one (1) kept at job site by Contractor for reference purposes.

C. Samples shall consist of physical examples furnished by Contractor in sufficient size and quantity to illustrate materials, equipment or workmanship, and to establish standards to compare the Work.
   1. Submit Samples in sufficient quantity (minimum of two (2)) to permit Architect / Engineer to make all necessary tests and of adequate size showing quality, type, color range, finish, and texture. Label each Sample stating material, type, color, thickness, size, project name, and Contractor's name.
   2. Submit transmittal letter requesting approval, and prepay transportation charges to Architect / Engineer's office on samples forwarded.
   3. Materials installed shall match approved Samples.

D. Contractor shall review Shop Drawings and place their dated stamp thereon to evidence their review and approval and shall submit with reasonable promptness and in orderly sequence to cause no delay in the Work or in work of any other contractor. At time of submission, Contractor shall inform Architect / Engineer in writing of any deviation in Shop Drawings or Samples from requirements of Construction Documents. Architect / Engineer will not consider partial lists.

E. Architect / Engineer will review and approve or reject Shop Drawings with reasonable promptness to cause no delay. Architect / Engineer's approval shall not relieve Contractor from responsibility for errors or omissions in Shop Drawings.

F. Contractor shall not commence any work requiring Shop Drawing, Product Data or Sample submission until Architect / Engineer has approved submission. All such work shall be in accordance with approved Shop Drawings, Product Data and Samples.

G. Contractor shall keep on site of the Work, approved or conformed copy of Shop Drawings and shall at all times give Department access thereto.

H. By stamping and submitting Shop Drawings, Product Data and Samples, Contractor thereby represents that he or she has or will determine and verify all field measurements, field construction criteria, materials, catalog numbers, and similar data and that he or she has checked and coordinated each Shop Drawing, Product Data and Sample with requirements of the Work and of Construction Documents. Architect / Engineer shall return without examination, Shop Drawings, Product Data and Samples not so noted.

I. All Shop Drawings from any one Contractor should be numbered consecutively and on cover sheet shall bear name and location of project, name of Contractor, date of submittal and date of each correction or revision and associated Specification section and page number.

5. CUTTING AND PATCHING

A. Contractor shall be responsible for all cutting, fitting or patching required to complete the Work or to make its parts fit together properly.

B. Contractor shall not damage or endanger portion of the Work or fully or partially completed construction of County or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. Contractor shall not cut or otherwise alter such construction by County or separate contractor except with written consent of County and of such separate contractor; such consent shall not be unreasonably withheld. Contractor shall not withhold unreasonably from County or separate contractor, Contractor's consent to cutting or otherwise altering the Work.

6. CLEANING UP

A. Contractor shall keep premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under Contract. Contractor shall remove from and about the Work waste materials, rubbish, Contractor's tools, construction equipment, machinery, and surplus materials at completion of the Work. Contractor shall maintain streets and sidewalks around the Work site in clean condition. Contractor shall remove all spillage and prevent tracking of spillage arising from performance of the Work, into, out of, and within the Work site. Contractor shall establish regular maintenance program of sweeping, vacuuming and / or hosing to minimize accumulation of dirt and dust upon such areas.

B. If Contractor fails to clean up as directed in Construction Documents, County may do so and shall charge Contractor cost thereof.

C. Contractor shall be responsible for broken windows and glass, and at completion of the Work shall replace such damaged or broken windows and glass. After replacing damaged or broken windows and glass, Contractor shall remove all labels, wash and polish both sides of all windows and glass.

D. In addition to general cleaning (sweeping, vacuuming and / or hosing, as is appropriate to work surface), Contractor shall perform following final cleaning for all trades at completion of the Work:
   1. Remove temporary protections;
   2. Remove marks, stains, fingerprints and other soil or dirt from painted, decorated and finished woodwork and wall surfaces;
   3. Remove spots, plaster, soil and paint from ceramic tile, marble and other finished materials, and wash or wipe clean;
   4. Clean fixtures, cabinet work and equipment, removing stains, paint, dirt and dust, and leave same in undamaged, new condition;
   5. Clean aluminum in accordance with recommendations of manufacturer; and
   6. Clean resilient floors thoroughly with well-rinsed mop containing only enough moisture to clean off any surface dirt or dust and buff dry by machine to bring surfaces to sheen.

7. USE OF SITE

A. Contractor shall provide County and Architect / Engineer access to the Work under all circumstances.

B. Contractor shall confine operations at site to areas permitted by County, law, ordinance, permits and Construction Documents and shall not unreasonably encumber site with materials

or equipment. Contractor shall assure free, convenient, unencumbered, direct and safe access to all properties adjacent to the Work for County, its employees, invitees and guests.

8. MATERIALS AND WORKMANSHIP

A. Contractor shall perform all work and furnish all supplies and materials, machinery, equipment, facilities and means, necessary to complete the Work required by this Contract, within time specified, in accordance with provisions of Construction Documents.

B. All equipment and materials incorporated in the Work covered by this Contract are to be new; use recycled and / or recovered materials to extent that such use is technically and economically feasible. Recovered materials are products recovered from solid waste in form identical to original form for use that is same as, or similar to original use. Recycled materials are products manufactured from solid waste.

C. If requested, Contractor shall furnish satisfactory evidence as to kind and quality of construction materials proposed or used. Contractor shall furnish to Architect / Engineer, for approval, manufacturer name and model, performance capacities and other pertinent information of machinery, mechanical, electrical or other types of equipment, which Contractor plans to install.

D. If not otherwise provided, materials and labor called for in this Contract shall be provided and performed in accordance with established practice and standards recognized by Architects, Engineers, Department, and construction industry.

E. Reference to "Standard" specifications of any association or manufacturer, or codes of County authorities, intends most recent printed edition or catalog in effect on date that corresponds with date of Construction Documents.

F. Whenever reference is made in Specifications that work shall be "performed", "applied", in accordance with "manufacturer's directions or instructions", Contractor to whom those instructions are directed shall furnish three (3) printed copies of such instructions to Architect / Engineer before execution of the Work.

9. CONTRACTOR'S TITLE TO MATERIALS

A. Contractor or any subcontractor shall not purchase materials or supplies for the Work subject to any chattel mortgage or under conditional sale contract or other agreement by which seller retains interest. Contractor warrants that all materials and supplies used in the Work are free from all liens, claims or encumbrances and Contractor has good title to them.

10. "OR EQUAL" CLAUSE

A. Whenever equipment or materials are identified on Drawings or in Specifications by reference to manufacturer's or vendor's name, trade name, catalog number, and other identifying information, it is intended to establish standards; and any equipment or material of other manufacturers and vendors which will perform adequately duties imposed by general design will be considered equally accepted provided equipment or material so proposed is, in opinion of Architect / Engineer, of equal substance and function. Architect / Engineer and Department shall provide written approval before Contractor may purchase or install it.

B. Equipment or materials of manufacturers, other than those named, may be used only upon following conditions:
   1. That, in opinion of Architect / Engineer and Department, proposed material or equipment item is fully equal or superior (in design, materials, construction, workmanship, performance, finish, etc.) to named item. No compromise in quality level, however small, is acceptable.
   2. That, in substituting materials or equipment, Contractor assumes responsibility for any changes in system or for modifications required in adjacent or related work to accommodate such substitution despite Architect / Engineer's and Department's approval, and all costs growing out of approval of "or equal" items shall be responsibility of Contractor. No extra costs resulting from such approval shall become responsibility of Department, Architect / Engineer or any other separate Contractor.
   3. It shall be understood that use of materials or equipment other than those specified, or approved equal by Architect / Engineer and Department, shall constitute violation of Contract, and that Architect / Engineer and Department shall have right to require removal of such materials or equipment and their replacement with specified materials or equipment at Contractor's expense.
   4. Product and manufacturer named first in Specifications or on information shown on Drawings is basis of selection of manufactured items and equipment, particularly mechanical equipment. In using other than first named products or manufacturers, including those specified as additionally approved or acceptable, Contractor assumes responsibility for any changes in system and for modifications in any work required to accommodate them. Architect / Engineer's approval of such additionally acceptable products or manufacturers, either in Specifications or in Addendum, does not relieve Contractor from obligation to coordinate such optional products with other Contractors, whose work may be affected by them, and to pay all additional costs resulting from their inclusion into the Work. Contractor's liability shall include payment of Architect / Engineer's fees for any additional services made necessary by or directly connected to such product changes. No extra costs resulting from such changes shall become responsibility of Department, Architect / Engineer or any other separate Contractor.

C. No request for approval of "or equal" materials will be entertained except from Contractor. Identify any request for substitution as substitution on Contractor's letter of transmittal and give reasons for substitution. Department may in its sole discretion allow substitutions of materials.

11. PATENTS AND ROYALTIES

A. If Contractor uses any design, device or material covered by letters, patent or copyright, it is mutually agreed and understood, that, without exception, contract prices shall include all royalties or costs arising from use of such design, device or materials, in any way involved in the Work.

B. Contractor shall indemnify and save harmless County from any and all claims for infringement by reason of use of such patent or copyright in connection with the Work agreed to be performed under this Contract, and shall indemnify County for any cost, expense or damage which it may be obliged to pay by reason of such infringement at any time during prosecution of the Work or after completion of the Work.

12. SURVEYS, PERMITS, REGULATIONS AND TAXES

A. Department will furnish to Contractor all site, topography and property surveys necessary for execution of the Work.

B. Contractor shall procure all permits, licenses and approvals necessary for execution of this Contract.

C. Contractor shall give all notices and comply with all State of Wisconsin, Federal and local laws, codes, rules and regulations relating to performance of the Work, protection of adjacent property, and maintenance of passageways, guard fences or other protective facilities.

D. Contractor shall pay all Sales, Consumer, Use and other similar taxes required by law.

E. Contractor shall promptly notify Architect / Engineer of any variances of Drawings or Specifications with that of any State of Wisconsin, federal or local law, code, rule or regulation. Upon such notification, Architect / Engineer will require correction of variance to comply with applicable law, code, rule or regulation at no additional cost to Contractor.

F. Work under this Contract shall comply with all applicable State of Wisconsin, Federal and local laws, codes and regulations.

G. Contractor shall pay charges for water, sewer and other utility connections made by municipalities where required by Specifications.

13. CONTRACTOR'S OBLIGATIONS AND SUPERINTENDENCE

A. Contractor shall provide and pay for all materials, labor, tools, equipment, transportation and superintendence necessary to execute, complete and deliver the Work within specified time. Contractor agrees to secure at their own expense all personnel necessary to carry out the Work. Such personnel shall not be deemed County employees nor shall they have or be deemed to have any direct contractual relationship with County.

B. Performance of any work necessary after regular working hours, on Sundays or Legal Holidays shall be without additional expense to County. Performance of any work at site at other than normal working hours must be coordinated with Public Works Project Manager.

C. Contractor shall furnish, erect, maintain and remove such temporary works as may be required.

D. Contractor shall observe, comply with, and be subject to all terms, conditions, requirements and limitations of Construction Documents.

E. At the Work site, Contractor shall give personal superintendence to the Work or shall employ construction superintendent or foreman, experienced in character of work covered by Contract, who shall have full authority to act for Contractor. Understand that such superintendent or foreman shall be acceptable to Architect / Engineer and Department.

F. Remove from project or take other corrective action upon notice from Architect / Engineer or Department for Contractor's employees whose work is considered by Architect / Engineer or Department to be unsatisfactory, careless, incompetent, unskilled or otherwise objectionable.

G. Contractor and subcontractors shall be required to conform to Labor Laws of State of Wisconsin and various acts amendatory and supplementary thereto and to other laws, ordinances and legal requirements applicable to the Work.

H. Presence and observation of the Work by Architect / Engineer or Public Works Project Manager shall not relieve Contractor of any obligations.

14. WEATHER CONDITIONS

A. In event of temporary suspension of work, or during inclement weather, or whenever Architect / Engineer shall direct, Contractor shall, and shall cause subcontractors to protect carefully all work and materials against damage or injury from weather. If, in opinion of Architect / Engineer or Department, any work or materials that have been damaged or injured due to failure on part of Contractor or any subcontractors so to protect the Work, such materials shall be removed and replaced at expense of Contractor.

15. PROTECTION OF WORK AND PROPERTY

A. Contractor shall at all times safely guard County's property from injury or loss in connection with this Contract. Contractor shall at all times safely guard and protect the Work, and adjacent property, from damage. Contractor shall replace or make good any such damage, loss or injury unless such is caused directly by errors contained in Contract, or by County, or County's duly authorized representative.

B. Contractor may act diligently, without previous instructions from Architect / Engineer and / or Department, in emergency that threatens loss or injury of property, or safety of life. Contractor shall notify Architect / Engineer and / or Department immediately thereafter. Promptly submit any claim for compensation by Contractor due to such extra work to Architect / Engineer and / or Department for approval as provided for in Article 18 herein.

16. INSPECTION AND TESTING OF MATERIALS

A. Authorized representatives and agents of County government shall have access at all times to the Work wherever it is in preparation or progress and Contractor shall provide facilities for such access and for inspection.

B. Should it be considered necessary or advisable at any time before final acceptance of the Work to make examination of work already completed, by removing or tearing out same, Contractor shall upon request, promptly furnish all necessary facilities, labor and materials. If such work is found to be defective in any aspect, due to fault of Contractor or subcontractors thereof, Contractor shall assume all expenses of such examination and of satisfactory reconstruction. Contractor will be reimbursed for such examination and replacement in accordance with Article 18 - A.3., of these General Conditions of Contract if such work is found to meet requirements of Contract.

C. If Specifications, Architect / Engineer's, or Public Works Project Manager's instructions require any work to be specially tested or approved, Contractor shall give Architect / Engineer and Public Works Project Manager timely notice of its readiness for testing or inspection. Test all materials and equipment requiring testing in accordance with accepted or specified standards, as applicable. Architect / Engineer shall recommend laboratory or inspection agency and Department will select and pay for all initial laboratory inspection services. Should retesting be required, due to failure of initial testing, cost of such retesting shall be borne by Contractor.

D. Cost of any testing performed by manufacturers or Contractor for substantiating acceptability of proposed substitution of materials and equipment, or necessary conformance testing in

conjunction with manufacturing processes or factory assemblage, shall be borne by Contractor or manufacturer responsible.

17. REPORTS, RECORDS AND DATA

A. Contractor shall submit to Architect / Engineer and Public Works Project Manager such schedule of quantities and costs, progress schedules, payrolls, reports, estimates, invoices, records and other data as either may request concerning work performed or to be performed under this Contract.

18. CHANGES IN THE WORK

A. Make no changes, except in cases of emergency, in the Work covered by approved Construction Documents without having prior written approval of Department. Charges or credits for the Work covered by approved change shall be determined by one of these methods:
   1. Unit bid prices previously approved.
   2. Agreed lump sum based on actual cost of:
      a) Labor, including foremen, and all fringe benefits that are associated with their wages.
      b) Materials entering permanently into the Work.
      c) Ownership or rental cost of construction tools and equipment during time of use on extra work.
      d) Power and consumable supplies for operation of power equipment.
      e) Workmen's Compensation Insurance, Contractor's Public Liability and Property Damage Insurance, and Comprehensive Automobile Liability Insurance.
      f) Social Security and old age and unemployment contributions.
      g) Add to cost under (2), fixed fee to be agreed upon, but not to exceed fifteen percent (15%) of actual cost of work performed with their own labor force. Fee shall be compensation to cover cost of supervision, overhead, bond, profit and any other general expense.
      h) On that portion of the Work under (2) done under subcontract, Contractor may include not over seven and one-half percent (7½%) for supervision, overhead, bond, profit and any other general expense.
      i) Department may require correct amount of costs with supporting vouchers; Contractor shall keep and present in such form as directed.
   3. Cost-plus work, with not-to-exceed dollar limit, based on actual cost of:
      a) Labor, including foremen, and all fringe benefits that are associated with their wages.
      b) Materials entering permanently into the Work.
      c) Ownership or rental cost of construction tools and equipment during time of use on extra work. Rental cost cannot exceed fifty percent (50%) replacement value of rented equipment.
      d) Power and consumable supplies for operation of power equipment.
      e) Workmen's Compensation Insurance, Contractor's Public Liability and Property Damage Insurance, and Comprehensive Automobile Liability Insurance.
      f) Social Security and old age and unemployment contributions.
      g) To cost under (3), there shall be added fixed fee to be agreed upon but not to exceed fifteen percent (15%) of actual cost of work performed with their own labor force. Fee shall be compensation to cover cost of supervision, overhead, bond, profit, and any other general expense.
      h) On that portion of the Work under (3) done under subcontract, Contractor may include not over seven and one-half percent (7½%) for supervision, overhead, bond, profit, and any other general expense.

i) Contractor shall keep and present, in such form as directed, correct amount of cost together with such supporting vouchers as may be required by Department.

B. If Contractor claims that by any instructions given by Architect / Engineer, Department, by drawings or otherwise, regarding performance of the Work or furnishing of material under Contract, involves extra cost, Contractor shall give Department written notice of cost thereof within two (2) weeks after receipt of such instructions and in any event before proceeding to execute work, unless delay in executing work would endanger life or property.

C. No claim for extra work or cost shall be allowed unless it was done in pursuance of written Change Order from Architect / Engineer and approved by Department, as previously mentioned, and claim presented with payment request submitted after changed or extra work is completed.

D. Negotiation of cost for change in the Work shall not be cause for Contractor to delay prosecution of the Work if Contractor has been authorized in writing by Public Works Project Manager to proceed.

19. EXTRAS

A. Without invalidating Contract, Department may order extra work or make changes by altering, adding to or deducting from the Work, contract sum being adjusted in accordance with Article 18 herein.

20. TIME FOR COMPLETION

A. Contractor agrees that the Work shall be prosecuted regularly and diligently and complete the Work as stated in Construction Documents.

21. CORRECTION OF WORK

A. All work, all materials whether incorporated in the Work or not, and all processes of manufacture shall at all times and places be subject to inspection of Architect / Engineer and Public Works Project Manager who shall be judge of quality and suitability of the Work, materials, and processes of manufacture for purposes for which they are used. Should they fail to meet Architect / Engineer's and Public Works Project Manager's approval they shall be reconstructed, made good, replaced or corrected, by Contractor at Contractor's expense. Immediately remove all rejected material from site.

B. If Contractor defaults or neglects to carry out the Work in accordance with Construction Documents or fails to perform any provision of Contract, Department may, after ten (10) business days' written notice to Contractor and without prejudice to any other remedy County may have, make good such deficiencies. In such case, appropriate Change Order shall be issued deducting from Contractor's payments then or thereafter, cost of correcting such deficiencies, including cost of Architect / Engineer's additional services made necessary by such default, neglect or failure.

22. SUBSURFACE CONDITIONS FOUND DIFFERENT

A. If Contractor encounters subsurface or latent conditions at site materially differing from those shown on Drawings or indicated in Specifications, Contractor shall immediately give notice to Architect / Engineer and Public Works Project Manager of such conditions before they are

disturbed. Architect / Engineer will thereupon promptly investigate conditions, and if Architect / Engineer finds that they materially differ from those shown on Drawings or indicated in Specifications, Architect / Engineer will at once make such changes as necessary, any increase or decrease of cost resulting from such changes to be adjusted in manner provided in above Article 18 entitled "Changes in the Work".

23. RIGHT OF DEPARTMENT TO TERMINATE CONTRACT

A. In event that any provisions of this Contract are violated by Contractor or by any subcontractors, County may serve written notice upon Contractor and Surety of its intention to terminate Contract, such notice to contain reasons for such intention to terminate Contract, and unless within ten (10) business days after serving of such notice upon Contractor, such violation or delay shall cease and satisfactory arrangement or correction be made, Contract shall, upon expiration of said ten (10) business days, cease and terminate.

B. In event of any such termination, County shall immediately serve notice thereof upon Surety and Contractor, and Surety shall have right to take over and perform Contract subject to County's approval; provided, however, that if Surety does not commence performance thereof within ten (10) business days from date of mailing to such Surety of notice of termination, County may take over the Work and prosecute same to completion by contract, or by force account, at expense of Contractor; Contractor and Surety shall be liable to County for any excess cost occasioned County thereby, and in such event County may take possession of and utilize in completing the Work, such materials and equipment as may be on the Work site and therefore necessary.

24. CONSTRUCTION SCHEDULE AND PERIODIC ESTIMATES

A. Contractor shall be responsible for Construction Schedule and coordination. Immediately after execution and delivery of Contract and before making first payment, Contractor shall notify all subcontractors to furnish all required information to develop Construction Schedule. Contractor and all subcontractors associated with the Work shall furnish following information from each Division of Specifications:
   1. List of construction activities;
   2. Start, finish and time required for completion of each activity;
   3. Sequential relationships between activities;
   4. Identify all long lead-time items, key events, meetings or activities such as required submittals, fabrication and delivery, procurement of materials, installation and testing;
   5. Weekly definition of extent of work and areas of activity for each trade or Subcontract; and
   6. Other information as determined by Public Works Project Manager.

B. In addition to above requested items, Contractor shall request delivery dates for all County-furnished equipment, materials or labor. This shall include any work handled by Department under separate contracts such as asbestos abatement, air and water balancing, etc. Indicate on Construction Schedule these associated delivery and installation dates.

C. Progress Reporting:
   1. Contractor shall update and publish Construction Schedule on monthly basis. Revisions to Schedule shall be by Contractor and made in same detail as original Schedule and accompanied by explanation of reasons for revision; and shall be subject to approval by Department.

2. Failure of Contractor to keep Schedule in updated format shall result in County hiring firm specializing in construction schedule development and deducting those costs associated with updating process from payments due Contractor.
3. Contractor shall submit show actual percentage of each activity completed, estimated future progress, and anticipated completion time.

D. Responsibility for timely completion requires:
   1. Contractor and subcontractors understand that performance of each is interdependent upon performance of others.
   2. Whenever it becomes apparent from current schedule, that phasing or progress completion dates will not be met, Contractor must take some or all following actions at no additional cost to County:
      a) Increase construction labor in such quantities and crafts as will eliminate backlog of work.
      b) Increase number of working hours per shift, shifts per working day, working days per week, amount of construction equipment, or any combination of foregoing to eliminate backlog of work.
      c) Reschedule work (yet remain in conformance with Drawings and Specifications).
   3. Prior to proceeding with any of above actions, Contractor shall notify Public Works Project Manager.

E. Maintain current Construction Schedule at all times. Revise Construction Schedule in same detail as original and accompany with explanation of reasons for revision. Schedule shall be subject to approval by Architect / Engineer and Public Works Project Manager.

25. PAYMENTS TO CONTRACTOR

A. Contractor shall provide:
   1. Detailed estimate giving complete breakdown of contract price by Specification Division; and
   2. Periodic itemized estimates of work done for purpose of making partial payments thereon.

B. Submit these estimates for approval first to Architect / Engineer, then to Public Works Project Manager. Costs employed in making up any of these schedules are for determining basis of partial payments and not considered as fixing basis for additions to or deductions from Contract price.

C. County will make partial payments to Contractor for value, proportionate to amount of Contract, of all labor and material incorporated in the Work during preceding calendar month upon receipt of Application and Certificate for Payment form from Architect / Engineer and approval of Department.

D. Contractor shall submit for approval first to Architect / Engineer, and then to Public Works Project Manager all Application and Certificate for Payment forms. If requested, Application and Certificate for Payment shall be supported by such additional evidence as may be required, showing Contractor's right to payment claimed.

E. Application and Certificate for Payment for preparatory work and materials delivered and suitably stored at site to be incorporated into the Work at some future period, will be given due consideration. Requesting payment for materials stored off site, may be rejected, however, if deemed essential for reasons of job progress, protection, or other sufficient cause, requests will be considered, conditional upon submission by Contractor of bills of sale,

photographs and such other procedures as will adequately protect County's interest such as storage in bonded warehouse with adequate coverage. If there is any error in payment, Contractor is obligated to notify Department immediately, but no longer than ten (10) business days from receipt of payment.

F. Payments by County will be due within forty-five (45) business days after receipt by Department of Application and Certificate for Payment.

G. County will retain five percent (5%) of each Application and Certificate for Payment until final completion and acceptance of all the Work covered by Contract. However, anytime after fifty percent (50%) of the Work has been furnished and installed at site, County will make remaining payments in full if Architect / Engineer and Public Works Project Manager find that progress of the Work corresponds with Construction Schedule. If Architect / Engineer and Public Works Project Manager find that progress of the Work does not correspond with Construction Schedule, County may retain up to ten percent (10%) of each Application and Certificate for Payment for the Work completed.

H. All material and work covered by partial payments made shall become sole property of County, but this provision shall not be construed as relieving Contractor from sole responsibility for care and protection of materials and work upon which payments have been made, or restoration of any damaged work, or as waiver of right of County to require fulfillment of all of terms of Contract.

I. County will make final payment within sixty (60) calendar days after final completion of the Work, and will constitute acceptance thereof. Submit Equal Benefits Compliance Payment Certification with final pay request. Payment may be denied if Certification is not included.

J. County may make payment in full, including retained percentages and less authorized deductions, upon completion and acceptance of each Division where price is stated separately in Contract.

K. Every contractor engaged in performance of any contract for Department of Public Works, Highway & Transportation shall submit to this Department, as requested and with final application for payment for work under said contract, affidavit(s) as required to prove that all debts and claims against this Work are paid in full or otherwise satisfied, and give final evidence of release of all liens against the Work and County. Use "Dane County, Wisconsin Contractor Wage Affidavit" form included in Supplementary Conditions.

26. WITHHOLDING OF PAYMENTS

A. County, after having served written notice on said Contractor, may either pay directly any unpaid bills of which Department has written notice, or withhold from Contractor's unpaid compensation sum of money deemed reasonably sufficient to pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged; whereupon, payment to Contractor shall be resumed in accordance with terms of this Contract, but in no event shall these provisions be construed to impose any obligations upon County to either Contractor or Contractor's Surety.

B. In paying any unpaid bills of Contractor, County shall be deemed agent of Contractor, and any payment so made by County, shall be considered as payment made under Contract by County to Contractor and County shall not be liable to Contractor for any such payment made in good faith.

C. Contractor shall indemnify, hold harmless and defend Dane County, its boards, commissions, agencies, officers, employees and representatives from all claims growing out of lawful demands of subcontractors, laborers, workers, mechanics, material men, and furnishers of machinery and parts thereof, equipment, power tools, and all supplies, including commissary, incurred in performance of this Contract.

D. At Department's request, Contractor shall furnish satisfactory evidence that all obligations of nature designated above have been paid, discharged or waived.

27. ACCEPTANCE OF FINAL PAYMENT AS RELEASE

A. Making of final payment shall constitute waiver of all claims by County except those arising from:
   1. Unsettled lien;
   2. Faulty or defective work appearing after substantial completion;
   3. Failure of the Work to comply with requirements of Construction Documents; or
   4. Terms of any special guarantees required by Construction Documents.

B. Acceptance of final payment shall constitute waiver of all claims by Contractor.

28. PAYMENTS BY CONTRACTOR

A. Contractor shall pay following not later than fifth (5^{th}) business day following each payment received from County:
   1. All transportation and utility services rendered;
   2. All materials, tools, and other expendable equipment that have been delivered at site of the Work to extent of ninety percent (90%) of cost thereof, and balance of cost thereof when said balance is paid to Contractor; and
   3. Each subcontractor, respective amount allowed Contractor because of work performed by subcontractor to extent of subcontractor's interest therein.

29. CONTRACT SECURITY

A. Contractor shall furnish Performance and Payment Bonds in amount at least equal to one hundred percent (100%) of Contract price as security for faithful performance of this Contract and payment of all persons performing labor on project under this Contract and furnishing materials in connection with this Contract.

B. Sample Performance and Payment Bonds that Contractor will be required to execute is bound into these Construction Documents. Before construction Contract is consummated, completed Performance and Payment Bonds must be approved by Department.

30. ASSIGNMENTS

A. Contractor shall not assign whole or any part of this Contract or any moneys due or to become due hereunder without written consent of Department. In case Contractor assigns all or any part of any moneys due or to become due under this Contract, instrument of assignment shall contain clause substantially to effect that it is agreed that right of assignee in and to any moneys due or to become due to Contractor shall be subject to prior claims of all persons, firms and corporations for services rendered or materials supplied for performance of the Work called for in this Contract.

31. MUTUAL RESPONSIBILITY OF CONTRACTORS

A. If, through acts of neglect on part of Contractor or any subcontractor shall suffer loss or damage on the Work, Contractor agrees to settle with such subcontractor by agreement or arbitration if such other subcontractor will so settle. If such subcontractor shall assert any claim against County on account of any damage alleged to have been sustained, Department shall notify Contractor, who shall indemnify, hold harmless and defend Dane County, its boards, commissions, agencies, officers, employees and representatives against any such claim.

32. SEPARATE CONTRACTS

A. Department may award other contracts for the Work and all Contractors shall fully cooperate with each other and carefully adjust their work to that provided under other contracts as may be directed by Department. No Contractor shall commit or permit any act that will interfere with performance of the Work by any other Contractor.

B. Contractor shall coordinate the Work with those of other Contractors. Cooperation will be required in arrangement for storage of materials and in detailed execution of the Work. Contractor, including subcontractors, shall keep informed of progress and detail work of others and shall notify Architect / Engineer or Department immediately of lack of progress or defective workmanship on part of others. Failure of Contractor to keep informed of the Work progressing on site and failure to give notice of lack of progress or defective workmanship by others shall be construed as acceptance by Contractor of status of the Work as being satisfactory for proper coordination with Contractor's own work.

33. SUBCONTRACTS

A. Contractor may use services of specialty subcontractors on those parts of the Work that, under normal contracting practices, are performed by specialty subcontractors.

B. Contractor shall not award any work to any subcontractor without prior approval of Department. Qualifications of subcontractors shall be same as qualifications of Contractor. Request for subcontractor approval shall be submitted to Department fifteen (15) business days before start of subcontractor's work. If subcontractors are changed or added, Contractor shall notify Department in writing.

C. Contractor shall be as fully responsible to County for acts and omissions of subcontractors, and of persons either directly or indirectly employed by them, as Contractor is for acts and omissions of persons directly employed by Contractor.

D. Contractor shall cause appropriate provisions to be inserted in all subcontracts relative to the Work to bind subcontractors to Contractor by terms of General Conditions of Contract and other Construction Documents insofar as applicable to work of subcontractors and to give Contractor same power as regards terminating any subcontract that Department may exercise over Contractor under any provision of Construction Documents.

E. Nothing contained in this Contract shall create any contractual relation between any subcontractor and County.

F. Contractor shall insert in all subcontracts, Articles 26, 33, 43 and 45, respectively entitled: "Withholding of Payments", "Subcontracts", "Affirmative Action Provision and Minority /

Women / Disadvantaged Business Enterprises", and "Minimum Wages", and shall further require all subcontractors to incorporate physically these same Articles in all subcontracts.

34. PUBLIC WORKS PROJECT MANAGER'S AUTHORITY

A. Public Works Project Manager shall:
   1. Administer and ensure compliance with Construction Documents;
   2. Provide responsible on-site observations of construction and have authority to request work and to stop work whenever necessary to insure proper enforcement of Construction Documents;
   3. Convene and chair project meetings and foreman's coordination meetings when necessary to coordinate resolution of conflicts between Contractors, Architects, Engineers, Consultants, and Department; and
   4. Check and inspect material, equipment and installation procedures of all trades for proper workmanship and for compliance with Drawings, Specifications and Shop Drawings, permit no material on project site that is not satisfactory and reject work not in compliance with Construction Documents.

35. ARCHITECT / ENGINEER'S AUTHORITY

A. Architect / Engineer is retained by, and is responsible to Department acting for County.

B. Architect / Engineer shall determine amount, quality, acceptability, and fitness of several kinds of work and materials that are provided under this Contract and shall decide all questions that may arise in relation to said work and construction thereof.

C. Architect / Engineer shall decide meaning and intent of any portion of Specifications and of any Drawings where they may be found obscure or be in dispute.

D. Architect / Engineer shall provide responsible observation of construction. Architect / Engineer has authority to stop the Work whenever such stoppage may be necessary to insure proper execution of Construction Documents.

E. Architect / Engineer shall be interpreter of conditions of Construction Documents and judge of its performance.

F. Within reasonable time, Architect / Engineer shall make decisions on all matters relating to progress of the Work or interpretation of Construction Documents.

G. Architect / Engineer's decisions are subject to review by Public Works Project Manager.

36. STATED ALLOWANCES

A. Stated allowances enumerated in Instructions to Bidders shall cover net cost of materials or equipment, and all applicable taxes. Contractor's cost of delivery and unloading at site, handling costs on site, labor, installation costs, overhead, profit and any other incidental costs shall be included in Contractor's bid, but not as part of cash allowance.

B. Department will solicit at least two (2) bids on materials or equipment for which allowance is stated and select on basis of lowest qualified responsible bid. Contractor will then be instructed to purchase "Allowed Materials". If actual price for purchasing "Allowed Materials", including taxes, is more or less than "Cash Allowance", Contract price shall be

adjusted accordingly. Adjustment in Contract price shall not contain any cost items excluded from cash allowance.

37. ESTIMATES OF QUANTITIES

A. Whenever estimated quantities of work to be done and materials to be furnished under this Contract are shown in any of Construction Documents, they are given for use in comparing bids and right is especially reserved to increase or diminish them as they may be deemed reasonably necessary or desirable by Department to complete the Work included in this Contract, and cost for such increase or diminution shall be adjusted in manner provided for in General Conditions of Contract Article 18 entitled "Changes in the Work".

38. LANDS AND RIGHTS-OF-WAY

A. Prior to start of construction, County shall furnish all land and rights-of-way necessary for carrying out and completion of the Work to be performed under this Contract.

39. GENERAL GUARANTEE

A. Neither final certificate of payment nor any provision in Construction Documents nor partial or entire occupancy of premises by County shall constitute acceptance of work not done in accordance with Construction Documents or relieve Contractor of liability in respect to any expressed warranties or responsibility for faulty materials or workmanship.
   1. In no event shall making of any payment required by Contract constitute or be construed as waiver by County of any breach of covenants of Contract or waiver of any default of Contractor and making of any such payment by County while any such default or breach shall exist shall in no way impair or prejudice right of County with respect to recovery of damages or other remedy as result of such breach or default.

B. Contractor shall remedy and make good all defective workmanship and materials and pay for any damage to other work resulting there from, which appear within period of one (1) year from date of substantial completion, providing such defects are not clearly due to abuse or misuse by County. Department will give notice of observed defects with reasonable promptness.

C. Guarantee on work executed after certified date of substantial completion will begin on date when such work is inspected and approved by Architect / Engineer and Public Works Project Manager.

D. Where guarantees or warrantees are required in sections of Specifications for periods in excess of one (1) year, such longer terms shall apply; however, Contractor's Performance and Payment Bonds shall not apply to any guarantee or warranty period in excess of one (1) year.

40. CONFLICTING CONDITIONS

A. Any provision in any of Construction Documents which may be in conflict or inconsistent with any Articles in these General Conditions of Contract or Supplementary Conditions shall be void to extent of such conflict or inconsistency.

B. In case of ambiguity or conflict between Drawings and Specifications, Specifications shall govern.

C. Printed dimensions shall be followed in preference to measurements by scale. Large-scale drawings take precedence over small-scale drawings. Dimensions on Drawings and details are subject to field measurements of adjacent work.

41. NOTICE AND SERVICE THEREOF

A. Any notice to Contractor from Department relative to any part of this Contract shall be in writing and considered delivered and service thereof completed, when said notice is posted, by certified or registered mail, to Contractor at Contractor's last given address, or delivered in person to said Contractor, or Contractor's authorized representative on the Work.

42. PROTECTION OF LIVES AND HEALTH

A. In order to protect lives and health of Contractor's employees under Contract, Contractor shall comply with all pertinent provisions of Wisconsin Administrative Code, Rules of Department of Commerce, relating to Safety and Health.

B. Contractor alone shall be responsible for safety, efficiency and adequacy of Contractor's tools, equipment and methods, and for any damage that may result from their failure or their improper construction, maintenance or operation.

43. AFFIRMATIVE ACTION PROVISION AND MINORITY / WOMEN / DISADVANTAGED BUSINESS ENTERPRISES

A. Affirmative Action Provisions.
   1. During term of their Contract, Contractor agrees not to discriminate on basis of race, religion, color, sex, handicap, age, sexual preference, marital status, physical appearance, or national origin against any person, whether recipient of services (actual or potential), employee, or applicant for employment. Such equal opportunity shall include but not be limited to following: employment, upgrading, demotion, transfer, recruitment, advertising, layoff, termination, training, rates of pay, and any other form of compensation or level of service(s). Contractor agrees to post in conspicuous places, these affirmative action standards so as to be visible to all employees, service recipients and applicants for this paragraph. Listing of prohibited bases for discrimination shall no be construed to amend in any fashion state or federal law setting forth additional bases and exceptions shall be permitted only to extent allowable in state or federal law.
   2. Contractor is subject to this Article only if Contractor has ten (10) or more employees and receives $10,000.00 or more in annual aggregate contracts with County. Contractor shall file and Affirmative Action Plan with Dane County Contract Compliance Officer in accord with Chapter 19 of Dane County Code of Ordinances. Such plan must be filed within fifteen (15) business days of effective date of this Contract and failure to do so by said date shall constitute ground for immediate termination of Contract by County. Contractor shall also, during term of this Contract, provide copies of all announcements of employment opportunities to County's Contract Compliance Office, and shall report annually number of persons, by race, sex and handicap status, who apply for employment, and, similarly classified, number hired and number rejected.
   3. Contact Dane County Contract Compliance Officer at Dane County Contract Compliance Office, 210 Martin Luther King, Jr. Blvd., Room 421, Madison, WI 53703, 608/266-4114.
   4. In all solicitations for employment placed on Contractor's behalf during term of this Contract, Contractor shall include statement to affect Contractor is "Equal Opportunity Employer". Contractor agrees to furnish all information and reports required by

County's Contract Compliance Officer as same relate to affirmative action and nondiscrimination, which may include any books, records, or accounts deemed appropriate to determine compliance with Chapter 19, Dane County Code of Ordinances, and provision of this Contract.

B. Minority / Women / Disadvantaged / Emerging Small Business Enterprises.
   1. Chapter 19.508 of Dane County Code of Ordinances is official policy of Dane County regarding utilization of, to fullest extent of, Minority Business Enterprises (MBEs), Women Business Enterprises (WBEs) Disadvantage Business Enterprises (DBEs) and Emerging Small Business Enterprises (ESBEs).
   2. Contractor may utilize MBEs / WBEs / DBEs / ESBEs as subcontractors or suppliers. List of subcontractors will be required of low bidder as stated in this Contract. List shall indicate which are MBEs / WBEs / DBEs / ESBEs and percentage of subcontract awarded, shown as percentage of total dollar amount of bid.

44. COMPLIANCE WITH FAIR LABOR STANDARDS

A. During term of this Contract, Contractor shall report to County Contract Compliance Officer, within ten (10) business days, any allegations to, or findings by National Labor Relations Board (NLRB) or Wisconsin Employment Relations Commission (WERC) that Contractor has violated statute or regulation regarding labor standards or relations. If investigation by Contract Compliance Officer results in final determination that matter adversely affects Contractor's responsibilities under this Contract, and which recommends termination, suspension or cancellation of this Contract, County may take such action.

B. Contractor may appeal any adverse finding by Contract Compliance Officer as set forth in Dane County Ordinance 25.015(11)(c) through (e).

C. Contractor shall post this statement in prominent place visible to employees: "As condition of receiving and maintaining contract with Dane County, this employer shall comply with federal, state and all other applicable laws prohibiting retaliation or union organizing."

45. DOMESTIC PARTNERSHIP BENEFITS

A. Not Used.

46. USE AND OCCUPANCY PRIOR TO ACCEPTANCE

A. Contractor agrees to use and occupancy of portion or unit of the Work before formal acceptance by Department, provided Department:
   1. Secures written consent of Contractor; except when in opinion of Public Works Project Manager, Contractor is chargeable with unwarranted delay in final cleanup of punch list items or other Contract requirements.
   2. Secures endorsement from insurance carrier and consent of Surety permitting occupancy of building or use of the Work during remaining period of construction, or, secures consent of Surety.
   3. Assumes all costs and maintenance of heat, electricity and water.
   4. Accepts all work completed within that portion or unit of the Work to be occupied, at time of occupancy.

47. MINIMUM WAGES

A. Not Used.

48. CLAIMS

A. No claim may be made until Department's Assistant Public Works Director has reviewed Architect / Engineer's decision as provided for in Article 35 of General Conditions of Contract. If any claim remains unresolved after such review by Department's Assistant Public Works Director the claim may be filed under Wisconsin Statute 893.80. Work shall progress during period of any dispute or claim. Unless specifically agreed between parties, venue will be in Dane County, Wisconsin.

49. ANTITRUST AGREEMENT

A. Contractor and County recognize that in actual economic practice, overcharges resulting from antitrust violations are in fact usually borne by County. Therefore, Contractor hereby assigns to County any and all claims for such overcharges as to goods and materials purchased in connection with this Contract, except as to overcharges which result from antitrust violations commencing after price is established under this Contract and any change order thereto.

50. INSURANCE

A. Contractor Carried Insurance:
   1. Contractor shall not commence work under this Contract until Contractor has obtained all insurance required under this Article and has provided evidence of such insurance to Risk Manager, 425 City-County Building, 210 Martin Luther King Jr. Blvd., Madison, WI 53703. Contractor shall not allow any subcontractor to commence work until insurance required of subcontractor has been so obtained and approved. Company providing insurance must be licensed to do business in Wisconsin.
   2. Worker's Compensation Insurance:
      a) Contractor shall procure and shall maintain during life of this Contract, Worker's Compensation Insurance as required by statute for all of Contractor's employees engaged in work at site of project under this Contract and, in case of any such work sublet, Contractor shall require subcontractor similarly to provide Worker's Compensation Insurance for all of latter's employees to be engaged in such work unless such employees are covered by protection afforded by Contractor's Worker's Compensation Insurance.
      b) If any claim of employees engaged in hazardous work on project under this Contract is not protected under Worker's Compensation Statute, Contractor shall provide and shall cause each subcontractor to provide adequate Employer's Liability Insurance for protection of such of Contractor's employees as are not otherwise protected.
   3. Contractor's Public Liability and Property Damage Insurance:
      a) Contractor shall procure and maintain during life of this Contract, Contractor's Public Liability Insurance and Contractor's Property Damage Insurance in amount not less than $1,000,000 bodily injury, including accidental death, to any one person, and subject to same limit for each person, in amount not less than $1,000,000 on account of one accident, and Contractor's Property Damage Insurance in amount not less then $1,000,000 or combined single limit of at least $1,000,000 with excess coverage over and above general liability in amount not less than $5,000,000. Contractor shall add "Dane County" as additional insured for each project.

b) Contractor's Public Liability and Property Damage Insurance shall include Products, Completed Operation, and Contractual Liability under Insurance Contract. "Contractor shall in all instances save, defend, indemnify and hold harmless County and Architect / Engineer against all claims, demands, liabilities, damages or any other costs which may accrue in prosecution of the Work and that Contractor will save, defend, indemnify and hold harmless County and Architect / Engineer from all damages caused by or as result of Contractor's operations" and each shall be listed as additional insured on Contractor's and sub-contractors' insurance policies.

c) Obligations of Contractor under Article 50.A.2.b) shall not extend to liability of Architect / Engineer, agents or employees thereof, arising out of:
   1) Preparation or approval of maps, drawings, opinions, reports, surveys, change orders, designs or specifications; or
   2) Giving of or failure to give directions or instructions by Architect / Engineer, agents or employees thereof provided such giving or failure to give is primary cause of injury or damage.

d) Contractor shall procure and shall maintain during life of this Contract, Comprehensive Automobile Liability Insurance covering owned, non-owned and hired automobiles for limits of not less than $1,000,000 each accident single limit, bodily injury and property damage combined with excess coverage over and above general liability in amount not less than $5,000,000.

e) Contractor shall either:
   1) Require each subcontractor to procure and to maintain during life of subcontract, subcontractor's Public Liability Property Damage Insurance, and Comprehensive Automobile Liability Insurance of type and in same amount specified in preceding paragraphs; or
   2) Insure activities of subcontractors in Contractor's own policy.

4. Scope of Insurance and Special Hazards: Insurance required under Article 50.A.2 & 50.A.3. hereof shall provide adequate protection for Contractor and subcontractors, respectively, against damage claims which may arise from operations under this Contract, whether such operation be by insured or by anyone directly or indirectly employed by insured and also against any of special hazards which may be encountered in performance of this Contract as enumerated in Supplementary Conditions.
5. Proof of Carriage of Insurance: Contractor shall furnish Risk Manager with certificates showing type, amount, class of operations covered, effective dates, dates of expiration of policies and "Dane County" listed as additional insured. Such certificates shall also contain (substantially) following statement: "Insurance covered by this certificate will not be canceled or materially altered, except after ten (10) business days written notice has been received by Risk Manager."

B. Builder's Risk:
1. County shall provide Builder's Risk insurance coverage for its insurable interests in construction or renovation projects with completed value of $1,000,000 or less. Therefore, if project completed value is more than $1,000,000, Contractor shall obtain and maintain in force, at its own expense, Builder's Risk Insurance on all risks for amount equal to full completed value of covered structure or replacement value of alterations or additions. Any deductible shall not exceed $25,000 for each loss. Policy shall include occupancy clause and list Dane County as loss payee.

C. Indemnification / Hold Harmless:
1. Contractor shall indemnify, hold harmless and defend Dane County, its boards, commissions, agencies, officers, employees and representatives from and against all claims, damages, losses and expenses including attorneys' fees arising out of or resulting from performance of the Work, provided that any such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of

tangible property (other than the Work itself) including loss of use resulting therefrom, and is caused in whole or in part by any act or omission of Contractor, any subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by part indemnified hereunder.

2. In any and all claims against Dane County, its boards, commissions, agencies, officers, employees and representatives or by any employee of Contractor, any subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, indemnification obligation under this Contract shall not be limited in any way by any limitation on amount or type of damages, compensation or benefits payable by or for Contractor or any subcontractor under worker's compensation acts, disability benefits or other employee benefit acts.
3. Obligations of Contractor under this Contract shall not extend to liability of Architect / Engineer, its agents or employees arising out of:
   a) Preparation or approval of maps, drawings, opinion, reports, surveys, change orders, designs or specifications; or
   b) Giving of or failure to give directions or instruction by Architect / Engineer, its agents or employees provided such giving or failure to give is primary cause of injury or damage.
4. Dane County shall not be liable to Contractor for damages or delays resulting from work by third parties or by injunctions or other restraining orders obtained by third parties.

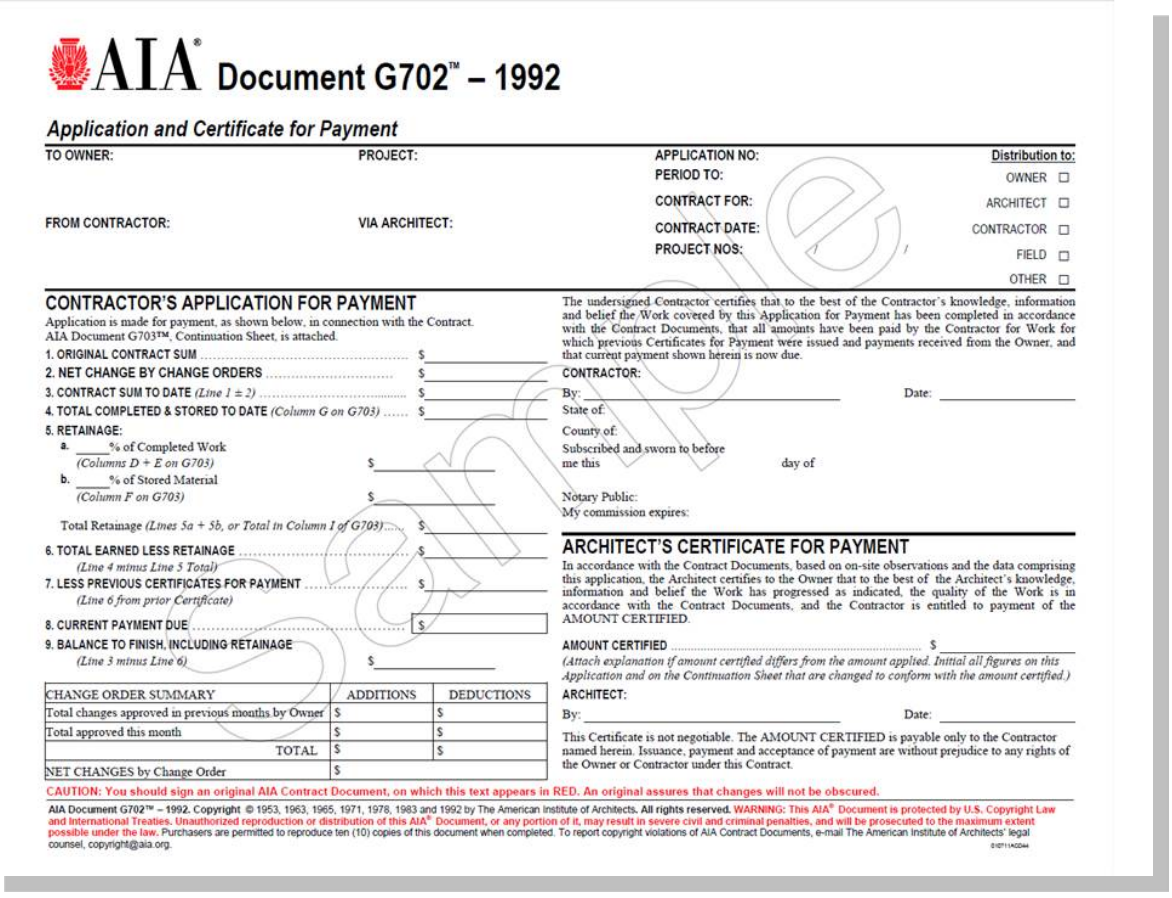
51. WISCONSIN LAW CONTROLLING

A. It is expressly understood and agreed to by parties hereto that in event of any disagreement or controversy between parties, Wisconsin law shall be controlling.

SUPPLEMENTARY CONDITIONS

1. APPLICATION & CERTIFICATE FOR PAYMENT

A. Every contractor engaged in performance of any contract for Department of Public Works, Highway & Transportation shall submit partial and final Application & Certificate for Payment for work under said contract. Form shall provide similar information as shown on AIA G702™ and G703™ forms (samples shown below). Forms shall be submitted to project Architect / Engineer for approval.



AIA® Document G702™ – 1992

Application and Certificate for Payment

TO OWNER: PROJECT: APPLICATION NO: Distribution to:
PERIOD TO: OWNER ☐
CONTRACT FOR: ARCHITECT ☐
FROM CONTRACTOR: VIA ARCHITECT: CONTRACT DATE: CONTRACTOR ☐
PROJECT NOS: / / FIELD ☐
OTHER ☐

CONTRACTOR'S APPLICATION FOR PAYMENT

Application is made for payment, as shown below, in connection with the Contract.
AIA Document G703™, Continuation Sheet, is attached.

1. ORIGINAL CONTRACT SUM ..... $
2. NET CHANGE BY CHANGE ORDERS ..... $
3. CONTRACT SUM TO DATE *(Line 1 ± 2)* ..... $
4. TOTAL COMPLETED & STORED TO DATE *(Column G on G703)* ..... $
5. RETAINAGE:
   a. ____% of Completed Work *(Columns D + E on G703)* $
   b. ____% of Stored Material *(Column F on G703)* $
   Total Retainage *(Lines 5a + 5b, or Total in Column I of G703)* ..... $
6. TOTAL EARNED LESS RETAINAGE ..... $ *(Line 4 minus Line 5 Total)*
7. LESS PREVIOUS CERTIFICATES FOR PAYMENT ..... $ *(Line 6 from prior Certificate)*
8. CURRENT PAYMENT DUE ..... $
9. BALANCE TO FINISH, INCLUDING RETAINAGE *(Line 3 minus Line 6)* $

CHANGE ORDER SUMMARY	ADDITIONS	DEDUCTIONS
Total changes approved in previous months by Owner	$	$
Total approved this month	$	$
TOTAL	$	$
NET CHANGES by Change Order	$	

The undersigned Contractor certifies that to the best of the Contractor's knowledge, information and belief the Work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid by the Contractor for Work for which previous Certificates for Payment were issued and payments received from the Owner, and that current payment shown herein is now due.

CONTRACTOR:
By: Date:
State of:
County of:
Subscribed and sworn to before me this day of
Notary Public:
My commission expires:

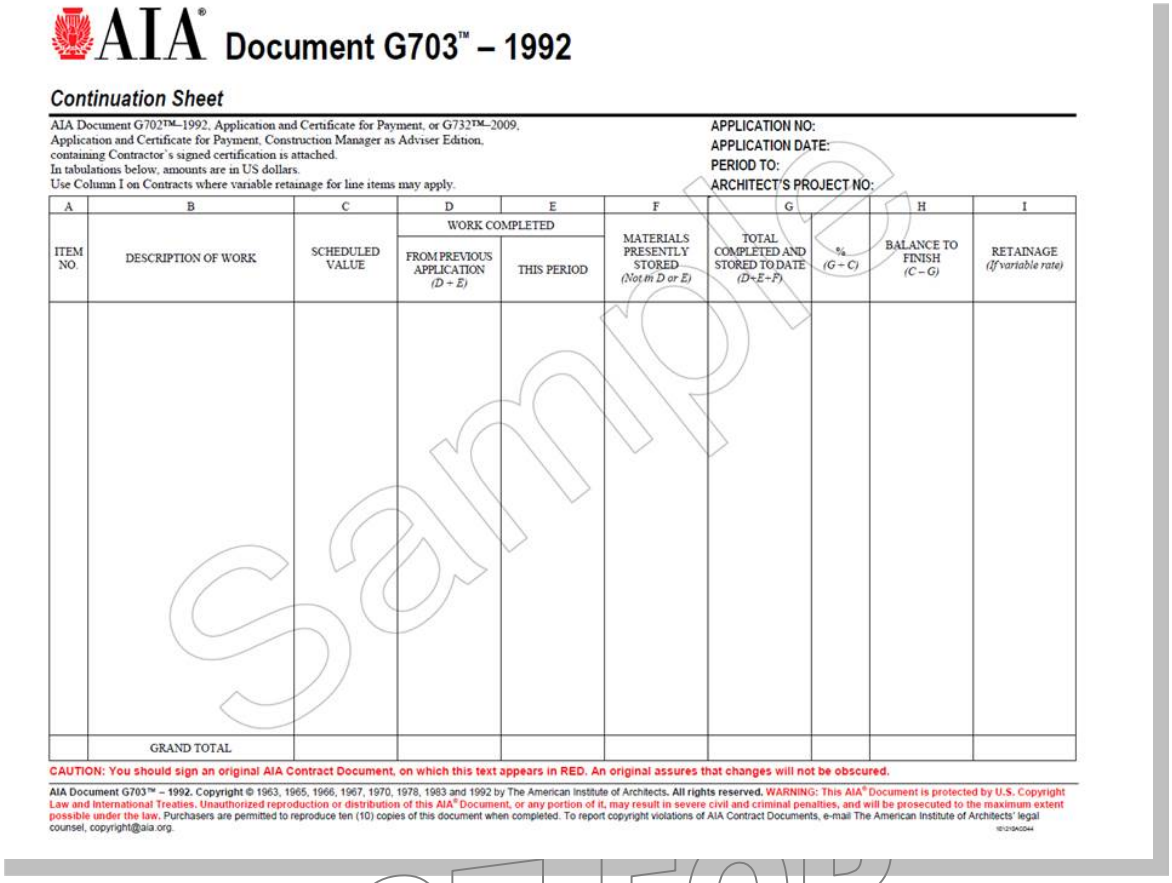
ARCHITECT'S CERTIFICATE FOR PAYMENT

In accordance with the Contract Documents, based on on-site observations and the data comprising this application, the Architect certifies to the Owner that to the best of the Architect's knowledge, information and belief the Work has progressed as indicated, the quality of the Work is in accordance with the Contract Documents, and the Contractor is entitled to payment of the AMOUNT CERTIFIED.

AMOUNT CERTIFIED ..... $
(Attach explanation if amount certified differs from the amount applied. Initial all figures on this Application and on the Continuation Sheet that are changed to conform with the amount certified.)
ARCHITECT:
By: Date:

This Certificate is not negotiable. The AMOUNT CERTIFIED is payable only to the Contractor named herein. Issuance, payment and acceptance of payment are without prejudice to any rights of the Owner or Contractor under this Contract.

CAUTION: You should sign an original AIA Contract Document, on which this text appears in RED. An original assures that changes will not be obscured.



AIA® Document G703™ – 1992

Continuation Sheet

AIA Document G702™–1992, Application and Certificate for Payment, or G732™–2009, Application and Certificate for Payment, Construction Manager as Adviser Edition, containing Contractor's signed certification is attached.
In tabulations below, amounts are in US dollars.
Use Column I on Contracts where variable retainage for line items may apply.

APPLICATION NO:
APPLICATION DATE:
PERIOD TO:
ARCHITECT'S PROJECT NO:

A	B	C	D	E	F	G		H	I
ITEM NO.	DESCRIPTION OF WORK	SCHEDULED VALUE	WORK COMPLETED: FROM PREVIOUS APPLICATION (D + E)	WORK COMPLETED: THIS PERIOD	MATERIALS PRESENTLY STORED (Not in D or E)	TOTAL COMPLETED AND STORED TO DATE (D+E+F)	% (G ÷ C)	BALANCE TO FINISH (C – G)	RETAINAGE (If variable rate)
	GRAND TOTAL								

CAUTION: You should sign an original AIA Contract Document, on which this text appears in RED. An original assures that changes will not be obscured.

AIA Document G703™ – 1992. Copyright © 1963, 1965, 1966, 1967, 1970, 1978, 1983 and 1992 by The American Institute of Architects. All rights reserved. WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. Purchasers are permitted to reproduce ten (10) copies of this document when completed. To report copyright violations of AIA Contract Documents, e-mail The American Institute of Architects' legal counsel, copyright@aia.org.

2. CONTRACTOR WAGE AFFIDAVIT

A. Every contractor engaged in performance of any contract for Department of Public Works, Highway & Transportation shall submit to this Department, as requested and with final application for payment for work under said contract, affidavit in form as hereinafter set forth in this section. Affidavit affirms that all persons employed by contractor or by any of contractor's subcontractors on such contract have been paid no less than minimum wages established under Dane County Ordinances, Chapter 40, Subchapter II (Minimum Wage Ordinance) and in effect at date of execution of contract, that full payment of wages earned has been made, and that no rebates either directly or indirectly have been made. Form of such affidavit is included in this section.

B. Form should be included with a copy of the final contract invoice forwarded to your contract representative at Dane County.

DANE COUNTY, WISCONSIN

CONTRACTOR WAGE AFFIDAVIT

COMPANY NAME: _____

ADDRESS: _____

_____

CONTRACT NO.: _____ DIVISION(S) OF WORK: _____

AFFIDAVIT

STATE OF WISCONSIN)
) ss.
DANE COUNTY)

I, _____, being
name and title of person signing affidavit
first duly sworn at _____,
city & state of company incorporation
on oath, depose and say that with respect to the payment of the persons employed by the
_____, subcontractors on the _____
contractor company name division(s) of work
_____, at the _____
building or site of project
that during the period commencing _____, and ending _____
date date
all persons employed on said project have been paid the full wages earned, that no rebates have been or will be made either directly or indirectly by said contractor or subcontractor from the full weekly wages earned by any person, and that no deductions have been made either directly or indirectly from the full weekly wages earned by any person, other than authorized legal deductions (including taxes such as Federal Income Withholding and Social Security, State and
_____,
state any other legal deductions such as union dues, unemployment insurance, 401k contributions, etc., or fill in "N/A"
and that there is full compliance with the provisions and intent of the requirements of Dane County Ordinances, Chapter 40, Subchapter II (Minimum Wage Ordinance). This affidavit is made to induce Dane County to approve the application for payment to which this affidavit is attached.

_____
Contractor Company Name

_____ _____
Signature Title

Sworn to before me this _____ day of _____, 20___.

_____ My Commission expires _____
Notary Public Date

3. INSURANCE

A. **Contractor Carried Insurance.** In order to protect itself and the County, Contractor shall not commence work under this Contract until obtaining all required insurance and the County has approved such insurance. Contractor shall not allow any subcontractor to commence work on subcontract until insurance required of subcontractor has been so obtained and approved.

1. Pollution Insurance Policy
   Contractor shall procure and maintain during life of this Contract, Pollution Insurance Policy in amount of at least $1,000,000 per occurrence, $5,000,000 aggregate.

SECTION 01 00 00

BASIC REQUIREMENTS

PART 1 GENERAL

1.1 SECTION SUMMARY

A. Section Includes:

1. Section Summary
2. Summary of the Work
3. Contractor Use of Premises
4. Applications for Payment
5. Change Procedures
6. Alternates
7. Coordination
8. Cutting and Patching
9. Conferences
10. Progress Meetings
11. Submittal Procedures
12. Proposed Products List
13. Shop Drawings
14. Product Data
15. Samples
16. Manufacturers' Instructions
17. Manufacturers' Certificates
18. Quality Assurance / Quality Control of Installation
19. References
20. Interior Enclosures
21. Protection of Installed Work
22. Parking
23. Staging Areas
24. Occupancy During Construction and Conduct of Work
25. Protection
26. Progress Cleaning
27. Products
28. Transportation, Handling, Storage and Protection
29. Product Options
30. Substitutions
31. Starting Systems
32. Demonstration and Instructions
33. Contract Closeout Procedures
34. Final Cleaning
35. Adjusting
36. Operation and Maintenance Data
37. Spare Parts and Maintenance Materials
38. As-Built and Record Drawings and Specifications

1.2 SUMMARY OF THE WORK

A. Project Description: The project consists of the removal and replacement of HVAC equipment.

B. Work by Owner: Not applicable.

C. Permits: Prior to commencement of the Work, Contractor to secure any and all necessary permits for completion of the Work and facility occupancy.

1.3 CONTRACTOR USE OF PREMISES

A. Limit use of premises to allow work by Contractors or Subcontractors and access by Owner.

B. Coordinate utility outages and shutdowns with Owner.

1.4 APPLICATIONS FOR PAYMENT

A. Submit one (1) original copies with “wet” signatures of each application on AIA G702™ and G703™ forms or approved contractors invoice form.

B. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.

C. Payment Period: Monthly.

D. Submit Applications for Payment to Public Works Project Manager for approval & processing for payment.

1.5 CHANGE PROCEDURES

A. Change Order Forms: Dane County Contract Change Order, Form 014-32-20 (latest issue).

B. Contractor's costs for Products, delivery, installation, labor, insurance, payroll, taxes, bonding, equipment rental, overhead and profit will be included in Change Orders authorizing expenditure of funds from contingency allowance.

1.6 ALTERNATES

A. Alternates quoted on Bid Form shall be reviewed and accepted or rejected at Owner's option.

B. Coordinate related work and modify surrounding work as required.

C. Schedule of Alternates:
1. Alternate Bid 1 - Price for providing ECM Motor.

2. Alternate Bid 2 - Price to remove existing pump disconnects, prepare existing inline pump shaft for grounding ring installation, provide differential pressure sensor, new VFD for existing pump, install shaft grounding rings on existing Bell & Gossett 4x9.5 (8.25BF) inline pumps, provide new Distech controls to reside in existing JCI control panel, new Distech controls to reside in Niagara/Distech control panel, 2-way solonoid valve (Base Bid is for no solonoid valve.

3. Alternate Bid 3 - Price to provide 1" bypass between heat pump supply and return piping, new heat pump water return temperature sensor/well, new Distech controls to reside in Niagara/Distech control panel, Variable Frequency Drive

1.7 COORDINATION

A. Coordinate scheduling, submittals, and work of various sections of Specifications to assure efficient and orderly sequence of installation of interdependent construction elements.

B. Verify utility requirement characteristics of operating equipment are compatible with building utilities.

C. Coordinate space requirements and installation of mechanical and electrical work that are indicated diagrammatically on Drawings.

D. Contractor shall provide Public Works Project Engineer with work plan that ensures the Work will be completed within required time of completion.

E. Public Works Project Manager may choose to photograph or videotape site or workers as the Work progresses.

1.8 CUTTING AND PATCHING

A. Employ skilled and experienced installer to perform cutting and patching new work; restore work with new Products.

B. Submit written request in advance of cutting or altering structural or building enclosure elements.

C. Fit work tight to adjacent elements. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.

D. Refinish surfaces to match adjacent finishes.

1.9 CONFERENCES

A. Project shall have pre-bid conference; see Instructions to Bidders.

B. Owner will schedule preconstruction conference after Award of Contract for all affected parties.

C. Contractor shall submit Construction Schedule at pre-construction meeting.

D. When required in individual Specification section, convene pre-installation conference at project site prior to commencing work of Section.

1.10 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the Work at minimum of one (1) per week, with Public Works Project Manager.

B. Preside at meetings, record minutes, and distribute copies within two (2) business days to those affected by decisions made.

C. Attendance at progress meetings by General Contractor, subcontractors, or their authorized representative, is mandatory.

D. Contractors shall give verbal reports of progress on the Work, discuss schedule for upcoming period and present all conflicts, discrepancies or other difficulties for resolution.

E. Day & time of progress meetings to be determined at pre-construction meeting.

1.11 SUBMITTAL PROCEDURES

A. Submittal form to identify Project, Contractor, Subcontractor or supplier; and pertinent Construction Documents references.

B. Apply Contractor's stamp, signed or initialed, certifying that review, verification of Products required, field dimensions, adjacent construction work, and coordination of information is in accordance with requirements of the Work and Construction Documents.

C. Identify variations from Construction Documents and Product or system limitations that may be detrimental to successful performance of completing the Work.

D. Revise and resubmit submittals as required; identify all changes made since previous submittal.

1.12 PROPOSED PRODUCTS LIST

A. Within fifteen (15) business days after date of Award of Contract, submit complete list of major Products proposed for use, with name of manufacturer, trade name, and model number of each Product.

1.13 SHOP DRAWINGS

A. Submit number of copies that Contractor requires, plus three (3) copies that shall be retained by Public Works Project Manager.

1.14 PRODUCT DATA

A. Submit number of copies that Contractor requires, plus two (2) copies that shall be retained by Public Works Project Manager.

B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturer's standard data to provide information unique to this Project.

1.15 SAMPLES

A. Submit samples to illustrate functional and aesthetic characteristics of Product.

B. Submit samples of finishes from full range of manufacturers' standard colors, textures, and patterns for Public Works Project Manager's selection.

1.16 MANUFACTURERS' INSTRUCTIONS

A. When specified in individual Specification sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, in quantities specified for Product Data.

1.17 MANUFACTURERS' CERTIFICATES

A. When specified in individual Specification sections, submit manufacturers' certificate to Public Works Project Manager for review, in quantities specified for Product Data.

B. Indicate material or Product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

1.18 QUALITY ASSURANCE / QUALITY CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, Products, services, site conditions, and workmanship, to produce work of specified quality.

B. Comply fully with manufacturers' instructions.

C. Comply with specified standards as minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

1.19 REFERENCES

A. Conform to reference standard by date of issue current as of date for receiving bids.

B. Should specified reference standard conflict with Construction Documents, request clarification from Public Works Project Manager before proceeding.

1.20 INTERIOR ENCLOSURES

A. Provide temporary partitions as required to separate work areas from Owner occupied areas, to prevent distribution of dust and moisture into Owner occupied areas, and to prevent damage to existing materials and equipment.

1.21 PROTECTION OF INSTALLED WORK

A. Protect installed work and provide special protection where specified in individual Specification sections.

1.22 PARKING

A. Arrange for temporary parking areas to accommodate construction personnel. Parking shall be available at the Work site.

B. All contractors and their employees shall cooperate with General Contractor and others in parking of vehicles to avoid interference with normal operations and construction activities.

C. Do not obstruct existing service drives and parking lots with equipment, materials and / or vehicles. Keep accessible for Owner's use at all times.

1.23 STAGING AREAS

A. Coordinate staging areas with Public Works Project Manager prior to starting the Work.

B. On-site space for use as staging areas and storage of materials is limited and will be apportioned among various Contractors as their needs dictate with due regard for storage requirements of each Contractor. Each Contractor shall be responsible for safety of equipment and materials that are stored on site.

1.24 OCCUPANCY DURING CONSTRUCTION AND CONDUCT OF WORK

A. Smoking is prohibited on Dane County property.

B. Owner reserves right at any time to dismiss from premises any Contractor or construction personnel that do not uphold requirements of this Section.

C. Owner shall not be held liable for any lost time, wages, or impacts to construction schedule by any Contractor or construction personnel dismissed for failure to uphold requirements of this Section.

D. Areas of existing facility will be occupied during period when the Work is in progress. Work may be done during normal business hours (7:00 am to 4:30 pm), but confer with Owner, schedule work and store materials so as to interfere as little as possible with

normal use of premises. Work performed on Saturday shall be by permission of Owner. Notify Owner when coring or similar noise making work is to be done and obtain Owner's written approval of schedule. If schedule is not convenient for Owner, reschedule and resubmit new times for Owner approval. Work shall be done and temporary facilities furnished so as not to interfere with access to any occupied area and so as to cause least possible interference with normal operation of facility or any essential service thereof.

E. Contractor shall, at all times, provide approved, safe walkways and facility entrances for use by Owner, employees and public.

F. Contractor shall provide adequate protection for all parts of facility, its contents and occupants wherever the Work under this Contract is to be performed.

G. Each Contractor shall arrange with Owner to make necessary alterations, do new work, make connections to all utilities, etc., at such times as will not cause interruption of utility services to facility. Contractor doing this work shall protect, cap, cut off and / or replace and relocate existing pipes, electrical work and other active utilities encountered which may interfere with new construction work.

H. New work in extension of existing work shall correspond in all respects with that to which it connects or similar existing work unless otherwise indicated or specified.
   1. Existing work shall be cut, altered, removed or replaced as necessary for performance of Contract obligations.
   2. Work remaining in place, damaged or defaced by reason of work done under this Contract shall be restored equal to its condition at time of Award of Contract.
   3. If removal of work exposes discolored or unfinished surfaces or work out of alignment, such surfaces shall be refinished or materials replaced as necessary to make continuous work uniform and harmonious.

I. Contractor is not responsible for providing & maintaining temporary toilet facilities.

1.25 PROTECTION

A. Contractor shall protect from damage / injury all trees, shrubs, hedges, plantings, grass, mechanical, electrical & plumbing equipment, walks and driveways and pay for any damage to same resulting from insufficient or improper protection.

B. Contractor shall provide and maintain barricades & signage to prohibit public access to construction site.

1.26 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in clean and orderly condition.

1.27 PRODUCTS

A. Products: Means new material, machinery, components, equipment, fixtures, and systems forming the Work, but does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components specifically identified for reuse.

B. Do not use materials and equipment removed from existing premises, except as specifically identified or allowed by Construction Documents.

1.28 TRANSPORTATION, HANDLING, STORAGE AND PROTECTION

A. Transport, handle, store and protect Products in accordance with manufacturer's instructions.

1.29 PRODUCT OPTIONS

A. Where definite material is specified, it is not intentional to discriminate against "equal" product made by another manufacturer. Intention is to set definite standard of material quality. Should bidder choose to bid materials other than those specified, bidder shall submit said materials specifications to Public Works Project Manager for approval at least seven (7) business days prior to Bid Due Date.

B. Products and materials that are not specified, but have been approved for use by Public Works Project Manager shall be identified in addenda to all bidding contractors.

C. Requests for material or product substitutions submitted after Bid Due Date may be considered. Owner reserves right to approve or reject substitutions based on Specification requirements and intended use.

1.30 SUBSTITUTIONS

A. Public Works Project Manager shall consider requests for Substitutions only within fifteen (15) calendar days after date of Public Works Construction Contract.

B. Document each request with complete data substantiating compliance of proposed Substitution with Construction Documents.

C. Submit three (3) copies of requests for Substitution for consideration. Limit each request to one (1) proposed Substitution.

D. Substitutions shall not change contract price established at Bid Due Date.

1.31 STARTING SYSTEMS

A. Provide written notification prior to start-up of each equipment item or system.

B. Ensure that each piece of equipment or system is ready for operation.

C. Execute start-up under supervision of responsible persons in accordance with manufacturers' instructions.

D. Submit written report that equipment or system has been properly installed and is functioning correctly.

1.32 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of Products to Owner's personnel prior to date of final inspection.

B. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed-upon times, at designated location.

C. Owner may choose to photograph or videotape demonstration session; demonstration and demonstrator shall be to level of satisfaction of Owner.

1.33 CONTRACT CLOSEOUT PROCEDURES

A. Submit written certification that Construction Documents have been reviewed, the Work has been inspected, and the Work is complete in accordance with Construction Documents and ready for Public Works Project Manager's inspection.

B. Submit final Application for Payment identifying total adjusted Contract Sum / Price, previous payments, and amount remaining due.

1.34 FINAL CLEANING

A. Execute final cleaning prior to final inspection.

B. Clean interior and exterior surfaces exposed to view.

C. Remove waste and surplus materials, rubbish, and construction facilities from site.

1.35 ADJUSTING

A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

1.36 OPERATION AND MAINTENANCE MANUAL

A. Provide two (2) bound, hard-copy operation and maintenance manuals that include all systems, materials, products, equipment, mechanical and electrical equipment and systems supplied and installed in the Work. Provide electronic version of operation and maintenance manual also.

1.37 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide Products, spare parts, maintenance and extra materials in quantities specified in individual Specification Sections.

B. Deliver to the Work site and place in location as directed.

1.38 AS-BUILT AND RECORD DRAWINGS AND SPECIFICATIONS

A. Contractor-produced Drawings and Specifications shall remain property of Contractor whether Project for which they are made is executed or not. Contractor shall furnish Architect / Engineer with original marked up redlines of Construction Documents' drawings and specifications that shall include all Addendums, Change Orders, Construction Bulletins, on-site changes, field corrections, etc. These are project As-Built Drawings & Specifications.

B. Architect / Engineer shall update original Construction Documents to include all Addendums & any other changes including those provided by Contractor in As-Built Drawings & Specifications. These updates are project Record Drawings & Specifications.

C. Architect / Engineer shall furnish Public Works Project Manager with Record Drawings as detailed in Professional Services Agreement.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01 74 19

CONSTRUCTION WASTE MANAGEMENT, DISPOSAL & RECYCLING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Summary
2. Waste Management Goals
3. Construction and / or Demolition Waste Management
4. Waste Management Plan
5. Reuse
6. Recycling
7. Materials Sorting and Storage On Site
8. Lists of Recycling Facilities Processors and Haulers
9. Waste Management Plan Form

B. Related Sections:
1. Section 01 00 00 - Basic Requirements

1.2 WASTE MANAGEMENT GOALS

A. Dane County requires that as many waste materials as possible produced as result of this project be salvaged, reused or recycled in order to minimize impact of construction waste on landfills and to minimize expenditure of energy and cost in fabricating new materials. Additional information may be found in Dane County Green Building Policy, Resolution 299, 1999-2000.

1.3 CONSTRUCTION AND / OR DEMOLITION WASTE MANAGEMENT

A. All construction and demolition waste suitable for recycling may go to Dane County Construction & Demolition Recycling Facility located at 7102 US Hwy 12, Madison, located across from Yahara Hills Golf Course. This facility can receive mixed loads of construction and demolition waste. For complete list of acceptable materials see www.countyofdane.com/pwht/recycle/CD_Recycle.aspx.

B. Dane County Landfill, also at 7102 US Hwy 12, Madison, must receive all other waste from this project. www.countyofdane.com/pwht/recycle/landfill.aspx.

1.4 WASTE MANAGEMENT PLAN

A. Contractor shall develop Waste Management Plan (WMP) for this project. Dane County's Special Projects & Materials Manager may be contacted with questions. Outlined in RECYCLING section of this specification are examples of materials that can be recycled or reused as well as recommendations for waste sorting methods.

B. Contractor shall complete WMP and include cost of recycling / reuse in Bid. WMP will be submitted to Public Works Project Manager within fifteen (15) business days of Bid Due date. Copy of blank WMP form is in this Section. Submittal shall include cover letter and WMP form with:
   1. Information on:
      a. Types of waste materials produced as result of work performed on site;
      b. Estimated quantities of waste produced;
      c. Identification of materials with potential to be recycled or reused;
      d. How materials will be recycled or reused;
      e. On-site storage and separation requirements (on site containers);
      f. Transportation methods; and
      g. Destinations.

1.5 REUSE

A. Contractors and subcontractors are encouraged to reuse as many waste materials as possible. Salvage should be investigated for materials not reusable on site.

1.6 RECYCLING

A. These materials may be recycled at Dane County Construction & Demolition Recycling Facility:
   1. Wood.
   2. Wood Pallets.
   3. PVC Plastic (pipe, siding, etc.).
   4. Asphalt & Concrete.
   5. Bricks & Masonry.
   6. Vinyl Siding.
   7. Cardboard.
   8. Metal.
   9. Unpainted Gypsum Drywall.
   10. Shingles.

B. These materials can be recycled elsewhere in Dane County area:
   1. Fluorescent Lamps.
   2. Foam Insulation & Packaging (extruded and expanded).
   3. Carpet Padding.
   4. Barrels & Drums.

C. All materials must be recycled at WDNR permitted waste processing facilities that adhere to all State Statutes.

1.7 MATERIALS SORTING AND STORAGE ON SITE

A. Contractor shall provide separate containers for recyclable materials. Number of containers will be dependent upon project and site conditions.

B. Contractor shall provide on-site locations for subcontractors supplied recycling containers to help facilitate recycling.

C. Mixed loads of recycled materials are allowed only per instructions at www.countyofdane.com/pwht/recycle/CD_Recycle.aspx.

1.8 LISTS OF RECYCLING FACILITIES PROCESSORS AND HAULERS

A. Refer to www.countyofdane.com/pwht/recycle/CD_Recycle.aspx for information on Dane County Construction & Demolition Recycling Facility.

B. Web site www.countyofdane.com/pwht/recycle/categories.aspx lists current information for Dane County Recycling Markets. Contractors can also contact Allison Hackner at 608/266-4990, or local city, village, town recycling staff listed at site www.countyofdane.com/pwht/recycle/contacts.aspx. Statewide listings of recycling / reuse markets are available from UW Extension at https://www.uwgb.edu/shwec/.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

WASTE MANAGEMENT PLAN FORM

Contractor Name: _____

Address: _____

_____

Phone No.: _____ Recycling Coordinator: _____

MATERIAL	ESTIMATED QUANTITY	DISPOSAL METHOD (CHECK ONE)	RECYCLING / REUSE COMPANY OR DISPOSAL SITE
Salvaged & reused building materials	_____ cu. yds. _____ tons	_____ Recycled _____ Reused _____ Landfilled _____ Other	Name:_____
Wood	_____ cu. yds. _____ tons	_____ Recycled _____ Reused _____ Landfilled _____ Other	Name:_____
Wood Pallets	_____ units	_____ Recycled _____ Reused _____ Landfilled _____ Other	Name:_____
PVC Plastic	_____ cu. ft. _____ lbs.	_____ Recycled _____ Reused _____ Landfilled _____ Other	Name:_____
Asphalt & Concrete	_____ cu. ft. _____ lbs.	_____ Recycled _____ Reused _____ Landfilled _____ Other	Name:_____
Bricks & Masonry	_____ cu. ft. _____ lbs.	_____ Recycled _____ Reused _____ Landfilled _____ Other	Name:_____
Vinyl Siding	_____ cu. ft. _____ lbs.	_____ Recycled _____ Reused _____ Landfilled _____ Other	Name:_____
Cardboard	_____ cu. ft. _____ lbs.	_____ Recycled _____ Reused _____ Landfilled _____ Other	Name:_____
Metals	_____ cu. yds. _____ tons	_____ Recycled _____ Reused _____ Landfilled _____ Other	Name:_____
Unpainted Gypsum / Drywall	_____ cu. yds. _____ tons	_____ Recycled _____ Reused _____ Landfilled _____ Other	Name:_____
Shingles	_____ cu. yds. _____ tons	_____ Recycled _____ Reused _____ Landfilled _____ Other	Name:_____
Fluorescent Lamps	_____ cu. ft. _____ lbs.	_____ Recycled _____ Reused _____ Landfilled _____ Other	Name:_____
Foam Insulation	_____ cu. ft. _____ lbs.	_____ Recycled _____ Reused _____ Landfilled _____ Other	Name:_____
Carpet Padding	_____ cu. ft. _____ lbs.	_____ Recycled _____ Reused _____ Landfilled _____ Other	Name:_____
Barrels & Drums	_____ units	_____ Recycled _____ Reused _____ Landfilled _____ Other	Name:_____

WASTE MANAGEMENT PLAN FORM

Glass	_____ cu. yds. _____ tons	_____ Recycled _____ Reused _____ Landfilled _____ Other	Name:_____
Other	_____	_____ Recycled _____ Reused _____ Landfilled _____ Other	Name:_____
Other	_____	_____ Recycled _____ Reused _____ Landfilled _____ Other	Name:_____
Other	_____	_____ Recycled _____ Reused _____ Landfilled _____ Other	Name:_____
Other	_____	_____ Recycled _____ Reused _____ Landfilled _____ Other	Name:_____
Other	_____	_____ Recycled _____ Reused _____ Landfilled _____ Other	Name:_____

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

PART 1 GENERAL

1.1 SCOPE

A. This section includes information common to two or more technical specification sections or items that are of a general nature, not conveniently fitting into other technical sections. Included are the following topics:
   1. Part 1 – General
      a. Scope
      b. Related Work
      c. Reference
      d. Reference Standards
      e. Quality Assurance
      f. Continuity of Existing Services
      g. Protection of Finished Surfaces
      h. Sleeves and Openings
      i. Sealing and Fire Stopping
      j. Submittals
      k. Off Site Storage
      l. Certificates and Inspections
      m. Operating and Maintenance Data
      n. Training of Owner Personnel
      o. Record Drawings
      p. Cleaning
      q. Warranty
   2. Part 2 – Products
      a. Access Panels and Doors
      b. Identification
      c. Sealing
   3. Part 3 – Execution
      a. Demolition
      b. Cutting and Patching
      c. Building Access
      d. Equipment Access
      e. Coordination
      f. Identification
      g. Lubrication
      h. Sleeves and Openings
      i. Sealing

1.2 RELATED WORK

A. Section 23 05 13 - Common Motor Requirements for HVAC.

B. Section 23 33 00 - Air Duct Accessories.

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

A. Abbreviations of standards organizations referenced in other sections are as follows:

1.	AABC	Associated Air Balance Council
2.	ADC	Air Diffusion Council
3.	AMCA	Air Movement and Control Association
4.	ANSI	American National Standards Institute
5.	ARI	Air-Conditioning and Refrigeration Institute
6.	ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
7.	ASME	American Society of Mechanical Engineers
8.	ASTM	American Society for Testing and Materials
9.	AWWA	American Water Works Association
10.	AWS	American Welding Society
11.	CGA	Compressed Gas Association
12.	CTI	Cooling Tower Institute
13.	EPA	Environmental Protection Agency
14.	IEEE	Institute of Electrical and Electronics Engineers
15.	ISA	Instrument Society of America
16.	MCA	Mechanical Contractors Association
17.	MICA	Midwest Insulation Contractors Association
18.	MSS	Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc.
19.	NBS	National Bureau of Standards
20.	NEBB	National Environmental Balancing Bureau
21.	NEC	National Electric Code
22.	NEMA	National Electrical Manufacturers Association
23.	NFPA	National Fire Protection Association
24.	SMACNA	Sheet Metal and Air Conditioning Contractors' National Association. Inc.
25.	UL	Underwriters Laboratories Inc.
26.	ASTM E814	Standard Test Method for Fire Tests of Through-Penetration Fire Stops
27.	ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
28.	UL1479	Fire Tests of Through-Penetration Firestops
29.	UL723	Surface Burning Characteristics of Building Materials

1.5 QUALITY ASSURANCE

A. Refer to Division 1, General Conditions, Equals and Substitutions.

B. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contract documents, the contractor is responsible for all costs involved in integrating the equipment or accessories into the system and for obtaining the performance from the system into which these items are placed. This may include changes found necessary during the testing, adjusting, and balancing phase of the project.

1.6 CONTINUITY OF EXISTING SERVICES

A. Do not interrupt or change existing services without prior written approval from the owner, or facilities maintenance. When interruption is required, coordinate the down-time with the user agency to minimize disruption to their activities. Unless specifically stated, all work involved in interrupting or changing existing services is to be done during normal working hours.

1.7 PROTECTION OF FINISHED SURFACES

A. Refer to Division 1, General Requirements, Protection of Finished Surfaces.

B. Furnish one can of touch-up paint for each different color factory finish which is to be the final finished surface of the product. Deliver touch-up paint with other "loose and detachable parts" as covered in the General Requirements.

1.8 SLEEVES AND OPENINGS

A. Refer to Division 1, General Requirements, Sleeves and Openings.

1.9 SEALING AND FIRE STOPPING

A. Sealing and fire stopping of sleeves/openings between ductwork, piping, etc. and the sleeve, structural or partition opening shall be the responsibility of the contractor whose work penetrates the opening. Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations.

1.10 SUBMITTALS

A. Refer to Division 1, General Conditions, Submittals.

B. Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal with that specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number, as indicated in the contract documents.

C. Before submitting electrically powered equipment, verify that the electrical power and control requirements for the equipment are in agreement with the motor starter schedule on the electrical drawings. Include a statement on the shop drawing transmittal to the architect/engineer that the equipment submitted and the motor starter schedules are in agreement or indicate any discrepancies. See related comments in Section 23 05 13 in Part 1 under Electrical Coordination.

D. Include wiring diagrams of electrically powered equipment.

E. Submit electronic (PDF) copy of all submittals for review by A/E, Architect, Owner, Owners Representative and Building Operator.

F. OFF SITE STORAGE
   1. Any required offset storage of material is the responsibility of the contractor. Materials or equipment damaged while stored offsite, or while transported to or from offset storage will not be allowed to be installed.

G. CERTIFICATES AND INSPECTIONS
   1. Refer also to Division 1, General Conditions, Permits, Regulations, Utilities and Taxes.
   2. Obtain and pay for all required State installation inspections except those provided by the Architect/Engineer in accordance with code. Deliver originals of these certificates to the Division Project Representative. Include copies of the certificates in the Operating and Maintenance Instructions.

H. OPERATION AND MAINTENANCE DATA
   1. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.
   2. In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:
      a. Records of tests performed a to certify compliance with system requirements
      b. Certificates of inspection by regulatory agencies
      c. Valve schedules
      d. Lubrication instructions, including list/frequency of lubrication
      e. Copies of all approved shop drawings.
      f. Manufacturer's wiring diagrams for electrically powered equipment
      g. Temperature control record drawings and control sequences
      h. Parts lists for manufactured equipment
      i. Warranties
      j. Additional information as indicated in the technical specification sections
   3. Provide three (3) hardcopies of the Operation and Maintenance Manual. Manuals shall be organized in three ring binders with dividers and reference tabs. Manuals shall be delivered as follows:
      a. One copy to the Building Engineer.
      b. One copy to the Tenant (to be kept on site).
      c. One copy to the Owners Representative.
   4. Provide three (3) electronic (Adobe PDF) copies of the Operation and Maintenance Manual.
      a. Provide each copy on a separate portable USB flash drive.
      b. Deliver each portable USB drive with hardcopy manuals to parties listed above.

I. TRAINING OF OWNER PERSONNEL
   1. Instruct user agency personnel in the proper operation and maintenance of systems and equipment provided as part of this project; video tape all training sessions. Include not less than 4 hours of instruction, using the Operating and Maintenance manuals during this instruction. Demonstrate startup and shutdown procedures for all equipment. All training to be during normal working hours.

J. RECORD DRAWINGS
   1. Refer to Division 1, General Requirements, Record Drawings.

2. In addition to the data indicated in the General Requirements, maintain temperature control record drawings on originals prepared by the installing contractor/subcontractor. Include copies of these record drawings with the Operating and Maintenance manuals.

K. CLEANING
1. Keep the premises broom clean and free of surplus materials, rubbish and debris.
2. Clean all equipment, piping, duct, strainers, filters, etc. prior to building turnover to owner. All systems shall be turned over to owner in condition ready for operation.

L. WARRANTY
1. Warrant that work shall function for one year immediately following the acceptance of the system(s). The date of acceptance shall be an agreed upon date by all parties, including Division 23 contractor, General Contractor, Owner, Tenant and A/E.
2. Keep the system in good working order at no expense, unless defects are clearly the result of improper usage.
3. Submit for acceptance of the work, written certification that the entire system has been installed and adjusted for operation in accordance with the Contract Documents.

PART 2 PRODUCTS

2.1 ACCESS PANELS AND DOORS

A. LAY-IN CEILINGS:
1. Removable lay-in ceiling tiles in 2 x 2 foot or 2 x 4 foot configuration provided under Section 09500 are sufficient; no additional access provisions are required unless specifically indicated.

B. Plaster Walls and Ceilings:
1. 16 gauge frame with not less than a 20 gauge hinged door panel, prime coated steel for general applications, stainless steel for use in toilets, showers, and similar wet areas, concealed hinges, screwdriver operated cam latch for general applications, key lock for use in public areas, UL listed for use in fire rated partitions if required by the application. Use the largest size access opening possible, consistent with the space and the equipment needing service; minimum size is 12" by 12".

2.2 IDENTIFICATION

A. STENCILS
1. Not less than 1 inch high letters/numbers for marking pipe and equipment.

B. SNAP-ON PIPE MARKERS
1. Cylindrical self-coiling plastic sheet that snaps over piping insulation and is held tightly in place without the use of adhesive, tape or straps. Not less than 1 inch high letters/numbers and flow direction arrows for piping marking. W. H. Brady, Seton, Marking Services, or equal.

C. ENGRAVED NAME PLATES
1. White letters on a black background, 1/16 inch thick plastic laminate, beveled edges, screw mounting, Setonply Style 2060 by Seton Name Plate Company or Emedolite- Style EIP by EMED Co., or equal by Marking Services, or W. H. Brady.

D. VALVE TAGS
1. Round brass tags with 1/2 inch numbers, 1/4 inch system identification abbreviation, 1-1/4 inch minimum diameter, with brass jack chains or brass "S" hooks around the valve stem, available from EMED Co., Seton Name Plate Company, Marking Services, or W. H. Brady.

2.3 SEALING

A. NON-RATED PENETRATIONS

1. Pipe Penetrations
   a. At pipe penetrations of non-rated interior walls, floors and exterior walls above grade, use urethane caulk in annular space between pipe insulation and sleeve. For non-rated drywall, plaster or wood walls where sleeve is not required use urethane caulk in annular space between pipe insulation and wall material.
2. Duct Penetrations
   a. Annular space between duct (with or without insulation) and the non-rated walls or floor opening shall not be larger than 2". Where existing openings have an annular space larger than 2", the space shall be patched to match existing construction to within 2" around the duct.
   b. Where shown or specified, pack annular space with fiberglass batt insulation or mineral wool insulation. Provide 4" sheet metal escutcheon around duct on both sides of partition or floor to cover annular space.

PART 3 EXECUTION

3.1 DEMOLITION

A. Perform all demolition as indicated on the drawings to accomplish new work. Where demolition work is to be performed adjacent to existing work that remains in an occupied area, construct temporary dust partition to minimize the amount of contamination of the occupied space. Where pipe or duct is removed and not reconnected with new work, cap ends of existing services as if they were new work. Coordinate work with the user agency to minimize disruption to the existing building occupants.

B. All pipe, wiring and associated conduit, insulation, ductwork, and similar items demolished, abandoned, or deactivated are to be removed from the site by the Contractor. All piping and ductwork specialties are to be removed from the site by the Contractor unless they are dismantled and removed or stored by the user agency. All designated equipment is to be turned over to the user agency for their use at a place and time so designated. Maintain the condition of material and/or equipment that is indicated to be reused equal to that existing before work began.

3.2 CUTTING AND PATCHING

A. Refer to Division 1, General Requirements, Cutting and Patching.

3.3 BUILDING ACCESS

A. Arrange for the necessary openings in the building to allow for admittance of all apparatus. When the building access was not previously arranged and must be provided by this contractor, restore any opening to its original condition after the apparatus has been brought into the building.

3.4 EQUIPMENT ACCESS

A. Install all piping, conduit, ductwork, and accessories to permit access to equipment for maintenance and service. Coordinate the exact location of wall and ceiling access panels and doors with the General Contractor, making sure that access is available for all equipment and specialties. Access doors in general construction are to be furnished by the Mechanical Contractor and installed by the General Contractor.

B. Provide color coded thumb tacks or screws, depending on the surface, for use in accessible ceilings which do not require access panels.

3.5 COORDINATION

A. Verify that all devices are compatible for the surfaces on which they will be used. This includes, but is not limited to, diffusers, register, grilles, and recessed or semi-recessed heating and/or cooling terminal units installed in/on architectural surfaces.

B. Coordinate all work with other contractors prior to installation. Any installed work that is not coordinated and that interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.

C. Cooperate with the test and balance agency in ensuring Section 23 05 93 specification compliance. Verify system completion to the test and balance agency (flushing, pressure testing, chemical treatment, filling of liquid systems, proper pressurization and air venting of hydronic systems, clean filters, clean strainers, duct and pipe systems cleaned, controls adjusted and calibrated, controls cycled through their sequences, etc.), ready for testing, adjusting and balancing work. Install dampers, shutoff and balancing valves, flow measuring devices, gauges, temperature controls, etc., required for functional and balanced systems. Demonstrate the starting, interlocking and control features of each system so the test and balance agency can perform its work.

3.6 IDENTIFICATION

A. Identify equipment in mechanical equipment rooms by stenciling equipment number and service with one coat of black enamel against a light background or white enamel against a dark background. Use a primer where necessary for proper paint adhesion. Do not label equipment such as cabinet heaters and ceiling fans in occupied spaces.

B. Where stenciling is not appropriate for equipment identification, engraved name plates may be used.

C. Identify piping not less than once every 30 feet, not less than once in each room, adjacent to each access door or panel, and on both side of the partition where exposed piping passes through walls, floors or roofs. Pipe shall be labeled with
   1. Pipe content (HWS, HWR, CWS, CWR, etc.).
   2. Pipe flow direction.
   3. Pipe size.

D. Use one coat of black enamel against a light background or white enamel against a dark background for stenciling, or provide snap-on pipe markers as specified in Part 2 – Products.

E. Identify valves with brass tags bearing a system identification and a valve sequence number. Valve tags are not required at a terminal device unless the valves are greater than ten feet from the device or located in another room not visible from the terminal unit. Provide a typewritten valve schedule indicating the valve number and the equipment or areas supplied by each valve; locate schedules in each mechanical room and in each Operating and Maintenance manual. Schedules in mechanical rooms to be framed under clear plastic.

F. Use engraved name plates to identify control equipment.

3.7 LUBRICATION

A. Lubricate all bearings with lubricant as recommended by the manufacturer before the equipment is operated for any reason. Once the equipment has been run, maintain lubrication in accordance with the manufacturer's instructions until the work is accepted by the owner. Maintain a log of all lubricants used and frequency of lubrication; include this information in the Operating and Maintenance Manuals at the completion of the project.

3.8 DUCT SLEEVES:

A. Duct sleeves are not required in non-rated partitions or floors.

3.9 SEALING

A. NON-RATED PENETRATIONS:
   1. At all interior walls and exterior walls, pipe penetrations are required to be sealed. Apply sealant to both sides of the penetration in such a manner that the annular space between the pipe sleeve or cored opening and the pipe or insulation is completely blocked.
   2. Duct penetrations through non-rated partitions shall require sheet metal escutcheons with fiberglass or mineral wool insulation fill for spaces that include janitor closets, toilet rooms, mechanical rooms, conference rooms, private consultation rooms, where ducts are exposed and where noted on drawings elsewhere.

END OF SECTION

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.1 SCOPE

A. This section includes requirements for single and three phase motors that are used with equipment specified in other sections. Included are the following topics:
   1. Part 1 – General
      a. Scope
      b. Related Work
      c. Reference
      d. Reference Standards
      e. Quality Assurance
      f. Shop Drawings
      g. Operating and Maintenance Data
      h. Electrical Coordination
      i. Product Criteria
   2. Part 2 – Products
      a. Three Phase, Single Speed Motors
      b. Single Phase, Single Speed Motors
      c. Motors Used on Variable Frequency Drives
   3. Part 3 – Execution
      a. Installation

1.2 RELATED WORK

A. Section 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC

B. Section 23 05 14 - Variable Frequency Drives

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

A. ANSI/IEEE 112 Test Procedure for Polyphase Induction Motors and Generators

B. ANSI/NEMA MG-1 Motors and Generators

C. ANSI/NFPA 70 National Electrical Code

1.5 QUALITY ASSURANCE

A. Refer to division 1, General Conditions, Equals and Substitutions.

1.6 SHOP DRAWINGS

A. Refer to division 1, General Conditions, Submittals.

B. Include with the equipment which the motor drives the following motor information: motor manufacturer, horsepower, voltage, phase, hertz, rpm, full load efficiency. Include project wiring diagrams prepared by the contractor specifically for this work.

1.7 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

B. In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:
   1. Lubrication instructions, including list/frequency of lubrication
   2. Table noting full load power factor, service factor, NEMA design designation, insulation class and frame type for each motor provided

1.8 ELECTRICAL COORDINATION

A. All starters, overload relay heater coils, disconnect switches and fuses, relays, wire, conduit, pushbuttons, pilot lights, and other devices required for the control of motors or electrical equipment are furnished and installed by this Contractor.

B. Drawings and/or specifications show number and horsepower rating of all motors furnished by this Contractor. Should any discrepancy in size, horsepower rating, electrical characteristics or means of control be found for any motor or other electrical equipment after contracts are awarded, Contractor is to immediately notify the architect/engineer of such discrepancy. Costs involved in any changes required due to equipment substitutions initiated by this contractor will be the responsibility of this contractor. See related comments in Section 23 05 00 - Common Work Results for HVAC, under Shop Drawings.

C. Contractor will provide all power wiring and control wiring.

1.9 PRODUCT CRITERIA

A. Motors to conform to all applicable requirements of NEMA, IEEE, ANSI, and NEC standards and shall be listed by U.L. for the service specified.

B. Select motors for conditions in which they will be required to perform; i.e., general purpose, splashproof, explosion proof, standard duty, high torque or any other special type as required by the equipment or motor manufacturer's recommendations.

C. Furnish motors for starting in accordance with utility requirements and compatible with starters as specified.

PART 2 PRODUCTS

2.1 THREE PHASE, SINGLE SPEED MOTORS

A. Use NEMA rated 460 volt, three phase, 60 hertz motors for all motors 1/2 HP and larger unless specifically indicated.

B. Use NEMA general purpose, continuous duty, Design B, normal starting torque, T-frame or U-frame motors with Class B or better insulation unless the manufacturer of the equipment on which the motor is being used has different requirements. Use open drip-proof motors unless totally enclosed fan-cooled, totally enclosed non-ventilated, explosion-proof, or encapsulated motors are specified in the equipment sections.

C. Use grease lubricated anti-friction ball bearings with housings equipped with plugged/capped provision for relubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at the end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

D. All open drip-proof motors to have a 1.15 service factor. Other motor types may have minimum 1.0 service factors.

E. All motors 1 HP and larger, except specially wound motors and inline pump motors 56 frame and smaller, to be high efficiency design with full load efficiencies which meet or exceed the values listed below when tested in accordance with NEMA MG 1.

FULL LOAD NOMINAL MOTOR EFFICIENCY BY MOTOR SIZE AND SPEED

MOTOR HP	-----Open Drip-Proof Motors------ -------Nominal Motor Speed------- 1200 rpm	1800 rpm	3600 rpm
1	82.5	85.5	77.0
1-1/2	86.5	86.5	84.0
2	87.5	86.5	85.5
3	88.5	89.5	85.5
5	89.5	89.5	86.5
7-1/2	90.2	91.0	88.5
10	91.7	91.7	89.5

MOTOR HP	----Totally Enclosed Fan-Cooled---- -------Nominal Motor Speed------ 1200 rpm	1800 rpm	3600 rpm
1	82.5	85.5	77.0
1-1/2	87.5	86.5	84.0
2	88.5	86.5	85.5
3	89.5	89.5	86.5
5	89.5	89.5	88.5
7-1/2	91.0	91.7	89.5
10	91.0	91.7	90.2

2.2 SINGLE PHASE, SINGLE SPEED MOTORS

A. Use NEMA rated 208 volt, single phase, 60 hertz motors for all motors 1/3 HP and smaller or as indicated on equipment schedules.

B. Use permanent split capacitor or capacitor start, induction run motors equipped with permanently lubricated and sealed ball or sleeve bearings and Class A insulation. Service factor to be not less than 1.35.

2.3 MOTORS USED ON VARIABLE FREQUENCY DRIVES

A. In addition to the requirements specified above, the motor must be suitable for use with the drive specified in Section 23 05 14, including but not limited to motor cooling. Motor shall comply with NEMA MG1 Part 31 to provide windings capable to withstand up to 1600 peak Volts with a rise time of 0.1 µs. Provide bearing protection grounding rings to bleed current from the motor shaft to the motor casing. Manufacturers: Aegis SGR, Inpro/Seal CDR, or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Mount motors on a rigid base designed to accept a motor, using shims if required under each mounting foot to get a secure installation.

B. When motor will be flexible coupled to the driven device, mount coupling to the shafts in accordance with the coupling manufacturer's recommendations. Using a dial indicator, check angular misalignment of the two shafts; adjust motor position as necessary so that the angular misalignment of the shafts does not exceed 0.002 inches per inch diameter of the coupling hub. Again using the dial indicator, check the shaft for run-out to assure concentricity of the shafts; adjust as necessary so that run-out does not exceed 0.002 inch.

C. When motor will be connected to the driven device by means of a belt drive, mount sheaves on the appropriate shafts in accordance with the manufacturer's instructions. Use a straight edge to check alignment of the sheaves; reposition sheaves as necessary so that the straight edge contacts both sheave faces squarely. After sheaves are aligned, loosen the adjustable motor base so that the belt(s) can be added and tighten the base so that the belt tension is in accordance with the drive manufacturer's recommendations. Frequently recheck belt tension and adjust if necessary during the first day of operation and again after 80 hours of operation.

D. Verify the proper rotation of each three-phase motor as it is being wired or before the motor is energized for any reason.

E. Lubricate all motors requiring lubrication. Record lubrication material used and the frequency of use. Include this information in the maintenance manuals.

END OF SECTION

SECTION 23 05 14
VARIABLE FREQUENCY DRIVES

PART 1 GENERAL

1.1 SCOPE

A. This section includes variable frequency drives, bypass starters, and line reactors. Included are the following topics:
   1. Part One – General
      a. Scope.
      b. Related Work
      c. Reference
      d. Reference Standards
      e. Submittals
      f. Operating and Maintenance Data
      g. Equipment Startup
      h. Warranty
   2. Part Two - Products
      a. Manufactures
      b. Design and Construction
      c. Performance Requirements
      d. Control Features
      e. Protection Features
      f. Diagnostics
      g. Quality Assurance Tests
      h. Bypass Equipment
      i. AC Input Line Reactors
   3. Part Three – Execution
      a. Variable Frequency Drives (VFD)
      b. Owner Training

1.2 RELATED WORK

A. Division 26 00 00 - Electrical

1.3 REFERERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

A. ANSI/IEEE 519 Guide for Harmonic Control and Reactive Compensation of Static Power Converters

1.5 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division 1, General Conditions of the Contract.

B. Include physical, electrical, and performance characteristics of each variable frequency drive and associated components, including dimensions; weight; input and output performance; voltage, phase, current and overcurrent characteristics; installation instructions; protective features; wiring and block diagrams indicating specified options; electrical noise attenuation equipment where required to meet the criteria specified; line side voltage notch wave form and line side current harmonics; certified efficiency versus load and speed curves; and required operating environment.

1.6 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.7 EQUIPMENT STARTUP AND AGENCY TRAINING

A. Provide the services of a factory trained and certified technician to approve the installation; start-up, test, and adjust for proper operation of the unit(s). Upon completion of the equipment startup, submit a complete manufacturer's field report, including startup and test log, signed by the factory trained technician. Coordinate with the Temperature Control Contractor and the Balancing Contractor. The startup shall be coordinated with Division 26. Electrical and shall be completed within ten (10) working days from the startup date as set by the Owners representative.

1.8 WARRANTY

A. The warranty shall be for a period of twenty-four (24) months from the date of project Substantial Completion. Further, the warranty shall include all parts, labor, travel time, administrative costs, overhead, travel expenses, technical support and any and all other costs to provide the warranty service.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. ABB is the only acceptable manufacturer.

2.2 DESIGN AND CONSTRUCTION

A. The unit shall be variable torque, modular design for control of the motors as specified in Division 23 and rated at the motor full load nameplate amps.

B. The unit shall be U.L. listed, solid state, microprocessor based with a pulse width modulated (PWM) output wave form (none others are acceptable).

C. The VFD shall employ a full wave bridge rectifier and capacitors to minimize the ripple of the rectified voltage to maintain near constant DC voltage. Insulated gate bipolar transistors (IGBT's) shall be employed as the output switching device.

D. The VFD package shall contain the equivalent of 5% impedance to reduce harmonic distortion. The 5% equivalent impedance shall be provided in the form of a DC bus choke, an input AC line reactor in each phase, or a combination of the two methods.

E. Control circuitry shall be plug-in, plug-out modular basis with a corrosion resistant coating on printed circuit boards.

F. Units to be suitable for an operating environment from 0°C to 40°C temperature and humidity up to 90% non-condensing.

G. Electrically and physically isolate control circuitry and conductors from power circuitry and power conductors. Control conductors and power conductors shall not be run in the same pathway.

H. The unit enclosure shall be NEMA [1, 12] as required for the application minimum and all components shall be fully factory assembled and tested prior to leaving the manufacturing facility.
   1. Include the following operating and monitoring devices mounted on the front cover:
   2. A fused disconnect switch to de-energize the drive and bypass circuit with door interlocked handle and lock-open padlocking provisions.
   3. Operating mode selector switch marked "hand-off-auto".
   4. Manual speed adjustment via keypad, mounted on the door.
   5. Manual bypass selector switch to select power through drive or bypass (if a bypass is provided).

I. Provide a manual bypass circuit and bypass starter to transfer from variable frequency drive operation to bypass operation (if a bypass is provided).

2.3 PERFORMANCE REQUIREMENTS

A. Units shall be suitable for input power of electrical system as scheduled on the drawings ±10%, 3 phase, 60 Hertz nominal.

B. Use a current limiting control device to limit output current to 110% continuous for one minute; also refer to Protection Features in this section. Full load output current available from drive shall not be less than motor nameplate amperage. The full load amp rating of the VFD shall not be less than the values indicated in the NEC Table 430-150.

C. Output power shall be suitable for driving standard NEMA B design, three phase alternating current induction motors at full rated speed with capability of 6:1 turndown.

D. Additional performance capabilities to include the following:
   1. Ride through a momentary power outage of 15 cycles.
   2. Start into a rotating load without damage to drive components or motor.

3. Capable of automatic restart into a rotating load after a preset, adjustable time delay following a power outage.
4. Input power factor: Min 0.95 throughout the speed range
5. Minimum efficiency: 95% at 100% speed, 85% at 50% speed

2.4 CONTROL FEATURES

A. Use control circuits compatible with input signal from temperature control system in the automatic mode and from manual speed control in the manual mode. Vary motor speed in response to the input control signal. Include components necessary to accept the signal from the temperature control system in the form that it is sent. Refer to Division 23 00 00.

B. Include the following additional control features:

C. Include the following additional control features:
1. Hand-Off-Automatic (HOA) selector switch to select local or remote start/stop and speed control
2. Analog input, selectable 0-10v or 4-20 mA, for automatic control from the temperature control system
3. Local speed control at the VFD
4. Adjustable acceleration and deceleration rate so that the time period from start to full speed and from full speed to stop can be field adjusted
5. Adjustable minimum and maximum speed settings for both automatic and manual modes of operation
6. Manual transfer bypass circuit
7. Field adjustment of minimum and maximum output frequency
8. Two (2) sets of programmable form “C” contacts for remote indication of variable frequency drive condition. Note: default programming to be set for “Drive Run & Fault”.
9. Illuminated display keypad.
10. External Fault indicator
11. One (1) input for a N.O. dry contact type input for a 2-wire remote start/stop
12. One (1) input for a N.C. dry contact type input for external faults: (freezestats, fire alarm, smokes, etc). This input shall be factory wired to prevent both the VFD and bypass starter operation when external fault is present.
13. One (1) N.O. dry contact output for proving motor status. This output shall be programmed to detect belt or coupling break that would remove the load from the motor. The dry contact will open on loss of load or VFD being off.
14. PID control loop capable of VFD control from an external device connected to a VFD analog input.

D. When specified in the 23 09 93 sequence of operations, provide a VFD input and output for shutoff damper control that shall operate as follows: When the fan is remotely or locally commanded to start, VFD contact shall energize the shutoff damper to open the damper. The damper position end switch shall be wired to a run permissive input on the VFD and enable the VFD to start when the damper end switch provides the damper is open. This feature shall be provided for both inverter and bypass operation (if bypass option is provided).

E. The VFD controller shall convert VFD information into the BACnet MSTP protocol that will be compatible with the building direct digital energy management system (EMS) supplied on the project. This output shall be through a serial interface port capable of two-way communication with the building EMS provided on this project. Final connection shall not require any additional intermediate gateway devices to provide throughput of data. The following data shall be provided at a minimum:
   1. Fault condition
   2. Speed
   3. Amperage
   4. Frequency
   5. Voltage
   6. Bypass status (if supplied)

2.5 PROTECTION FEATURES

A. Use electronic protection circuitry in the power circuits to provide an orderly shutdown of the drive without blowing fuses and prevent component loss under the following abnormal conditions:
   1. Activation of any safety device;
   2. Instantaneous overcurrent and/or over voltage of output;
   3. Power line overvoltage and undervoltage protection;
   4. Phase loss;
   5. Single and three phase short circuiting;
   6. Ground faults;
   7. Control circuit malfunction;
   8. Overtemperature; and
   9. Output current over limit.

B. Provide the following additional protective features:
   1. Input transient overvoltage protection up to 3000 volts per ANSI 37.90A;
   2. DC bus fusing which limit the rate of rise of the DC bus current and de-energizes the drive at a predetermined current level;
   3. Fusing for the control circuit transformer;
   4. Grounded control chassis; and
   5. Devices and/or control circuitry to ensure that the variable frequency drive and bypass starter are not both energized and driving motor simultaneously.

2.6 DIAGNOSTICS

A. Provide an English character display (no error codes) with indicators for the following:
   1. Phase loss
   2. Ground fault
   3. Overcurrent
   4. Overvoltage
   5. Undervoltage
   6. Over temperature
   7. Overload
   8. DC bus status

2.7 QUALITY ASSURANCE TESTS

A. Use a factory heat stress test to verify proper operation of all functions and components under full load.

B. Field performance test of variable frequency drives to determine compliance with this specification will be performed at the Owner's discretion and may include any specified feature, including operation of protective devices through a simulated fault. Contractor will pay for initial testing. Should drive be found deficient by this testing, drive manufacturer will be required to make any and all changes necessary to bring unit(s) into compliance with the specified performance and demonstrate this performance by retesting. Cost of changes and retest will be by this contractor.

C. Variable frequency drive manufacturer or designated representative to perform a field test of each drive, in the presence of the Owner's representative, for the following items:
   1. Provide general inspection to verify proper installation;
   2. Demonstrate drive reaction to simulated power interruptions of two seconds and sixty seconds;
   3. Demonstrate adequate protection during switching from variable frequency drive operation to bypass starter operation and back again.

2.8 BYPASS EQUIPMENT

A. Bypass Starters:
   1. The bypass starters for 208 volt motors, 20 HP and less; and 480 volt motors, 40 HP and less, shall be across-the-line magnetic starter type.
   2. The bypass starters for 208 volt motors, 25 HP and more; and 480 volt motors, 50 HP and more, shall be solid state reduced voltage starting type.

B. Bypass Configuration:
   1. Provide one main fused disconnect switch to de-energize both the drive and bypass circuit. Provide a drive input disconnect switch to allow the drive to be isolated while the bypass circuit is energized. Provide one output drive contactor and one output bypass contactor. The two output contactors shall be electrically interlocked to allow only one contactor to be closed at any one time.

C. Provide motor overload protection in the bypass circuit.

D. Provide bypass equipment in a common enclosure with the VFD or, if not available, in a separate enclosure.

2.9 AC INPUT LINE REACTORS

A. When needed to comply with the requirement for 5% equivalent impedance, furnish and factory install AC input line reactors.

B. Line reactors shall be installed in each phase of the AC input side of the VFD and mounted within a common enclosure with the VFD.

C. Line reactor shall be a three phase inductor, iron core, 600V, Class H insulation, 115 degree C rise, copper windings with screw type terminal blocks.

PART 3 EXECUTION

3.1 VARIABLE FREQUENCY DRIVES

A. Install where indicated on drawings and in accordance with approved submittals and manufacturer's published recommendations. Installation to be by the Division 26 00 00 - Electrical contractor.

B. Input power wiring shall be installed in a separate conduit, output power wiring shall be installed in a separate conduit and control wiring shall be installed in a separate conduit. Do not mix input power, output power, or control wiring in a common conduit. Separate conduits for input and output power wiring shall be provided for each motor. Input and output power wiring for more than one motor shall not share a common conduit. Power wiring shall be furnished and installed by the Div. 26 contractor. If provided, do not mount output line filter above the drive.

C. Control signal for drive will be provided under Division 23.

D. Temperature Control Contractor will furnish and install the required temperature control wiring in metal conduit and in accordance with Division 26 00 00 - Electrical of this specification.

3.2 OWNER TRAINING

A. Contractor to provide factory authorized representative and/or field personnel knowledgeable with the operations, maintenance and troubleshooting of the system and/or components defined within this section for a minimum period of 4 hours.

END OF SECTION

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SECTION 23 05 15

PIPING SPECIALTIES

PART 1 GENERAL

1.1 SCOPE

A. This section includes specifications for piping specialties for all piping systems on this project. Included are the following topics:
   1. Part One – General
      a. Scope.
      b. Related Work
      c. Reference
      d. Quality Assurance
      e. Shop Drawings
      f. Operation and Maintenance Data
      g. Design Criteria
   2. Part 2 – Products
      a. Test Wells
      b. P/T (Pressure/Temperature) Test Plugs
      c. Hose Connection Caps
      d. Air Vents
   3. Part 3 – Execution
      a. Test Wells
      b. P/T (Pressure/Temperature) Test Plugs
      c. Air Vents

1.2 RELATED WORK

A. Section 23 05 23 - General-Duty Valves for HVAC Piping

B. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment

C. Section 23 07 00 - HVAC Insulation

D. Section 23 21 13 - Hydronic Piping

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 QUALITY ASSURANCE

A. Refer to division 1, General Conditions, Equals and Substitutions.

1.5 SHOP DRAWINGS

A. Refer to division 1, General Conditions, Submittals.

B. Required for all items in this section; Include materials of construction, dimensional data, ratings/capacities/ranges, pressure drop data where appropriate, and identification as referenced in this section and/or on the drawings.

1.6 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.7 DESIGN CRITERIA

A. All piping specialties are to be rated for the highest pressures and temperatures in the respective system in accordance with ANSI B31, but not less than 125 psig unless specifically indicated otherwise.

PART 2 PRODUCTS

2.1 TEST WELLS

A. Similar to thermometer sockets except with a brass cap that thread into the inside of the test well to prevent dirt from accumulating. Secure cap to body with a short chain. Furnish with extension necks, where appropriate, to accommodate the pipeline insulation.

2.2 P/T (PRESSURE/TEMPERATURE) TEST PLUGS

A. Brass plug with 1/4" NPT threads, EPDM or neoprene valve core, knurled cap with cap strap. Use extended length plugs to clear insulated piping. Adaptors shall have 1/4" FPT connection for standard pressure gauges.

2.3 HOSE CONNECTON CAPS

A. Hose connection caps shall be pressure rated for 150 psig at 180 deg F.

2.4 AIR VENTS

A. Manual Key Type Vents:
   1. Bell and Gossett Model 4V; Eaton/Dole Model 9, 9B, or 14A.
   2. Bronze body with nonferrous internal parts, screwdriver operated, designed to relieve air from the system when vent is opened, rated at not less than 125 psig at 220°F.

PART 3 - EXECUTION

3.1 TEST WELLS

A. Install in piping systems as indicated on the drawings and/or details wherever provisions are needed for inserting a thermometer at a later date.

3.2 P/T (PRESSURE/TEMPERATURE) TEST PLUGS

A. Install in piping systems as indicated on the drawings and/or details. Do not insulate over test plugs.

3.3 AIR VENTS

A. Manual Key Type Vents
   1. Install at all high points where air may collect and not be carried by the system fluid. Use a soft Type L copper "pigtail" so the vent can be positioned for venting and collecting any water that might escape.

END OF SECTION

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SECTION 23 05 23

GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 GENERAL

1.1 SCOPE

A. This section includes valve specifications for all HVAC systems except where indicated under Related Work. Included are the following topics:
   1. Part 1 – General
      a. Scope
      b. Related Work
      c. Reference
      d. Quality Assurance
      e. Submittals
      f. Operation and Maintenance Data
      g. Design Criteria
   2. Part 2 – Products
      a. Manufacturers
      b. Water System Valves
         1) Ball Valves
         2) Balance Valves
         3) Drain Valves
      c. Specialty Valves and Valve Accessories
         1) Stem Extensions
   3. Part 3 – Execution
      a. General
      b. Shut-off Valves
      c. Calibrated Balancing Valves
      d. Drain Valves

1.2 RELATED WORK

A. Section 23 05 15 - Piping Specialties

B. Section 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 QUALITY ASSURANCE

A. Refer to division 1, General Conditions, Equals and Substitutions.

1.5 SUBMITTALS

A. Refer to division 1, General Conditions, Submittals.

B. Contractors shall submit a schedule of all valves indicating type of service, dimensions, materials of construction, and pressure/temperature ratings for all valves to be used on the project. Temperature ratings specified are for continuous operation.

1.6 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.7 DESIGN CRITERIA

A. Where valves are specified for individual mechanical services (i.e. hot water heating, steam, etc.) all valves shall be of the same manufacturer unless prior written approval is obtained from DFD.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Anvil, Apollo, Armstrong, Bell & Gossett, Cash-Acme, Dresser Consolidated, Conval, Crane, Anderson Greenwood and Crosby, Danfoss-Flomatic, DeZurik, Durco, Fisher, Grinnell, Griswold, Hammond, Hancock, Hoffman, Jamesbury, Keystone, Kunkle, Leslie, Lunkenheimer/Cincinnati, Metraflex, Milwaukee, Mueller, Newco, Nexus, Nibco, Powell, RP&C, Sarco, Spence, Stockham, Taco, Tasco, Thrush-Amtrol, Vogt, Watts, or approved equal.

2.2 WATER SYSTEM VALVES

A. All water system valves to be rated at not less than 125 psig water working pressure at 240°F unless noted otherwise.

B. Ball Valve
1. 2" and smaller: Two piece bronze body; threaded or soldered ends, as appropriate to the pipe material; stainless steel or chrome plated brass/bronze ball; conventional port; glass filled teflon seat; threaded packing gland follower; blowout-proof stem; 600 psig WOG.
2. Valve stems shall allow operators to clear insulation without interference. Provide stem extensions when valve operators interfere with pipe insulation.

3. Apollo 70-100/200 series, Hammond 8301/8311, Milwaukee BA100/150, Nibco T/S 585-70, Stockham S206/216.

4. 2-1/2" and over: Ball valves will not be accepted in sizes over 2 inch.

C. Balance Valves
   1. 2" and smaller: Bronze or copper alloy body with calibrated ball, globe or venturi/valve arrangement, integral pointer and calibrated scale to register degree of valve opening, memory stop, drain tapping, threaded or soldered ends, with or without integral unions, P/T or Shraeder pressure taps with integral check valves and seals, adjustable memory stop, suitable for 200 psig water working pressure at 250°F.
      a. Armstrong CBV, Bell & Gossett Circuit Setter Plus, Griswold Quickset, Nexus Orturi, Nibco 1710 Series, Taco Accu-Flo, Tour & Anderson STAS/STAD, Victaulic series 786/787.

D. Drain Valves
   1. Use 3/4 inch ball valve with threaded hose adapter except strainer blowdown valves to be the same size as the blowdown connection. Provide hose connection caps pressure rated for 150 psig at 180 deg F.

2.3 STEM EXTENSIONS

A. Provide stem extensions when valve operators interfere with pipe insulation.

PART 3 EXECUTION

3.1 GENERAL

A. Properly align piping before installation of valves in an upright position; operators installed below the valves will not be accepted.

B. Install valves in strict accordance with valve manufacturer's installation recommendations. Do not support weight of piping system on valve ends.

C. Install all temperature control valves.

D. Install all valves with the stem in the upright position. Valves may be installed with the stem in the horizontal position only where space limitations do not allow installation in an upright position or where large valves are provided with chain wheel operators. Where valves 2-1/2" and larger are located more than 12'-0" above mechanical room floors, install valve with stem in the horizontal position and provide a chain wheel operator. Valves installed with the stems down, will not be accepted.

E. Install stem extensions when shipped loose from valve.

F. Prior to flushing of piping systems, place all valves in the full-open position.

3.2 SHUT-OFF VALVES

A. Install shut-off valves at all equipment, at each branch take-off from mains, and at each automatic valve for isolation or repair.

3.3 CALIBRATED BALANCE VALVES

A. Install where indicated on the drawings and details for balancing of hydronic systems. Retain the shipping container for use as removable insulation.

3.4 DRAIN VALVES

A. Provide drain valves for complete drainage of all systems. Locations of drain valves include low points of piping systems, equipment locations specified or detailed including reheat coils, other locations required for drainage of systems.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SCOPE

A. This section includes specifications for supports of all HVAC equipment and materials as well as piping system anchors. Included are the following topics:
   1. Part 1 – General
      a. Scope
      b. Related Work
      c. Reference
      d. Reference Standards
      e. Quality Assurance
      f. Description
      g. Shop Drawings
      h. Design Criteria
   2. Part 2 – Products
      a. Pipe Hanger and Support Manufacturers
      b. Structural Supports
      c. Pipe Hangers and Supports
      d. Beam Clamps
   3. Part 3 – Execution
      a. Installation
      b. Hanger and Support Spacing

1.2 RELATED WORK

A. Section 23 07 00 - HVAC Insulation

1.3 REFERENCE

A. Applicable provisions of Division 1 shall govern work under this section.

1.4 REFERENCE STANDARDS

A. MSS SP-58 Materials, Design, Manufacture, Selection, Application, and Installation

1.5 QUALITY ASSURANCE

A. Refer to Division 1, General Conditions, Equals and Substitutions.

1.6 DESCRIPTION

A. Provide all supporting devices as required for the installation of mechanical equipment and materials. All supports and installation procedures are to conform to the latest requirements of the ANSI Code for pressure piping.

B. Do not hang any mechanical item directly from a metal deck or run piping so it rests on the bottom chord of any truss or joist.

C. Support apparatus and material under all conditions of operation, variations in installed and operating weight of equipment and piping, to prevent excess stress, and allow for proper expansion and contraction.

D. Protect insulation at all hanger points; see Related Work above.

1.7 SHOP DRAWINGS

A. Schedule of all hanger and support devices indicating shields, attachment methods, and type of device for each pipe size and type of service. Reference section 23 05 00.

1.8 DESIGN CRITERIA

A. Materials and application of pipe hangers and supports shall be in accordance with MSS Standard Practice SP-58 unless noted otherwise.

B. Piping flexible connections and vibration isolation supports are required for piping connected to coils that are in a fan assembly where the entire assembly is mounted on vibration supports; the vibration isolation supports are required for a distance of one hundred pipe diameters or three supports away from the equipment, whichever is greater. Piping flexible connection and vibration isolation supports are not required when the fan section is separately and independently isolated by means of vibration supports and duct flexible connections. Standard pipe hangers/supports as specified in this section are required when there are no vibration isolation devices in the piping and beyond the 100 pipe diameter/3 support distance.

C. Piping supported by laying on the bottom chord of joists or trusses will not be accepted.

D. Fasteners depending on soft lead for holding power or requiring powder actuation will not be accepted.

E. Allow sufficient space between adjacent pipes and ducts for insulation, valve operation, routine maintenance, etc.

PART 2 PRODUCTS

2.1 PIPE HANGER AND SUPPORT MANUFACTURERS

A. Anvil, B-Line, Fee and Mason, Kindorf, Michigan Hanger, Unistrut, or approved equal. Anvil figure numbers are listed below; equivalent material by other manufacturers is acceptable.

2.2 STRUCTURAL SUPPORTS

A. Provide all supporting steel required for the installation of mechanical equipment and materials, whether or not it is specifically indicated or sized, including angles, channels, beams, etc. to suspend or floor support tanks and equipment.

2.3 PIPE HANGERS AND SUPPORTS

A. Hangers For Steel Pipe Sizes 1/2" Through 2"
   1. Carbon steel, adjustable, clevis, black finish. Anvil figure 65 or 260.

B. Copper Pipe Support
   1. Carbon steel ring, adjustable, copper plated or polyvinylchloride coated.

C. Insulation Protection Shields
   1. Galvanized carbon steel of not less than 18 gauge for use on insulated pipe 2-1/2 inch and larger. Minimum shield length is 12 inches. Equal to Anvil figure 167.

D. Steel Hanger Rods
   1. Threaded both ends, threaded one end, or continuous threaded, black finish.
   2. Size rods for individual hangers and trapeze support as indicated in the following schedule.
   3. Total weight of equipment, including valves, fittings, pipe, pipe content, and insulation, are not to exceed the limits indicated.

Maximum Load (Lbs.) (650°F Maximum Temp.)	Rod Diameter (inches)
610	3/8
1130	1/2
1810	5/8

   4. Provide rods complete with adjusting and lock nuts.

2.4 BEAM CLAMPS

A. MSS SP-58 Type 23 malleable black iron clamp for attachment to beam flange to 0.62 inches thick for single threaded rods of 3/8, 1/2, and 5/8 inch diameter, for use with pipe sizes 4 inch and less. Furnish with a hardened steel cup point set screw. Anvil figure 86.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install supports to provide for free expansion of the piping and duct system. Support all piping from the structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.

B. Piping shall be supported independently from ductwork and all other trades.

C. Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes for the supporting steel.

3.2 HANGER AND SUPPORT SPACING

A. Place a hanger within 12 inches of each horizontal elbow, valve, strainer, or similar piping specialty item.

B. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.

C. Support riser piping independently of connected horizontal piping.

D. Adjust hangers to obtain the slope specified in the piping section of this specification.

E. Space hangers for pipe as follows:

Pipe Material	Pipe Size	Max. Spacing
Steel	1/2" through 1-1/4"	6'-6"
Steel	1-1/2" through 6"	10'-0"
Copper	1/2" through 1-1/4"	5'-0"
Copper	1-1/2" and larger	8'-0"

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SCOPE

A. This section includes air and water testing, adjusting and balancing for the entire project. Included are the following topics:
   1. Part 1 – General
      a. Scope
      b. Related Work
      c. Reference
      d. Reference Standards
      e. Description
      f. Pre-Installation Meeting and Scheduling
      g. Pre-Balance Conference
      h. Submittals
   2. Part 2 – Products
      a. Instrumentation
   3. Part 3 – Execution
      a. Preliminary Procedures
      b. Existing Equipment
      c. Performing Testing, Adjusting and Balancing
      d. Deficiencies

1.2 RELATED WORK

A. Section 23 05 00 Common Work Results for HVAC

B. Section 23 07 00 HVAC Insulation

C. Section 23 09 14 Pneumatic and Electric Instrumentation and Control Devices for HVAC

D. Section 23 09 23 Direct Digital Control System for HVAC

1.3 REFERENCE

A. Applicable provisions of the General Conditions, Supplementary General Conditions and General Requirements in Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

A. AABC National Standards for Total System Balance, Sixth Edition, 2002.

B. ASHRAE ASHRAE Handbook, 2015 HVAC Applications, Chapter 38, Testing Adjusting and Balancing.

C. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems, Seventh Edition, 2005.

D. TABB Tab Procedural Guide, First Edition, 2003.

1.5 DESCRIPTION

A. The Contractor will separately contract with an independent test and balance agency to perform all testing, adjusting, and balancing of air and hydronic systems required for this project. Work related to the testing, adjusting, and balancing that must be performed by the installing mechanical contractor is specified in other section of these specifications.

B. Provide total mechanical systems testing, adjusting and balancing. Requirements include the balance of air and water distribution, adjustment of new and existing systems and equipment to provide design requirements indicated on the drawings, electrical measurement and verification of performance of all mechanical equipment, all in accordance with standards published by AABC, NEBB, or TABB.

C. Test, adjust and balance all air and hydronic systems so that each room, piece of equipment or terminal device meets the design requirements indicated on the drawings and in the specifications.

D. Accomplish testing, adjusting and balancing work in a timely manner that allows partial occupancy of major buildings, occupancy of one building when the project involves many buildings, and completion of the entire project in the time stated in the Instruction to Bidders and in accordance with the completion schedule established for this project.

E. Verify that provisions are being made to accomplish the specified testing, adjusting and balancing work. If problems are found, handle as specified in Part 3 under Deficiencies.

1.6 QUALITY ASSURANCE

A. Qualifications
   1. An independent Firm specializing in the Testing and Balancing of HVAC systems for a minimum of 3 years. A Firm not engaged in the commerce of furnishing or providing equipment or material generally related to HVAC work other then that specifically related to installing Testing and Balancing components necessary for work in this section such as, but not limited to sheaves, pulleys, and balancing dampers.
   2. A certified member of AABC or certified by NEBB or TABB in the specific area of work performed. Maintain certification for the entire duration of the project. If certification of firm or any staff performing work is terminated or expires during the duration of the project, contact A/E immediately.
   3. Technicians on this project must have satisfactorily completed work on a minimum of (3) three projects of at least 50% in size, and of similar complexity. Size is defined as the quantity of each specific individual item requiring testing and balancing such as, but not limited to, equipment, devices, terminal devices, and grilles and diffusers.
   4. Submit Qualifications of firm and project staff to A/E and Owners Representative when requested.

1.7 PRE-INSTALLATION MEETING AND SCHEDULING

A. The test and balance agency is required to attend a pre-installation meeting with all other project contractors before the construction process is started. The test and balance agency shall give the Mechanical Contractor a detailed schedule of testing and balancing tasks for incorporation into the project schedule.

1.8 PRE-BALANCE CONFERENCE

A. 90 days prior to beginning testing, adjusting and balancing, schedule and conduct a conference with the Architect/Engineer, Owners Project Representative and the mechanical system and temperature control system installing Contractors. Provide AE and Commissioning Provider (CxP) with a complete copy of the TAB plan for the project. The objective is final coordination and verification of system operation and readiness for testing, adjusting and balancing procedures and scheduling procedures with the above mentioned parties. Indicate work required to be completed prior to testing, adjusting, and balancing and identify the party responsible for completion of that work.

1.9 SUBMITTALS

A. See also Related Work in this section.

B. Submit testing, adjusting and balancing reports bearing the seal and signature of the NEBB, AABC or TABB Certified Test and Balance Supervisor. The reports certify that the systems have been tested, adjusted and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed and are operating; and are an accurate record of all final quantities measured to establish normal operating values of the systems.

C. Format:
   1. Cover page identifying project name, project number and descriptive title of contents. Divide the contents of the report into the below listed divisions:
      a. General Information
      b. Summary
      c. Air Systems
      d. Hydronic Systems
      e. Special Systems

D. Contents: Provide the following minimum information, forms and data:
   1. General Information: Inside cover sheet identifying Test and Balance Agency, Contractor, Architect, Engineer, Project Name and Project Number. Include addresses, contact names and telephone numbers. Also include a certification sheet containing the seal and signature of the Test and Balance Supervisor.
   2. Summary: Provide summary sheet describing mechanical system deficiencies. Describe objectionable noise or drafts found during testing, adjusting and balancing. Provide recommendations for correcting unsatisfactory performances and indicate whether modifications required are within the scope of the contract, are design related or installation related. List instrumentation used during testing, adjusting and balancing procedures.

3. The remainder of the report to contain the appropriate standard NEBB, AABC, or TABB forms for each respective item and system. Fill out forms completely. Where information cannot be obtained or is not applicable indicate same.

PART 2 PRODUCTS

2.1 INSTRUMENTATION

A. Provide all required instrumentation to obtain proper measurements. Application of instruments and accuracy of instruments and measurements to be in accordance with the requirements of NEBB, AABC, or TABB Standards and instrument manufacturer's specifications.

B. All instruments used for measurements shall be accurate, and calibration histories for each instrument to be available for examination by A/E upon request. Calibration and maintenance of all instruments to be in accordance with the requirements of NEBB, AABC, or TABB Standards

PART 3 EXECUTION

3.1 DAILY REPORTS

A. Submit to Owners Project Representative, when requested, daily work activity reports for each day on which testing and balancing work is performed. Reports shall include description of day's activities and description of any system deficiencies.

3.2 PRELIMINARY PROCEDURES

A. Review preconstruction meeting report, applicable construction bulletins, applicable change orders and approved shop drawings of equipment, outlets/inlets and temperature controls.

B. Check filters for cleanliness, dampers and valves for correct positioning, equipment for proper rotation and belt tension, temperature controls for completion of installation and hydronic systems for proper charge and purging of air.

C. Notify Owners Project Representative on a daily basis during balancing. Identify deficiencies preventing completion of testing, adjusting and balancing procedures. Do not proceed until systems are fully operational with all components necessary for complete testing, adjusting and balancing. Installing Contractors are required to provide personnel to check and verify system completion, readiness for balancing and assist Balancing Agency in providing specified system performance.

3.3 EXISTING EQUIPMENT

A. The existing heat pump water system pumps (P-1 and P-2) shall be balanced to flows as indicated on drawings.

B. Each new heat pump shall be balanced to water and airflows scheduled. Each individual supply and return grille will not require balancing.

3.4 PERFORMING TESTING, ADJUSTING AND BALANCING

A. Perform testing, adjusting and balancing procedures on each system identified, in accordance with the detailed procedures outlined in the referenced standards except as may be modified below.

B. Unless specifically instructed in writing, all work in this specification section is to be performed during the normal workday.

C. In areas containing ceilings, remove ceiling tile to accomplish balancing work; replace tile when work is complete and provide new tile for any tile that are damaged by this procedure. If the ceiling construction is such that access panels are required for the work of this section and the panels have not been provided, inform the owner's project representative.

D. Cut insulation, ductwork and piping for installation of test probes to the minimum extent necessary for adequate performance of procedures. Patch using materials identical to those removed, maintaining vapor barrier integrity and pressure rating of systems.

E. In air systems employing filters, blank off sufficient filter area to simulate a pressure drop that is midway between that of a clean filter and that of a dirty filter.

F. Measure and record system measurements at the fan and/or pump to determine total flow. Adjust equipment as required to yield specified total flow at terminals. Proceed taking measurements in mains and branches as required for final terminal balancing. Perform terminal balancing to specified flows balancing branch dampers, deflectors, extractors and valves prior to adjustment of terminals.

G. Final air system measurements to be within the following range of specified cfm:
   1. Fans 0% to +10%
   2. Supply grilles, registers, diffusers 0% to +10%

H. Final water system measurements must be within the following range of specified gpm:
   1. Heat pump flow rates 0% to +5%

I. Contact the temperature control Contractor for assistance in operation and adjustment of controls during testing, adjusting and balancing procedures. Cycle controls and verify proper operation and setpoints. Include in report description of temperature control operation and any deficiencies found.

J. Permanently mark equipment settings, including damper and valve positions, control settings, and similar devices allowing settings to be restored. Set and lock memory stops.

K. Leave systems in proper working order, replacing belt guards, closing access doors and electrical boxes, and restoring temperature controls to normal operating settings.

3.5 HYDRONIC SYSTEM DIFFERENTIAL PRESSURE CONTROL SET POINT

A. For hydronic systems with variable speed pumping (Alternate Bid #2), determine the minimum required system differential pressure set point needed to ensure that all terminal devices are

operating at their design water flows with the most demanding terminals device control valve wide open. Provide the differential control setting set point to the DDC temperature control contractor and record them in the T&B report for each system.

B. For HVAC pumps valve throttling may be used for hydronic system balancing.

C. Throttling of triple-duty valves shall not exceed 50% closed. Where additional throttling would be necessary to achieve the system design flow the impellor shall be trimmed.

D. Verify Triple duty valve utilized on systems with Variable Frequency Drives are 100% open when balancing work is complete.

E. The pressure drop across triple duty valves shall not exceed 25 ft. w.g. Where additional throttling would be necessary to achieve the system design flow the impellor shall be trimmed.

3.6 DEFICIENCIES

A. Division 23 00 00 contractor to correct any installation deficiencies found by the test and balance agency that were specified and/or shown on the Contract Documents to be performed as part of that division of work. Test and balance agency will notify the A/E of these items and instructions will be issued to the Division 23 00 00 contractor for correction of the deficient work. All corrective work to be done at no cost to the Owner or A/E. Retest mechanical systems, equipment, and devices once corrective work is complete as specified.

END OF SECTION

SECTION 23 07 00

HVAC INSULATION

PART 1 GENERAL

1.1 SCOPE

A. This section includes insulation specifications for heating, ventilating and air conditioning piping, ductwork and equipment. Included are the following topics:
   1. Part 1 – General
      a. Scope
      b. Related Work
      c. Reference
      d. Reference Standards
      e. Quality Assurance
      f. Description
      g. Definitions
      h. Shop Drawings
      i. Operation and Maintenance Data
      j. Environmental Requirements
   2. Part 2 – Products
      a. Materials
      b. Insulation Types
      c. Adhesives, Mastics, Sealants, and Reinforcing Materials Jackets
      d. Insulation Inserts and Pipe Shields
      e. Accessories
   3. Part 3 – Execution
      a. Examination
      b. Installation
      c. Protective Jacket Installation
      d. Piping, Valve and Fitting Insulation
      e. Piping Protective Jackets
      f. Pipe Insulation Schedule
      g. Duct Insulation
      h. Ductwork Protective Coverings
      i. Duct Insulation Schedule

1.2 RELATED WORK

A. Section 23 05 00 - Common Work Results for HVAC

B. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment

C. Section 23 21 13 - Hydronic Piping

D. Section 23 31 00 - HVAC Ducts and Casings

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

A. ASTM International
1. ASTM B209 Aluminum and Aluminum Alloy Sheet and Plate
2. ASTM C165 Test Method for Compressive Properties of Thermal Insulations
3. ASTM C177 Heat Flux and Thermal Transmission Properties
4. ASTM C195 Mineral Fiber Thermal Insulation Cement
5. ASTM C240 Cellular Glass Insulation Block
6. ASTM C302 Density of Preformed Pipe Insulation
7. ASTM C272 Water Absorption of Core Materials for Sandwich Constructions
8. ASTM C303 Density of Preformed Block Insulation
9. ASTM C355 Test Methods for Test for Water Vapor Transmission of Thick Materials
10. ASTM C449 Mineral Fiber Hydraulic Setting Thermal Insulation Cement
11. ASTM C518 Heat Flux and Thermal Transmission Properties
12. ASTM C552 Cellular Glass Block and Pipe Thermal Insulation
13. ASTM C610 Expanded Perlite Block and Thermal Pipe Insulation
14. ASTM C612 Mineral Fiber Block and Board Thermal Insulation
15. ASTM C921 Properties of Jacketing Materials for Thermal Insulation
16. ASTM C1136 Flexible Low Permeance Vapor Retarders for Thermal Insulation
17. ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension
18. ASTM D1000 Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications
19. ASTM D1621 Standard Test Method for Compressive Properties Of Rigid Cellular Plastics
20. ASTM D1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics
21. ASTM D1940 Method of Test for Porosity of Rigid Cellular Plastics
22. ASTM D2126 Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
23. ASTM D2240 Standard Test Method for Rubber Property—Durometer Hardness
24. ASTM D5590 Test Method for Determining the Resistance of Coatings to Fungal Defacement
25. ASTM E84 Surface Burning Characteristics of Building Materials
26. ASTM E814 Standard Test Method for Fire Tests of Penetration Firestop Systems
27. ASTM E2336 Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems

B. MICA National Commercial & Industrial Insulation Standards

C. NFPA 225 Surface Burning Characteristics of Building Materials

D. UL 723 Surface Burning Characteristics of Building Materials

1.5 QUALITY ASSURANCE

A. Refer to division 1, General Conditions, Equals and Substitutions

B. Label all insulating products delivered to the construction site with the manufacturer's name and description of materials.

C. Insulation systems shall be applied by experienced contractors. Within the past five (5) years, the contractor shall be able to document the successful completion of a minimum of three (3) projects of at least 50% of the size and similar scope of the work specified in this section.

1.6 DESCRIPTION

A. Furnish and install all insulating materials and accessories as specified or as required for a complete installation. The following types of insulation are specified in this section:
1. Pipe Insulation
2. Duct Insulation

B. Install all insulation in accordance with the latest edition of MICA (Midwest Insulation Contractors Association) Standard and manufacturer's installation instructions. Exceptions to these standards will only be accepted where specifically modified in these specifications, or where prior written approval has been obtained from the A/E.

1.7 DEFINITIONS

A. Concealed: shafts, furred spaces, space above finished ceilings, utility tunnels and crawl spaces. All other areas, including walk-through tunnels, shall be considered as exposed.

1.8 SHOP DRAWINGS

A. Refer to division 1, General Conditions, Submittals.

B. Submit a schedule of all insulating materials to be used on the project, including adhesives, fastening methods, fitting materials along with material safety data sheets and intended use of each material. Include manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and manufacturer's installation instructions.

1.9 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Do not store insulation materials on grade or where they are at risk of becoming wet. Do not install insulation products that have been exposed to water.

B. Protect installed insulation work with plastic sheeting to prevent water damage.

PART 2 PRODUCTS

2.1 MATERIALS

A. Manufacturers: Armacell, CertainTeed, Manson, Childers, Dow, Extol, Fibrex, Halstead, Foster, Imcoa, Johns Manville, Knauf, Owens-Corning, , Pittsburgh Corning, , VentureTape or approved equal.

B. Materials or accessories containing asbestos will not be accepted.

C. Use composite insulation systems (insulation, jackets, sealants, mastics, and adhesives) that have a flame spread rating of 25 or less and smoke developed rating of 50 or less, with the following exceptions:
   1. Pipe insulation which is not located in an air plenum may have a flame spread rating not over 25 and a smoke developed rating no higher than 450 when tested in accordance with UL 723 and ASTM E84.

2.2 INSULATION TYPES

A. Insulating materials shall be fire retardant, moisture and mildew resistant, and vermin proof. Insulation shall be suitable to receive jackets, adhesives and coatings as indicated.

B. Flexible Fiberglass Insulation
   1. Minimum nominal density of 0.75 lbs. per cu. ft., and thermal conductivity of not more than 0.30 at 75 degrees F, rated for service to 250 degrees F.

C. Rigid Fiberglass Insulation
   1. Minimum nominal density of 3 lbs. per cu. ft., and thermal conductivity of not more than 0.23 at 75 degrees F, 0.25 at 125 degrees F, 0.27 at 150 degrees F, 0.29 at 200 degrees F, 0.32 at 250 degrees F, minimum compressive strength of 25 PSF at 10% deformation, rated for service to 450 degrees F.

2.3 ADHESIVES, MASTIC, SEALANTS, AND REINFORCING MATERIALS

A. Products shall be compatible with surfaces and materials on which they are applied, and shall be suitable for use at operating temperatures of systems to which they are applied.

B. Fiberglass Insulation Adhesive
   1. Must comply with ASTM C916, Type II: Foster 85-60, Childers CP-127, Duro Dyne SSG.

C. Vapor Retarding Mastic
   1. Below ambient equipment/piping insulation, mastic water vapor permeance shall be less than 0.03 perms at 45 mils dry film thickness per ASTM E 96: Foster 30-65 Vapor Fas, Childers CP-34,Vimasco 749.

D. Lagging Adhesive / Coatings
   1. Indoors applications used in conjunction with canvas/glass cloth: Foster 30-36, Childers CP-50 AMV1, Vimasco 713.

E. Reinforcing Mesh
   1. Foster 42-24 Mast A Fab, Childers Chil Glas #10 or Pittsburgh Corning PC 79.

F. Insulation Joint Sealant (cellular glass, polyisocyanurate, phenolic)
   1. Used on all below ambient piping to prevent moisture ingress. Foster 95-50 Flextra, Childers CP-76 Chil-Byl, Pittsburgh Corning CW Sealant.

2.4 JACKETS

A. PVC Fitting Covers And Jackets (PFJ)
   1. White PVC film, gloss finish one side, semi-gloss other side, FS LP-535D, Composition A, Type II, Grade GU. Ultraviolet inhibited indoor/outdoor grade to be used where exposed to high humidity, ultraviolet radiation, in kitchens or food processing areas or installed outdoors. Jacket thickness to be minimum .02” indoors/.03”outdoors for piping 12” and smaller, .03” indoors/.04” outdoors for piping 15” and larger.

B. All Service Jackets (ASJ)
   1. Heavy duty, fire retardant material with white kraft reinforced foil vapor retarding jacket, factory applied to insulation with a self-sealing pressure sensitive adhesive lap, maximum permeance of .02 perms and minimum beach puncture resistance of 50 units.

C. Foil Scrim All Service Jackets (FSJ)
   1. Glass fiber reinforced foil kraft laminate, factory applied to insulation. Maximum permeance of .02 perms and minimum beach puncture resistance of 25 units.

2.5 INSULATION INSERTS AND PIPE SHIELDS

A. Manufacturers: B-Line, Pipe Shields, Value Engineered Products.

B. Construct inserts with calcium silicate or polyisocyanurate (service temperatures below 300 degrees F only), minimum 140 psi compressive strength. Piping 12” and larger, supplement with high density 600 psi structural calcium silicate insert. Provide galvanized steel shield. Insert and shield to be minimum 180 degree coverage on bottom supported piping and full 360 degree coverage on clamped piping. On roller mounted piping and piping designed to slide on support, provide additional load distribution steel plate.

C. Where contractor proposes shop/site fabricated inserts and shields, submit schedule of materials, thicknesses, gauges and lengths for each pipe size to demonstrate equivalency to pre-engineered/premanufactured product described above. On low temperature systems, high density rigid polyisocyanurate may be substituted for calcium silicate provided insert and shield length and shield gauge are increased to compensate for lower insulation compressive strength.

D. Precompressed 20# density molded fiberglass blocks, Hamfab or equal, of the same thickness as adjacent insulation may be substituted for calcium silicate inserts with one 1”x6” block for piping through 2-1/2” and three 1”x6” blocks for piping through 4”. Submit shield schedule to demonstrate equivalency to pre-engineered/premanufactured product described above.

E. Wood blocks will not be accepted.

2.6 ACCESSORIES

A. All products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at operating temperatures of the systems to which they are applied.

B. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.

C. Insulation bands to be 3/4 inch wide, constructed of aluminum or stainless steel. Minimum thickness to be 0.015 inch for aluminum and 0.010 inch for stainless steel.

D. Tack fasteners to be stainless steel ring grooved shank tacks.

E. Staples to be clinch style.

F. Insulating cement to be ANSI/ASTM C195, hydraulic setting mineral wool.

G. Finishing cement to be ASTM C449.

H. Fibrous glass or canvas fabric reinforcing used with lagging adhesive shall have a minimum untreated weight of 6 oz./sq. yd.

I. Joint sealants and metal jacketing sealants to be non-shrinking and permanently flexible.

J. Vapor retarding coatings to have maximum applied water vapor permeance of 0.03 perms or less at 45 mils dry as tested by ASTM E96.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that all piping, equipment, and ductwork are tested and approved prior to installing insulation. Do not insulate systems until testing and inspection procedures are completed.

B. Verify that all surfaces are clean, dry and without foreign material before applying insulation materials.

3.2 INSTALLATION

A. All materials shall be installed by skilled labor regularly engaged in this type of work. All materials shall be installed in strict accordance with manufacturer’s recommendations, building codes, and industry standards. Do not install products when the ambient temperature or conditions are not consistent with the manufacturer’s recommendations. Surfaces to be insulated must be clean and dry.

B. Locate insulation and cover seams in the least visible location. All surface finishes shall be extended in such a manner as to protect all raw edges, ends and surfaces of insulation.

C. Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Provide neatly beveled and coated terminations at all nameplates, uninsulated fittings, or at other locations where insulation terminates.

D. Install fabric reinforcing without wrinkles. Overlap seams a minimum of 2 inches.

E. Use full length material (as delivered from manufacturer) wherever possible. Scrap piecing of insulation or pieces cut undersize and stretched to fit will not be accepted.

F. All pipe and duct insulation shall be continuous through walls, ceiling or floor openings and through sleeves except where firestop or firesafing materials are required. Vapor retarding jacket shall be maintained continuous through all penetrations.

G. Provide a continuous unbroken moisture vapor retarding jacket on insulation applied to systems noted below. Attachments to cold surfaces shall be insulated and vapor sealed to prevent condensation.

H. Provide a complete vapor retarding jacket for insulation on the following systems:
   1. Insulated Duct

3.3 PROTECTIVE JACKET INSTALLATION

A. PVC Fitting Covers And Jackets (PFJ)
   1. Lap seams and joints a minimum of 2 inches and continuously seal PVC with welding solvent recommended by jacket manufacturer. Lap slip joint ends 4" without fasteners where required to absorb expansion and contraction. For sections where vapor retarding jacket is not required and jacket requires routine removal, tack fasteners may be used. Secure PVC fitting covers with tack fasteners. For systems requiring a vapor retarding jacket, apply a 1-1/2” band of mastic over ends, throat, seams and penetrations.

B. All Service Jackets (ASJ) and Foil Scrim All Service Jackets (FSJ)
   1. Install according to manufacturer’s recommendations using factory supplied lap seals and butt strip seals.

3.4 PIPING, VALVE, AND FITTING INSULATION

A. General
   1. Install insulation with butt joints and longitudinal seams closed tightly. Provide minimum 2” lap on jacket seams and 2” tape on butt joints, firmly cemented with lap adhesive unless otherwise noted. Additionally secure with staples along seams and butt joints.
   2. On systems requiring a vapor retarding jacket, seal off all raw ends of insulation and butt joints with vapor retarding mastic at intervals of not more than 20 feet on piping. Coat staples, longitudinal and transverse seams with vapor retarding mastic and on systems requiring vapor retarding jacket, coat insulated elbows, fittings, and valves with vapor retarding mastic.

3. Install insulation continuous through pipe hangers and supports with hangers and supports on the exterior of insulation. Where a vapor retarding jacket is not required or where roller hangers are not being used, hangers and supports may be attached directly to piping with insulation completely covering hanger or support and jacket sealed at support rod penetration. Where riser clamps are required to be attached directly to piping requiring vapor retarding jacket, extend insulation and vapor retarding jacketing/coating around riser clamp.
4. Where insulated piping is installed on hangers and supports, the insulation shall be installed continuous through the hangers and supports. High density inserts shall be provided as required to prevent the weight of the piping from crushing the insulation. Pipe shields are required at all support locations. The insulation shall not be notched or cut to accommodate the supporting channels.

B. Insulation Inserts And Pipe Shields
1. Provide pipe shields at all hanger and support locations. Rigid insulation inserts shall be installed between the pipe and the insulation shields. Quantity and placement of inserts shall be according to the manufacturer's installation instructions, however the inserts shall be no less than 12" in length. Inserts shall be of equal thickness to the adjacent insulation and shall be vapor sealed as required for system.
2. Provide insulation inserts and pipe shields at all hanger and support locations. Inserts may be omitted on 3/4" and smaller copper piping provided 12" long 22 gauge pipe shields are used.

3.5 PIPE INSULATION SCHEDULE

A. Provide insulation on new and existing remodeled piping as indicated in the following schedule:

SERVICE	INSULATION	JACKET	INSULATION THICKNESS BY PIPE SIZE				
			< 1"	1" to < 1-1/2"	1-1/2" to < 4"	4" to < 8"	8" and Larger
Cooling Coil Condensate Drain	Rigid Fiberglass	ASJ	0.5"	0.5"	1"	1"	1"

3.6 DUCT INSULATION

A. General
1. Secure flexible duct insulation on sides and bottom of ductwork over 24" wide and all rigid duct insulation with weld pins. Space fasteners 18" on center or less as required to prevent sagging.
2. Secure rigid board insulation to ductwork with weld pins. Apply insulation with joints firmly butted as close as possible to the equipment surface. Pins shall be located a maximum of 3" from each edge and spaced no greater than 12" on center.
3. Install weld pins without damage to the interior galvanized surface of the duct. Clip pins back to washer and cover penetrations with tape of same material as jacket. Firmly butt seams and joints and cover with 4" tape of same material as jacket. Seal tape with plastic applicator and secure with staples. All joints, seams, edges and penetrations to be fully vapor sealed with vapor retarding mastic.
4. Stop and point insulation around access doors and damper operators to allow operation without disturbing insulation or jacket material.

5. Where insulated ductwork is supported by trapeze hangers, the insulation shall be installed continuous through the hangers. Drop the supporting channels required to facilitate the installation of the insulation. Where rigid board or flexible insulation is specified, install high density inserts to prevent the weight of the ductwork from crushing the insulation.

3.7 DUCT INSULATION SCHEDULE

A. Provide duct insulation on new and existing remodeled ductwork in the following schedule:

SERVICE	INSULATION TYPE	JACKET	THICKNESS
Mixed air ducts	Rigid Fiberglass	FSJ	2"
Concealed supply ducts	Flexible Fiberglass	FSJ	2.2"

END OF SECTION

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SECTION 23 09 23

DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.1 SCOPE

A. The existing building utilizes both a Johnson Controls (JCI) and Distech direct digital control (MC) systems. This project consists of:
   (MCI) Air to Water Source Heat Pump Replacement (Base Bid)
      a. Remove 34 existing air to water source heat pumps, associated Johnson Controls (JCI) DDC controllers and thermostats. Replace with new air to water source heat pumps, Distech DDC controllers and wall mounted thermostat.
      b. Integrate control of heat pumps from JCI DDC system to Distech DDC system.
   (MCII) Variable Frequency Drive Installation (Alternate Bid #2)
      a. Installation of (2) new variable frequency drives and associated controls to control (2) existing in-line water circulation pumps.
      b. Integrate control of heat pumps from JCI DDC system to Distech DDC system.
   (MCIII) Existing Boiler and In-Line Pump Control Migration (Alternate Bid #3)
      a. Migrate direct digital control of (2) existing boilers from the existing JCI building automaton system to the existing Distech building automation system.
      b. Dane County will demolish the existing JCI control panels within the mechanical room.

B. All systems shall be integrated into the Distech DDC system.

C. All new controllers, control wiring and temperature control valves shall follow current Fen Oak Center and Dane County protocols to provide County and building continuity in regards to controllers, wiring and equipment.

D. Work in this section includes Direct Digital Control (DDC) panels, main communication trunk, software programming, and other equipment and accessories necessary to constitute a complete Direct Digital Control (DDC) system.
   1. Part 1 – General
      a. Scope
      b. Related Work
      c. Reference
      d. Reference Standards
      e. Quality Assurance
      f. Submittals
      g. Operation and Maintenance Data
      h. Material Delivery and Storage
      i. Demolition
      j. Design Criteria
   2. Part 2 – Products
      a. General
      b. Current Status Switches
      c. Pressure Transducers

d. Differential Pressure Switches
e. Power Supplies
f. Local Control Panels
g. Networking/Communications
h. BACnet Requirements
i. Supervisory Controllers
j. Software License Agreement
k. System Software Features
l. Programmable Controllers
m. Application Specific Controllers – HVAC
n. Operator Interface Requirements
o. Web Based HTML Browser Interface

3. Part 3 – Execution
   a. General
   b. Installation
   c. Differential Pressure Switches
   d. Current Status Switches
   e. BAS Graphics
   f. Sequences of Control
   g. Training
   h. Points List

1.2 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.

B. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC – Coordination

C. Division 23 - HVAC - Equipment provided to be controlled or monitored

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

A. FCC Part 15, Subpart J, Class A - Digital Electronic Equipment to Radio Communication Interference

1.5 QUALITY ASSURANCE

A. Manufacturer:
   1. Approved manufacturer is Distech.

B. Installer:
   1. Acceptable installers are:
      a. CBRE – ESI
         3410 Gateway Rd
         Brookfield, WI 53045

Attn: Jerry Gitlewski

b. Mechanical Technologies Inc.
701 Morely Rd
Green Bay, WI 54303
Attn: Mike van Zeeland

C. Response Time
1. During warrantee period, four (4) hours or less, 24-hours/day, 7 days/week.

D. Electrical Standards
1. Provide electrical products, which have been tested, listed and labeled by Underwriters' Laboratories (UL) and comply with NEMA standards.

E. DDC Standards
1. DDC manufacturer shall provide written proof with shop drawings that the equipment being provided is in compliance with F.C.C. rules governing the control of interference caused by Digital Electronic Equipment to Radio Communications (Part 15, Subpart J, Class A).

1.6 SUBMITTALS

A. Include the following information:
1. Details of construction, layout, and location of each temperature control panel within the building, including instruments location in panel and labeling. Indicate which piece of mechanical equipment is associated with each controller and what area within the building is being served by that equipment. For terminal unit control, provide a room schedule that would list mechanical equipment tag, room number of space served, address of DDC controller, and any other pertinent information required for service.
2. Product Data
a. Submit manufacturer's specifications for each control device furnished, including installation instructions and startup instructions. General catalog sheets showing a series of the same device is not acceptable unless the specific model is clearly marked. Annotated software program documentation shall be submitted for system sequences, along with descriptive narratives of the sequence of operation of the entire system involved. Submit wiring diagram for each electrical control device along with other details required to demonstrate that the system has been coordinated and will function as a system.
3. Maintenance Data
a. Submit maintenance data and spare parts lists for each control device. Include this data in maintenance manual.
4. Record Drawings
a. Prior to request for final payment provide complete composite record drawings to incorporate the DDC and Pneumatic/Electric field work. All software addressing for device communication shall be noted for all devices provided under this section and the communication addressing required for devices provided by others that are integrated into the direct digital control system provided under this section. Point to point routing of communication trunks and power wiring between DDC controllers, DDC communication devices, control panels, and Ethernet switches shall be documented. Coordinate with the supplier of the equipment specified to be interfaced through digital communications for communication addressing. Provide circuit number of 120VAC

panel power circuit(s) feeding each control panel on record drawings. Label circuit number(s) inside the panel served.

1.7 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.8 MATERIAL DELIVERY AND STORAGE

A. Provide factory shipping cartons for each piece of equipment and control device. This contractor is responsible for storage of equipment and materials inside and protected from the weather.

1.9 DEMOLITION

A. Where existing control devices, piping, or wiring are discontinued from use, remove and turn over to owner. If owner does not want them remove from premises. Remove any previously abandoned control devices in a similar manner.

1.10 DESIGN CRITERIA

A. Size all control apparatus to properly supply and/or operate and control the apparatus served.

B. Provide control devices subject to corrosive environments with corrosion protection or construct them so they are suitable for use in such an environment.

C. Provide devices exposed to outside ambient conditions with weather protection or construct them so they are suitable for outdoor installation.

D. Use only UL labeled products that comply with NEMA Standards. Electrical components and installation to meet all requirements of the NEC.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide DDC control products in sizes and of capacities as required, conforming to manufacturer's standard materials and components as published in their product information, designed and constructed as recommended by the manufacturer and as required for application indicate.

B. System shall be capable of operating with 120 VAC power supply, fully protected with a shutdown-restart circuit, and associated hardware and software.

2.2 CURRENT STATUS SWITCHES

A. Provide a current sensor with adjustable threshold and digital output with LED display, equal to a Veris model H-708/H-904. Threshold adjustment must be by a multi-turn potentiometer or set by

multiprocessor that will automatically compensate for frequency and amperage changes associated with variable frequency drives. When used on variable speed motor applications, use a current sensor that will not change state due to varying speeds.

2.3 PRESSURE TRANSDUCERS

A. Provide a transmitter that utilizes capacitive or thin film strain gauge sensing. Provide for an analog gauge piped in parallel with the transducer. Gauge shall meet specifications as specified in Section 23 05 15. Coordinate with mechanical contractor to provide and install this gauge. For differential pressure applications provide with bypass valve manifold assembly with valved venting capability.

1.	Accuracy (including non-linearity and hysteresis)	± 0.5% FS
2.	Compensated Temperature Range	32°-150° F
3.	Temperature Effect (over compensated range)	0.03%/°F
4.	Output	4-20 MA
5.	Load Impedance (smallest maximum acceptable)	600 Ω Minimum
6.	Operating Temperature	0°-175° F
7.	Hysteresis	0.75% of span

2.4 DIFFERENTIAL PRESSURE SWITCHES

A. Differential pressure switches shall sense both inlet and outlet of fans and pumps. Device shall be rated for 150% of maximum system pressures that may be encountered. Provide with pressure differential that will be required to meet specified operation and/or to prevent nuisance “toggling” of the device in the system served. For static pressure sensing, use gasketed metal static pressure sensors for insertion into fan housing and ductwork. Mamac A-520 or equal.

2.5 POWER SUPPLIES

A. Provide all required power supplies for transducers, sensors, transmitters and relays. All low voltage transformers shall have a resettable secondary circuit breaker and be listed as class 2 power supplies.

2.6 LOCAL CONTROL PANELS

A. Existing control panels within the mechanical room shall be used.

B. Provide new control panels as required in mechanical room if existing control panels are not adequate.

C. Use control panels with suitable mounting brackets for each supply fan system. Locate panel adjacent to system served.

D. Provide UL listed cabinets for use with line voltage devices.

E. Control panels that have devices or terminations that are fed or switch 50V or higher shall enclose the devices, terminations, and wiring so that Personal Protective Equipment (PPE) is not required to service the under 50V devices and terminations within the control panel. As an alternative, a separate panel for only the 50V and higher devices may be provided and mounted adjacent to the

under 50V control panel. For DDC controllers that are directly fed by 120VAC, provide an externally mounted 120VAC, 5A fast blow fuse to feed these controllers.

F. Plastic control enclosures will be approved provided all conduits are bonded and grounded.

G. Provide terminal unit equipment enclosures with removable cover for all terminal units located in exposed ceilings or in mechanical rooms that completely enclose the DDC controller and allow for conduit terminations.

H. All wiring for controllers shall be managed in a neat and workmanlike manner.

I. Permanently label all controls; tag all control wiring, and document both on control drawings.

2.7 NETWORKING/COMMUNICATIONS

A. The design of the DDC shall be networked. The highest level networking shall use Ethernet and the sub-level networking shall use serial communications. Inherent in the system's design shall be the ability to expand or modify the highest network either via a local area network (LAN), wide area network (WAN), or a combination of the two schemes.

B. The highest-level DDC communications network shall be capable of direct connection to and communication with a high-speed LAN or WAN utilizing an Ethernet connection.

C. The supervisory controller shall directly oversee a local network such that communications may be executed directly to and between programmable controllers and ASC's. All operator devices, either network resident or connected via dial-up modems, shall have the ability to access all points and application reports on the network.

D. Provide serial communication ports on all ASC's for operator's terminal communications with the DDC Controller.

E. Access to system data shall not be restricted by the hardware configuration of the DDC system.

F. Global data sharing or global point broadcasting shall allow point data to be shared between programmable controllers and ASC's when it would be impractical to locate multiple sensors.

G. Network design shall include the following provisions:
1. Data transfer rates for alarm reporting and quick point status from multiple programmable controllers and ASC's. The minimum baud rate shall be 9600 baud.
2. Support of any combination of programmable controllers and ASC's. A minimum of 32 programmable controllers and ASC's shall be supported on a single local network. The buss shall be addressable for up to 32 ASC's.
3. Detection of single or multiple failures of ASC's or the network media.
4. Error detection, correction, and re-transmission to guarantee data integrity.
5. Use commonly available, multiple-sourced, networking components.
6. Use of an industry standard communication transport, such as, ARCNET, Ethernet, and IEEE RS-485 communications interface.

2.8 BACNET REQUIREMENTS

A. BACnet of highest level network communications shall be capable of BACnet/IP over Ethernet and field level communications shall utilize BACnet MSTP.

B. All controllers shall provide a Protocol Implementation Conformance Statement (PICS) and BACnet Interoperability Building Blocks (BIBB"S) as required by the American National Standards Institute/American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ANSI/ASHRAE) Standard 135-2001, BACnet protocol.

C. In general all devices shall support the following:
   1. Segmentation Capability
   2. Segmentation requests supported
   3. Segmentation responses supported

D. Standard Object Types Supported
   1. Analog input
   2. Analog output
   3. Analog value
   4. Binary input
   5. Binary output
   6. Binary value
   7. Calendar
   8. Device
   9. Event enrollment
   10. Group
   11. Multistate input
   12. Multistate output
   13. Multistate value
   14. Notification class
   15. Schedule

E. Character Sets supported
   1. ANSI X3.4
   2. ISO 10646 Universal Character Set-2

F. All highest level networked supervisory devices shall support the following:
   1. Data Link Layer Option
      a. BACnet Internet Protocol (IP) (Annex J)

G. Networking Options
   1. BACnet/IP Broadcast Management Device (BBDM)

H. BACnet object name and description shall match the existing naming conventions used by the state Agency for their existing Building Automation System. Coordinate with Agency control personnel to establish the naming conventions prior to programming of any controllers provided under this specification section. All controllers shall have object names, descriptions, and engineering units that are writable at the controller level and shall be programmed so that the object names, descriptions, and engineering units match the desired naming standards as specified

above. Ensure that the BACnet object attributes for object name, object description, engineering units and other required attributes will be transferred through to the Supervisory Controller when the auto-discovery function is executed.

I. Coordinate BACnet device instance numbering with the agency facility personnel for controllers provided under this Section that are being connected to an existing building automation system. This contractor shall be responsible for correcting any conflicts with existing devices that may occur or changing the device instance numbers to comply to follow the agency BACnet device instance numbering scheme.

2.9 SUPERVISORY CONTROLLERS

A. Supervisory controllers shall be microprocessor-based, multi-tasking, multi-user and digital control processors.

B. If the system being provided is Niagara based, it shall be provided with open connectivity to any manufacturers BACnet programmable or application specific direct digital controllers. These controllers shall be JACE 8000 series models or the identical hardware private label equivalent. The programmable controllers and application specific controllers provided under this Section shall be able to be programmed by their respective engineering software application tools through the Niagara based supervisory controllers from the Ethernet level network. The engineering software application tools shall be able to be loaded on a personal computer with Ethernet connectivity and no additional hardware shall be required to connect to and download any programmable or application specific controller.

C. The contractor shall provide all labor to build the supervisory controller database in conjunction with and under the supervision of the Agency control personnel. Naming conventions, database structure, and global application strategies shall be reviewed and approved by the Agency control personnel before implementation.

D. Each supervisory controller shall have sufficient memory to support its own operating system and databases including:
1. Control processes
2. Energy management application
3. Alarm management
4. Trend data
5. Maintenance support applications
6. Operator I/O
7. Dial-up communications
8. Manual override monitoring

E. The system shall be modular in nature, and shall permit easy expansion through the addition of field controllers, sensors, and actuators.

F. Supervisory controllers shall provide at least two RS-232C or USB serial communication ports or Ethernet ports for simultaneous operation of multiple operator I/O devices, such as laptop computers, personal computers, and video display terminals.

G. Supervisory controllers shall monitor the status of all overrides and include this information in the logs and summaries to inform the operator that automatic control has been inhibited.

H. Each supervisory controller shall continuously perform self-diagnostics, communications diagnostics, and diagnostics of all subsidiary equipment. Supervisory controllers shall provide both local and remote annunciation of any detected component failures, or repeated failure to establish communication. Indication of the diagnostic results shall be provided at each supervisory controller.

I. Isolation shall provide at all network terminations, as well as all field point terminations, to suppress induced voltage transients consistent with IEEE Standard 587-1980. Isolation levels shall be sufficiently high to allow all signal wiring to be run in the same conduit as high voltage wiring acceptable by electrical code.

J. In the event of the loss of normal power, there shall be an orderly shutdown of the supervisory controller to prevent the loss of data base or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data, and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.

K. Upon restoration of normal power, the supervisory controller shall automatically resume full operation without manual intervention.

L. Should supervisory controller memory be lost for any reason, the supervisory controller shall have the capability of reloading it's programming via high speed local area network from the control system archive workstation or server, the local RS-232C port, or telephone line dial-in.

2.10 SOFTWARE LICENSE AGREEMENT

A. For Niagara based systems, it is the express goal of this specification to implement an open system that will allow products from various suppliers to be integrated into a unified system in order to provide flexibility for expansion, maintenance, and service of the system. The user Agency shall be the named license holder of all software associated with any and all incremental work on the project(s). All Niagara software licenses shall have the "accept.station.in=*"; "accept.station.out=*" and "accept.wb.in=*" and "accept.wb.out=*" section of the software licenses. The intent is to ensure that the installed Niagara products may be completely open for integrations. The user Agency shall be free to direct the modification of the any software license, regardless of supplier. In addition, the user Agency shall receive ownership of all job specific software configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and /or configured for use within Niagara Framework (Niagara) based controllers and/or servers and any related LAN / WAN / Intranet and Internet connected routers and devices. Any and all required Ids and passwords for access to any component or software program shall be provided to the user Agency. Provide all software necessary for developing software algorithms in all supervisory, programmable, and application specific direct digital controllers which is licensed to the owner

B. Programming tools for programmable and application specific controllers that utilize the Niagara Framework shall not be restricted to any specific brand of Jace. Tools and controllers shall be able to connect to any brand of Jace that are provided under this specification Section.

2.11 SYSTEM SOFTWARE FEATURES

A. All necessary software to form a complete operating system, as described in this specification, shall be provided as an integral part of the supervisory controller, and shall not be dependent upon higher level computer for execution.

B. Control software shall include a provision for limiting the number of times that each piece of equipment may be cycled within any one-hour period.

C. The system shall provide protection against excessive demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.

D. Supervisory controllers shall have the ability to perform any or all of the following energy management routines:
   1. Time of day scheduling
   2. Calendar based scheduling
   3. Holiday scheduling
   4. Optimal start
   5. Optimal stop
   6. Demand limiting
   7. Load rolling
   8. Heating/cooling interlock

E. All programs to be executed automatically without the need for operator intervention, and be flexible enough to allow user customization. Programs shall be applied to building equipment described in Section 23 09 93 of this specification.

F. Supervisory controllers shall be able to execute configured processes defined by the user to automatically perform calculations and control routines.

G. It shall be possible to use any of the following in a configured process:
   1. Any system-measured point data or status
   2. Any calculated data
   3. Any results from other processes
   4. Boolean logic operators (and, or)

H. Configured processes may be triggered based on any combination of the following:
   1. Time of day
   2. Calendar date
   3. Other processes
   4. Events (e.g., point alarms)

I. A single process shall be able to incorporate measured or calculated data from any and all other ASC's.

J. A single process shall be able to issue commands to points in any and all other programmable controllers and ASC's on the local network.

K. Alarm management shall be provided to monitor, buffer, and direct alarm reports to operator devices and memory files. Each supervisory controller shall perform distributed; independent alarm analysis and filtering to minimize network traffic and prevent alarms from being lost. At no time shall the ability of supervisory controllers to report alarms be affected by either operator activity at the local I/O device or communications with other ASC's on the network.

L. All alarm or point change reports shall include the English language description of each point and the time and date of the occurrence.

M. The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of three priority levels shall be provided. Users shall have the ability to manually inhibit alarm reporting for each point.

N. The user shall also be able to define conditions under which point changes need to be acknowledged by an operator and/or logged for analysis at a later date.

O. Alarms reports and messages shall be directed to an operator device.

P. In addition to the point's descriptor and the time and date, the user shall be able to print, display or store a 60-character alarm message to more fully describe the alarm condition or direct operator response.

Q. Each supervisory controller shall be capable of storing a library of at least 100 messages. Each message may be assignable to any number of points in the panel.

R. A data collection utility shall be provided to automatically sample, store, and display system data.

S. Measured and calculated analog and binary data shall be assignable to user definable trends for the purpose of collecting operator specified performance data over extended periods of time. Sample intervals of 1 minute to 24 hours, in one minute or one hour intervals, shall be provided. Each supervisory controller shall have a dedicated buffer for trend data and shall be capable of storing 16 trend logs. Each trend log shall have up to four points trended at 48 data samples each. Data shall be stored at the supervisory controller and up-loaded to the DDC system server when archiving is desired.

T. Supervisory controllers shall automatically accumulate and store runtime hours for binary input and output points specified in Section 23 09 14 of this specification.

U. Supervisory controllers shall automatically sample, calculate and store consumption totals on a daily, weekly, or monthly basis, user defined, for user-selected analog and binary pulse input type points.

V. Totalization shall provide calculation and storage accumulations of up to 9,999,999 units (e.g., KWH, gallons KBTU, tons, etc.).

W. The totalization routine shall have a sampling resolution of one minute.

X. The user shall have the ability to define a warning limit. Unique, user specified messages shall be generated when the limit is reached.

Y. The information available from pulse totalization shall include, but not be limited to, the following:
1. Peak demand, with date and time stamp
2. 24-hour demand log
3. Accumulated KWH for day
4. Sunday through Saturday KWH usage
5. Demand KW annual history for past 12 periods
6. KWH annual history for past periods

Z. Supervisory controllers shall have the ability to count events, such as the number of times a pump or fan system is cycled on and off.

AA. The event totalization feature shall be able to store the records associated with a minimum of 9,999,999 events before reset.

2.12 PROGRAMMABLE CONTROLLERS

A. Programmable controllers shall be provided with a software program that shall allow the user to design flexible software algorithms for the control sequences as described in Sections 23 09 14 and 23 09 93 portions of this specification.

B. Programmable controllers shall support all necessary point inputs and outputs to perform the specified control sequence in a totally stand-alone fashion.

C. Each programmable controller shall perform its own limit and status monitoring and analysis to maximize network performance by reducing unnecessary communications.

D. Each programmable controller shall support the use of a locally mounted status and adjust panel interface to allow for the local adjustment of all setpoints, temporary override of any input or output points and status of all points directly at the controller. The capabilities of the locally mounted status and adjust panel shall include, but not be limited to, the following information for the programmable controllers to which:
1. Display temperatures
2. Display status
3. Display setpoints
4. Display control parameters
5. Override binary output control
6. Override analog output control
7. Override analog setpoints
8. Modification of gain and offset constants

E. All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the programmable controller.

F. Programmable controllers shall support, but not be limited to, the following configurations of systems to address current requirements as described in Sections 23 09 14 and 23 09 93 portions of this specification, and for future expansion of air handling units:
   1. Mixed air handling units
   2. Boiler plants with pump logic
   3. Generic system interlocking through hardware

2.13 APPLICATION SPECIFIC CONTROLLERS - HVAC APPLICATIONS

A. Each supervisory controller shall be able to extend its monitoring and control through the use of stand-alone application specific controllers (ASC's).

B. Each ASC shall operate as a stand-alone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a microprocessor based, multi-tasking, real-time digital control processor.

C. Each ASC shall have sufficient memory to support its own operating system and databases including:
   1. Control Processes
   2. Energy Management Applications
   3. Operator I/O (Portable Service Terminal)

D. The operator interface to any ASC point or program shall be through the supervisory controller connection to any ASC on the network.

E. ASC's shall directly support the temporary use of a portable service terminal that can be connected to the ASC via zone temperature or directly at the controller. The capabilities of the portable service terminal shall include, but not be limited to, the following information for the:
   1. Display temperatures
   2. Display status
   3. Display setpoints
   4. Display control parameters
   5. Override binary output control
   6. Override analog output control
   7. Override analog setpoints
   8. Modification of gain and offset constants

F. All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the ASC.

G. Terminal unit space sensors shall be provided with digital displays with setpoint adjustments and manual occupancy override and indication of occupancy status. Provide information to the AE on sensor colors offered by the manufacturer and obtain approval on what color should be provided on the project. Provide setpoint adjustment as specified in the DDC Input/Output Summary Table and sequence of operation

H. All system setpoints, proportional bands, control algorithms, calibration constants, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the ASC.

I. All application specific controllers shall be fully programmable. Question and answer or template programming is not acceptable unless this is used to generate the initial application program and the result is able to be freely modified without restriction. Control sequences for terminal unit control that utilize devices wired directly to the terminal unit application controller shall be programmed in the application specific controller and shall be stand-alone in function, i.e. occupancy sensing, temperature setpoint setback, etc. Supervisory controllers shall not be involved in the control sequence logic unless it involves sharing data between or from individual terminal unit controllers to be utilized in a global sequence, i.e. trim and respond strategies, terminal unit grouping, etc.

2.14 OPERATOR INTERFACE REQUIREMENTS

A. Graphic-Based Displays
1. Update the existing graphic based display to reflect new devices, points, etc.

2.15 WEB BASED HTML BROWSER INTERFACE

A. The existing web-based HTML browser interface shall be used.

PART 3 EXECUTION

3.1 GENERAL

A. All electronic work required as an integral part of the Direct Digital Control system work is the responsibility of this section.

B. This contractor shall provide all labor, materials, engineering, software, permits, tools, checkout and certificates required to install a complete Direct Digital Control system as herein specified.

C. Any and all points added with this project shall be grouped for display purposes into the system such that all points associated with a new or existing DDC system can appear together on the flat panel display or printed log. Assignment of points to a group shall not be restricted by hardware configuration of the points of direct digital control. It shall be possible to assign a point to appear in more than one system. An English descriptor and an alpha/numeric identifier shall identify each system.

D. This Direct Digital Control system as herein specified shall be fully integrated and completely installed by this section. It shall include all required computer CPU software and hardware. Include the engineering, installation, supervision, calibration, software programming, and checkout necessary for a fully operational system.

3.2 INSTALLATION

A. All work and materials are to conform in every detail to the rules and requirements of the National Electrical Code and present manufacturing standards. All wiring and cable installation shall conform with the wiring installation as specified in the installation section of Section 23 09 14. All material shall be UL approved.

B. Install system and materials in accordance with manufacturer's instructions, rough-in drawings and details on drawings.

C. Required line voltage wiring to power the DDC Controllers to be by this contractor.

D. Control panels serving equipment fed by emergency power shall also be served by emergency power.

E. Provide uninterruptable power supplies where necessary to provide proper startup of equipment or to accomplish power restart control sequences specified.

F. Mount control panels adjacent to associated equipment on vibration-free walls or free-standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and on cabinet face.

G. Provide as-built control drawings of all systems served by each local panel in a location adjacent to or inside of panel cover. Provide a protective cover or envelope for drawings.

H. Cable tray routing of the communication trunks is acceptable.

I. All tubing, cable and individual wiring is to be permanently tagged, with numbers corresponding with "Record Drawings", spares are to be labelled as "Spare".

J. Provide documentation to demonstrate that all points, input and output, have been checked out and verified operational, note any points not operating properly with notation of reason.

3.3 WIRE AND AIR PIPING CONDUIT AND TUBING INSTALLATION SCHEDULE

A. The following conduit schedule shall apply to both polyethylene tubing and wire in conduit where conduit is specified for air tubing or wiring. Conduit and tubing referenced below shall follow National Electrical Code and Local and State codes and as defined below.

B. Conduit other than that specified below for specific applications shall not be used.

C. Concealed Dry Interior Locations: Rigid steel conduit. Intermediate metal conduit. Electrical metallic tubing.

D. Exposed Dry Interior Locations: Rigid steel conduit. Intermediate metal conduit. Electrical metallic tubing.

3.4 DIFFERENTIAL PRESSURE SWITCHES

A. Provide for each fan or pump specified, or shown on point list. Provide shutoff valves at piping takeoff points. Readjust pressure and/or differential setpoints for proper operation after final balancing is completed.

3.5 CURRENT STATUS SWITCHES

A. Set threshold adjustment to indicate belt or coupling loss. Readjust threshold for proper operation after final balancing is completed. Use the variable frequency drive (VFD) integrated relay output for motor status, if provided on the VFD, in lieu of a discrete current switch. A separate current switch provided under this Section shall be wired in parallel with the VFD motor status relay when a bypass starter is provided on the VFD to prove motor status in the bypass mode.

3.6 BAS GRAPHICS

A. Update existing BAS system graphics and user interface to include new points, variable frequency drives, equipment, setpoints, sequences, etc.

3.7 SEQUENCES OF OPERATION

A. Air to Water Heat Pumps (New Heat Pumps)
   1. System consists of:
      a. New packaged air to water heat pump.
   2. Provide:
      a. New heat pump DDC controller.
      b. New wall mounted digital communicating thermostat (thermostat to match existing thermostats).
      c. New discharge air temperature sensor for communication to heat pump controller.
      d. All required relays and controls required.
      e. Existing control wiring can be reused. Provide new control wiring as required.
   3. Each heat pump to include:
      a. High condensate alarm switch (factory installed and wired by 23 81 46).
      b. 2 position heat pump supply water control valve (factory installed and wired by 23 81 46) (Alternate Bid #2 only).
   4. Heat pump control shall migrate from the existing JCI DDC system to the existing Distech DDC system.
   5. The BAS shall control the heat pump.
   6. Units shall be enabled/disabled (occupied/unoccupied) by the BAS.
   7. Occupied Mode
      a. During the occupied mode the fan shall be energized and run continuously.
      b. On a call for either heating or cooling, the unit mounted DDC controller shall open the 2-way isolation valve (Alternate Bid #2 only) and the unit, via unit controls shall provide heating or cooling to maintain space temperature setpoint.
      c. Upon satisfied setpoint, unit heating or cooling shall be disabled via unit controls and the 2-way isolation valve (Alternate Bid #2) shall close.

8. Unoccupied Mode
    a. During the unoccupied mode, the unit supply fan and heating/cooling shall be "off". On a call for setback or setup heating/cooling, the unit fan shall cycle on and unit heating/cooling shall be enabled to maintain setback/setup space temperature setpoint.

B. Heat Pump Loop Water Pumps P-1(E) and P-2(E) - **Alternate Bid #2**.
1. System consists of:
    a. Water pumps P-1(E) and P-2(E).
    b. New variable frequency drives (VFD-5 and VFD-6).
    c. New differential pressure sensor.
    d. Updated DDC controls.
2. Pump control shall migrate from the existing JCI DDC system to the Distech DDC system. Provide new local Distech controller.
3. Pumps shall continue to operate in a lead/lag sequence with 100% redundancy.
4. Start / Stop:
    a. One pump shall operate at all times (24/7/365) with the other pump serving as standby.
    b. The DDC shall monitor pumps at all times.
    c. The lead pump shall change weekly (adj.).
5. Lead / Lag Control:
    a. Current status switches, either integral to the VFD and/or discreet devices, shall prove lead and lag pump operation. If the lead pump is called to run and the current status switch indicates that the lead pump is not operating for 30 seconds (adj.), an alarm shall be sent to the operator interface and the DDC system shall start the lag pump. Upon sensing the lead pump is operating, the lag pump shall be stopped. The DDC system shall index the lag pump to become the lead pump through weekly scheduling feature of the building automation system.
6. Speed Control:
    a. Speed Control: Install a differential pressure sensor across the supply and return piping at the point in the system with the highest pressure drop as indicated on plans. The DDC system shall control the operating pump VFD to maintain a setpoint as described below.
    b. The operating pump VFD shall be modulated to maintain a constant setpoint of 10 psig (adj.) at the differential pressure sensor. Final setpoint shall be optimized by the Balancing Contractor.

C. Boiler (Existing) and Misc. Control Points – **Alternate #3**
1. The boiler system consists of a single high efficiency boiler.
2. As part of **Alternate #3**, the existing boiler control and points shall migrate from the existing JCI DDC system to the Distech DDC system. Provide local controller as required. See input/output summary table for list of existing points.
    a. Provide new heat pump water supply temperature sensor.
3. Provide the following new points, to be integrated into the Distech DDC system:
    a. Heat pump water return.

D. Fluid Cooler and Spray Pump (Existing)
1. There is no change to the existing fluid cooler and spray pump control sequence.

E. Energy Recovery Ventilator (Existing)
1. There is no change to the existing fluid cooler and spray pump control sequence.

3.8 TRAINING

A. Contractor to provide factory authorized representative and/or field personnel knowledgeable with the operations, maintenance and troubleshooting of the system and/or components defined within this section for a minimum period of 16 hours over (2) separate days.

B. Provide two follow-up visits for troubleshooting and instruction, one six months after substantial completion and the other at the end of the warranty period. Length of each visit to be not less than 4 hours or the time necessary to provide required information and complete troubleshooting and inspection activity for all controls installed under this project. Coordinate the visit with the owner and provide an inspection report to the owner of any deficiencies found.

END OF SECTION

DDC INPUT / OUTPUT SUMMARY TABLE

JDR Project No: 18.0036

PROJECT: Fen Oak Heat Pump Replacement

LOCATION: Madison, WI

SYSTEM: Air to Water Heat Pumps (Typical)

POINT DESCRIPTION	HARDWARE: OUTPUT: DIGITAL: Control Relay	Solenoid	Contactor	24 VAC	ANALOG: Tri-State Actuator	Duration Adjust Actuator	4-20 mA	0-10 VDC	INPUT: DIGITAL: Current Sensing Switch	Control Relay Contact	Switch Closure	Auxiliary Contact	Diff Pressure Switch	Flow Switch	ANALOG: Temperature	Relative Humidity	Differential Pressure	Actuator Feedback	Static Pressure	Flow	SOFTWARE: ALARMS: DIGITAL: Equipment Status	Maintenance	Pressure	ANALOG: High Limit	Low Limit	Maintenance	ENERGY MANAGEMENT SYSTEM FUNCTIONS: Day/Night Setback	Demand Limiting	Dial-up I/O	Duty Cycling	Optimum Start/Stop	Scheduled Start/Stop	Totalization	Trend	Redundancy Control	Lighting Integration	Fire Alarm Integration	Security/Access Integration	Elect PQM Integration	Chiller Integration	CFM Offset	HW/OA Reset	CHW Reset	Smoke Control	Fire Alarm Override	Comments
Zone Temperature Setpoint															X																															Existing Point/Migrate to Distech
Zone Temperature															X									X	X		X																			Existing Point/Migrate to Distech
Compressor Control	X																																												Existing Point/Migrate to Distech
Fan Enable	X																																												Existing Point/Migrate to Distech
Fan Status									X																																				Existing Point/Migrate to Distech
Reversing Valve Status												X																							X										Existing Point/Migrate to Distech
System Enable/Disable	X																															X	X												Existing Point/Migrate to Distech
Discharge Air Temperature															X									X	X									X										Existing Point/Migrate to Distech
General Heat Pump Alarm												X														X																			New Point

Notes:

DDC INPUT / OUTPUT SUMMARY TABLE

JDR Project No: 18.0036

PROJECT: Fen Oak Heat Pump Replacement	HARDWARE																				SOFTWARE																														
LOCATION: Madison, WI	OUTPUT									INPUT														ALARMS																													
	DIGITAL				ANALOG					DIGITAL							ANALOG							DIGITAL			ANALOG				ENERGY MANAGEMENT SYSTEM FUNCTIONS																									
P-1(E) and P-2(E)																																																			
POINT DESCRIPTION	Control Relay	Solenoid	Contactor	24 VAC	Tri-State Actuator	Duration Adjust Actuator	4-20 mA	0-10 VDC	Current Sensing Switch	Control Relay Contact	Switch Closure	Auxiliary Contact	Diff Pressure Switch	Flow Switch	Temperature	Resistive	Differential Pressure	Actuator Feedback	Static Pressure	Flow	Equipment Status	Maintenance	Pressure	High Limit	Low Limit			Day/Night Setback	Demand Limiting	Dial-up I/O	Duty Cycling	Optimum Start/Stop	Scheduled Start/Stop	Totalization	Trend	Redundancy Control	Lighting Integration	Fire Alarm Integration	Security/Access Integration	Elect PQM Integration	Chiller Integration	CFM Offset	HW/OA Reset	CHW Reset	Smoke Control	Fire Alarm Override	**Comments**
Pump P-1 (E) S/S	X																																																
Pump P-1 (E)Status									X												X										X	X																
Pump P-1 (E)VFD Speed								X																								X																
Pump P-1 (E)VFD Fault																						X																										
Pump P-2 (E)S/S	X																																															
Pump P-2 (E)Status									X												X										X	X																
Pump P-2 (E)VFD Speed								X																								X																
Pump P-2 (E)VFD Fault																						X																										

Notes:

DDC INPUT / OUTPUT SUMMARY TABLE

JDR Project No: 18.0036

PROJECT: Fen Oak Heat Pump Replacement	HARDWARE																				SOFTWARE																																
LOCATION: Madison, WI	OUTPUT									INPUT												ALARMS																																
	DIGITAL				ANALOG					DIGITAL							ANALOG							DIGITAL			ANALOG				ENERGY MANAGEMENT SYSTEM FUNCTIONS																												
Boiler and Misc Points																																																						
POINT DESCRIPTION	Control Relay	Solenoid	Contactor	24 VAC	Tri-State Actuator	Duration Adjust Actuator	4-20 mA	0-10 VDC	Current Sensing Switch	Control Relay Contact	Switch Closure	Auxiliary Contact	Diff Pressure Switch	Flow Switch	Temperature	Resistive	Differential Pressure	Actuator Feedback	Static Pressure	Flow	Equipment Status	Maintenance	Pressure	High Limit	Low Limit			Day/Night Setback	Demand Limiting	Dial-up I/O	Duty Cycling	Optimum Start/Stop	Scheduled Start/Stop	Totalization	Trend	Redundancy Control	Lighting Integration	Fire Alarm Integration	Security/Access Integration	Elect PQM Integration	Chiller Integration	CFM Offset	HW/OA Reset	CHW Reset	Smoke Control	Fire Alarm Override	**Comments**
Boiler Enable/Disable	X																																																		
Boiler Fault												X										X																														
2-Way TCV - HP Loop							X																																													
2-Way TCV - HP Loop							X																																													
Heat Pump Water Supply															X									X	X										X																	
Heat Pump Water Return															X									X	X										X																	

Notes:

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SECTION 23 21 13

HYDRONIC PIPING

PART 1 GENERAL

1.1 SCOPE

A. This section contains specifications for all HVAC hydronic pipe and pipe fittings for this project. Included are the following topics:
   1. Part 1 – General
      a. Scope
      b. Related Work
      c. Reference
      d. Reference Standards
      e. Shop Drawings
      f. Quality Assurance
      g. Delivery, Storage, and Handling
      h. Design Criteria
      i. Welder Qualifications
   2. Part 2 – Products
      a. Heat Pump Water (Indoor Piping Only)
      b. Cooling Coil Condensate
      c. Unions and Flanges
   3. Part 3 – Execution
      a. Erection
      b. Threaded Pipe Joints
      c. Copper Pipe Joints
      d. Water Systems
      e. Cooling Coil Condensate
      f. Unions and Flanges
      g. Fill and Vent

1.2 RELATED WORK

A. Section 23 05 15 - Piping Specialties

B. Section 23 05 23 - General-Duty Valves for HVAC Piping

C. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment

D. Section 23 07 00 - HVAC Insulation

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

A. ANSI B16.3 Malleable Iron Threaded Fittings

B. ANSI B16.4 Cast Iron Threaded Fittings

C. ANSI B16.5 Pipe Flanges and Flanged Fittings

D. ANSI B16.22 Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings

E. ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless

F. ASTM A74 Cast Iron Soil Pipe and Fittings

G. ASTM A105 Forgings, Carbon Steel, for Piping Components

H. ASTM A126 Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings

I. ASTM A181 Forgings, Carbon Steel for General Purpose Piping

J. ASTM A197 Cupola Malleable Iron

K. ASTM A234 Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

L. ASTM A380 Practice for Cleaning and Descaling Stainless Steel Parts, Equipment, and Systems

M. ASTM B75 Seamless Copper Tube

N. ASTM B88 Seamless Copper Water Tube

1.5 SHOP DRAWINGS

A. Refer to division 1, General Conditions, Submittals.

B. Contractor shall submit schedule indicating the ASTM specification number of the pipe being proposed along with its type and grade and sufficient information to indicate the type and rating of fittings for each service.

C. Type F Steel Pipe
1. Statement from manufacturer on his letterhead that the pipe furnished meets the ASTM specification contained in this section.

D. Type E or S Steel Pipe
1. Mill certification papers, also known as material test reports, for the pipe furnished for this project, in English. Heat numbers on these papers to match the heat numbers stenciled on the pipe. Chemical analysis indicated on the mill certification papers to meet or exceed the requirements of the referenced ASTM specification.

E. Copper Tube
   1. Statement from manufacturer on his letterhead that the pipe furnished meets the ASTM specification contained in this section.

1.6 QUALITY ASSURANCE

A. Order all Type E and Type S steel pipe with heat numbers rolled, stamped, or stenciled to each length or each bundle, depending on the size of the pipe, and in accordance with the appropriate ASTM specification.

B. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Promptly inspect shipments to insure that the material is undamaged and complies with specifications.

B. Cover pipe to eliminate rust and corrosion while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.

C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.

D. Storage and protection methods must allow inspection to verify products.

1.8 DESIGN CRITERIA

A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM specifications as listed in this specification.

B. Construct all piping for the highest pressures and temperatures in the respective system in accordance with ANSI B31, but not less than 125 psig unless specifically indicated otherwise.

C. Where ASTM A53 type F pipe is specified, ASTM A53 grade A type E or S, or ASTM A53 grade B type E or S may be substituted at Contractor's option. Where ASTM A53 grade A pipe is specified, ASTM A53 grade B pipe may be substituted at Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially available.

D. Where ASTM B88, type L hard temper copper tubing is specified, ASTM B88, type K hard temper copper tubing may be substituted at Contractor's option.

PART 2 PRODUCTS

2.1 HEAT PUMP WATER

A. 2" and Smaller: ASTM A53, type F, standard weight (schedule 40) black steel pipe with ASTM A126/ANSI B16.4, class 125, standard weight cast iron threaded fittings.

B. Contractor may use ASTM B88 seamless, type L, hard temper copper tube with ANSI B16.22 wrought copper solder-joint fittings in lieu of steel pipe for all sizes. Mechanically formed tee fittings may be used in lieu of wrought copper solder-joint tee fittings for branch takeoff up to one-half (1/2) the diameter of the main.

2.2 COOLING COIL CONDENSATE

A. ASTM B88, type L hard temper copper tubing with ASTM B145/ANSI B16.23 cast red bronze or ASTM B75/ANSI B16.29 wrought solder-type drainage fittings.

2.3 UNIONS AND FLANGES

A. 2" and Smaller: ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping. Use ANSI B16.18 cast copper alloy unions on copper piping. Use unions of a pressure class equal to or higher than that specified for the fittings of the respective piping service but not less than 250 psi.

PART 3 EXECUTION

3.1 ERECTION

A. Carefully inspect all pipe, fittings, valves, equipment and accessories before installation. Any items that are unsuitable, cracked or otherwise defective shall be rejected and removed from the job site immediately. Excluding minor surface rust, piping that exhibits significant oxidation or corrosion will be rejected.

B. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not erect or install any item that is not clean.

C. Remove all lose dirt, scale, oil, chips, burrs and other foreign material from the internal and external surfaces of all pipe and piping components prior to assembly, including debris associated with cutting, threading and welding.

D. During fabrication and assembly, remove slag and weld spatter from internal pipe surfaces at all joints by peening, chipping and wire brushing.

E. During construction, until system is fully operational, keep all openings in piping and equipment closed except when actual work is being performed on that item of the system. Use plugs, caps, blind flanges or other items designed for this purpose.

F. Furnish and install all flanges, caps, bypasses, drains, valves, etc. required to facilitate flushing and draining all heating and cooling system piping.

G. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.

H. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.

I. Mitered ells, notched tees, and orange peel reducers are not acceptable. On threaded piping, bushings are not acceptable.

J. "Weldolets" and "Threadolets" may be used for branch takeoffs up to one-half (1/2) the diameter of the main.

K. Install drains throughout the systems to permit complete drainage.

L. Install all valves, control valves, and piping specialties, including items furnished by others, as specified and/or detailed. Make connections to all equipment installed by others where that equipment requires the piping services indicated in this section.

3.2 THREADED PIPE JOINTS

A. Use a Teflon based thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

3.3 COPPER PIPE JOINTS

A. Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean fitting and tube with emery cloth or sandpaper. Remove residue from the cleaning operation, apply flux, and assemble joint. Use 95-5 solder or brazing to secure joint as specified for the specific piping service.

B. Where mechanically formed tee fittings are allowed, form mechanically extracted collars in a continuous operation, consisting of drilling a pilot hole and drawing out the tube surface to form a collar having a height of not less than three times the thickness of the tube wall. Use an adjustable collaring device. Notch and dimple the branch tube. Remove all debris created by the forming process from the inside of the pipe. Braze the joint, applying heat properly so that pipe and tee do not distort; remove distorted connections.

3.4 WATER SYSTEM

A. Run water mains level or pitch horizontal mains up 1 inch in 40 feet in the direction of flow. Install manual air vents at all high points where air may collect. If vent is not in an accessible location, extend air vent piping to the nearest code acceptable drain location with vent valve located at the drain.

B. Main branches and runouts to terminal equipment may be made at the top, top 45 degree, side, and/or bottom 45 degree of the main provided that there are drain valves suitably located for complete system drainage and manual air vents are located at all top and top 45 degree connections. Bottom connections are not acceptable unless approved by the DFD Mechanical Inspector.

C. Use top or top 45 degree connection to main for upfeed risers and bottom 45 degree connection to main for downfeed risers. Bottom connections are not acceptable unless approved by the DFD Mechanical Inspector.

D. Use a minimum of two elbows in each pipe line to a piece of terminal equipment to provide flexibility for expansion and contraction of the piping systems. Offset pipe connections at equipment to allow for service, such as removal of the terminal device.

E. Use eccentric fittings for changes in horizontal pipe sizes with the fittings installed for proper air venting. Concentric fittings may be used for changes in vertical pipe sizes.

3.5 COOLING COIL CONDENSATE

A. Trap each cooling coil drain pan connection with a trap seal of sufficient depth to prevent conditioned air from moving through the piping. Extend drain piping to nearest code approved drain location. Construct trap with plugged tee for cleanout purposes as detailed.

3.6 UNIONS AND FLANGES

A. Install a union or flange, as required, at each automatic control valve and at each piping specialty or piece of equipment which may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange or union connection on the equipment side of the valve. Concealed unions or flanges are not acceptable.

3.7 FILL AND VENT

A. Fill hydronic systems with appropriate working fluids as specified.

B. For closed piping systems, all air trapped at high points shall be relieved through the manual air vents prior to testing and balancing.

END OF SECTION

SECTION 23 31 00

HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.1 SCOPE

A. This section includes specifications for all duct systems used on this project. Included are the following topics:
   1. Part 1 – General
      a. Scope
      b. Related Work
      c. Reference
      d. Reference Standards
      e. Quality Assurance
      f. Shop Drawings
      g. Design Criteria
   2. Part 2 – Products
      a. General
      b. Ductwork Pressure Class
      c. Materials
      d. Low Pressure Ductwork (Maximum 2 inch pressure class)
      e. Duct Sealant
      f. Gaskets
   3. Part 3 – Execution
      a. Installation
      b. Low Pressure Duct (Maximum 2 inch pressure class)
      c. Cleaning

1.2 RELATED WORK

A. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC

B. Section 23 33 00 – Air Duct Accessories

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this Section.

1.4 REFERENCE STANDARDS

A. ASTM International
   1. ASTM B209 Specification for Aluminum and Aluminum-Alloy Sheet and Plate
   2. ASTM A90 Test Method for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles
   3. ASTM A167 Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
   4. ASTM A623 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
   5. ASTM A527 Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality
   6. ASTM 924 Standard Specification for General Requirements for Sheet Steel, Metallic-coated by the Hot-dip Method
   7. ASTM C 1071 Specification for Fibrous Glass Duct Lining Insulation

8. ASTM C 411 Test Method for Hot Surface Performance of High Temperature Thermal Insulation
9. ASTM E 84 Test Method for Surface Burning Characteristics of Building Materials
10. ASTM C 1338 Test Method for Determining Fungal Resistance of Insulation Materials and Facings
11. ASTM G 21 Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi
12. ASTM C 916 Standard Specification for Adhesives for Duct Thermal Insulation

B. NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems

C. ANSI SS-EN 485-2 Aluminum and Aluminum Alloys-Sheet, Strip and Plate-Part 2: Mechanical Properties

D. UL 181 Standard for Safety for Factory Made Air Ducts and Air Connectors.

E. NAIMA Fibrous Glass Duct Liner Standard

1.5 QUALITY ASSURANCE

A. Refer to division 1, General Conditions, Equals and Substitutions.

1.6 SHOP DRAWINGS

A. Refer to Division 1, General Conditions, Submittals.
   1. Include manufacturer's data and/or Contractor data for the following:
      a. Fabrication and installation drawings.
      b. Schedule of duct systems including material of construction, gauge, pressure class, system class, method of reinforcement, joint construction, fitting construction, and support methods, all with details as appropriate.
      c. Duct sealant and gasket material.
      d. Duct liner including data on thermal conductivity, air friction correction factor, and limitation on temperature and velocity.

1.7 DESIGN CRITERIA

A. Construct all ductwork to be free from vibration, chatter, objectionable pulsations and leakage under specified operating conditions.

B. Use material, weight, thickness, gauge, construction and installation methods as outlined in the following SMACNA publications, unless noted otherwise:
   1. HVAC Duct Construction Standards, Metal and Flexible, 3rd Edition, 2005
   2. HVAC Air Duct Leakage Test Manual, 2nd Edition, 2012
   3. HVAC Systems - Duct Design, 4th Edition, 2006
   4. Rectangular Industrial Duct Construction Standard, 2nd Edition, 2004
   5. Round Industrial Duct Construction Standards, 2nd Edition, 1999

C. Use products which conform to NFPA 90A, possessing a flame spread rating of not over 25 and a smoke developed rating no higher than 50.

1.8 DELIVERY, STORAGE AND HANDLING

A. Promptly inspect shipments to ensure that Ductwork is undamaged and complies with the specification.

B. Protect Ductwork against damage.

C. Protect Ductwork by storing inside or by durable, waterproof, above ground packaging. Do not store material on grade. Protect Ductwork from dirt, dust, construction debris and foreign material. Where end caps/packaging are provided, take precautions so caps/packaging remain in place and free from damage.

D. Offsite storage agreements do not relieve the contractor from using proper storage techniques.

E. Storage and protection methods must allow inspection to verify products.

PART 2 PRODUCTS

2.1 GENERAL

A. All sheet metal used for construction of duct shall be 24 gauge or heavier except for round and spiral ductwork and spiral duct take-offs 12" and below may be 26 gauge where allowed in SMACNA HVAC Duct Construction Standards, Metal and Flexible, 3rd Edition, 2005.

B. Duct sizes indicated on plans are net inside dimensions; where duct liner is specified, dimensions are net, inside of liner.

2.2 DUCTWORK PRESSURE CLASS

A. Minimum acceptable duct pressure class, for all ductwork except transfer ductwork, is 2 inch W.G. positive or negative, depending on the application. Transfer ductwork minimum acceptable duct pressure class is 1 inch W.G. positive or negative, depending on the application. Duct system pressure classes not indicated on the drawings to be as follows:

1.	Supply duct	2.0 in. pressure class
2.	Return air ducts	2.0 in. pressure class
3.	Outside air ducts	2.0 in. pressure class
4.	Mixed air ducts	2.0 in. pressure class

2.3 MATERIALS

A. Galvanized Steel Sheet
1. Use ASTM A 653 galvanized steel sheet of lock forming quality. Galvanized coating to be 1.25 ounces per square foot, both sides of sheet, G90 in accordance with ASTM A90. Provide "Paint Grip" finish or galvanneal sheetmetal for ductwork that will be painted.

2.4 LOW PRESSURE DUCTWORK (Maximum 2 inch pressure class)

A. Fabricate and install ductwork in sizes indicated on the drawings and in accordance with SMACNA recommendations, except as modified below.

B. Construct so that all interior surfaces are smooth. Use slip and drive or flanged and bolted construction when fabricating rectangular ductwork. Use spiral lock seam construction when fabricating round spiral ductwork. Sheet metal screws may be used on duct hangers, transverse joints and other SMACNA approved locations if the screw does not extend more than 1/2 inch into the duct.

C. Use elbows and tees with a center line radius to width or diameter ratio of 1.5 wherever space permits. When a shorter radius must be used due to limited space, install single wall sheet metal splitter vanes in accordance with SMACNA publications, Type RE 3. Where space will not allow and the C value of the radius elbow, as given

in SMACNA publications, exceeds 0.31, use rectangular elbows with turning vanes as specified in Section 23 33 00. Square throat-radius heel elbows will not be acceptable. Straight taps or bullhead tees are not acceptable.

D. Where rectangular elbows are used, provide turning vanes in accordance with Section 23 33 00.

E. Provide expanded take-offs or 45 degree entry fittings for branch duct connections with branch ductwork airflow velocities greater than 700 fpm. Square edge 90-degree take-off fittings or straight taps will not be accepted.

F. Button punch snaplock construction will not be accepted on aluminum ductwork.

G. Round ducts may be substituted for rectangular ducts if sized in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by written permission of the Architect/Engineer.

H. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

2.5 DUCT SEALANT

A. Manufacturer: 3M 800, 3M 900, H.B. Fuller/Foster, Hardcast, Hardcast Peal & Seal, Lockformer cold sealant, Mon-Eco Industries, United Sheet Metal, or approved equal. Silicone sealants are not allowed in any type of ductwork installation.

B. Install sealants in strict accordance with manufacturer's recommendations, paying special attention to temperature limitations. Allow sealant to fully cure before pressure testing of ductwork, or before startup of air handling systems.

2.6 GASKETS

A. 2 inch pressure class and lower
   1. Soft neoprene or butyl gaskets in combination with duct sealant for flanged joints.

PART 3 EXECUTION

3.1 INSTALLATION

A. Verify dimensions at the site, making field measurements and drawings necessary for fabrication and erection. Check plans showing work of other trades and consult with Architect in the event of any interference.

B. Make allowances for beams, pipes or other obstructions in building construction and for work of other contractors. Transform, divide or offset ducts as required, in accordance with SMACNA HVAC Duct Construction Standards, Figure 4-7, except do not reduce duct to less than six inches in any dimension and do not exceed an 8:1 aspect ratio. Where it is necessary to take pipes or similar obstructions through ducts, construct easement as indicated in SMACNA HVAC Duct Construction Standards, Figure 4-8, Fig. E. In all cases, seal to prevent air leakage. Pipes or similar obstructions may not pass through high pressure or fume exhaust ductwork.

C. Test openings for test and balance work will be provided under Section 23 05 93.

D. Provide frames constructed of angles or channels for coils, filters, dampers or other devices installed in duct systems, and make all connections to such equipment including equipment furnished by others. Secure frames with gaskets and screws or nut, bolts and washers.

E. Where two different metal ducts meet, the joint shall be installed in such a manner that metal ducts do not contact each other by using proper seal or compound.

F. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

G. Provide adequate access to ductwork for cleaning purposes.

H. Provide temporary capping of ductwork openings to prevent entry of dirt, dust and foreign material.

I. Protect diffusers, registers and grilles with plastic wrap or some other approved form of protection to maintain dirt and dust free and to prevent entry of dirt, dust and foreign material into the Ductwork.

J. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

3.2 DUCTWORK SUPPORT

A. Support ductwork in accordance with SMACNA HVAC Duct Construction Standards, Figure 5-5, except supporting ductwork with secure wire method is not allowed.

B. Support with 3/32 inch, 7 x 7, stainless steel air-craft cable, with matching serrated spring loaded wedge mechanism fasteners rated for actual load. Steel cable hanging systems will be allowed on round ductwork under 12 inches diameter if installed utilizing two fasteners with two cable loops. Comply with the manufacturer’s installation instructions.

3.3 LOW PRESSURE DUCT (Maximum 2 inch pressure class)

A. Seal all duct, with the exception of transfer ducts, in accordance with SMACNA seal class "A"; all seams, joints, and penetrations shall be sealed.

B. Install a manual balancing damper in each branch duct and for each diffuser or grille. The use of splitter dampers, extractors, or grille face dampers will not be accepted for balancing dampers.

C. Hangers must be wrapped around bottom edge of duct and securely fastened to duct with sheetmetal screws or pop rivets. Trapeze hangers may be used at contractor's option.

3.4 CLEANING

A. Remove all dirt and foreign matter from the entire duct system and clean diffusers, registers, grilles and the inside of air-handling units before operating fans.

B. Clean duct systems with high power vacuum machines where systems have been used for temporary heat, air-conditioning, or ventilation purposes during construction. Protect equipment that may be harmed by excessive dirt with filters, or bypass during cleaning.

END OF SECTION

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SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 SCOPE

A. This section includes accessories used in the installation of duct systems. Included are the following topics:
   1. Part 1 – General
      a. Related Work
      b. Reference
      c. Reference Standards
      d. Quality Assurance
      e. Shop Drawings
      f. Operation and Maintenance Data
   2. Part 2 – Products
      a. Manual Volume Dampers
      b. Turning Vanes
      c. Access Doors
      d. Flexible Duct
      e. Duct Lining
      f. Duct Flexible Connections
   3. Part 3 – Execution
      a. Manual Volume Dampers
      b. Turning Vanes
      c. Access Doors
      d. Duct Flexible Connections

1.2 RELATED WORK

A. Section 23 05 29 – Hanger and Supports for HVAC Piping and Equipment

B. Section 23 31 00 – HVAC Ducts and Casings

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this Section.

1.4 REFERENCE STANDARDS

A. NFPA 90A Standard for Installation of Air Conditioning and Ventilating Systems

B. SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition, 1995

C. UL 214

D. UL 555 (6th edition) Standard for Fire Dampers and Ceiling Dampers

E. UL 555S (4th edition) Leakage Rated Dampers for Use in Smoke Control Systems

1.5 QUALITY ASSURANCE

A. Refer to division 1, General Conditions, Equals and Substitutions

1.6 SHOP DRAWINGS

A. Refer to division 1, General Conditions, Submittals.

B. Submit for all accessories and include dimensions, capacities, ratings, installation instructions, and appropriate identification.

C. Include certified test data on dynamic insertion loss, self-noise power levels, and aerodynamic performance of sound attenuators.

D. Submit manufacturer's color charts where finish color is specified to be selected by the Architect/Engineer.

1.7 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

PART 2 PRODUCTS

2.1 MANUAL VOLUME DAMPERS

A. Manufacturers: Ruskin, Vent Products, Air Balance, or approved equal.

B. Dampers must be constructed in accordance with SMACNA Fig. 2-12, Fig. 2-13, and notes relating to these figures, except as modified below.

C. Reinforce all blades to prevent vibration, flutter, or other noise. Construct dampers in multiple sections with mullions where width is over 48 inches. Use rivets or tack welds to secure individual components; sheet metal screws will not be accepted. Provide operators with locking devices and damper position indicators for each damper; use an elevated platform on insulated ducts. Provide end bearings or bushings for all volume damper rods penetrating ductwork constructed to a 3" w.c. pressure class or above.

2.2 TURNING VANES

A. Manufacturers: Aero Dyne, Anemostat, Barber-Colman, Hart & Cooley, or approved equal.

B. Construct turning vanes and runners for square elbows in accordance with SMACNA Fig. 2-3 and Fig. 2-4 except use only airfoil type vanes. Construct turning vanes for short radius elbows

and elbows where one dimension changes in the turn in accordance with SMACNA Fig. 2-5 and Fig. 2-6.

2.3 ACCESS DOORS

A. Access doors to be designed and constructed for the pressure class of the duct in which the door is to be installed. Doors in exposed areas shall be hinged type with cam sash lock. Hinges shall be aluminum or steel full length continuous piano type. Doors in concealed spaces shall be secured in place with cam sash latches. For both hinged and non-hinged doors provide sufficient number of camp sash latches to provide air tight seal when door is closed. Do not use hinged doors in concealed spaces if this will restrict access. Use minimum 1" deep 24 gauge galvanized steel double wall access doors with minimum 24 gauge galvanized steel frames. For non-galvanized ductwork, use minimum 1" deep double wall access door with frame that shall use materials of construction identical to adjacent ductwork. Provide double neoprene gasket that shall provide seals from the frame to the door and frame to the duct. When access doors are installed in insulated ductwork or equipment provide insulated doors with insulation equivalent to what is provided for adjacent ductwork or equipment. Access doors constructed with sheet metal screw fasteners will not be accepted.

B. Use insulated, 1-1/2 hour UL 1978 listed and labeled access doors in kitchen exhaust ducts.

2.4 FLEXIBLE DUCT

A. Manufacturers: Anco Products, Clevaflex, Thermaflex, Flexmaster or approved equal.

B. Factory fabricated , UL 181 listed as a class 1 duct, and having a flame spread of 25 or less and a smoke developed rating of 50 or under in accordance with NFPA 90A.

C. Suitable for pressures and temperatures involved but not less than a 180°F service temperature and ±2 inch pressure class, depending on the application.

D. Duct to be composed of polyester film, aluminum laminate or woven and coated fiberglass fabric bonded permanently to corrosion resistant coated steel wire helix. Two-ply, laminated, and corrugated aluminum construction may also be used.

E. Where duct is specified to be insulated, provide a minimum 1 inch fiberglass insulation blanket with maximum thermal conductance of 0.23 K (75 degrees F.) and vapor barrier jacket of polyethylene or metalized reinforced film laminate. Maximum perm rating of vapor barrier jacket to be 0.1 perm.

2.5 DUCT LINING

A. Manufacturer: Manville, Owens-Corning, Knauf, or approved equal.

B. 1 inch thick, flexible, mat faced insulation made from inorganic glass fibers bonded with a thermosetting resin with thermal conductivity of .25 Btu inch / hour sq.ft. deg F.

C. Meet erosion testing per UL 181 or ASTM C 1071 for 5000 fpm maximum air velocity. ASTM C 411 maximum operating temperature rating of 250 deg F. ASTM E84 flame spread less than 25 and smoke developed less than 50.

D. Meet requirements of ASTM C 1338 and ASTM G21 for fungi resistance.

E. Install liner using adhesive conforming to ASTM C 916.

2.6 DUCT FLEXIBLE CONNECTIONS

A. Material to be fire retardant, be UL 214 listed, and meet the requirements of NFPA 90A.

B. Connections to be a minimum of 3 inches wide, crimped into metal edging strip, and air tight. Connections to have adequate flexibility and width to allow for thermal expansion/contraction, vibration of connected equipment, and other movement.

C. Use coated glass fiber fabric for all applications. Material for inside applications to be double coated with neoprene, air and water tight, suitable for temperatures between -10°F and 200°F, and have a nominal weight of 30 ounces per square yard.

PART 3 EXECUTION

3.1 MANUAL VOLUME DAMPERS

A. Install manual volume dampers in each branch duct and for each grille, register, or diffuser as far away from the outlet as possible while still maintaining accessibility to the damper. Install so there is no flutter or vibration of the damper blade(s).

3.2 TURNING VANES

A. Install turning vanes in all rectangular, mitered elbows in accordance with SMACNA standards and/or manufacturer's recommendations.

B. Install double wall, airfoil, 2 inch radius vanes in ducts with vane runner length 18" or greater and air velocity less than 2000 fpm. Install double wall, airfoil, 4-1/2 inch radius vanes in ducts with vane runner length 18" or greater and air velocity 2000 fpm or greater.

C. If duct size changes in a mitered elbow, use single wall type vanes with a trailing edge extension. If duct size changes in a radius elbow or if short radius elbows must be used, install sheetmetal turning vanes in accordance with SMACNA Figure 2-5 and Figure 2-6.

3.3 ACCESS DOORS

A. Install access doors where specified, indicated on the drawings, and in locations where maintenance, service, cleaning or inspection is required. Examples include, but are not limited to motorized dampers, fire and smoke dampers, smoke detectors, fan bearings, heating and cooling coils, filters, valves, and control devices needing periodic maintenance.

B. Size and numbers of duct access doors to be sufficient to perform the intended service. Minimum access door size shall be 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, or other size as indicated. Install access doors on both inlet and outlet sides of reheat coils as well as other duct mounted coils.

C. Label fire, smoke and combination fire smoke dampers on the exterior surface of ductwork directly adjacent to access doors using a minimum of 0.5 inch height lettering reading, “SMOKE DAMPER” or “FIRE DAMPER”. Smoke and combination fire smoke dampers shall also include a second line listing the individual damper tag. The tags must be coordinated with the mechanical schedules. Utilize stencils or manufactured labels. All other forms of identification are unacceptable. All labels shall be clearly visible from the ceiling access point.

3.4 FLEXIBLE DUCT

A. Flexible duct may only be used for final connections of air inlets and outlets at diffuser, register, and grille locations. Where flexible duct is used, it shall be the minimum length required to make the final connections, but no greater than 5 feet in length, and have no more than one (1) 90 degree bend.

B. Secure inner jacket of flexible duct in place with stainless steel metal band clamp. Secure insulation vapor barrier jacket in place with steel or nylon draw band. Sheetmetal screws and/or duct tape will not be accepted.

C. Flexible duct used to compensate for misalignment of main duct or branch duct will not be accepted.

D. Individual sections of flexible ductwork shall be of one piece construction. Splicing of short sections will not be accepted.

E. Flexible ductwork used as transfer duct shall be sized for a maximum velocity of 300 fpm.

F. Penetration of any partition, wall, or floor with flexible duct will not be accepted.

3.5 DUCT LINING

A. Apply lining to the following ductwork:
   1. New return and mixed air ducting.

B. Do not apply lining to the following ductwork:
   1. Supply air ductwork.
   2. Outside air ductwork.

C. Install liner in compliance with the latest edition of NAIMA’s Fibrous Glass Duct Liner Standard. Locate longitudinal joints at the corners of duct only. Cut and fit to assure lapped, compressed joints. Coat all transverse and longitudinal joints and edges with adhesive. Provide metal nosing on leading edge where lined duct is preceded by unlined duct. Adhere liner to duct with full coverage area of adhesive. Additionally secure liner to duct using mechanical fasteners spaced as recommended by the liner manufacturer without compressing liner more than 1/8” with the fasteners.

3.6 DUCT FLEXIBLE CONNECTIONS

A. Install at all duct connections to rotating or vibrating equipment, including air handling units (unless unit is internally isolated), fans, or other motorized equipment in accordance with SMACNA Figure 2-19. Install thrust restraints to prevent excess strain on duct flexible connections at fan inlets and outlets; see Related Work.

B. For applications in corrosive environments or fume exhaust systems, use a double layer of the Teflon coated fabric when making the connector.

END OF SECTION

SECTION 23 81 46

WATER SOURCE HEAT PUMPS

PART 1 GENERAL

1.1 SCOPE

A. This section includes specifications for water source heat pumps for this project. Included are the following topics:
   1. Part One – General
      a. Scope.
      b. Related Work
      c. Reference
      d. Quality Assurance
      e. Design Criteria
      f. Shop Drawings
      g. Warranty
   2. Part 2 –Products
      a. Manufacturers
      b. General
      c. Air to Water Heat Pumps
   3. Part 3 – Execution
      a. Installation

1.2 RELATED WORK

A. Section 23 05 13 - Common Motor Requirements for HVAC Equipment

B. Section 23 05 23 - Hydronic Valves and Piping Specialties

C. Section 23 05 29 - Hangers, Supports for HVAC Equipment

D. Section 23 09 23 - Temperature Control System

E. Section 23 09 93 - Sequence of Operation for HVAC Controls

F. Section 23 21 13 - Hydronic Piping

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this Section.

1.4 QUALITY ASSURANCE

A. Substitution of Materials: Refer to Division 1 and the General Conditions of the Contract, Article 3.

1.5 DESIGN CRITERIA

A. ARI 320 - Water Source Heat Pump Equipment

B. ANSI/UL 559 - Standard for Heat Pumps
C. CSA C22.2 No. 186.1 Central Forced Air Unitary Heat Pumps with or without Electric Resistance Heat.
D. The units shall be furnished complete with all controls, piping connections, filters, etc. as required for a complete installation.

1.6 SHOP DRAWINGS

A. Submit shop drawings for all equipment specified under this section. Include data concerning sizes, dimensions, weights, cooling and heating capacities, materials of construction, ratings, electrical data, wiring diagrams, controls and options. Shop drawings shall indicate all water, drain and electrical rough-in connections and the manufacturers installation requirements, instructions, installation recommendations and maintenance and repair data.

1.7 WARRANTY

A. Unit shall be provided with a one-year manufacturer's warranty on parts and labor, and an extended warranty which shall include coverage of the refrigeration system and compressor for an extended time period from the end of the standard 1 year coverage through the 5th year.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Carrier is only approved manufacturer.

2.2 GENERAL

A. Units shall be designed to operate throughout an extended range of entering fluid temperature, 25°F to 110°F. All equipment in this section with a nominal capacity of 134,000 BTUH Total Cooling or lower must be listed in the current AHRI Applied Equipment Directory under the AHRI Standard ISO-13256-1, GLHP Rating. Equipment with an AHRI listing only for the WLHP Rating shall not be allowed. All equipment in this section with a nominal capacity greater than 134,000 BTUH Total Cooling shall be rated in accordance to AHRI Standard ISO-13256-1, GLHP Rating with published submittal performance from the manufacturer.
B. All equipment in this section must meet or exceed the efficiencies (EER and COP) as listed on the drawings and schedules, and minimum standards indicated in ASHRAE 90.1-2007 for the AHRI-ISO-13256-1, GLHP Rating. All units shall be listed with Underwriters Laboratories (UL), NRTL or Canadian Standards Association (CSA). All units shall have ARI-13256-1 labels, and UL or NRTL or CSA labels.
C. Unit shall include integral unit cabinet, micro-electronic unit control processor, high efficiency compressor, water-to-refrigerant coil, thermostatic expansion valve, filter dryer, refrigerant access ports, air-to-air refrigerant coil and motor and fan assembly.
D. Units shall be completely factory assembled and tested, piped, internally wired fully charged with refrigerant and oil and shipped in one piece. All units shall be factory run tested.

2.3 AIR TO WATER HEAT PUMPS

A. Unit Cabinet

1. Units shall have the air flow arrangement as shown on the plans. If units with these arrangements are not used, the contractor supplying the water source heat pumps is responsible for any extra costs incurred by other trades and must submit mechanical drawings showing ductwork requirements and changes or relocation of any other mechanical or electrical system. If other arrangements make servicing difficult the contractor must provide access panels and clear routes to ease service.
2. All units shall have stainless steel drain pans to comply with this project's IAQ requirements. Galvanized drain pans shall not be allowed.
3. All water source heat pumps shall be fabricated from heavy gauge corrosion resistant sheet metal. Units 70,000 BTUH or smaller shall have Galvalume Plus sheet metal with a clear acrylic coating. Units 72,000 BTUH and larger shall have G90 galvanized sheet metal. All interior surfaces shall be lined with 1/2 inch thick, multi density acoustic insulation. All insulation must meet NFPA 90A and be certified to meet the GREENGUARD Indoor Air Quality Standard for Low Emitting Products. One blower access panel and two compressor compartment access panels shall be removable with supply and return air ductwork in place.
4. Cabinets shall have separate holes and knockouts for entrance of line voltage and low voltage control wiring. Supply and return water connections shall be FPT fittings and shall be securely mounted flush to the cabinet allowing for connection to a flexible hose without the use of a back-up wrench. Water connections which protrude through the cabinet shall not be allowed.

B. Fans and Motors (0.5 Ton to 6.0 Ton)
1. Units shall have a direct-drive centrifugal fan. The fan motor shall be 3-speed, permanently lubricated, PSC type with thermal overload protection. The fan motor shall be isolated from the fan housing by torsionally flexible isolation.
2. (Alternate Bid #1) - Units shall have a direct-drive centrifugal fan with an ECM type fan motor. The fan motor shall be isolated from the fan housing by torsionally flexible isolation.
3. The fan and motor assembly must be capable of overcoming the external static pressures as shown on the schedule. External static pressure rating of the unit shall be based on a wet coil. Ratings based on a dry coil shall NOT be acceptable.
4. The unit fan assembly shall have the ability to the discharge on the right side, left side or on the end. The discharge must also be capable of being changed to any of these location a in the field.
5. The Unit return air opening shall have the ability to be located on either side of the unit, including the same side of the unit as the discharge.

C. Refrigeration System
1. Units shall use R-410A refrigerant.
2. All units shall have a factory sealed and fully charged refrigerant circuit with the following components. All units with a nominal rating of 72,000 BTUH Total Cooling and above shall have two independent refrigerant circuits each with the following components:
    a. Hermetic compressor(s): Hermetic rotary, reciprocating, and scroll compressors shall be specifically designed for R-410A refrigerant and shall be internally sprung with thermal overload protection. Compressors shall have double external isolation from the base pan: each compressor shall be mounted on rubber isolators and the rubber isolators shall be located on mounting rails in an insulated compartment to minimize sound transmission. Reciprocating compressors shall require a discharge gas muffler.
    b. Provide refrigerant metering thermal expansion valve.

c. Baked polyester enamel coated (rated at 1,000 hour salt spray protection equivalent or better) finned tube refrigerant to air heat exchanger not exceeding 14 fins per inch. Refrigerant to air heat exchangers shall utilize enhanced aluminum fins and rifled copper tube construction rated to withstand 450 PSIG refrigerant working pressure. All air coils shall have non-ferrous aluminum end plates.
d. Reversing valve. Reversing valves shall be four-way solenoid activated refrigerant valves which shall fail to the heating operation should the solenoid fail to function. Reversing valves which fail to the cooling operation shall not be allowed.
e. A fully insulated, coaxial (tube in tube) refrigerant to water heat exchanger. Refrigerant to water heat exchangers shall be of copper inner water tube and steel outer refrigerant tube design rated to withstand 450 PSIG working refrigerant pressure and 400 PSIG working water pressure.
f. Safety controls including both a high pressure and low pressure switch. Temperature sensors shall not replace these safety switches. All Horizontal units shall have a high level condensate sensor mounted within the primary drain pan. See the controls section of this specification for additional information.
g. Access fittings shall be factory installed on high and low pressure refrigerant lines to facilitate field service.
h. Activation of any safety device shall prevent compressor operation via a lockout circuit. The lockout circuit shall be reset at the thermostat or at the contractor supplied disconnect switch. Units which may be reset at the disconnect switch only shall not be acceptable. Refer to solid state safety circuit below.
i. Hanging brackets shall be provided for horizontal units having a capacity of 70,000 Btu/hr or less.
j. The unit compressor(s) shall be internally isolated to provide quiet operation. Compressor motors shall include internal thermal overload protection.

D. Unit Safety Controls
1. All units shall have a solid-state UPM safety control circuit with the following features:
a. Anti-short cycle time delay on compressor operation.
b. Random start on power up mode.
c. Brown out/Surge/Power Interruption protection.
d. Low Pressure Switch 90 second bypass timer.
e. Shutdown on high or low refrigerant pressure safety switch inputs, and shutdown for the optional freezestat or optional high level condensate sensor.
f. Alarm output which closes for 24VAC remote fault indication.
g. Alarm output selectable for constant output for general alarm notification, or pulse output for annunciation of the specific fault alarm
h. Reset unit at thermostat or disconnect.
i. Automatic intelligent reset. Unit shall automatically reset the unit after a safety shut down and restart the unit after the anti-short cycle timer and random start timer expire. Should a fault re-occur within 60 minutes after reset, then a permanent lockout will occur.
j. Ability to defeat time delays for servicing.
k. A light emitting diode (LED) to indicate safety alarms. The LED shall annunciate the following alarms: high refrigerant pressure, low refrigerant pressure, low water temperature, a high level of condensate in the drain pan, or brown out/surge/ power interruption. The LED will display each fault condition as soon as the fault occurs. If a

permanent lockout occurs, then the fault LED will display the type of fault until the unit is reset.

l. UL listed, CUL listed, and RFI, ESD, and transient protected.

m. All control and power wiring shall be numbered and all wiring shall be connected to numbered wiring terminals.

E. Unit Electrical

1. A control box shall be located within the unit and shall contain a transformer, controls for the compressor, reversing valve and fan motor operation and shall have a terminal block for low voltage field wiring connections. The transformer shall be rated for a minimum 50 VA for single compressor units and 75 VA for dual compressor units. All units shall be name-plated for use with time delay fuses or HACR circuit breakers. Unit controls shall be 24 volts.

F. Unit Filter Section

1. The contractor shall purchase one spare set of filters and replace factory-shipped filters upon completion of start-up. Filter to be installed in existing grid mounted filter/return grille.

G. Accessories

1. Freeze Protection: A freezestat shall sense the leaving water temperature of the unit and shall activate the lockout circuit when water temperature drops below 35F. Refrigerant temperature sensors or pressure switches shall not be acceptable.
2. Non-Fused Disconnect Switch: For all units rated provide a factory mounted and wired non-fused disconnect switch with lock out, tag out provisions.
3. Voltage Monitor: Where indicated on the heat pump schedule for three phase voltage units, a voltage monitor shall activate the lockout circuit when a phase loss, phase reversal, or phase imbalance occurs. An LED shall indicate that the phase monitor is functioning and a separate LED shall indicate when a fault has occurred.
4. Isolation Valve (Alternate Bid #2): Provide unit with internally factory mounted and controlled two-way water valve for variable speed pumping requirements. Provide factory mounted or field installed high pressure switch in the water piping to disable compressor operation in the event water pressure builds.
5. Hose Kits and Valves: Provide 2’-0” long stainless-steel braided hose rated to 400 psig at 225°F. Hose kits shall contain ball valve with P/T ports, Y-strainer with P/T ports and blow-down valve.
6. Extra Quiet Construction: Provide additional sound attenuation to the compressor, air handling compartment and on the base pan of the compressor compartment.
7. Condensate pan float switch: water-level sensing device mounted on the condensate pan stops the cooling function should the condensate rise to a predetermined level. (float switch prevents drain pan overflow caused by clogged drain lines).
8. Provide vibration isolation hangers.

H. Controls

1. The heat pump manufacturer shall provide a discharge air temperature sensor.
2. The heat pump manufacturer shall provide leaving water temperature sensor, discharge air temperature sensor,
3. 2-position water isolation valve (closed when heating/cooling) (Alternate Bid #2).
4. The following list of software points shall be available to the 23 09 23 contractor and controller:

a. Occupied/unoccupied mode.
b. Occupied/unoccupied heating setpoints and cooling setpoints.
c. Continuous fan/Cycling fan control for occupied mode.
d. System status: occupied/unoccupied/fan only/heating/cooling.
e. Fan status.
f. Compressor 1 status.
g. Compressor 2 status.
h. Auxiliary heat status.
i. Leaving Water Temperature.
j. Discharge Air Temperature.
k. Room Temperature.
l. Override Button Status/Time remaining on override.
m. Accumulated fan runtime (to announce Filter Change Notice).
n. High pressure switch alarm for compressor 1.
o. High pressure switch alarm for compressor 2.
p. Low pressure switch alarm for compressor 1.
q. Low pressure switch alarm for compressor 2.
r. Freezestat alarm (optional).
s. Condensate Overflow alarm.
t. Brown out/low voltage alarm.
u. Effective cooling and heating setpoints (when warmer/cooler slide option is chosen for the Room Sensor)

5. Section 23 09 23 contractor shall provide and wire a wall mounted Room Thermostat

PART 3 EXECUTION

3.1 INSTALLATION

A. Install the units in accordance with manufacturer's instructions and recommendations.

B. Coordinate installation of units with architectural, mechanical, and electrical work.

C. Each unit shall be supplied fully charged with refrigerant and oil.

D. Install all factory furnished components and accessories as required for a complete installation.

E. Provide complete unit start-up and check-out to ensure that unit is installed and operating in accordance with the manufacturer's instructions and recommendations.

F. Provide flexible duct connections at the unit supply discharge and return air inlet.

G. Adjust fan speeds or sheaves as required to obtain design air volumes.

H. Suspend the units from the structure above using threaded hanger rod and spring vibration isolators. Install the units level.

I. Remove and discard existing filters located in filter return grilles. Install new filters in existing filter/return grille.

J. Local BAS controller to be mounted to building structural members and not to panels of air to water heat pump.

END OF SECTION

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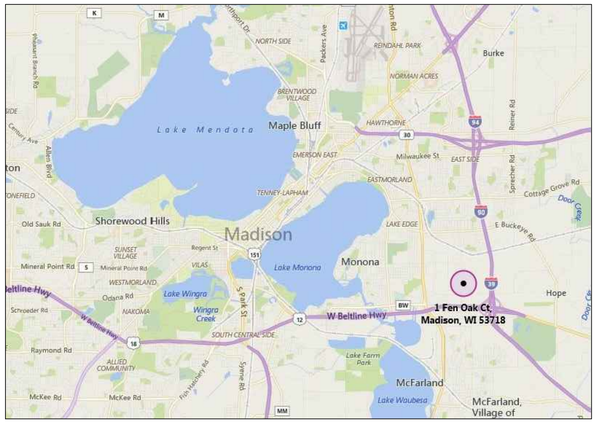
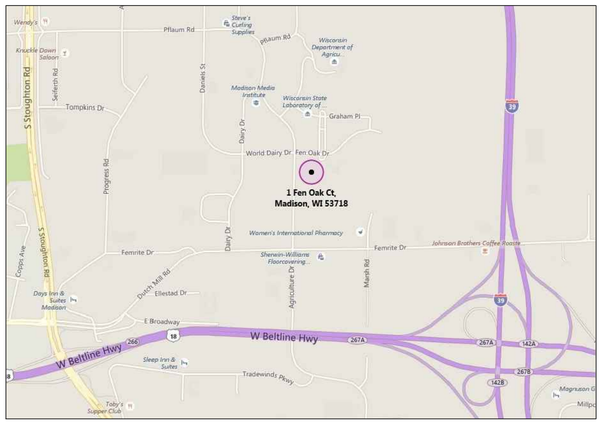
FEN OAK HEAT PUMP REPLACEMENT
LYMAN F. ANDERSON
AGRICULTURE & CONSERVATION CENTER
MADISON, WISCONSIN

BID DOCUMENT PACKAGE

MAY 11th, 2018

COUNTY OF DANE RFB NO 317003





5201 FEN OAK DRIVE
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SHEET INDEX

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PROJECT

FEN OAK HEAT PUMP REPLACEMENT
LYMAN F. ANDERSON
AG & CONSERVATION CNTR
5201 FEN OAK DRIVE
MADISON, WISCONSIN

TITLE SHEET

T1.0

ABBREVIATIONS

AD	ACCESS DOOR
ADJ	ADJUSTABLE
A/E	ARCHITECT/ENGINEER
AFF	ABOVE FINISHED FLOOR
AL	ALUMINUM
AMP	AMPERE
AP	ACCESS PANEL
APD	AIR PRESSURE DROP
ASC	ABOVE SUSPENDED CEILING
AUTO	AUTOMATIC
BB	BASEBOARD
BDD	BACK DRAFT DAMPER
BHP	BRAKE HORSEPOWER
BI	BACKWARD INCLINED
BLDG	BUILDING
BOD	BOTTOM OF DUCT
BOP	BOTTOM OF PIPE
BOS	BOTTOM OF STRUCTURE
BTU	BRITISH THERMAL UNIT
CD	CEILING DIFFUSER
CFM	CUBIC FEET PER MINUTE
CL	CENTERLINE
CLG	CEILING
COND	CONDENSATE
CONTR	CONTRACTOR
COP	COEFFICIENT OF PERFORMANCE
D	DRAIN
DDC	DIRECT DIGITAL CONTROL
DEPT	DEPARTMENT
DIA	DIAMETER
DN	DOWN
DWG	DRAWING
E	EXISTING
EAT	ENTERING AIR TEMPERATURE
EC	ELECTRICAL CONTRACTOR
EF	EXHAUST FAN
EG	EXHAUST GRILLE
EL	ELEVATION
ELEC	ELECTRICAL
EQUIP	EQUIPMENT
ETR	EXISTING TO REMAIN
EWH	ELECTRIC WALL HEATER
EWT	ENTERING WATER TEMPERATURE
EXH	EXHAUST
EXT	EXTERIOR OR EXTERNAL
°F	DEGREES FAHRENHEIT
FA	FREE AREA
FC	FORWARD CURVED
FD	FLOOR DRAIN OR FIRE DAMPER
FFA	FROM FLOOR ABOVE
FFB	FROM FLOOR BELOW
FILL	FILL LINE
FLA	FULL LOAD AMPS
FLEX	FLEXIBLE
FPC	FIRE PROTECTION CONTRACTOR
FPM	FEET PER MINUTE
FS	FLOW SWITCH
FT	FOOT OR FEET
GA	GAUGE
GALV	GALVANIZED
GC	GENERAL CONTRACTOR
GPM	GALLONS PER MINUTE
HC	HEATING CONTRACTOR
HD	HUB DRAIN
HG	MERCURY
HGT	HEIGHT
HP	HORSEPOWER
HPU	HEAT PUMP UNIT
HPR	HEAT PUMP WATER RETURN
HPS	HEAT PUMP WATER SUPPLY
HR	HOUR
HVAC	HEATING VENTILATING AND AIR CONDITIONING
HZ	HERTZ
IN	INCH
KW	KILOWATT
LAT	LEAVING AIR TEMPERATURE
LBS	POUNDS
LWT	LEAVING WATER TEMPERATURE
M	MOTOR OPERATED DAMPER
MAT	MIXED AIR TEMPERATURE
MA	MIXED AIR
MAX	MAXIMUM
MBH	1000 BRITISH THERMAL UNITS/HOUR
MCA	MINIMUM CIRCUIT AMPS
MCC	MOTOR CONTROL CENTER
MECH	MECHANICAL
MFS	MAXIMUM FUSE SIZE
MIN	MINIMUM
MOCP	MAXIMUM OVERCURRENT PROTECTION
MTD	MOUNTED
NC	NOISE CRITERIA
NC	NORMALLY CLOSED
NIC	NOT IN CONTRACT
NO	NORMALLY OPEN
NTS	NOT TO SCALE
OA	OUTDOOR AIR
OAT	OUTDOOR AIR TEMPERATURE
OC	ON CENTER
OPD	OPPOSED BLADE DAMPER
PC	PLUMBING CONTRACTOR
PLBG	PLUMBING
POC	POINT OF CONNECTION
PRELIM	PRELIMINARY
PRESS	PRESSURE
PRV	PRESSURE REDUCING VALVE
PS	PRESSURE SWITCH
PSI	POUNDS PER SQUARE INCH
PVC	POLYVINYL CHLORIDE
RA	RETURN AIR
REQD	REQUIRED
RG	RETURN GRILLE
RPM	REVOLUTIONS PER MINUTE
RR	RETURN REGISTER
S	SUPPLY
SA	SUPPLY AIR
SF	SUPPLY FAN
SG	SUPPLY GRILLE
SM	SHEET METAL
SQ FT	SQUARE FEET
SR	SUPPLY REGISTER
SWD	SINGLE WALL DUCTWORK
T	THERMOSTAT/TEMPERATURE SENSOR
TA	THROWAWAY
TCC	TEMPERATURE CONTROL CONTRACTOR
TCP	TEMPERATURE CONTROL PANEL
TCV	TEMPERATURE CONTROL VALVE
TEMP	TEMPORARY
TF	TRANSFER FAN
TFA	TO FLOOR ABOVE
TFB	TO FLOOR BELOW
TG	TRANSFER GRILLE
TO	TEST OPENINGS
TS	TIP SPEED
TYP	TYPICAL
UH	UNIT HEATER
VD	VOLUME DAMPER
VEL	VELOCITY
VERT	VERTICAL
WB	WET BULB
WC	WATER COLUMN
WP	WEATHER PROOF
WPD	WATER PRESSURE DROP

DUCTWORK SYSTEMS

- 20/12 — DUCT SIZE, (FIRST FIGURE IS SIDE SHOWN)
- 12" Ø — ROUND DUCT
- UP/DN — CHANGE OF ELEVATION IN DIRECTION OF AIR FLOW
- AD — ACCESS DOOR, VERTICAL OR HORIZONTAL
- ACOUSTICAL DUCT LINER
- FLEXIBLE CONNECTION
- DUCT TRANSITION (DOUBLE LINE)
- DUCT TRANSITION (RECT. TO ROUND)
- DUCT TRANSITION (SINGLE LINE)
- HIDDEN DUCTWORK
- STANDARD BRANCH, SUPPLY, RETURN, OR EXHAUST, NO SPLITTER
- M — MOTOR OPERATED DAMPER
- MANUAL VOLUME DAMPER
- DUCT CAP
- END OF DUCT
- EXISTING / EXISTING / NEW / NEW — POSITIVE PRESSURE DUCT SECTION
- POSITIVE PRESSURE DUCT (DOWN OR AWAY)
- EXISTING / EXISTING / NEW / NEW — NEGATIVE PRESSURE DUCT SECTION
- NEGATIVE PRESSURE DUCT (DOWN OR AWAY)
- FLEXIBLE DUCT DIFFUSER CONNECTION
- OR — SIDEWALL AIR DEVICE
- EXHAUST, RETURN, OR TRANSFER AIR DEVICE
- SUPPLY AIR DEVICE
- SIZE — TRANSFER GRILLE ASSEMBLY
- ELBOW WITH TURNING VANES
- AIR FLOW
- EXISTING / NEW — POINT OF NEW CONNECTION (PIPE OR DUCT)

PIPING SYSTEMS

- GENERAL SHUTOFF VALVE SEE SPECIFICATIONS FOR TYPE
- CALIBRATED BALANCE/SHUTOFF VALVE (FLOW MEASURING)
- BLIND FLANGE
- CAP
- CONNECTION, BOTTOM
- CONNECTION, TOP
- ELBOW, TURNED UP
- ELBOW, TURNED DOWN
- REDUCER, CONCENTRIC
- REDUCER, ECCENTRIC - STRAIGHT INVERT
- REDUCER, ECCENTRIC - STRAIGHT CROWN
- FLOW DIRECTION IN PIPES
- HPS — HEAT PUMP SUPPLY
- HPR — HEAT PUMP RETURN
- COND — CONDENSATE

GENERAL SYMBOLS

- T — THERMOSTAT OR TEMPERATURE SENSOR
- EXISTING TO REMAIN (DUCTWORK, PIPING, & EQUIPMENT)
- EXISTING TO BE REMOVED (DUCTWORK, PIPING, & EQUIPMENT)
- NEW DUCTWORK/PIPING
- NEW EQUIPMENT

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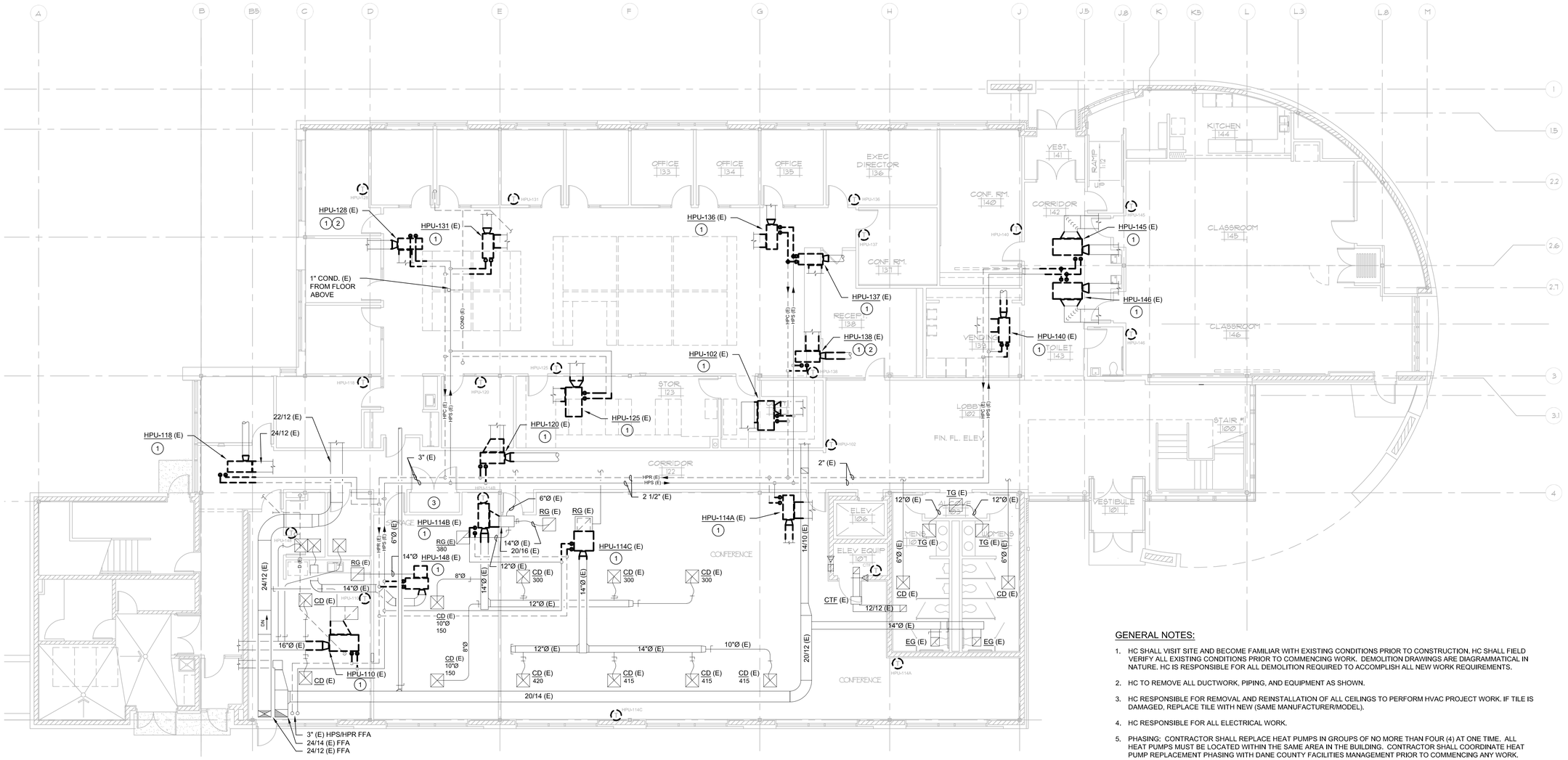
PROJECT

FEN OAK HEAT PUMP REPLACEMENT
LYMAN F. ANDERSON
AG & CONSERVATION CNTR
5201 FEN OAK DRIVE
MADISON, WISCONSIN

SYMBOLS AND ABBREVIATIONS – HVAC

M0.0



1 M1.1 PARTIAL FIRST FLOOR DEMOLITION PLAN - HVAC

SCALE: 1/8"=1'-0"

NORTH

GENERAL NOTES:

1. HC SHALL VISIT SITE AND BECOME FAMILIAR WITH EXISTING CONDITIONS PRIOR TO CONSTRUCTION. HC SHALL FIELD VERIFY ALL EXISTING CONDITIONS PRIOR TO COMMENCING WORK. DEMOLITION DRAWINGS ARE DIAGRAMMATICAL IN NATURE. HC IS RESPONSIBLE FOR ALL DEMOLITION REQUIRED TO ACCOMPLISH ALL NEW WORK REQUIREMENTS.
2. HC TO REMOVE ALL DUCTWORK, PIPING, AND EQUIPMENT AS SHOWN.
3. HC RESPONSIBLE FOR REMOVAL AND REINSTALLATION OF ALL CEILINGS TO PERFORM HVAC PROJECT WORK. IF TILE IS DAMAGED, REPLACE TILE WITH NEW (SAME MANUFACTURER/MODEL).
4. HC RESPONSIBLE FOR ALL ELECTRICAL WORK.
5. PHASING: CONTRACTOR SHALL REPLACE HEAT PUMPS IN GROUPS OF NO MORE THAN FOUR (4) AT ONE TIME. ALL HEAT PUMPS MUST BE LOCATED WITHIN THE SAME AREA IN THE BUILDING. CONTRACTOR SHALL COORDINATE HEAT PUMP REPLACEMENT PHASING WITH DANE COUNTY FACILITIES MANAGEMENT PRIOR TO COMMENCING ANY WORK.

KEYED NOTES:

(1) HC TO DISCONNECT AND REMOVE EXISTING WATER SOURCE HEAT PUMP INCLUDING:
- DISCONNECT SUPPLY AIR AND RETURN AIR DUCTS.
- REMOVE EXISTING FLEXIBLE DUCT CONNECTORS ON SUPPLY AND RETURN DUCT.
- REMOVE EXISTING CONTROLLER. VERIFY OWNER DOES NOT WANT TO RETAIN FOR ATTIC STOCK.
- DISCONNECT HPS AND HPR WATER FROM UNIT BACK TO ISOLATION VALVE. REMOVE AND DISCARD FLEXIBLE HOSE CONNECTORS. ISOLATION VALVES TO REMAIN.
- DISCONNECT POWER TO UNIT. REMOVE AND DISCARD DISCONNECT.
- REMOVE EXISTING THERMOSTAT.
- CONTROL WIRING BETWEEN CONTROLLER AND THERMOSTAT TO REMAIN.
- DISCONNECT CONDENSATE PIPING. REMOVE AND DISCARD CONDENSATE TRAP.

(2) REMOVE ALL POWER WIRING FROM HEAT PUMP TO PANEL. REMOVE EXISTING 20 AMP BREAKER IN PANEL.

(3) EXISTING ELECTRICAL PANEL LOCATION.

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PARTIAL FIRST FLOOR DEMOLITION PLAN – HVAC

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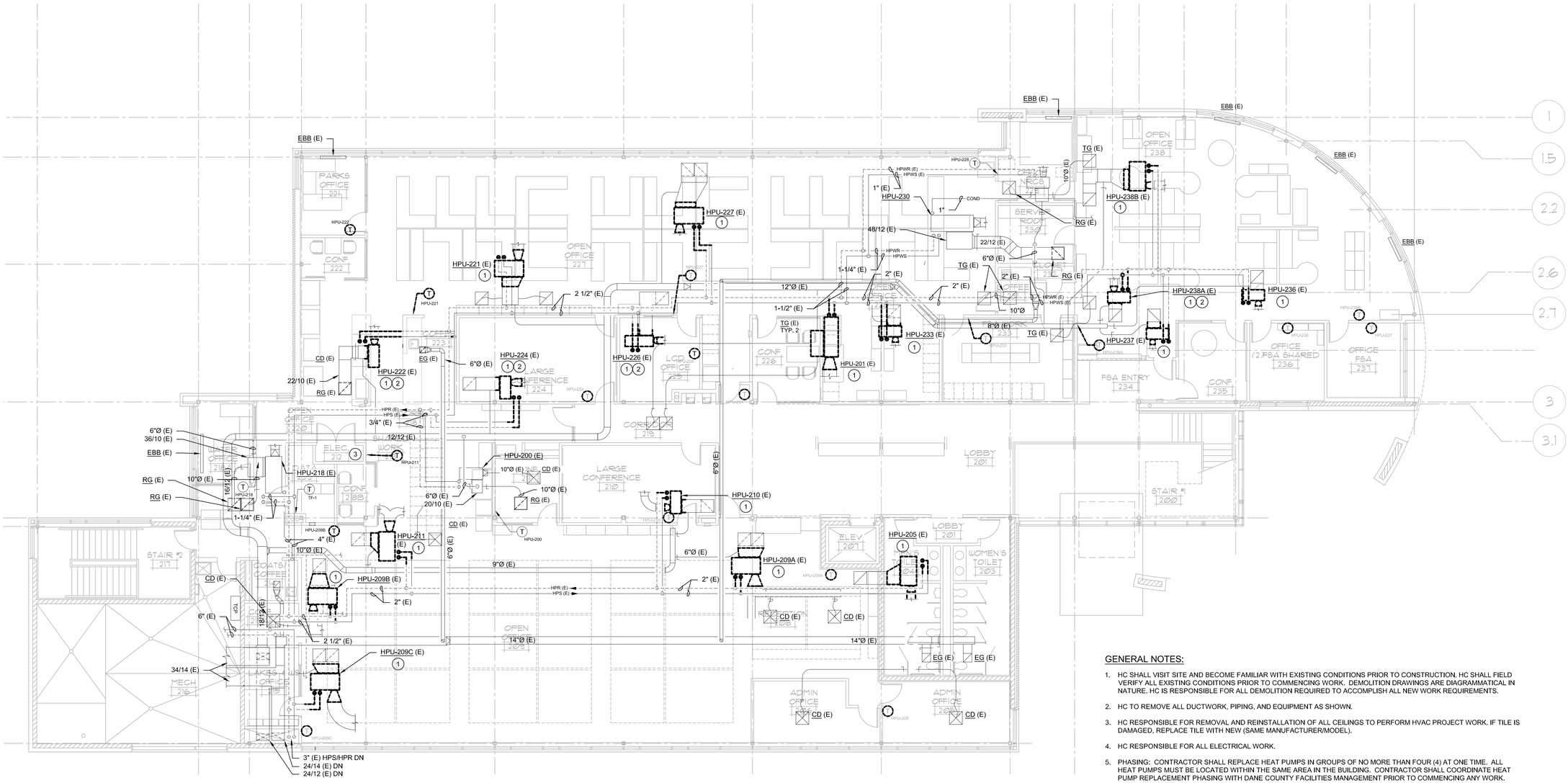

1 M1.2 PARTIAL SECOND FLOOR DEMOLITION PLAN - HVAC

SCALE: 1/8"=1'-0"

NORTH

GENERAL NOTES:

1. HC SHALL VISIT SITE AND BECOME FAMILIAR WITH EXISTING CONDITIONS PRIOR TO CONSTRUCTION. HC SHALL FIELD VERIFY ALL EXISTING CONDITIONS PRIOR TO COMMENCING WORK. DEMOLITION DRAWINGS ARE DIAGRAMMATICAL IN NATURE. HC IS RESPONSIBLE FOR ALL DEMOLITION REQUIRED TO ACCOMPLISH ALL NEW WORK REQUIREMENTS.
2. HC TO REMOVE ALL DUCTWORK, PIPING, AND EQUIPMENT AS SHOWN.
3. HC RESPONSIBLE FOR REMOVAL AND REINSTALLATION OF ALL CEILINGS TO PERFORM HVAC PROJECT WORK. IF TILE IS DAMAGED, REPLACE TILE WITH NEW (SAME MANUFACTURER/MODEL).
4. HC RESPONSIBLE FOR ALL ELECTRICAL WORK.
5. PHASING: CONTRACTOR SHALL REPLACE HEAT PUMPS IN GROUPS OF NO MORE THAN FOUR (4) AT ONE TIME. ALL HEAT PUMPS MUST BE LOCATED WITHIN THE SAME AREA IN THE BUILDING. CONTRACTOR SHALL COORDINATE HEAT PUMP REPLACEMENT PHASING WITH DANE COUNTY FACILITIES MANAGEMENT PRIOR TO COMMENCING ANY WORK.

KEYED NOTES:

(1) HC TO DISCONNECT AND REMOVE EXISTING WATER SOURCE HEAT PUMP INCLUDING:

- DISCONNECT SUPPLY AIR AND RETURN AIR DUCTS.
- REMOVE EXISTING FLEXIBLE DUCT CONNECTORS ON SUPPLY AND RETURN DUCT.
- REMOVE EXISTING CONTROLLER. VERIFY OWNER DOES NOT WANT TO RETAIN FOR ATTIC STOCK.
- DISCONNECT HPS AND HPR WATER FROM UNIT BACK TO ISOLATION VALVE. REMOVE AND DISCARD FLEXIBLE HOSE CONNECTORS. ISOLATION VALVES TO REMAIN.
- DISCONNECT POWER TO UNIT. REMOVE AND DISCARD DISCONNECT.
- REMOVE EXISTING THERMOSTAT.
- CONTROL WIRING BETWEEN CONTROLLER AND THERMOSTAT TO REMAIN.
- DISCONNECT CONDENSATE PIPING. REMOVE AND DISCARD CONDENSATE TRAP.

(2) REMOVE ALL POWER WIRING FROM HEAT PUMP TO PANEL. REMOVE EXISTING 20 AMP BREAKER FROM PANEL.

(3) EXISTING ELECTRICAL PANEL LOCATION.

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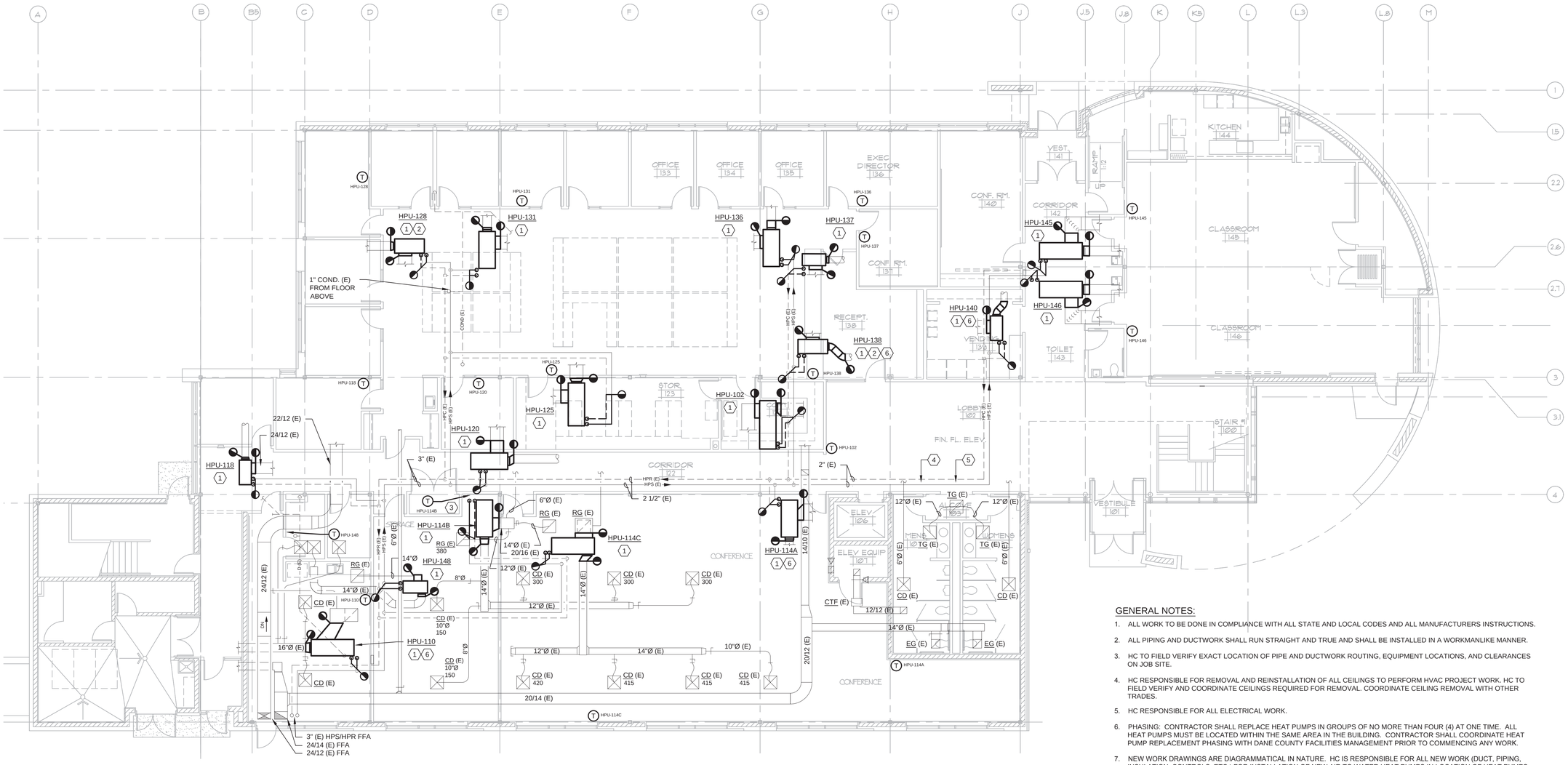
FEN OAK HEAT PUMP REPLACEMENT
LYMAN F. ANDERSON AG & CONSERVATION CNTR
5201 FEN OAK DRIVE
MADISON, WISCONSIN

PARTIAL SECOND FLOOR DEMOLITION PLAN - HVAC

M1.2



1 M2.1 PARTIAL FIRST FLOOR NEW WORK PLAN - HVAC

SCALE: 1/8"=1'-0"

NORTH

GENERAL NOTES:

1. ALL WORK TO BE DONE IN COMPLIANCE WITH ALL STATE AND LOCAL CODES AND ALL MANUFACTURERS INSTRUCTIONS.
2. ALL PIPING AND DUCTWORK SHALL RUN STRAIGHT AND TRUE AND SHALL BE INSTALLED IN A WORKMANLIKE MANNER.
3. HC TO FIELD VERIFY EXACT LOCATION OF PIPE AND DUCTWORK ROUTING, EQUIPMENT LOCATIONS, AND CLEARANCES ON JOB SITE.
4. HC RESPONSIBLE FOR REMOVAL AND REINSTALLATION OF ALL CEILINGS TO PERFORM HVAC PROJECT WORK. HC TO FIELD VERIFY AND COORDINATE CEILINGS REQUIRED FOR REMOVAL. COORDINATE CEILING REMOVAL WITH OTHER TRADES.
5. HC RESPONSIBLE FOR ALL ELECTRICAL WORK.
6. PHASING: CONTRACTOR SHALL REPLACE HEAT PUMPS IN GROUPS OF NO MORE THAN FOUR (4) AT ONE TIME. ALL HEAT PUMPS MUST BE LOCATED WITHIN THE SAME AREA IN THE BUILDING. CONTRACTOR SHALL COORDINATE HEAT PUMP REPLACEMENT PHASING WITH DANE COUNTY FACILITIES MANAGEMENT PRIOR TO COMMENCING ANY WORK.
7. NEW WORK DRAWINGS ARE DIAGRAMMATICAL IN NATURE. HC IS RESPONSIBLE FOR ALL NEW WORK (DUCT, PIPING, INSULATION, CONTROLS, ETC.) FOR INSTALLATION OF NEW AIR TO WATER HEAT PUMPS IN LOCATION OF HEAT PUMPS REMOVED.

KEYED NOTES:

1. PROVIDE NEW WATER SOURCE HEAT PUMP TO REPLACE EXISTING WATER SOURCE HEAT PUMP.
   - VERIFY CONFIGURATION OF NEW HEAT PUMP WITH EXISTING CONDITIONS.
   - PROVIDE VIBRATION ISOLATION AT HANGERS.
   - RECONNECT SUPPLY AND RETURN DUCT. PROVIDE NEW FLEXIBLE DUCT CONNECTIONS.
   - RECONNECT HPS AND HPR TO UNIT. SEE DETAIL FOR PIPING DETAILS.
   - RECONNECT POWER TO UNIT. PROVIDE NEW DISCONNECT.
   - PROVIDE AND INSTALL NEW DDC CONTROLLER ON UNIT. CONTROLLER TO BE MOUNTED TO BUILDING STRUCTURE SIMILAR TO EXISTING CONTROLLER.
   - PROVIDE AND INSTALL NEW DDC THERMOSTAT.
   - RECONNECT CONDENSATE PIPING. PROVIDE NEW CONDENSATE TRAP.
   - REBALANCE UNIT TO AIRFLOWS SCHEDULED.
   - REBALANCE UNIT TO WATER FLOW SCHEDULED.
2. PROVIDE NEW POWER WIRING (#10 WIRES) AND 30 AMP BREAKER IN EXISTING ELECTRICAL PANEL FOR NEW REPLACEMENT HEAT PUMP.
3. EXISTING ELECTRICAL PANEL LOCATION.
4. NEW DIFFERENTIAL PRESSURE SENSOR (ALTERNATE BID #2). VERIFY LOCATION WITH DANE COUNTY FACILITIES MANAGEMENT.
5. PROVIDE 1" BYPASS BETWEEN HEAT PUMP SUPPLY AND RETURN PIPING (ALTERNATE BID #3). BYPASS SHALL CONSIST OF BALANCE VALVE WITH ISOLATION VALVE BOTH UPSTREAM AND DOWNSTREAM. PROVIDE UNIONS TO ALLOW FUTURE VALVE REPLACEMENT.
6. NEW HPU LOCATION ADJUSTED FROM EXISTING UNIT LOCATION TO PROVIDE REQUIRED SERVICE CLEARANCES.

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FEN OAK HEAT PUMP REPLACEMENT
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5201 FEN OAK DRIVE
MADISON, WISCONSIN

PARTIAL FIRST FLOOR NEW WORK PLAN – HVAC

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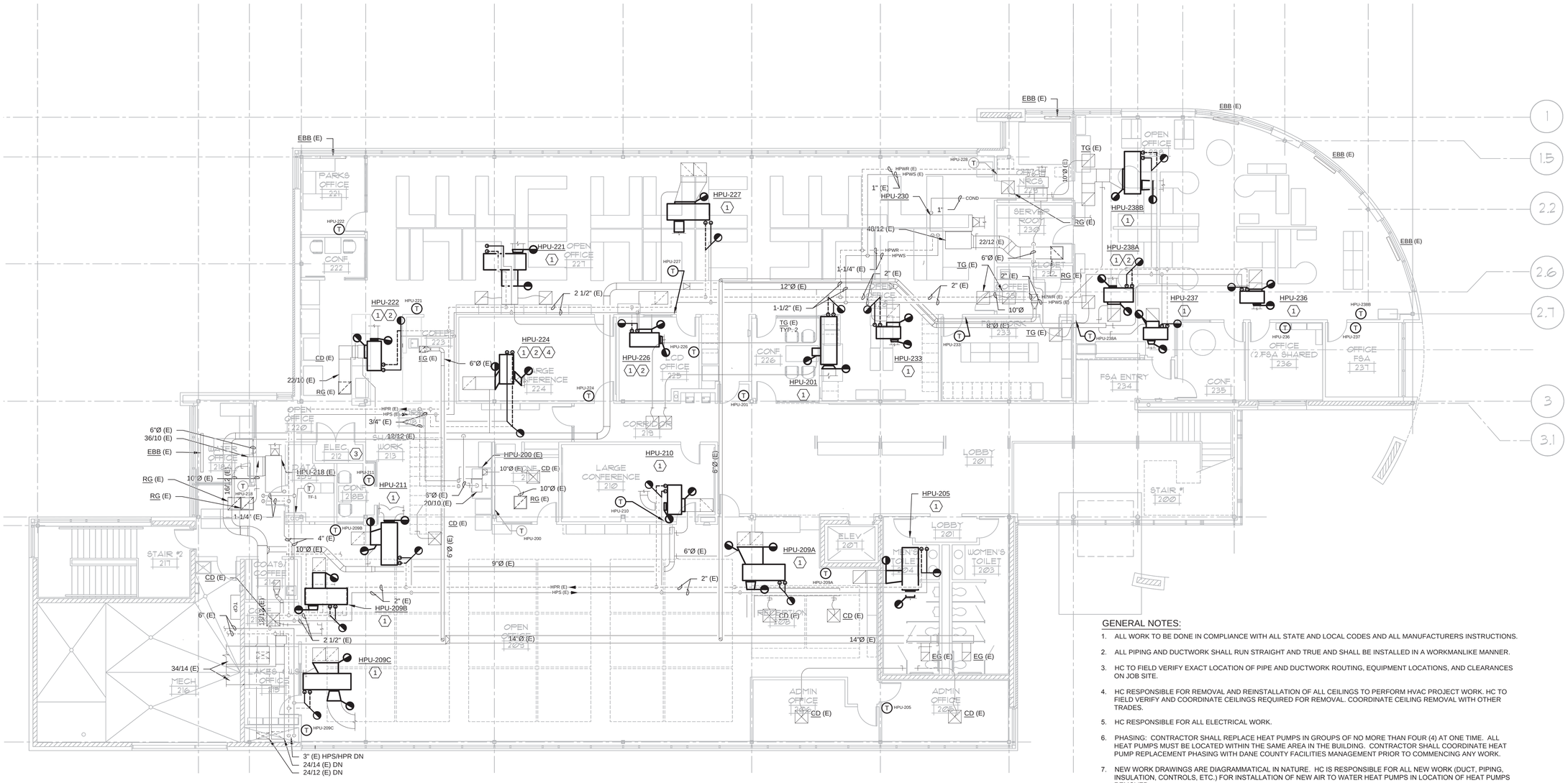

1 M2.2 PARTIAL SECOND FLOOR NEW WORK PLAN - HVAC

SCALE: 1/8"=1'-0"

NORTH

GENERAL NOTES:

1. ALL WORK TO BE DONE IN COMPLIANCE WITH ALL STATE AND LOCAL CODES AND ALL MANUFACTURERS INSTRUCTIONS.
2. ALL PIPING AND DUCTWORK SHALL RUN STRAIGHT AND TRUE AND SHALL BE INSTALLED IN A WORKMANLIKE MANNER.
3. HC TO FIELD VERIFY EXACT LOCATION OF PIPE AND DUCTWORK ROUTING, EQUIPMENT LOCATIONS, AND CLEARANCES ON JOB SITE.
4. HC RESPONSIBLE FOR REMOVAL AND REINSTALLATION OF ALL CEILINGS TO PERFORM HVAC PROJECT WORK. HC TO FIELD VERIFY AND COORDINATE CEILINGS REQUIRED FOR REMOVAL. COORDINATE CEILING REMOVAL WITH OTHER TRADES.
5. HC RESPONSIBLE FOR ALL ELECTRICAL WORK.
6. PHASING: CONTRACTOR SHALL REPLACE HEAT PUMPS IN GROUPS OF NO MORE THAN FOUR (4) AT ONE TIME. ALL HEAT PUMPS MUST BE LOCATED WITHIN THE SAME AREA IN THE BUILDING. CONTRACTOR SHALL COORDINATE HEAT PUMP REPLACEMENT PHASING WITH DANE COUNTY FACILITIES MANAGEMENT PRIOR TO COMMENCING ANY WORK.
7. NEW WORK DRAWINGS ARE DIAGRAMMATICAL IN NATURE. HC IS RESPONSIBLE FOR ALL NEW WORK (DUCT, PIPING, INSULATION, CONTROLS, ETC.) FOR INSTALLATION OF NEW AIR TO WATER HEAT PUMPS IN LOCATION OF HEAT PUMPS REMOVED.

KEYED NOTES:

1. PROVIDE NEW WATER SOURCE HEAT PUMP TO REPLACE EXISTING WATER SOURCE HEAT PUMP.
   - VERIFY CONFIGURATION OF NEW HEAT PUMP WITH EXISTING CONDITIONS.
   - PROVIDE VIBRATION ISOLATION AT HANGERS.
   - RECONNECT SUPPLY AND RETURN DUCT. PROVIDE NEW FLEXIBLE DUCT CONNECTIONS.
   - RECONNECT HPS AND HPR TO UNIT. SEE DETAIL FOR PIPING DETAILS.
   - RECONNECT POWER TO UNIT. PROVIDE NEW DISCONNECT.
   - PROVIDE AND INSTALL NEW DDC CONTROLLER ON UNIT. CONTROLLER TO BE MOUNTED TO BUILDING STRUCTURE SIMILAR TO EXISTING CONTROLLER.
   - PROVIDE AND INSTALL NEW DDC THERMOSTAT.
   - RECONNECT CONDENSATE PIPING. PROVIDE NEW CONDENSATE TRAP.
   - REBALANCE UNIT TO AIRFLOWS SCHEDULED.
   - REBALANCE UNIT TO WATER FLOW SCHEDULED.
2. PROVIDE NEW POWER WIRING (#10 WIRE) AND 30 AMP BREAKER IN EXISTING ELECTRICAL PANEL FOR NEW REPLACEMENT HEAT PUMP.
3. EXISTING ELECTRICAL PANEL LOCATION.
4. NEW HPU LOCATION ADJUSTED FROM EXISTING UNIT LOCATION TO PROVIDE REQUIRED SERVICE CLEARANCES.

JDR ENGINEERING, INC.
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CONSULTANTS

ISSUED

REVISIONS / ADDENDA

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-

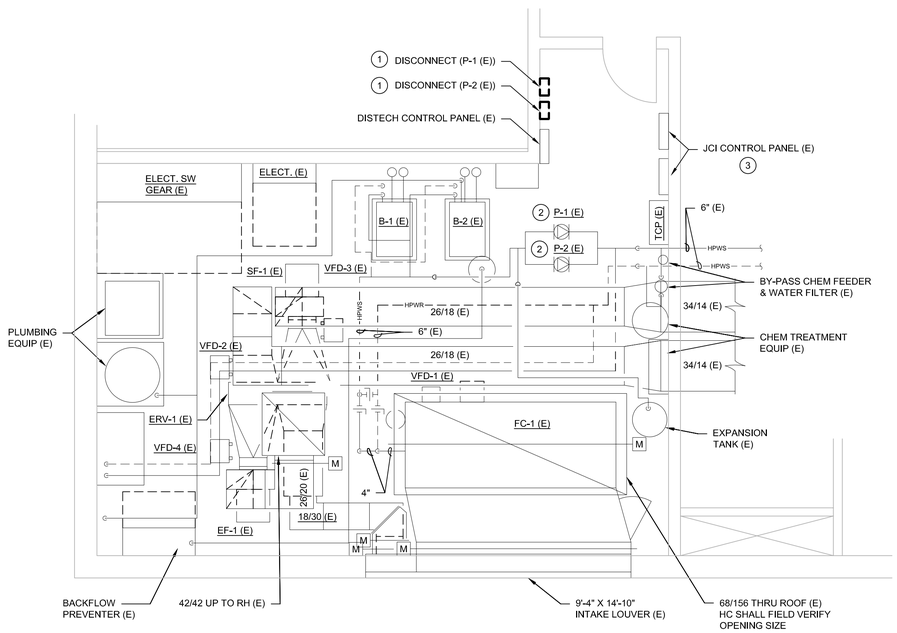
PROJECT # :	18.0036
DRAWN :	NJS
CHECKED :	TDM
DATE :	05/11/2018
PHASE :	BD

PROJECT

FEN OAK HEAT PUMP REPLACEMENT
LYMAN F. ANDERSON AG & CONSERVATION CNTR
5201 FEN OAK DRIVE
MADISON, WISCONSIN

PARTIAL SECOND FLOOR NEW WORK PLAN – HVAC

M2.2



1 M3.0 MECHANICAL ROOM DEMOLITION PLAN - HVAC

SCALE: 1/4"=1'-0"

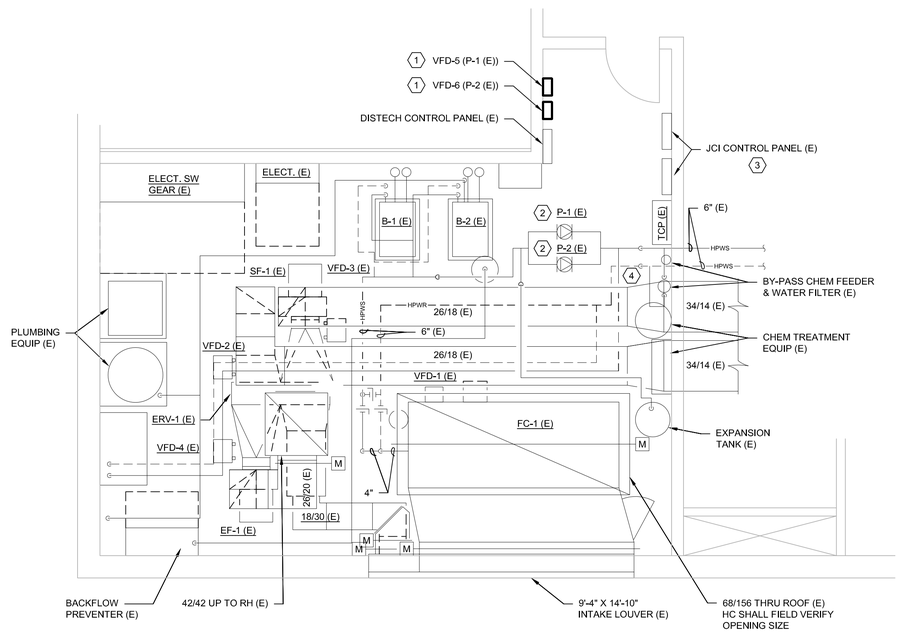
NORTH

GENERAL NOTES:

1. HC SHALL VISIT SITE AND BECOME FAMILIAR WITH EXISTING CONDITIONS PRIOR TO CONSTRUCTION. HC SHALL FIELD VERIFY ALL EXISTING CONDITIONS PRIOR TO COMMENCING WORK. DEMOLITION DRAWINGS ARE DIAGRAMMATICAL IN NATURE. HC IS RESPONSIBLE FOR ALL DEMOLITION REQUIRED TO ACCOMPLISH ALL NEW WORK REQUIREMENTS.
2. HC TO REMOVE ALL DUCTWORK, PIPING, AND EQUIPMENT AS SHOWN.
3. HC RESPONSIBLE FOR REMOVAL AND REINSTALLATION OF ALL CEILINGS TO PERFORM HVAC PROJECT WORK. IF TILE IS DAMAGED, REPLACE TILE WITH NEW (SAME MANUFACTURER/MODEL).
4. HC RESPONSIBLE FOR ALL ELECTRICAL WORK.

KEYED NOTES:

1. ALTERNATE BID #2: REMOVE EXISTING PUMP DISCONNECTS.
2. ALTERNATE BID #2: PREPARE EXISTING INLINE PUMP FOR SHAFT GROUNDING RING INSTALLATION.
3. ALTERNATE BID #2 AND #3: NEW DISTECH CONTROLS TO RESIDE IN NIAGARA/DISTECH CONTROL PANEL.



2 M3.0 MECHANICAL ROOM NEW WORK PLAN - HVAC

SCALE: 1/4"=1'-0"

NORTH

GENERAL NOTES:

1. ALL WORK TO BE DONE IN COMPLIANCE WITH ALL STATE AND LOCAL CODES AND ALL MANUFACTURERS INSTRUCTIONS.
2. ALL PIPING AND DUCTWORK SHALL RUN STRAIGHT AND TRUE AND SHALL BE INSTALLED IN A WORKMANLIKE MANNER.
3. HC TO FIELD VERIFY EXACT LOCATION OF PIPE AND DUCTWORK ROUTING, EQUIPMENT LOCATIONS, AND CLEARANCES ON JOB SITE.
4. HC RESPONSIBLE FOR REMOVAL AND REINSTALLATION OF ALL CEILINGS TO PERFORM HVAC PROJECT WORK. HC TO FIELD VERIFY AND COORDINATE CEILINGS REQUIRED FOR REMOVAL. COORDINATE CEILING REMOVAL WITH OTHER TRADES.
5. HC RESPONSIBLE FOR ALL ELECTRICAL WORK.

KEYED NOTES:

1. ALTERNATE BID #2: PROVIDE NEW VFD FOR EXISTING PUMP.
2. ALTERNATE BID #2: INSTALL SHAFT GROUNDING RINGS ON EXISTING BELL & GOSSETT 4X9.5 (8.25BF) INLINE PUMPS. NEW DISTECH CONTROLS TO RESIDE IN EXISTING JCI CONTROL PANEL.
3. ALTERNATE BID #2 AND #3: NEW DISTECH CONTROLS TO RESIDE IN NIAGARA/DISTECH CONTROL PANEL.
4. ALTERNATE BID #3: PROVIDE NEW HEAT PUMP WATER RETURN TEMPERATURE SENSOR/WELL. VERIFY FINAL LOCATION WITH DANE COUNTY FACILITIES MANAGEMENT.

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CONSULTANTS

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REVISIONS / ADDENDA

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PROJECT # : 18.0036

DRAWN : NJS

CHECKED : TDM

DATE : 05/11/2018

PHASE : BD

PROJECT

FEN OAK HEAT PUMP REPLACEMENT
LYMAN F. ANDERSON AG & CONSERVATION CNTR
5201 FEN OAK DRIVE
MADISON, WISCONSIN

MECHANICAL ROOM – HVAC

M3.0

WATER SOURCE HEAT PUMP UNIT - DATA AND SCHEDULE

UNIT NO.		HPU-102	HPU-110	HPU-114A	HPU-114B	HPU-114C	HPU-118	HPU-120	HPU-125	HPU-128	HPU-131	HPU-136	HPU-137	HPU-138	HPU-140	HPU-145	HPU-146	HPU-148
EXISTING UNIT DATA																		
EXISTING DATA	MANUFACTURER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER
	MODEL NO.	50HQA060SMC601DK	50HQA042BMC601DK	50HQA036EMC601DK	50HQA036EMC601DK	50HQA048SMC601DK	50PCH018ZCC30130	50HQA036EMC601DK	50HQA048SMC601DK	50HQA024SMC301DK	50HQA036BMC601DK	50HQA036SMC601DK	50HQA009BMC301RD	50HQA024EMC301DK	50HQA019EMC301DK	50HQA048SMC601DK	50HQA048SMC601DK	50HQA019SMC301DK
	NOMINAL TONS	5.0	3.5	3.0	3.0	4.0	1.5	3.0	4.0	2.0	3.0	3.0	0.75	2.0	1.5	4.0	4.0	1.5
	SUPPLY AIRFLOW (CFM)	2,000	1,395	1,050	1,200	1,665	500	1,095	1,800	900	1,000	1,050	300	650	600	1,375	1,425	
	OUTSIDE AIRFLOW (CFM)	30	45	30	30		15	30	150	45	60	60	75	45	150	540	525	
	GPM	15.0	10	9.0	9.0		5.0	9.0	12.0	6.0	9.0	9.0	2.0	6.0	5.0	12.0	12.0	
	VOLTAGE / PHASE	460 / 3	460 / 3	460 / 3	460 / 3	460 / 3	208 / 1	460 / 3	460 / 3	208 / 1	460 / 3	460 / 3	208 / 1	208 / 1	208 / 1	460 / 3	460 / 3	208 / 230
	MCA	12.3	8.2	7.6	7.6	10.9	10.0	7.6	10.9	12.5	7.6	7.6	5.2	12.5	11.3	10.9	10.9	11.3
	MOCP	20	15	15	15	15	15	15	15	20	15	15	15	20	15	15	15	15
	REMARKS																	
REPLACEMENT UNIT DATA																		
NEW UNIT DATA	MANUFACTURER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER
	MODEL NO.	50PSH060	50PSH042	50PSH036	50PSH036	50PSH048	50PSH018	50PSH036	50PSH048	50PSH024	50PSH036	50PSH036	50PSH009	50PSH024	50PSH018	50PSH048	50PSH048	50PSH018
	UNIT EER	16.2	18.2	17.2	17.2	17.2	16.4	17.2	17.2	18.2	17.2	17.2	16.2	18.2	16.4	17.2	17.2	16.4
	UNIT COP	5.7	6	5.6	5.6	5.3	5.3	5.6	5.3	5.7	5.6	5.6	5.5	5.7	5.3	5.3	5.3	5.3
	MOTOR TYPE	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
	NOMINAL TONS	5.0	3.5	3.0	3.0	4.0	1.5	3.0	4.0	2.0	3.0	3.0	0.75	2.0	1.5	4.0	4.0	1.5
	STAGES OF CAPACITY	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	AIR FLOW (CFM)	2,000	1,395	1,050	1,200	1,665	500	1,095	1,800	900	1,000	1,050	300	650	600	1,375	1,425	
	OUTSIDE AIR CFM	30	45	30	30		15	30	150	45	60	60	75	45	150	540	525	
	GPM	15.0	10.0	9.0	9.0		5.0	9.0	12.0	6.0	9.0	9.0	2.0	6.0	5.0	12.0	12.0	
	2-WAY SOLONOID VALVE	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
	VOLTAGE / PHASE	460 / 3	460 / 3	460 / 3	460 / 3	460 / 3	208 / 1	460 / 3	460 / 3	208 / 1	460 / 3	460 / 3	208 / 1	208 / 1	208 / 1	460 / 3	460 / 3	208 / 1
	MCA	15.8	12.8	11.4	11.4	13.1	12.1	11.4	13.1	19.7	11.4	11.4	5.2	19.7	12.1	13.1	13.1	12.1
	MOCP	20	15	15	15	15	15	15	15	30	15	15	15	30	15	15	15	15
	REMARKS									3				3				

GENERAL NOTES:
1. ALL HEAT PUMP REPLACEMENTS ARE A "ONE FOR ONE" REPLACEMENT.
2. CONTRACTOR TO REBALANCE WATER FLOW TO EACH HEAT PUMP (NEW AND EXISTING HEAT PUMP).
3. CONTRACTOR TO REBLANCE AIRFLOW (SUPPLY AND OUTSIDE AIR) AT EACH HEAT PUMP (NEW AND EXISTING HEAT PUMP).
4. PROVIDE FLEXIBLE HOSE KIT WITH HPU. SEE SPECIFICATION SECTION 23 81 46.

KEYED NOTES:
(1) BASE BID: PROVIDE PSC MOTOR. ALTERNATIVE BID NO. 1: PROVIDE ECM MOTOR.
(2) BASE BID: NO 2-WAY SOLONOID VALVE. ALTERNATIVE BID NO. 2: PROVIDE 2-WAY SOLONOID VALVE.
(3) HC TO REMOVE EXISTING POWER WIRING AND BREAKER (20 AMP). PROVIDE NEW POWER WIRING AND 30 AMP BREAKER.

WATER SOURCE HEAT PUMP UNIT - DATA AND SCHEDULE

UNIT NO.		HPU-200	HPU-201	HPU-205	HPU-209A	HPU-209B	HPU-209C	HPU-210	HPU-211	HPU-218	HPU-221	HPU-222	HPU-224	HPU-226	HPU-227	HPU-230	HPU-233	HPU-236
EXISTING UNIT DATA																		
EXISTING DATA	MANUFACTURER		CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER		CARRIER	CARRIER	CARRIER	CARRIER	CARRIER		CARRIER	CARRIER
	MODEL NO.		50RNR060ZCC60130	50HQA042BMC601DK	50HQA048SMC601DK	50HQA042ZMC601DK	50HQA060SMC601DK	50HQA024SMC301DK	50HQA048SMC601DK		50HQA048SMC601DK	50HQA024EMC301DK	50HQA024SMC301DK	50HQA024EMC301DK	50HQA048SMC601DK		50HQA019ZMC301DK	50HQA019SMC301DK
	NOMINAL TONS		5.0	3.5	4.0	3.5	5.0	2.0	4.0		4.0	2.0	2.0	2.0	4.0		1.5	1.5
	SUPPLY AIRFLOW (CFM)	EXISTING UNIT TO REMAIN	2,000	1,225	1,480	1,210	2,000	700	1,375	EXISTING UNIT TO REMAIN	1,575	750	700	700	1,400	EXISTING UNIT TO REMAIN	600	400
	OUTSIDE AIRFLOW (CFM)		30	30	110	100	90	120	60		150	15	60	75	90		120	50
	GPM		15.0	10	12.0	10.0	15.0	6.0	12.0		12.0	6.0	6.0	6.0	12.0		5.0	5.0
	VOLTAGE / PHASE		460 / 3	460 / 3	460 / 3	460 / 3	460 / 3	208 / 1	460 / 3		460 / 3	208 / 1	208 / 1	208 / 1	460 / 3		208 / 1	208 / 1
	MCA		11.8	8.2	10.9	8.2	12.3	12.2	10.9		10.9	12.5	12.5	12.5	10.9		11.3	11.3
	MOCP		15	15	15	15	20	20	15		15	20	20	20	15		15	15
	REMARKS																	
REPLACEMENT UNIT DATA																		
NEW UNIT DATA	MANUFACTURER		CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER		CARRIER	CARRIER	CARRIER	CARRIER	CARRIER		CARRIER	CARRIER
	MODEL NO.		50PSH060	50PSH042	50PSH048	50PSH042	50PSH060	50PSH024	50PSH048		50PSH048	50PSH024	50PSH024	50PSH024	50PSH048		50PSH018	50PSH018
	UNIT EER		16.2	18.2	17.2	18.2	16.2	18.2	17.2		17.2	18.2	18.2	18.2	17.2		16.4	16.4
	UNIT COP		5.7	6.0	5.3	6.0	5.7	5.7	5.3		5.3	5.7	5.7	5.7	5.3		5.3	5.3
	MOTOR TYPE		(1)	(1)	(1)	(1)	(1)	(1)	(1)		(1)	(1)	(1)	(1)	(1)		(1)	(1)
	NOMINAL TONS		5.0	3.5	4.0	3.5	5.0	2.0	4.0		4.0	2.0	2.0	2.0	4.0		1.5	1.5
	STAGES OF CAPACITY		1	1	1	1	1	1	1		1	1	1	1	1		1	1
	AIR FLOW (CFM)	NO BASE BID UNIT	2,000	1,225	1,480	1,210	2,000	700	1,375	NO BASE BID UNIT	1,575	750	700	700	1,400	NO BASE BID UNIT	600	400
	OUTSIDE AIR CFM		30	30	110	100	90	120	60		150	15	60	75	90		120	50
	GPM		15.0	10.0	12.0	10.0	15.0	6.0	12.0		12.0	6.0	6.0	6.0	12.0		5.0	5.0
	2-WAY SOLONOID VALVE		(2)	(2)	(2)	(2)	(2)	(2)	(2)		(2)	(2)	(2)	(2)	(2)		(2)	(2)
	VOLTAGE / PHASE		460 / 3	460 / 3	460 / 3	460 / 3	460 / 3	208 / 1	460 / 3		460 / 3	208 / 1	208 / 1	208 / 1	460 / 3		208 / 1	208 / 1
	MCA		15.8	12.8	13.1	12.8	15.8	19.7	13.1		13.1	19.7	19.7	19.7	13.1		12.1	12.1
	MOCP		20	15	15	15	20	30	15		15	30	30	30	15		15	15
	REMARKS							3				3	3	3				

GENERAL NOTES:
1. ALL HEAT PUMP REPLACEMENTS ARE A "ONE FOR ONE" REPLACEMENT.
2. CONTRACTOR TO REBALANCE WATER FLOW TO EACH HEAT PUMP (NEW AND EXISTING HEAT PUMP).
3. CONTRACTOR TO REBLANCE AIRFLOW (SUPPLY AND OUTSIDE AIR) AT EACH HEAT PUMP (NEW AND EXISTING HEAT PUMP).
4. PROVIDE FLEXIBLE HOSE KIT WITH HPU. SEE SPECIFICATION SECTION 23 81 46.

KEYED NOTES:
(1) BASE BID: PROVIDE PSC MOTOR. ALTERNATIVE BID NO. 1: PROVIDE ECM MOTOR.
(2) BASE BID: NO 2-WAY SOLONOID VALVE. ALTERNATIVE BID NO. 2: PROVIDE 2-WAY SOLONOID VALVE.
(3) HC TO REMOVE EXISTING POWER WIRING AND BREAKER (20 AMP). PROVIDE NEW POWER WIRING AND 30 AMP BREAKER.

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CONSULTANTS

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REVISIONS / ADDENDA

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PROJECT # : 18.0036

DRAWN : NJS

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DATE : 05/11/2018

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PROJECT

FEN OAK HEAT PUMP REPLACEMENT
LYMAN F. ANDERSON
AG & CONSERVATION CNTR
5201 FEN OAK DRIVE
MADISON, WISCONSIN

SCHEDULES – HVAC

M8.0

WATER SOURCE HEAT PUMP UNIT - DATA AND SCHEDULE

UNIT NO.		HPU-237	HPU-238A	HPU-238B
EXISTING UNIT DATA				
EXISTING DATA	MANUFACTURER	CARRIER	CARRIER	CARRIER
	MODEL NO.	50PCH018BCC3ACC1	50HQA024SMC301DK	50HQA042SMC601DK
	NOMINAL TONS	1.5	2.0	3.5
	SUPPLY AIRFLOW (CFM)	350	800	1,100
	OUTSIDE AIRFLOW (CFM)	15	60	75
	GPM	5.0	6.0	10.0
	VOLTAGE / PHASE	208 / 1	208 / 1	460 / 3
	MCA	9.9	12.5	8.2
	MOCP	15	20	15
	REMARKS			
REPLACEMENT UNIT DATA				
NEW UNIT DATA	MANUFACTURER	CARRIER	CARRIER	CARRIER
	MODEL NO.	50PSH018	50PSH024	50PSH042
	UNIT EER	16.4	18.2	18.2
	UNIT COP	5.3	5.7	6.0
	MOTOR TYPE	(1)	(1)	(1)
	NOMINAL TONS	1.5	2.0	3.5
	STAGES OF CAPACITY	1	1	1
	AIR FLOW (CFM)	350	800	1,100
	OUTSIDE AIR CFM	15	60	75
	GPM	5.0	6.0	10.0
	2-WAY SOLONOID VALVE	(2)	(2)	(2)
	VOLTAGE / PHASE	208 / 1	208 / 1	460 / 3
	MCA	12.1	19.7	12.8
	MOCP	15	30	15
	REMARKS		3	

GENERAL NOTES:
1. ALL HEAT PUMP REPLACEMENTS ARE A "ONE FOR ONE" REPLACEMENT.
2. CONTRACTOR TO REBALANCE WATER FLOW TO EACH HEAT PUMP (NEW AND EXISTING HEAT PUMP).
3. CONTRACTOR TO REBLANCE AIRFLOW (SUPPLY AND OUTSIDE AIR) AT EACH HEAT PUMP (NEW AND EXISTING HEAT PUMP).
4. PROVIDE FLEXIBLE HOSE KIT WITH HPU. SEE SPECIFICATION SECTION 23 81 46.

KEYED NOTES:
(1) BASE BID. PROVIDE PSC MOTOR. ALTERNATIVE BID NO. 1: PROVIDE ECM MOTOR.
(2) BASE BID. NO 2-WAY SOLONOID VALVE. ALTERNATIVE BID NO. 2: PROVIDE 2-WAY SOLONOID VALVE.
(3) HC TO REMOVE EXISTING POWER WIRING AND BREAKER (20 AMP). PROVIDE NEW POWER WIRING AND 30 AMP BREAKER.

VARIABLE FREQUENCY DRIVE SCHEDULE

UNIT NO.	VFD-5	VFD-6			
SERVICE	P-1 (E)	P-2 (E)			
MANUFACTURER	ABB	ABB			
LOCATION	MECH	MECH			
HP	10.0	10.0			
VOLTS	208	208			
PHASE	3	3			
BY-PASS	YES	YES			
REMARKS	1, 2	1, 2			

KEY NOTES:
1. PROVIDE UNDER ALTERNATE BID #3
2. INTEGRATE POINTS TO BAS. SEE SECTION 23 05 14.

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CONSULTANTS

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REVISIONS / ADDENDA
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PROJECT # : 18.0036
DRAWN : NJS
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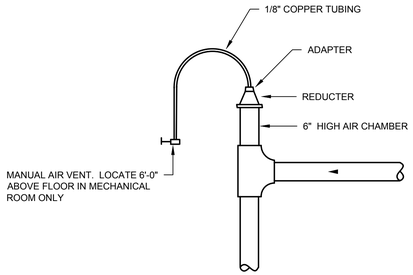
DATE : 05/11/2018
PHASE : BD

PROJECT
FEN OAK HEAT PUMP REPLACEMENT
LYMAN F. ANDERSON AG & CONSERVATION CNTR
5201 FEN OAK DRIVE
MADISON, WISCONSIN

SCHEDULES - HVAC

M8.1

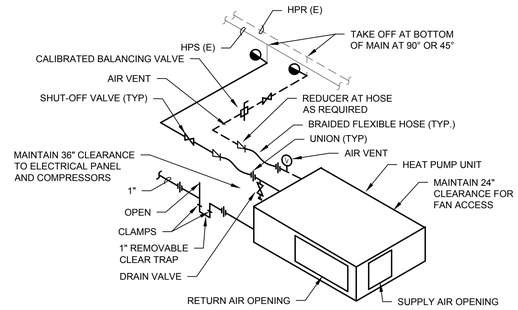


NOTES:

1. PROVIDE AT ALL HIGH POINTS IN PIPING SYSTEM.
2. PROVIDE 1/2" BALL VALVE AND PIPING WITH HOSE BIBB ADAPTER FOR PIPING 2 1/2" DIAMETER AND LARGER.

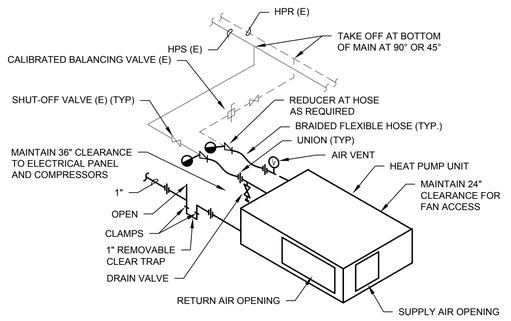
4 M9.0 MANUAL AIR VENT DETAIL

SCALE: NONE



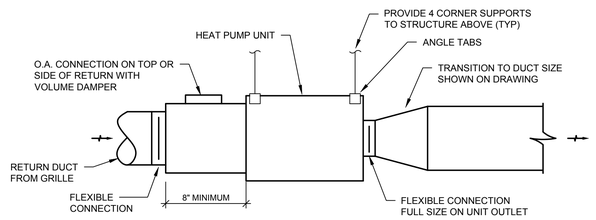
1 M9.0 HEAT PUMP UNIT PIPING DETAIL

SCALE: NONE



2 M9.0 HEAT PUMP UNIT PIPING DETAIL

SCALE: NONE



3 M9.0 HEAT PUMP UNIT DUCT CONNECTION DETAIL

SCALE: NONE

JDR ENGINEERING, INC.
5525 NOBEL DRIVE
SUITE 110
MADISON, WI 53711
PH: 608.277.1728 FAX: 608.271.7046

CONSULTANTS

ISSUED

REVISIONS / ADDENDA

-
-
-
-

PROJECT # :	18.0036
DRAWN :	NJS
CHECKED :	TDM
DATE :	05/11/2018
PHASE :	BD

PROJECT

FEN OAK HEAT PUMP REPLACEMENT
LYMAN F. ANDERSON AG & CONSERVATION CNTR
5201 FEN OAK DRIVE
MADISON, WISCONSIN

DETAILS - HVAC

M9.0