Hanover College
Veterinary Teaching Center
Hanover, IN

Bid Date: *04/11/2025 @ 2:00pm*

ADDENDUM 02

Date of Addendum: 04/01/2025
To the Drawings and Specifications for:

Hanover College
Veterinary Teaching Center
Hanover, IN

This addendum modifies the original CONTRACT DOCUMENTS dated 03/07/2025. Acknowledge receipt of this Addendum in the space provided on the Bid Form. Failure to do so may subject the Bidder to disqualification.

This addendum consists of two (2) pages plus attachments.

CHANGES TO SPECIFICATIONS:

1. Specification 000115 TABLE OF CONTENTS:

    a. Add 054400 “Cold-Formed Metal Trusses” to the table of contents and specifications.

2. Specification 132700 COLD ROOMS:

    a. 2.1.A.1.c – Remove “Bush Refrigeration.”

3. Specification 250000 TEMPERATURE CONTROLS; refer to attached document. The summary of changes is as follows:

    a. Revised acceptable manufacturers to include a Base Bid of “Distech by Jackson Systems and Supply” and an alternate for “Trane Tracer Synchrony SC+”.
    b. Revised paragraph 3.05-E-4 to correct the quantity of boilers.
    c. Revised paragraph 3.05-E-5 to change the low-end heating water set-point in the reset schedule to 120°F.
    d. Revised paragraph 3.05-F to correct the pump labels.

e. Revised paragraph 3.05-G to correct the pump labels and add a sequence for the minimum flow bypass control valve.
f. Revised paragraph 3.05-H-4 to remove erroneous references to existing control valves.
g. Revised paragraph 3.05-I-3 to add a sequence of the minimum flow bypass control valve.
h. Revised paragraph 3.05-M to correct room numbers.
i. Added paragraphs 3.05-R and 3.05-S to clarify control requirements for Laboratory Airflow Controls and Exhaust Air Terminal Boxes.

4. Specification 263213 NATURAL GAS GENERATORS; refer to attached document. The summary of changes is as follows:

a. Paragraph 2.2(C)(1), replace “700kVA” with “200kVA”
b. Added paragraph 2.4(K) to clarify generator paralleling capability integral to onboard controller.
c. Deleted breaker separation provisions in paragraph 2.5(A).
d. Added new paragraph 2.5(C) to clarify paralleling breaker capability.

5. Specification 263623 AUTOMATIC TRANSFER SWITCHES

a. Revised paragraph 2.3€ to apply to emergency transfer switch only.
b. Added paragraphs 2.3(F)(1), (F)(2), and (G) for programmed neutral switch position capability for base bid and alternate optional standby transfer switches.

CHANGES TO DRAWINGS:

Note: Revisions for this addendum on attached reissued sheets are clouded and labeled “Delta B”.

1. Sheet A-103 FLOOR PLAN – NORTH; refer to attached document. The summary of changes is as follows:
   a. Add code note (10) “ PROVIDE WALL MOUNTED METAL HANDRAIL, PAINT.”
   b. Coded note (10) added to CORRIDOR 166.

2. Sheet A-702 BID ALT.; refer to attached document. The summary of changes is as follows:
   a. Revised detail 1/A702

3. Sheet H-100 FIRST FLOOR HVAC PLAN NORTH; refer to attached document. The summary of changes is as follows:

a. Clarified location of duct rising into truss space.

4. Sheet H-101 FIRST FLOOR HVAC PLAN SOUTH; refer to attached document. The summary of changes is as follows:
   a. Revised location of humidifier distributer and high limit sensor.
   b. Re-routed medium pressure supply duct main associated with VAV-17.
   c. Deleted return air grille from Room 131A.

5. Sheet H-110 FIRST FLOOR HVAC PIPING PLAN NORTH; refer to attached document. The summary of changes is as follows:
   a. Clarified pipe size for chilled water piping mains as 6”.

6. Sheet H-111 FIRST FLOOR HVAC PIPING PLAN SOUTH; refer to attached document. The summary of changes is as follows:
   a. Added heating water minimum flow bypass piping and associated coded note.

7. Sheet H-130 ENLARGED MECHANICAL PLANS; refer to attached document. The summary of changes is as follows:
   a. Added chilled water minimum flow bypass piping and associated coded note.
   b. Clarified chilled water piping main size entering the east mechanical room is 6”.

8. Sheet H-402 HVAC DETAILS; refer to attached document. The summary of changes is as follows:
   a. Revised AHU-1 Preheat Coil Piping Detail and AHU-3 Preheat Coil Piping Detail to add heating coil circulating pumps for freeze protection.

9. Sheet H-500 HVAC SCHEDULES; refer to attached document. The summary of changes is as follows:
   a. Added heating coil circulating pumps HCCP-1 and HCCP-2 to the Pump Schedule.

10. Sheet E-000 SITE ELECTRICAL PLAN; refer to attached document. The summary of changes is as follows:
    a. Added Base Bid conduit provisions to site plan per new coded note 12 to support future generator installation if Alternate is not accepted.
    b. Added alternate generator 2 feeder for Base Bid and Alternator scope.

11. Sheet E-110 FIRST FLOOR POWER PLAN NORTH; refer to attached document. The summary of changes is as follows:
    a. Added HCCP-1 & 2 per HVAC revisions noted above. Added coded note 10 accordingly.
    b. Revised equipment sizes, layout, and types of generator equipment in Utility 182 per changes noted below.

12. Sheet E-400 ELECTRICAL ONE-LINE DIAGRAM; refer to attached document. The summary of changes is as follows:
    a. Revised Base Bid and Alternate generator scope to clarify onboard-breakers, paralleling generator bus strategy, Base Bid provisions to support addition of 2nd generator in the future if Alternate is not accepted, etc.
    b. Revised all standby branches to be 800A rated. Revised feeder schedule accordingly.
    c. Reduced emergency branch to be 60A in lieu of 100A.
    d. Revised source and loads of Alternate ATS-SB2/Panel SB4 branch.

13. Sheet E-401 ELECTRICAL PANEL SCHEDULES; refer to attached document. The summary of changes is as follows:
    a. Revised Panel SB1 to include HCCP-1 and generator 1 battery charger and block heater.
    b. Revised Panel SB1 ampacity.
    c. Added Alternate Panel SB4 schedule.

14. Sheet E-402 ELECTRICAL PANEL SCHEDULES; refer to attached document. The summary of changes is as follows:
    a. HCCP-2 added to Panel A (Base Bid only).

15. Sheet E-500 ELECTRICAL SCHEDULES AND DETAILS; refer to attached document. The summary of changes is as follows:
    a. Added equivalent manufactures to Light Fixture Schedule. Note, cloud is around all manufacturers and product series for drawing clarity. No basis-of-design (first line) entries have changed except EX1 product series.

ATTACHMENTS:

Specification Sections:
054400 COLD-FORMED METAL TRUSSES
250000 TEMPERATURE CONTROLS
263213 NATURAL GAS GENERATORS
263623 AUTOMATCI TRANSFER SWITCHES

Drawings:
Arch: A-103, A-702
Struct: S-003, S-101, S-102, S-103, S-104
Mech: H-100, H-101,H-110, H-111, H-130, H-402, H-500
Elec: E-000, E-110, E-400, E-401, E-500

END ADDENDUM NO. 01

SECTION 054400 - COLD-FORMED METAL TRUSSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof trusses.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Cold-formed steel truss materials.
2. Power-actuated fasteners.
3. Mechanical fasteners.

B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel trusses; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

C. Delegated Design Submittal: For cold-formed steel trusses.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.

1. Steel sheet.
2. Power-actuated anchors.
3. Mechanical fasteners.
4. Miscellaneous structural clips and accessories.

D. Research Reports: For post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

E. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment, indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Aegis Metal Framing.
2. MarinoWARE.
3. TrusSteel; an ITW company.
4. USA Frametek.
5. WESTCO Steel Systems, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel trusses.

B. Structural Performance: Provide cold-formed steel trusses capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated on Drawings.
2. Deflection Limits: Design trusses to withstand design loads without deflections greater than the following:

a. Roof Trusses: As indicated on Drawings.

3. Design trusses to provide for movement of truss members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.

C. Cold-Formed Steel Truss Standards: Unless more stringent requirements are indicated, trusses comply with the following:

1. Floor and Roof Systems: AISI S210.
2. Lateral Design: AISI S213.
3. Roof Trusses: AISI S214.

D. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL or from the listings of another qualified testing agency acceptable to authorities having jurisdiction.

2.3 COLD-FORMED STEEL TRUSS MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:

1. Grade: As required by structural performance.
2. Coating: G60, A60, AZ50, or GF30.

2.4 ROOF TRUSSES

A. Roof Truss Members: Manufacturer's standard C-shaped steel sections.

1. Connecting Flange Width: 1-5/8 inches, minimum at top and bottom chords connecting to sheathing or other directly fastened construction.
2. Minimum Base-Metal Thickness: 0.0428 inch.

2.5 TRUSS ACCESSORIES

A. Fabricate steel-truss accessories from steel sheet, ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for truss members.

B. Provide accessories of manufacturer's standard thickness and configuration unless otherwise indicated.

2.6 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.

B. Power-Actuated Fasteners: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

C. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.

1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

D. Welding Electrodes: Comply with AWS standards.

2.7 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A780/A780M, MIL-P-21035B or SSPC-Paint 20.

B. Shims: Load-bearing, high-density multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as truss members supported by shims.

2.8 FABRICATION

A. Fabricate cold-formed steel trusses and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate trusses using jigs or templates.
2. Cut truss members by sawing or shearing; do not torch cut.
3. Fasten cold-formed steel truss members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator.

    a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

4. Fasten other materials to cold-formed steel trusses by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace trusses to withstand handling, delivery, and erection stresses. Lift fabricated trusses by means that prevent damage or permanent distortion.

C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet and as follows:

1. Spacing: Space individual truss members no more than plus or minus 1/8 inch from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel truss to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, conditions, and abutting trusses and framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed steel trusses without reducing thickness of fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLATION

A. Install bridge, and brace cold-formed steel trusses according to AISI S200, AISI S202, AISI S214, and manufacturer's written instructions unless more stringent requirements are indicated.

1. Coordinate with wall framing to align webs of bottom chords and load-bearing studs or continuously reinforce track to transfer loads to structure.
2. Anchor trusses securely at all bearing points.
3. Install continuous bridging and permanently brace trusses as indicated on Drawings.

B. Install cold-formed steel trusses and accessories true to line and location, and with connections securely fastened.

1. Erect trusses with plane of truss webs plumb and parallel to each other. Align and accurately position trusses at required spacings.
2. Erect trusses without damaging truss members or connections.
3. Fasten cold-formed steel trusses by welding or mechanical fasteners.

    a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.

C. Install temporary bracing and supports to secure trusses and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to trusses are secured.

D. Truss Spacing: As indicated on Drawings.

E. Do not alter, cut, or remove truss members or connections of trusses.

3.4 ERECTION TOLERANCES

A. Install cold-formed steel trusses level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual trusses no more than plus or minus 1/8 inch from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.

3.5 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel trusses with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

3.6 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Cold-Formed Steel Trusses Spanning 60 Feet or Longer: Verify temporary installation restraint/bracing and the permanent individual truss member restraint/bracing are installed according to the approved truss submittal package.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Cold-formed metal trusses will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.7 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel trusses are without damage or deterioration at time of Substantial Completion.

END OF SECTION 054400

SECTION 25 00 00 - TEMPERATURE CONTROLS

PART 1 GENERAL

1.01 REFERENCES

A. Section 23 05 13 - ELECTRICAL WORK

1.02 SCOPE

A. Furnish and install a complete Direct Digital Control (DDC) Temperature Control System fully BACnet compliant from top to bottom to automatically control the operation of the entire Heating, Ventilating, and Air Conditioning System. Failure to mention any specific item or device does not relieve the Contractor of the responsibility for installing such device or item in order to comply with the intent of the Drawings or this Specification.

1. The BAS shall be a complete system designed for use on Intranets and the Internet. Supervisory controllers shall be fully IT compatible devices that mount and communicate directly on the Local Area Network (LAN). Contractor shall be responsible for coordination with the owner's IT staff to ensure that the BAS will perform in the owner's environment without disruption to any of the other activities taking place on that LAN. All points of user interface shall be on standard PCs that do not require the purchase of any special software from the BAS manufacturer for use as a building operations terminal. The primary point of interface on these PCs will be a standard Web Browser such as Internet Explorer.

2. The temperature controls contractor shall supply a dedicated server for the building automation system unless the supervisory building controller has an integral server.

3. The terms "Temperature Control Contractor" and "Building Automation System Contractor" are used synonymously in this specification.

B. Building Automation System (BAS) installer shall provide:

1. A fully integrated Building Automation System (BAS) incorporating direct digital control (DDC) for energy management, equipment monitoring and control.

2. Control system to be native BACnet DDC as specified herein.

3. All wiring, conduit and panels.

4. All final electrical connections to each DDC Controller. Pick up power immediately outside of panel.

5. BAS installer shall provide coordination of communications with all equipment and devices specified and provided as part of this project. The system shall be designed with capacity to control the future tenant improvement HVAC equipment. For the core and shell project, assume that up to 20 additional VAV terminal boxes will be installed on the fourth floor of the White Castle building and up to 5 additional VAV terminal boxes will be installed in the basement of the Community Center as part of the tenant improvements project.

6. BAS installer shall be responsible for all electrical work associated with the BAS control system and as called for on the Drawings.

   a) Perform all wiring in accordance with all local and national codes.

   b) Install all line voltage wiring, concealed or exposed, in accordance with Division 16.

   c) Electrical Contractor shall provide 120 volt, 20 amp circuits and circuit breakers from normal and/or emergency power panel for direct digital control systems.

   d) Surge transient protection shall be incorporated in design of system to protect electrical components in all DDC Controllers.

   e) All 120V wiring throughout the building whether exposed or concealed shall be run in conduit in accordance with Division 26. All horizontal low voltage temperature control wiring located above 10 feet above the floor can be run as plenum rated cable and does not need to be installed in conduit. Vertical low voltage temperature control wiring shall be installed in conduit from the device being served to the point the wire turns horizontal in the joist or ceiling space. Low voltage temperature control wiring located above ceilings shall be plenum rated cable and does not need to be installed in conduit. Cables shall be supported by the building structure in such a manner that the cable will not be damaged by normal building use. Such cables shall be secured by j-hooks, hangers, or similar fittings designed and installed so as not to damage the cable.

   f) All 24V power shall be by the BAS installer and the HVAC Contractor.

C. HVAC Contractor provides:

1. All packaged unit control panels.

2 Installation of airflow monitoring devices and alarms furnished by the BAS Contractor.

3. Installation of smoke dampers; outdoor air, return air, exhaust air and vent dampers; with adjacent access doors.

D. Electrical Contractor provides:

1. Run 120V power circuit to the control power transformer panel provided by the BAS Contractor.

E. BAS Contractor to furnish to HVAC Contractor for installation:

1. Automatic control dampers not provided with air handling equipment.

1.03 SYSTEM DESCRIPTION

A. Scope: Furnish all labor, materials and equipment necessary for a complete and operating Building Management System (BMS), utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only. All controllers furnished in this section shall communicate on a peer-to-peer bus over an open protocol bus (Examples: LonTalk, BACnet, ModBus BACnet IP).
   1. The intent of this specification is to provide a system that is consistent with BMS systems throughout the owner's facilities running the NiagaraN4 Framework.
   2. System architecture shall fully support a multi-vendor environment and be able to integrate third party systems via existing vendor protocols including, as a minimum, LonTalk, BACnet and Modbus N2 and BACnet IP.
   3. System architecture shall provide secure Web access using a Browser from any computer on the owner's LAN.
   4. All control devices furnished with this Section shall be programmable directly from the Niagara4 Workbench upon completion of this project. The use of configurable or programmable controllers that require additional software tools for post-installation maintenance shall not be acceptable.
   5. Any control vendor that shall provide additional BMS server software shall be unacceptable. Only systems that utilize the Niagara4 Framework shall satisfy the requirements of this section.
   6. The BMS server shall host all graphic files for the control system. All graphics and navigation schemes for this project shall match those that are on the existing campus Niagara4 Framework server.
   7. At minimum, laptop computer including engineering/programming software to modify Operating System Server BMS programs and graphics shall be included. Owner shall receive all Administrator level login and passwords for engineering toolset at first training session. The Owner shall have full licensing and full access rights for all network management, operating system server, engineering and programming software required for the ongoing maintenance and operation of the BMS.
   8. OPEN NIC STATEMENTS - All Niagara N4 software licenses shall have the following NiCS: "accept.station.in=*"; "accept.station.out=*"and "accept.wb.in=*"and "accept.wb.out=*". All open NIC statements shall follow Niagara Open NIC specifications.
   9. All JACE hardware will be the new 8000 Titan product series.

B. All products of the BMS shall be provided with the following agency approvals. Verification that the approvals exist for all submitted products shall be provided on request, with the submittal package. Systems or products not currently offering the following approvals are not acceptable.

1. Federal Communications Commission (FCC), Rules and Regulations, Volume II -July 1986 Part 15 Class A Radio Frequency Devices.
2. FCC, Part 15, Subpart J, Class A Computing Devices.
3. UL 504 - Industrial Control Equipment.
4. UL 506 - Specialty Transformers.
5. UL 910 - Test Method for Fire and Smoke Characteristics of Electrical and Optical-Fiber Cables Used in Air-Handling Spaces.
6. UL 916 - Energy Management Systems All.
7. UL 1449 - Transient Voltage Suppression.
8. Standard Test for Flame Propagation Height of Electrical and Optical - Fiber Cables Installed Vertically in Shafts.
9. EIA/ANSI 232-E - Interface Between Data Technical Equipment and Data Circuit Terminal Equipment Employing Serial Binary Data Interchange.
10. EIA 455 - Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Connecting and Terminating Devices.
11. IEEE C62.41- Surge Voltages in Low-Voltage AC Power Circuits.
12. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
    a. NEMA 250 - Enclosures for Electrical Equipment.
13. NEMA ICS 1 - Industrial Controls and Systems.
14. NEMA ST 1 - Specialty Transformers.
15. NCSBC Compliance, Energy: Performance of control system shall meet or surpass the requirements of ASHRAE/IESNA 90.1-1999.

1.04 SPECIFICATION NOMENCLATURE

A. Acronyms used in this specification are as follows:
1. Actuator: Control device that opens or closes valve or damper in response to control signal.
2. AI: Analog Input.
3. AO: Analog Output.
4. Analog: Continuously variable state over stated range of values.
5. BMS: Building Management System.
6. DDC: Direct Digital Control.
7. Discrete: Binary or digital state.
8. DI: Discrete Input.
9. DO: Discrete Output.
10. FC: Fail Closed position of control device or actuator. Device moves to closed position on loss of control signal or energy source.
11. FO: Fail open (position of control device or actuator). Device moves to open position on loss of control signal or energy source.
12. GUI: Graphical User Interface.
13. HVAC: Heating, Ventilating and Air Conditioning.
14. IDC: Interoperable Digital Controller.
15. ILC: Interoperable Lon Controller.
16. LAN: Local Area Network.
17. Modulating: Movement of a control device through an entire range of values, proportional to an infinitely variable input value.
18. Motorized: Control device with actuator.
19. NAC: Network Area Controller.

20. NC: Normally closed position of switch after control signal is removed or normally closed position of manually operated valves or dampers.
21. NO: Normally open position of switch after control signal is removed; or the open position of a controlled valve or damper after the control signal is removed; or the usual position of a manually operated valve.
22. OSS: Operating System Server, host for system graphics, alarms, trends, etc.
23. Operator: Same as actuator.
24. PC: Personal Computer.
25. Peer-to-Peer: Mode of communication between controllers in which each device connected to network has equal status and each shares its database values with all other devices connected to network.
26. P: Proportional control; control mode with continuous linear relationship between observed input signal and final controlled output element.
27. PI: Proportional-Integral control, control mode with continuous proportional output plus additional change in output based on both amount and duration of change in controller variable (reset control).
28. PICS: BACnet Product Interoperability Compliance Statement.
29. PID: Proportional-Integral-Derivative control, control mode with continuous correction of final controller output element versus input signal based on proportional error, its time history (reset) and rate at which it's changing (derivative).
30. Point: Analog or discrete instrument with addressable database value.
31. WAN: Wide Area Network.

1.05 QUALITY ASSURANCE

A. Materials and equipment shall be the catalogued products of manufacturers regularly engaged in production and installation of automatic temperature control systems and shall be manufacturer's latest standard design that complies with the specification requirements.

B. Install system using competent workmen who are fully trained in the installation of temperature control equipment.

C. Single Source Responsibility of Supplier: The Control System Contractor shall be responsible for the complete installation and proper operation of the control system. The Control System Contractor shall exclusively be in the regular and customary business of design, installation and service of computerized building management systems similar in size and complexity to the system specified. The Control System Contractor shall be the manufacturer of the primary DDC system components or shall have been the authorized representative for the primary DDC components manufacturer for at least 5 years. All control panels shall be assembled by the Control System Contractor in a UL-Certified 508A panel shop

D. Supplier shall have an in-place support facility within 50 miles of the site with technical staff, spare parts inventory and all necessary test and diagnostic equipment.

E. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Section 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.

F. Design and build all system components to be fault-tolerant.

1. Satisfactory operation without damage at 110% and 85% of rated voltage and at plus 3 Hertz variation in line frequency.

2. Static, transient and short-circuit protection on all inputs and outputs.

3. Protect communication lines against incorrect wiring, static transients and induced magnetic interference.

4. Network-connected devices to be A.C. coupled or equivalent so that any single device failure will not disrupt or halt network communication.

5. All real time clocks and data file RAM to be battery-backed for a minimum 72 hours and include local and system low battery indication.

6. All programs shall retain their memory for a minimum of 7 days upon loss of power.

G. The BAS Installer shall have a competent Project Manager who is able to answer field questions, is aware of all schedules and schedule changes, and is responsible for the BAS Installer's work and the coordination of their work with all other trades. This Project Manager shall be available for on site and shall respond to design, programming, and equipment related questions. Failure to provide the above services shall be considered a substantial breech of Contract Documents.

1.05 SUBMITTALS

A. Submit complete sets of documentation including, but not limited to the following information:

1. Manufacturer's Product Data:

a. All equipment components

2. Shop Drawings:

a. System wiring diagrams with sequence of operation for each system as specified.

b. Submit manufacturer's product information on all hardware items along with descriptive literature for all software programs to show compliance with specifications.

c. System configuration diagram showing <u>all</u> panel types and locations as well as communications network and workstations.

B. Where installation procedures, or any part thereof, are required to be in accord with the recommendations of the manufacturer of the material being installed, printed copies of

these recommendations shall be furnished to the Engineer prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received.

1.06 JOB CONDITIONS

A. Coordinate the exact location of this work with the work of other trades prior to fabrication or installation of same and verify all dimensions and elevations. Provide additional offsets and sections of wiring, conduit, etc., as may be required to meet the applicable job condition requirements. Coordinate with and review all related Drawings of all trades prior to start of work.

B. Before any specified work is considered acceptable and approved for payment, a walk-through with the controls manufacturer's agent and an authorized representative of the Associate shall be scheduled with the Associate. Work not meeting the sequence of controls and job specifications shall be subjected to rework at no charge to the Owner or Associate until acceptable by the Associate. No job will be considered complete for payment until all corrections are complete and "closeout information" has been submitted by the Contractor.

C. All low-voltage (120 volt and less) control and interlock wiring shall be provided by the BAS contractor. In addition, it is the responsibility of the BAS contractor to review the scope of work and extent of HVAC system items that are presently included to be wired by the Electrical Contractor within the electrical part of the Specification and Drawing Documents.

D. Any additional safety, pressure, or other related devices and switches that are not presently within the Electrical Contractor's scope of work shall be properly wired, per required codes, etc., by the BAS contractor, and shall also include wiring of same to electric and/or control panels along with providing any and all required temperature control and interlock system monitoring, final connectors, etc. for a completely operable system.

E. Wiring systems for the control, interlock, and supervisory systems are to be selected by the controls subcontractor to match and be compatible with the equipment being furnished and served. Wire, conduit, and fittings are to meet the National Electrical Code and all applicable state and local codes. Run conduits straight and parallel with building lines. Support conduit at least every four feet on centers. The entire installation is to meet the requirements of the electrical codes and Division 16.

F. Interfacing of the BAS to various building systems and equipment: The BAS shall communicate to the various systems through the BACnet communications interface. Coordinate integration with equipment/system and supplier / manufacturer.

1.07 SYSTEM CHECK-OUT

A. Provide necessary personnel as required to assist the Engineer and Owner in providing complete system operational testing. Provide all labor necessary to fine tune the control sequences until they operate to the satisfaction of the Engineer and Owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:
~~1. Tridium by Jackson Control~~

~~Jackson Control~~
~~1708 East 10th Street~~
~~Indianapolis, IN 46201~~
~~(317) 231 - 2200~~

1. Base Bid:

a. Distech by Jackson Systems & Supply

Jackson Systems & Supply

5418 Elmwood Avenue

Indianapolis, IN 46203

(317) 672-0411

2. Alternate:

a. **Bidders shall state the amount to be ADDED TO or DEDUCTED FROM the Base Bid for providing a "Tracer Synchrony SC+" building automation system by Trane, in lieu of the Distech System with Niagara N4 protocol.**

2.02 GENERAL

A. The Building Management System (BMS) shall be comprised of a network of interoperable, stand-alone digital controllers, a network area controller, graphics and programming and other control devices for a complete system as specified herein.

B. The installed system shall provide secure password access to all features, functions and data contained in the overall BMS.

2.03 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURE

A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system utilizing Open protocols in one open, interoperable system.

B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. Physical connection of any BACnet control equipment, such as chillers, shall be via Ethernet or IP.

C. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.

D. The supplied system shall incorporate the ability to access all data using Java enabled browsers without requiring proprietary operator interface and configuration programs. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on the Operating System Server located in the Facilities Office on the LAN. Systems requiring proprietary database and user interface programs shall not be acceptable.

E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.
   1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
   2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2.04 BAS SERVER HARDWARE

A. Minimum Computer Configuration (Hardware Independent).
   1. Central Server. Owner shall provide a dedicated BAS server with configuration that includes the following components as a minimum:
   2. 16 Core AMD Opteron Processor.
   3. 4 Gb of RAM minimum.
   4. 250GB Hard Drive, SVGA Card with 1024 x 768, 24-bit True Color, Back-up system 24X CD Rom Drive, 19" Flat Screen Color Monitor, Keyboard and mouse.
   5. Operating system for the server shall be Microsoft Windows 7+ or RedHat Linux 6.0+.
   6. Internet Explorer 10.0 or later.
   7. 10/100Base-T Ethernet Port.

B. Standard Client: The thin-client Web Browser BAS GUI running on Microsoft 7+. No special software shall be required to be installed on the PCs used to access the BAS via a web browser.

2.05 SYSTEM NETWORK CONTROLLER (SNC)

A. These controllers are designed to manage communications between the programmable equipment controllers (PEC), application specific controllers (ASC) and advanced unitary controllers (AUC) which are connected to its communications trunks, manage communications between itself and other system network controllers (SNC) and with any operator workstations (OWS) that are part of the BAS, and perform control and operating strategies for the system based on information from any controller connected to the BAS.

B. The controllers shall be fully programmable to meet the unique requirements of the facility it shall control.

C. The controllers shall be capable of peer-to-peer communications with other SNC's and with any OWS connected to the BAS, whether the OWS is directly connected, connected via modem or connected via the Internet.

D. The communication protocols utilized for peer-to-peer communications between SNC's will be Niagara4, BACnet TCP/IP and SNMP. Use of a proprietary communication protocol for peer-to-peer communications between SNC's is not allowed.

E. The SNC shall be capable of executing application control programs to provide:
1. Calendar functions.
2. Scheduling.
3. Trending.
4. Alarm monitoring and routing.
5. Time synchronization.
6. Integration of LonWorks, BACnet, and ModBus controller data.
7. Network management functions for all SNC, PEC and ASC based devices.

F. The SNC shall provide the following hardware features as a minimum:
1. One Ethernet Port-10/100 Mdps.
2. One RS-232/485 port.
3. One LonWorks Interface Port - 78KB FTT-10A.
4. Battery Backup.
5. Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller shall contain a hard disk with at least 1 gigabyte storage capacity).

G. The SNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.

H. The SNC shall provide alarm recognition, storage, routing, management and analysis to supplement distributed capabilities of equipment or application specific controllers.

I. The SNC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up, telephone connection, or wide-area network.
1. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:
    a. Alarm.
    b. Return to normal.
    c. To default.
2. Alarms shall be annunciated in any of the following manners as defined by the user:
    a. Screen message text.
    b. Email of complete alarm message to multiple recipients.
    c. Pagers via paging services that initiate a page on receipt of email message.
    d. Graphics with flashing alarm object(s).
3. The following shall be recorded by the SNC for each alarm (at a minimum):
    a. Time and date.
    b. Equipment (air handler #, access way, etc.).
    c. Acknowledge time, date, and user who issued acknowledgement.

J. Programming software and all controller "Setup Wizards" shall be embedded into the SNC.

2.06 PROGRAMMABLE EQUIPMENT CONTROLLER (PEC)

A. HVAC control shall be accomplished using BACnet based devices where the application has

a BTL Listed PICS defined. Where LonMark devices are not available for a particular application, devices based on LonWorks shall be acceptable. For each LonWorks device that does not have LonMark certification, the device supplier shall provide an XIF file for the device. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara4 Framework, that allow standard and customizable control solutions required in executing the "Sequence of Operation".

B. All PECs shall be application programmable and shall at all times maintain their certification. All control sequences within or programmed into the PEC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.

C. The PECs shall communicate with the SNC at a baud rate of not less than 78.8K baud. The PEC shall provide LED indication of communication and controller performance to the technician, without cover removal.

D. The following integral and remote Inputs/Outputs shall be supported per each PEC:
1. Eight integral dry contact digital inputs.
2. Any two digital inputs may be configured as pulse counters with a maximum pulse read rate of 15 Hz.
3. Eight integral analog inputs (configurable as 0-10V, 0-10,000 ohm or, 20K NTC).
4. Six integral 4-20 ma analog outputs.
5. Eight integral 24 Vac Triac digital outputs, configurable as maintained or floating motor control outputs.
6. One integral 20 Vdc, 65-mA power supply for auxiliary devices.
7. If a 20 Vdc 65-mA power supply terminal is not integral to the PEC, provide at each PEC a separate, fully isolated, enclosed, current limited and regulated UL listed auxiliary power supply for power to auxiliary devices.

E. Each PEC shall have expansion ability to support additional I/O requirements through the use of remote input/output modules.

F. PEC Controllers shall support at minimum the following control techniques:
1. General-purpose control loops that can incorporate Demand Limit Control strategies, Setpoint reset, adaptive intelligent recovery, and time of day bypass.
2. General-purpose, non-linear control loops.
3. Start/stop Loops.
4. If/Then/Else logic loops.
5. Math Function loops (MIN, MAX, AVG, SUM, SUB, SQRT, MUL, DIV, ENTHALPY).

2.07 ADVANCED UNITARY CONTROLLER

A. The advanced unitary controller (AUC) platform shall be designed specifically to control HVAC - ventilation, filtration, heating, cooling, humidification, and distribution. Equipment includes: constant volume air handlers, VAV air handlers, packaged RTU, heat pumps, unit vents, fan coils, natural convection units and radiant panels. The control shall use BACnet BTL listed devices where the application has a BTL Listed PICS defined. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara4 Framework, that allow standard and customizable control solutions required in executing the "Sequence of Operation".

B. Minimum Requirements:

1. The controller shall be fully programmable with full functionality on any Niagara N4 brand platform.
    a. Support downloads to the controller from any brand of Niagara4 platform.
    b. Support uploads from the controller to any brand of Niagara4 platform.
    c. Support simulation/debug mode of the controller.
    d. Maintain native GUI.
    e. Native function-block programming within the Niagara4 environment.
2. The controller shall be capable of either integrating with other devices or stand-alone operation.
3. The controller shall have two microprocessors. The Host processor contains on-chip FLASH program memory, FLASH information memory, and RAM to run the main HVAC application. The second processor for network communications. Controller memory minimum requirements include:
    a. FLASH Memory Capacity: 60 Kilobytes with 8 Kilobytes for application program.
    b. FLASH Memory settings retained for ten years.
    c. RAM: 2 Kilobytes.
4. The controller shall have an internal time clock with the ability to automatically revert from a master time clock on failure.
    a. Operating Range: 24 hour, 365 day, multi-year calendar including day of week and configuration for automatic day-light savings time adjustment to occur on configured start and stop dates.
    b. Accuracy: ±1 minute per month at 77 degrees F (25 degrees C).
    c. Power Failure Backup: 24 hours at 32 degrees to 122 degrees F (0 degrees to 50 degrees C).
5. The controller shall have Significant Event Notification, Periodic Update capability, and Failure Detect when network inputs fail to be detected within their configurable time frame.
6. The controller shall have an internal DC power supply to power external sensors.
    a. Power Output: 20 VDC ±10% at 75 mA.
7. The controller shall have a visual indication (LED) of the status of the devise:
    a. Controller operating normally.
    b. Controller in process of download.
    c. Controller in manual mode under control of software tool.
    d. Controller lost its configuration.
    e. No power to controller, low voltage, or controller damage.
    f. Processor and/or controller are not operating.
8. The minimum controller Environmental ratings.
    a. Operating Temperature Ambient Rating: -40 degrees to 150 degrees F (-40 degrees to 65.5 degrees C).
    b. Storage Temperature Ambient Rating: -40 degrees to 150 degrees F (-40 degrees to 65.5 degrees C).
    c. Relative Humidity: 5% to 95% non-condensing.
9. The controller shall have the additional approval requirements, listings, and approvals:
    a. UL/cUL (E87741) listed under UL916 (Standard for Open Energy Management Equipment) with plenum rating.
    b. CSA (LR95329-3) Listed.
    c. Meets FCC Part 15, Subpart B, Class B (radiated emissions) requirements.
    d. Meets Canadian standard C108.8 (radiated emissions).

e. Conforms requirements European Consortium standard EN 61000-6-1; 2001 (EU Immunity).
f. Conforms requirements European Consortium standard EN 61000-6-3; 2001 (EU Emission).

10. The controller housing shall be UL plenum rated mounting to either a panel or DIN rail (standard EN50022; 7.5mm x 35mm).
11. The controller shall have a mix of digital inputs (DI), digital Triac outputs (DO), analog outputs (AO), and universal inputs (UI).
    a. Analog outputs (AO) shall be capable of being configured as digital outputs (DO).
    b. Input and Output wiring terminal strips shall be removable from the controller without disconnecting wiring.
    c. Input and Output wiring terminals shall be designated with color coded labels.
    d. Universal inputs shall be capable of being configured as binary inputs, resistive inputs, voltage inputs (0-10 VDC), or current inputs (4-20 mA).
12. The controller shall provide "continuous" automated loop tuning with an Adaptive Integral Algorithm Control Loop.
13. The controller platform shall have standard HVAC application programs that are modifiable to support both the traditional and specialized "sequence of operations" as outlined in Section 4.
    a. Discharge air control and low limit.
    b. Pressure-dependent dual duct without flow mixing.
    c. Variable air volume with return flow tracking.
    d. Economizer with differential enthalpy.
    e. Minimum airflow coordinated with CO2.
    f. Unit ventilator cycle (1, 2, 3) 2-pipe.
    g. Unit ventilator cycle (1, 2, 3) 2-pipe with face/bypass.
    h. Unit ventilator cycle (1, 2, 3) 4-pipe.
    i. Unit ventilator cycle (1, 2, 3) 4-pipe with EOC valve.

2.08 ADVANCED VARIABLE AIR VOLUME CONTROLLER

A. The advanced VAV controller platform shall be designed specifically for room-level VAV control - pressure-independent air flow control, pressure dependent damper control, supply and exhaust pressurization/de-pressurization control; temperature, humidity, complex CO2, occupancy, and emergency control. Equipment includes: VAV terminal unit, VAV terminal unit with reheat, Series fan powered terminal unit, Parallel fan powered terminal unit, Supply and Exhaust air volume terminals and Constant volume dual-duct terminal unit. Control shall be accomplished using BACnet based devices where the application has a BTL Listed PICS defined. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara4 Framework, that allow standard and customizable control solutions required in executing the "Sequence of Operation".

B. Minimum Requirements:
1. The controller shall be fully programmable with full functionality on any Niagara4 brand platform.
    a. Support downloads to the controller from any brand of Niagara4 platform.
    b. Support uploads from the controller to any brand of Niagara4 platform.
    c. Support simulation/debug mode of the controller.

d. Maintain native GUI.
e. Native function-block programming within the Niagara4 environment.

2. The controller shall be capable of either integrating with other devices or stand-alone room-level control operation.
3. The controller shall have an internal velocity pressure sensor.
   a. Sensor Type: Microbridge air flow sensor with dual integral restrictors.
   b. Operating Range: 0 to 1.5 inch H2O (0 to 374 Pa).
   c. Accuracy: ±2% of full scale at 32 degrees to 122 degrees F (0 degrees to 50 degrees C); ±1% of full scale at null pressure.
4. The controller shall have two microprocessors. The Host processor contains on-chip FLASH program memory, FLASH information memory, and RAM to run the main HVAC application. The second processor for network communications.
   a. FLASH Memory Capacity: 60 Kilobytes with 8 Kilobytes for application program.
   b. FLASH Memory settings retained for ten years.
   c. RAM: 2 Kilobytes.
5. The controller shall have an internal time clock with the ability to automatically revert from a master time clock on failure.
   a. Operating Range: 24 hour, 365 day, multi-year calendar including day of week and configuration for automatic day-light savings time adjustment to occur on configured start and stop dates.
   b. Accuracy: ±1 minute per month at 77 degrees F (25 degrees C).
   c. Power Failure Backup: 24 hours at 32 degrees to 122 degrees F (0 degrees to 50 degrees C).
6. The controller shall have Significant Event Notification, Periodic Update capability and Failure Detect when network inputs fail to be detected within their configurable time frame.
7. The controller shall have an internal DC power supply to power external sensors.
   a. Power Output: 20 VDC ±10% at 75 mA.
8. The controller shall have a visual indication (LED) of the status of the devise:
   a. Controller operating normally.
   b. Controller in process of download.
   c. Controller in manual mode under control of software tool.
   d. Controller lost its configuration.
   e. No power to controller, low voltage, or controller damage.
   f. Processor and/or controller are not operating.
9. The minimum controller Environmental ratings:
   a. Operating Temperature Ambient Rating: 32 degrees to 122 degrees F (0 degrees to 50 degrees C).
   b. Storage Temperature Ambient Rating: 32 degrees to 122 degrees F (0 degrees to 50 degrees C).
   c. Relative Humidity: 5% to 95% non-condensing.
10. The controller shall have the additional approval requirements, listings, and approvals:
    a. UL/cUL (E87741) listed under UL916 (Standard for Open Energy Management Equipment) with plenum rating.
    b. CSA (LR95329-3) Listed.
    c. Meets FCC Part 15, Subpart B, Class B (radiated emissions) requirements.
    d. Meets Canadian standard C108.8 (radiated emissions).
    e. Conforms requirements European Consortium standard EN 61000-6-1; 2001 (EU

Immunity).
f. Conforms requirements European Consortium standard EN 61000-6-3; 2001 (EU Emission).

11. The controller housing shall be UL plenum rated mounting to either a panel or DIN rail (standard EN50022; 7.5mm x 35mm).
12. The controller shall provide an integrated actuator option.
    a. Actuator type: Series Floating.
    b. Rotation stroke: 95 degrees ±3 degrees for CW or CCW opening dampers.
    c. Torque rating: 44 lb-inch (5 Nm).
    d. Run time for 90 degrees rotation: 90 seconds at 60 Hz.
13. The controller shall have digital inputs (DI), digital Triac outputs (DO), three analog outputs (AO), and universal inputs (UI).
    a. Analog outputs (AO) shall be capable of being configured as digital outputs (DO).
    b. Input and Output wiring terminal strips shall be removable from the controller without disconnecting wiring.
    c. Input and Output wiring terminals shall be designated with color coded labels.
14. The controller shall provide "continuous" automated loop tuning with an Adaptive Integral Algorithm Control Loop.
15. The controller shall have a loop execution response time of 1 second.
16. The controller platform shall have standard HVAC application programs that are modifiable to support both the traditional and specialized "sequence of operations" as outlined in Section 4.
    a. VAV terminal unit.
    b. VAV terminal unit fan speed control.
    c. Series fan.
    d. Parallel fan.
    e. Regulated air volume (room pressurization/de-pressurization).
    f. CV dual-duct.
    g. Room CO2 control.
    h. Room Humidity.
    i. TOD occupancy sensor stand-by set points.

2.09 OTHER CONTROL SYSTEM HARDWARE

A. Motorized control dampers that will not be integral to the equipment shall be furnished by the Control System Contractor. Control damper frames shall be constructed of galvanized steel, formed into changes and welded or riveted. Dampers shall be galvanized, with nylon bearings. Blade edge seals shall be vinyl. Blade edge and tip seals shall be included for all dampers. Blades shall be 16-gauge minimum and 6 inches wide maximum and frame shall be of welded channel iron. Damper leakage shall not exceed 10 CFM per square foot, at 1.5 inches water gauge static pressure.

B. Control damper actuators shall be furnished by the Control System Contractor. Two-position or proportional electric actuators shall be direct-mount type sized to provide a minimum of 5 in-lb torque per square foot of damper area. Damper actuators shall be spring return type. Operators shall be heavy-duty electronic type for positioning automatic dampers in response to a control signal. Motor shall be of sufficient size to operate damper positively and smoothly to obtain correct sequence as indicated. All applications requiring proportional operation shall utilize truly proportional electric actuators.

C. Control Valves: Control valves shall be 2-way or 3-way pattern as shown and constructed for tight shutoff at the pump shut-off head or steam relief valve pressure. Control valves shall operate satisfactorily against system pressures and differentials. Two-position valves shall be ' line' size. Proportional control valves shall be sized for a maximum pressure drop of 5.0 psi at rated flow (unless otherwise noted or scheduled on the drawings). Valves with sizes up to and including 2 inches (51 mm) shall be "screwed" configuration and 2-1/2 inches (63.5 mm) and larger valves shall be "flanged" configuration. All control valves, including terminal unit valves, less than 2 inches (51 mm) shall be globe valves. Electrically-actuated control valves shall include spring return type actuators sized for tight shut-off against system pressures (as specified above) and, when specified, shall be furnished with integral switches for indication of valve position (open-closed). Pneumatic actuators for valves, when utilized, shall be sized for tight shut-off against system pressures (as specified above).

D. Control Valve Actuators: Actuators for VAV terminal unit heating coils shall be "drive-open; drive-closed" type. All actuators shall have inherent current limiting motor protection. Valve actuators shall be 24-volt, electronic type, modulating or two-position as required for the correct operating sequence. Actuators on valves needing ' fail-safe' operation shall have spring return to Normal position. Modulating valves shall be positive positioning in response to the signal. All valve actuators shall be UL listed.

E. All control valves 2-1/2 inches (63.5 mm) or larger shall have position indication. All hot water control valves shall be Normally-Open arrangement; all chilled water control valves shall be Normally-Closed arrangement.

F. Wall Mount Room Temperature sensors: Each room temperature sensor shall provide temperature indication to the digital controller, provide the capability for a software-limited occupant set point adjustment (warmer-cooler slider bar or switch) and limited operation override capability. Room Temperature Sensors shall be 20,000-ohm thermistor type with a temperature range of -40 to 140 degrees F (-38 to 60 degrees C). The sensor shall be complete with a decorative cover and suitable for mounting over a standard electrical utility box. These devices shall have an accuracy of 0.5 degrees F (.024 degrees C) over the entire range.

G. Duct-mounted and Outside Air Temperature Sensors: 20,000-ohm thermistor temperature sensors with an accuracy of ± 0.2 degrees C. Outside air sensors shall include an integral sun shield. Duct-mounted sensors shall have an insertion measuring probe of a length appropriate for the duct size, with a temperature range of -40 to 160 degrees F(-38 to 71 degrees C) The sensor shall include a utility box and a gasket to prevent air leakage and vibration noise. For all mixed air and preheat air applications, install bendable averaging duct sensors with a minimum 8 feet (2438 mm) long sensor element. These devices shall have accuracy of 0.5 degrees F (.024 degrees C) over the entire range.

H. Humidity sensors shall be thin-film capacitive type sensor with on-board nonvolatile memory, accuracy to plus or minus two percent (2%) at 0 to 90% RH, 12 - 30 VDC input voltage, analog output (0 - 10 VDC or 4 - 20mA output). Operating range shall be 0 to 100% RH and 32 to 140 degrees F (0 to 60 degrees C). Sensors shall be selected for wall, duct or outdoor type installation as appropriate.

I. Carbon Dioxide Sensors (CO2): Sensors shall utilize Non-dispersive infrared technology (N.D.I.R.), repeatable to plus or minus 20 PPM. Sensor range shall be 0 - 2000 PPM.

Accuracy shall be plus or minus five percent (5%) or 75 PPM, whichever is greater. Response shall be less than one minute. Input voltage shall be 20 to 30 VAC or DC. Output shall be 0 - 10 VDC. Sensor shall be wall or duct mounted type, as appropriate for the application, housed in a high impact plastic enclosure.

J. Current Sensitive Switches: Solid state, split core current switch that operates when the current level (sensed by the internal current transformer) exceeds the adjustable trip point. Current switch to include an integral LED for indication of trip condition and a current level below trip set point.

K. Differential Analog (duct) Static Pressure Transmitters Provide a pressure transmitter with integral capacitance type sensing and solid-state circuitry. Accuracy shall be plus or minus 1% of full range; range shall be selected for the specific application. Provide zero and span adjustment capability. Device shall have integral static pickup tube.

L. Differential Air Pressure Switches: Provide SPDT type, UL-approved, and selected for the appropriate operating range where applied. Switches shall have adjustable setpoints and barbed pressure tips.

M. Water Flow Switches: Provide a SPST type contact switch with bronze paddle blade, sized for the actual pipe size at the location. If installed outdoors, provide a NEMA-4 enclosure. Flow switch shall be UL listed.

N. Temperature Control Panels: Furnish temperature control panels of code gauge steel with locking doors for mounting all devices as shown. All electrical devices within a control panel shall be factory wired. Control panel shall be assembled by the BMS in a UL-Certified 508A panel shop. A complete set of ' as-built' control drawings (relating to the controls within that panel) shall be furnished within each control panel.

O. Pipe and Duct Temperature sensing elements: 20,000-ohm thermistor temperature sensors with and accuracy of ±1% accuracy. Their range shall be -5 to 250 degrees F (-20 to 121 degrees C). Limited range sensors shall be acceptable provided they are capable of sensing the range expected for the point at the specified accuracy. Thermal wells with heat conductive gel shall be included.

P. Low Air Temperature Sensors: Provide SPST type switch, with 15 to 55 degrees F (-9 to 13 degrees C), range, vapor-charged temperature sensor. Honeywell model L482A, or approved equivalent.

Q. Relays: Start/stop relay model shall provide either momentary or maintained switching action as appropriate for the motor being started. All relays shall be plugged in, interchangeable, mounted on a subbase and wired to numbered terminals strips. Relays installed in panels shall all be DPDT with indicating lamp. Relays installed outside of controlled devices shall be enclosed in a NEMA enclosure suitable for the location. Relays shall be labeled with UR symbol. RIB-style relays are acceptable for remote enable/disable.

R. Emergency Stop Switches: Provide toggle-type switch with normally-closed contact. Switch shall be labeled "AIR HANDLER EMERGENCY SHUTOFF, NORMAL - OFF.".

S. Transducers: Differential pressure transducers shall be electronic with a 4-20 mA output signal compatible to the Direct Digital Controller. Wetted parts shall be stainless steel. Unit

shall be designed to operate in the pressure ranges involved.

T. Control Power Transformers: Provide step-down transformers for all DDC controllers and devices as required. Transformers shall be sized for the load, but shall be sized for 50 watts, minimum. Transformers shall be UL listed Class 2 type, for 120 VAC/24 VAC operation.

U. Line voltage protection: All DDC system control panels that are powered by 120 VAC circuits shall be provided with surge protection. This protection is in addition to any internal protection provided by the manufacturer. The protection shall meet UL, ULC 1449, IEEE C62.41B. A grounding conductor, (minimum 12 AWG), shall be brought to each control panel.

2.10 BAS SERVER & WEB BROWSER GUI - SYSTEM OVERVIEW

A. The BAS Contractor shall provide system software based on server/thin-client architecture, designed around the open standards of web technology. The BAS server shall communicate using Ethernet and TCP. Server shall be accessed using a web browser over Owner intranet and remotely over the Internet.

B. The intent of the thin-client architecture is to provide the operator(s) complete access to the BAS system via a web browser. The thin-client web browser Graphical User Interface (GUI) shall be browser and operating system agnostic, meaning it will support Microsoft and Firefox and Chrome browsers (current released versions), and Windows as well as non-Window operating systems. No special software, other than free public domain programs such as "JAVA VIRTUAL MACHINE" shall be required to be installed on PCs used to access the BAS via a web browser.

C. The BAS server software shall support at least the following server platforms (Windows, and/or Linux). The BAS server software shall be developed and tested by the manufacturer of the system stand-alone controllers and network controllers/routers.

D. The web browser GUI shall provide a completely interactive user interface and shall offer and be configured with the following features as a minimum:
1. Trending.
2. Scheduling.
3. Electrical demand limiting.
4. Duty Cycling.
5. Downloading Memory to field devices.
6. Real time 'live' Graphic Programs.
7. Tree Navigation.
8. Parameter change of properties.
9. Setpoint adjustments.
10. Alarm / event information.
11. Configuration of operators.
12. Execution of global commands.
13. Add, delete, and modify graphics and displayed data.

E. Software Components: All software shall be the most current version. All software components of the BAS system software shall be provided and installed as part of this project. BAS software components shall include:
1. Server Software, Database and Web Browser Graphical User Interface.

2. System Configuration Utilities for future modifications to the system and controllers.
3. Graphical Programming Tools.
4. Direct Digital Control software.
5. Application Software.
6. Any required third party software.
7. If licensing credits are required provide a minimum of 10% additional to as built control system requires.

F. BAS Server Database: The BAS server software shall utilize a Java DataBase Connectivity (JDBC) compatible database such as: MS SQL 8.0, Oracle 8i or IBM DB2. BAS systems written to Non -Standard and/or Proprietary databases are NOT acceptable.

G. Thin Client - Web Browser Based: The GUI shall be thin client or browser based and shall meet the following criteria:
1. Web Browser's for PC's: Only the current released browser (Explorer/Firefox/Chrome) will be required as the GUI and a valid connection to the server network. No installation of any custom software shall be required on the operator's GUI workstation/client. Connection shall be over an intranet or the Internet.
2. Secure Socket Layers: Communication between the Web Browser GUI and BAS server shall offer encryption using 128-bit encryption technology within Secure Socket Layers (SSL). Communication protocol shall be Hyper-Text Transfer Protocol (HTTP).

2.11 WEB BROWSER GRAPHICAL USER INTERFACE

A. Web Browser Navigation: The Thin Client web browser GUI shall provide a comprehensive user interface. Using a collection of web pages, it shall be constructed to "feel" like a single application, and provide a complete and intuitive mouse/menu driven operator interface. It shall be possible to navigate through the system using a web browser to accomplish requirements of this specification. The Web Browser GUI shall (as a minimum) provide for navigation, and for display of animated graphics, schedules, alarms/events, live graphic programs, active graphic setpoint controls, configuration menus for operator access, reports and reporting actions for events.

B. Login: On launching the web browser and selecting the appropriate domain name or IP address, the operator shall be presented with a login page that will require a login name and password. Navigation in the system shall be dependent on the operator's role privileges and geographic area of responsibility.

C. Navigation: Navigation through the GUI shall be accomplished by clicking on appropriate level of a navigation tree (consisting of expandable and collapsible tree control like Microsoft's Explorer program) and/or by selecting dynamic links to other system graphics. Both the navigation tree and action pane shall be displayed simultaneously, enabling the operator to select a specific system or equipment and view the corresponding graphic. The navigation tree shall as a minimum provide the following views: Geographic, Network, Groups and Configuration.
1. Geographic View shall display a logical geographic hierarchy of the system including: cities, sites, buildings, building systems, floors, equipment and objects.
2. Groups View shall display Scheduled Groups and custom reports.
3. Configuration View shall display all the configuration categories (Operators, Schedule, Event, Reporting and Roles).

D. Action Pane: The Action Pane shall provide several functional views for each HVAC or mechanical/electrical subsystem specified. A functional view shall be accessed by clicking on the corresponding button:
   1. Graphics: Using graphical format suitable for display in a web browser, graphics shall include aerial building/campus views, color building floor-plans, equipment drawings, active graphic setpoint controls, web content and other valid HTML elements. The data on each graphic page shall automatically refresh.
   2. Properties: Shall include graphic controls and text for the following: Locking or overriding objects, demand strategies, and any other valid data required for setup. Changes made to the properties pages shall require the operator to depress an ' accept/cancel' button.
   3. Schedules: Shall be used to create, modify/edit and view schedules based on the systems geographical hierarchy (using the navigation tree).
   4. Alarms: Shall be used to view alarm information geographically (using the navigation tree), acknowledge alarms, sort alarms by category, actions and verify reporting actions.
   5. Trends: Shall be used to display associated trend and historical data, modify colors, date range, axis and scaling.
   6. Logic - Live Graphic Programs: Shall be used to display' live' graphic programs of the control algorithm, (micro block programming) for the mechanical/electrical system selected in the navigation tree.
   7. Other actions such as Print, Help, Command, and Logout shall be available via a drop-down window.

E. Color Graphics: The Web Browser GUI shall make extensive use of color in the graphic pane to communicate information related to set points and comfort. Animated .gifs or .jpg, vector scalable, active setpoint graphic controls shall be used to enhance usability. Graphics tools used to create Web Browser graphics shall be non-proprietary and conform to the following basic criteria:
   1. Display Size: The GUI workstation software shall graphically display in a minimum of 1024 by 768 pixels 24 bit True Color.
   2. General Graphic: General area maps shall show locations of controlled buildings in relation to local landmarks.
   3. Color Floor Plans: Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors, as selected by Owner. Provide a visual display of temperature relative to their respective set points. The colors shall be updated dynamically as a zone's actual comfort condition changes.
   4. Mechanical Components: Mechanical system graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. Selected I/O points being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation shall be used for rotation or moving mechanical components to enhance usability. .
   5. Minimum System Color Graphics: Color graphics shall be selected and displayed via a web browser for the following:
      a. Each piece of equipment monitored or controlled including each terminal unit.
      b. Each building.
      c. Each floor and zone controlled.

F. Hierarchical Schedules: Utilizing the Navigation Tree displayed in the web browser GUI, an operator (with password access) shall be able to define a Normal, Holiday or Override

schedule for an individual piece of equipment or room, or choose to apply a hierarchical schedule to the entire system, site or floor area. For example, Independence Day ' Holiday' for every level in the system would be created by clicking at the top of the geographic hierarchy defined in the Navigation Tree. No further operator intervention would be required and every control module in the system with would be automatically downloaded with the ' Independence Day' Holiday. All schedules that affect the system/area/equipment highlighted in the Navigation Tree shall be shown in a summary schedule table and graph.

1. Schedules: Schedules shall comply with BACnet standards, (Schedule Object, Calendar Object, Weekly Schedule property and Exception Schedule property) and shall allow events to be scheduled based on:
    a. Types of schedule shall be Normal, Holiday or Override.
    b. A specific date,.
    c. A range of dates,.
    d. Any combination of Month of Year (1-12, any), Week of Month (1-5, last, any), Day of Week (M-Sun, Any).
    e. Wildcard (example, allow combinations like second Tuesday of every month).
2. Schedule Categories: The system shall allow operators to define and edit scheduling categories (different types of "things" to be scheduled; for example, lighting, HVAC occupancy, etc.). The categories shall include: name, description, icon (to display in the hierarchy tree when icon option is selected) and type of value to be scheduled.
3. Schedule Groups: In addition to hierarchical scheduling, operators shall be able to define functional Schedule Groups, comprised of an arbitrary group of areas/rooms/equipment scattered throughout the facility and site. For example, the operator shall be able to define an ' individual tenant' group - who may occupy different areas within a building or buildings. Schedules applied to the ' tenant group' shall automatically be downloaded to control modules affecting spaces occupied by the ' tenant group'.
4. Intelligent Scheduling: The control system shall be intelligent enough to automatically turn on any supporting equipment needed to control the environment in an occupied space. If the operator schedules an individual room in a VAV system for occupancy, for example, the control logic shall automatically turn on the VAV air handling unit, chiller, boiler and/or any other equipment required to maintain the specified comfort and environmental conditions within the room.
5. Partial Day Exceptions: Schedule events shall be able to accommodate a time range specified by the operator (ex: board meeting from 6 pm to 9 pm overrides Normal schedule for conference room).
6. Schedule Summary Graph: The schedule summary graph shall clearly show Normal versus Holiday versus Override Schedules and the net operating schedule that results from all contributing schedules. Note: In case of priority conflict between schedules at the different geographic hierarchy, the schedule for the more detailed geographic level shall apply.

G. Alarms: Alarms associated with a specific system, area, or equipment selected in the Navigation Tree, shall be displayed in the Action Pane by selecting an ' Alarms' view. Alarms, and reporting actions shall have the following capabilities:

1. Alarms View: Each Alarm shall display an Alarms Category (using a different icon for each alarm category), date/time of occurrence, current status, alarm report and a bold URL link to the associated graphic for the selected system, area or equipment. The URL link shall indicate the system location, address and other pertinent information. An operator shall easily be able to sort events, edit event templates and categories,

acknowledge or force a return to normal in the Events View as specified in this section.

2. Alarm Categories: The operator shall be able to create, edit or delete alarm categories such as HVAC, Maintenance, Fire, or Generator. An icon shall be associated with each alarm category, enabling the operator to easily sort through multiple events displayed.
3. Alarm Templates: Alarm template shall define different types of alarms and their associated properties. As a minimum, properties shall include a reference name, verbose description, severity of alarm, acknowledgement requirements, and high/low limit and out of range information.
4. Alarm Areas: Alarm Areas enable an operator to assign specific Alarm Categories to specific Alarm Reporting Actions. For example, it shall be possible for an operator to assign all HVAC Maintenance Alarm on the 1st floor of a building to email the technician responsible for maintenance. The Navigation Tree shall be used to setup Alarm Areas in the Graphic Pane.
5. Alarm Time/Date Stamp: All events shall be generated at the DDC control module level and comprise the Time/Date Stamp using the standalone control module time and date.
6. Alarm Configuration: Operators shall be able to define the type of Alarm generated per object. A ' network' view of the Navigation Tree shall expose all objects and their respective Alarm Configuration. Configuration shall include assignment of Alarm, type of Acknowledgement and notification for return to normal or fault status.
7. Alarm Summary Counter: The view of Alarm in the Graphic Pane shall provide a numeric counter, indicating how many Alarms are active (in alarm), require acknowledgement and total number of Alarms in the BAS Server database.
8. Alarm Auto-Deletion: Alarms that are acknowledged and closed shall be auto-deleted from the database and archived to a text file after an operator defined period.
9. Alarm Reporting Actions: Alarm Reporting Actions specified shall be automatically launched (under certain conditions) after an Alarm is received by the BAS server software. Operators shall be able to easily define these Reporting Actions using the Navigation Tree and Graphic Pane through the web browser GUI. Reporting Actions shall be as follows:
    a. Print: Alarm information shall be printed to the BAS server's PC or a networked printer.
    b. Email: Email shall be sent via any POP3-compatible e-mail server (most Internet Service Providers use POP3). Email messages may be copied to several email accounts. Note: Email reporting action shall also be used to support alphanumeric paging services, where email servers support pagers.
    c. File Write: The ASCII File write reporting action shall enable the operator to append operator defined alarm information to any alarm through a text file. The alarm information that is written to the file shall be completely definable by the operator. The operator may enter text or attach other data point information (such as AHU discharge temperature and fan condition upon a high room temperature alarm).
    d. Write Property: The write property reporting action updates a property value in a hardware module.
    e. SNMP: The Simple Network Management Protocol (SNMP) reporting action sends an SNMP trap to a network in response to receiving an alarm.
    f. Run External Program: The Run External Program reporting action launches

specified program in response to an event.

H. Trends: As system is engineered, all points shall be enabled to trend. Trends shall both be displayed and user configurable through the Web Browser GUI. Trends shall comprise analog, digital or calculated points simultaneously. A trend log's properties shall be editable using the Navigation Tree and Graphic Pane.
   1. Viewing Trends: The operator shall have the ability to view trends by using the Navigation Tree and selecting a Trends button in the Graphic Pane. The system shall allow y- and x-axis maximum ranges to be specified and shall be able to simultaneously graphically display multiple trends per graph.
   2. Local Trends: Trend data shall be collected locally by Multi-Equipment/Single Equipment general-purpose controllers, and periodically uploaded to the BAS server if historical trending is enabled for the object. Trend data, including run time hours and start time date shall be retained in non-volatile module memory. Systems that rely on a gateway/router to run trends are NOT acceptable.
   3. Resolution. Sample intervals shall be as small as one second. Each trended point will have the ability to be trended at a different trend interval. When multiple points are selected for displays that have different trend intervals, the system will automatically scale the axis.
   4. Dynamic Update. Trends shall be able to dynamically update at operator-defined intervals.
   5. Zoom/Pan. It shall be possible to zoom-in on a particular section of a trend for more detailed examination and ' pan through' historical data by simply scrolling the mouse.
   6. Numeric Value Display. It shall be possible to pick any sample on a trend and have the numerical value displayed.
   7. Copy/Paste. The operator shall have the ability to pan through a historical trend and copy the data viewed to the clipboard using standard keystrokes (i.e. CTRL+C, CTRL+V).

I. Security Access: Systems that Security access from the web browser GUI to BAS server shall require a Login Name and Password. Access to different areas of the BAS system shall be defined in terms of Roles, Privileges and geographic area of responsibility as specified:
   1. Roles: Roles shall reflect the actual roles of different types of operators. Each role shall comprise a set of ' easily understood English language' privileges. Roles shall be defined in terms of View, Edit and Function Privileges.
      a. View Privileges shall comprise: Navigation, Network, and Configuration Trees, Operators, Roles and Privileges, Alarm/Event Template and Reporting Action.
      b. Edit Privileges shall comprise: Setpoint, Tuning and Logic, Manual Override, and Point Assignment Parameters.
      c. Function Privileges shall comprise: Alarm/Event Acknowledgement, Control Module Memory Download, Upload, Schedules, Schedule Groups, Manual Commands, Print and Alarm/Event Maintenance.
   2. Geographic Assignment of Roles: Roles shall be geographically assigned using a similar expandable/collapsible navigation tree. For example, it shall be possible to assign two HVAC Technicians with similar competencies (and the same operator defined HVAC Role) to different areas of the system.

2.12 GRAPHICAL PROGRAMMING

A. The system software shall include a Graphic Programming Language (GPL) for all DDC control algorithms resident in all control modules. Any system that does not use a drag and

drop method of graphical icon programming shall not be accepted. All systems shall use a GPL is a method used to create a sequence of operations by assembling graphic microblocks that represent each of the commands or functions necessary to complete a control sequence. Microblocks represent common logical control devices used in conventional control systems, such as relays, switches, high signal selectors etc., in addition to the more complex DDC and energy management strategies such as PID loops and optimum start. Each microblock shall be interactive and contain the programming necessary to execute the function of the device it represents.

B. Graphic programming shall be performed while on screen and using a mouse; each microblock shall be selected from a microblock library and assembled with other microblocks necessary to complete the specified sequence. Microblocks are then interconnected on screen using graphic "wires," each forming a logical connection. Once assembled, each logical grouping of microblocks and their interconnecting wires then forms a graphic function block which may be used to control any piece of equipment with a similar point configuration and sequence of operation.

C. Graphic Sequence: The clarity of the graphic sequence shall be such that the operator has the ability to verify that system programming meets the specifications, without having to learn or interpret a manufacturer's unique programming language. The graphic programming shall be self-documenting and provide the operator with an understandable and exact representation of each sequence of operation.

D. GPL Capabilities: The following is a minimum definition of the capabilities of the Graphic Programming software:
   1. Function Block (FB): Shall be a collection of points, microblocks and wires which have been connected together for the specific purpose of controlling a piece of HVAC equipment or a single mechanical system.
   2. Logical I/O: Input/Output points shall interface with the control modules in order to read various signals and/or values or to transmit signal or values to controlled devices.
   3. Microblocks: Shall be software devices that are represented graphically and may be connected together to perform a specified sequence. A library of microblocks shall be submitted with the control contractors bid.
   4. Wires: Shall be Graphical elements used to form logical connections between microblocks and between logical I/O.
   5. Reference Labels: Labels shall be similar to wires in that they are used to form logical connections between two points. Labels shall form a connection by reference instead of a visual connection, i.e. two points labeled 'A' on a drawing are logically connected even though there is no wire between them.
   6. Parameter: A parameter shall be a value that may be tied to the input of a microblock.
   7. Properties: Dialog boxes shall appear after a microblock has been inserted which has editable parameters associated with it. Default parameter dialog boxes shall contain various editable and non-editable fields, and shall contain 'push buttons' for the purpose of selecting default parameter settings.
   8. Icon: An icon shall be graphic representation of a software program. Each graphic microblock has an icon associated with it that graphically describes its function.
   9. Menu-bar Icon: Shall be an icon that is displayed on the menu bar on the GPL screen, which represents its associated graphic microblock.
   10. Live Graphical Programs: The Graphic Programming software shall support a ' live' mode, where all input/output data, calculated data and setpoints shall be displayed in a

' live' real-time mode.

PART 3 EXECUTION

3.01 WIRING AND CONDUIT

A. All control wiring incidental to the Temperature Control System shall be by the BAS contractor except as follows:

1. Wiring shown on the Electrical Contract Drawings shall be wired by the Electrical Contractor.

B. All temperature control panels shall be completely prewired by the Temperature Control Manufacturer to terminal strips within the control cabinet. Provide 20 amp toggle switch to disconnect power at each panel. All internal interlock wiring within the control panel shall be complete to the terminal strips.

C. All exposed wiring, including low voltage, shall be installed in conduit. All wiring, conduit and installation shall be in accordance with the latest edition of the National Electrical Code and the requirements of Division 26 Electrical Specification, except low voltage wiring may be of the type and size recommended by the BAS Manufacturer.

D. Low voltage wiring concealed above accessible ceilings does not require conduit except as required in air plenums. Open wiring shall be bundled and supported at 3 ft. intervals with a system of J-hooks and plastic tie-wraps secured to permanent building structure.

E. All conduit and conduit installation, including conduit utilized for plastic pneumatic tubing, shall be in accordance with the requirements of Division 26, Electrical Specification.

F. All electrical control wiring to the control panels shall be the responsibility of the Control System Contractor.

G. All wiring shall be in accordance with the Project Electrical Specifications (Division 16), the National Electrical Code and any applicable local codes. All control wiring shall be installed in raceways.

H. Excess wire shall not be looped or coiled in the controller cabinet.

I. Incorporate electrical noise suppression techniques in relay control circuits.

J. There shall be no drilling on the controller cabinet after the controls are mounted inside.

K. Careful stripping of wire while inside the cabinet is required to ensure that no wire strand fragments land on circuit boards.

L. Use manufacturer-specified wire for all network connections.

M. Use approved optical isolation and lightning protection when penetrating building envelope.

N. Read installation instructions carefully. Any unavoidable deviations shall be approved by owner's rep prior to installation.

3.02 TEMPERATURE CONTROL SYSTEM DIAGRAMS

A. Complete Temperature Control System diagrams including motor control schematics, wiring diagrams and a written description of the system operation shall be provided by the Temperature Control System Installer. Diagrams shall include face elevations of the temperature control panels.

B. Prepare, as a part of Temperature Control System shop drawings, complete terminal-to-terminal wiring diagrams. These will show terminal designations on control items and equipment. Wiring diagrams to be compatible with Electrical Drawings.

C. The Control diagrams, along with product literature on all system components shall be submitted as "Shop Drawings" for review by the Associate prior to starting work. Submit two sets of drawings for "preliminary" review before making a formal submittal.

D. Control diagrams, laminated in plastic or in full size heavy plastic binders with mounting rings, shall be hung adjacent to each control panel showing all schematic diagrams and descriptions related to the systems served by that panel.

E. Furnish four (4) complete sets of Operating and Maintenance Instructions for Temperature Controls, including control diagrams, to the HVAC Contractor for inclusion in the "Operating and Maintenance Manuals". Record control drawings must show set points and spring ranges.

3.03 CALIBRATION

A. Inasmuch as controllers are factory calibrated and controlled devices have nominal operating ranges, different from actual field conditions, all controllers shall be calibrated and set for the actual field conditions. A listing of actual spring ranges on controlled devices such as for valves, damper motors, etc., shall be submitted to the Owner's Operating Associate in the Operating and Maintenance Manual, for future recalibration/maintenance.

3.04 SUPERVISION

A. All temperature controls shall be installed, and calibrated under the supervision of a qualified representative of the Temperature Control System Manufacturer. The Temperature Control System Manufacturer shall certify in writing the qualification of the installing company.

3.05 SEQUENCES OF OPERATION

A. Outside Air Conditions:

1. The BAS shall monitor the outside air temperature and humidity and calculate the outside air enthalpy on a continual basis. These values shall be made available to the system at all times.

B. High Pressure Variable Volume Air Handling Unit with Energy Recovery Control – AHU-1

1. All auto control dampers and control valves shall be provided with electric actuators. All damper and control valve actuators shall be controlled from separate outputs.

2. The air handling unit shall have an occupied and unoccupied sequence of operation as described herein. The Temperature Control Contractor shall be responsible for meeting with Miami University's Facility Manager to determine the appropriate "occupied" days and hours of operation.

   The return air fan shall operate through separate DDC contacts when the supply fans are operating during the occupied cycle. Return fan shall be OFF when the unit is operating in the "unoccupied" heating, cooling, or dehumidification cycle and the morning warm-up cycle.

3. Unit to run continually during the "occupied" cycle as determined through DDC control. When the unit is indexed ON, the DDC system shall slowly ramp the supply and return fans up to speed (60 seconds minimum) and after a 2 minute delay, to allow the dampers to modulate.

   When the unit is operating in the "occupied" cycle, the DDC system shall modulate the outside air damper to the position that is determined to provide the minimum outdoor air volume as scheduled on the Drawings. This position shall be determined in conjunction with the Air Balancing Contractor. The DDC system shall modulate the return air damper in sequence with the outside air damper. The return damper shall be full open when the outside air damper is at the minimum position and full closed when the outside air damper is full open.

4. The DDC system shall monitor relative space pressure of the building with respect to the outdoors. The return fans speed shall be modulated by the return fans AFD through DDC controls to keep areas under .05" w.c. (adjustable) positive pressure condition.

   The DDC system shall monitor the pressure of the return/relief air section of the air handler and modulate the relief air damper at the unit and at the mechanical room exterior wall open as required to maintain a constant return air plenum static pressure upstream of the return air damper. Static set point shall be field determined.

5. When the unit is indexed to the "unoccupied" cycle, the outdoor and relief air dampers shall be closed, the return air damper opened, and the supply and return fans shut off and the adjustable frequency drives returned to the lowest setting. A temperature sensor downstream of the preheat coil shall modulate the preheat

coil control valve to maintain a 55°F (adjustable) temperature inside the air handling unit. Unit shall remain in this position, except for unoccupied heating, cooling, and dehumidification and morning warm-up cycles, until the next occupied cycle.

a.) Provide temperature sensors in the supply air and exhaust air streams both upstream and downstream of the heat recovery wheel.

7. The DDC system shall modulate the return air damper opposite to the outside air and relief air dampers. The relief air dampers shall lag the return air damper by 10% (adjustable). The minimum outside air flow (scheduled on the drawings) will require the relief damper to be opened at some percentage during the ventilation cycle.

   Under minimum outside air heating and/or cooling occupied conditions, the DDC system shall modulate the outside air damper based on feedback from the measuring station to maintain the fixed minimum outside air volume at all times when the unit is operating. This is a fixed amount and does not vary with the units variable volume operation. The return air damper shall start in the open position and may modulate toward closed to maintain the required outside air CFM under full or reduced total flow conditions. A DDC control loop shall monitor the "mixed air static", the "measuring station CFM", and the return air damper position to prevent a high negative mixed air static in the mixed air plenum. Static setpoint shall be field determined. The DDC system shall close the outside air damper when the air handling unit is operating in morning warm-up or unoccupied heating, cooling or dehumidification cycles.

8. Carbon dioxide (CO_2) sensors shall be provided by the Temperature Control Contractor and located in the unit return air and in the building interior spaces as shown on the Drawings. The DDC system shall monitor the CO_2 sensors for the worst case situation in the area supplied by the unit and in the unit return air.

   If, during minimum outside air heating and/or cooling occupied conditions, the concentration of CO_2 reaches 900 parts per million (adjustable) at any interior CO_2 sensor within area served by the unit, or in the return air, then the DDC system shall increase the “minimum outside air damper” from the minimum open position to the maximum open position (as determined by the airflow measuring station). If the “minimum outside air damper” reaches 100% open without achieving the required outside air ventilation amount, then the return air damper shall start in the open position and shall be modulated toward close to achieve the required outside air amount. The same DDC control loop as described above, “return air damper position” to prevent a high negative mixed air static in the mixed air plenum. Static setpoint shall be field determined. If either concentration of the CO_2 falls below 700 PPM (adjustable) for 20 minutes at all the sensors, the DDC system shall return the minimum outside air damper to the minimum open position.

The operator's terminal shall be alarmed when any of the sensors exceeds 1200 PPM or falls below 100 PPM for more than 30 minutes. The high/low setpoint indicates that the sensor has most likely failed.

The above CO_2 sequence applies to AHU-1 and AHU-2. The DDC system shall reset the outside airflow between the CO_2 Minimum and CO_2 Maximum airflows as shown in air handling schedule at all times for these units.

9. The DDC system shall provide indication at the operator's workstation when the air handling unit is in economizer operation. Economizer operation shall be "locked out" when outside air temperature is below 55ºF or above 75ºF at the building.

   A global return air enthalpy setting is assumed by calculating a fixed return air enthalpy of 26 BTU/lb of dry air which equates to a temperature of 72 degrees F. and a humidity of 50% RH. When the outside air enthalpy is below this calculated value the economizer program is enabled. An outside air temperature high limit of 75 degrees F is provided to override the enthalpy economizer enable if outside air temperature is greater than 75 degrees F.

   When the air handling unit is in economizer mode, the outside air dampers shall modulate and the return air damper shall modulate opposite to the outside air dampers, to control the discharge air temperature per the reset schedule. The mixed air sensor shall prevent the mixed air temperature from dropping below 50°F (adjustable). Dampers shall modulate in sequence with the heating and cooling coil valves to maintain the discharge air temperature. The relief air damper shall lag the return air damper by 10%.

10. A DDC static pressure sensor located approximately two-thirds down the length of the supply air duct run with the greatest static pressure shall maintain the minimum duct static pressure by modulating the adjustable frequency drive on the supply fans. The static pressure setpoint shall be reset based on zone damper position and airflow requirements as described below.

    a. The initial duct static pressure setpoint shall be 1.0" (adjustable).
    b. The AHU controller shall monitor the damper position of all associated VAV terminal units and determined each VAV AHU's Critical Zone (CZ), which is the VAV terminal unit that has the lowest percentage of actual airflow compared to its current operating airflow setpoint.
    c. When the CZ damper is fully open and actual/setpoint airflow ratio is greater than 95%, (excess airflow/static) the duct static pressure setpoint shall be incrementally reset down by 10% of previous setpoint at a frequency of 5 minutes to a minimum of 0.75" (adjustable) or the supply fan VFD has reached its lowest operating speed limit.
    d. When the CZ damper is fully open and actual/setpoint airflow ratio is less than 90% (insufficient airflow/static) and space temperature is not satisfied, the reverse shall occur and the duct static pressure setpoint shall incrementally reset up to a maximum of 1.5" (adjustable). Monitor and alarm to DDC system if any zone cannot maintain at least 90% of

actual/setpoint airflow ratio for more than 30 minutes (adjustable) if duct static pressure is at maximum setpoint.

e. Static pressure sensor location shall be recorded on the "Record" control drawings and noted on the graphic display.

A static pressure sensor in the mixed air plenum shall provide an alarm at the operator's terminal if the mixed air plenum pressure exceeds negative 0.75 inches (adjustable).

Install a manual reset low limit static pressure switch in the mixed air plenum to stop the fans, through the electrical control circuit, upon sensing a mixed air static pressure that exceeds negative 1.0 inches (adjustable). The DDC system shall monitor the mixed air pressure switch and provide an alarm at the operator's terminal when tripped.

Static pressure readout shall be provided at the operator's terminal for all duct static pressure sensors. The DDC system shall provide an alarm at the operator's workstation if the supply air duct static pressure falls 0.2 inches (adjustable) below setpoint.

11. Install a 2-pole manual reset high limit static pressure switch in the supply air discharge duct to stop the fans, through the electrical control circuit, upon sensing a discharge static pressure above 4.0 inches (adjustable). The DDC system shall monitor the high static pressure switch and provide an alarm at the operator's terminal when tripped.

12. The DDC system, with temperature sensors located in the outside air and supply air, shall modulate the outside, return and relief air dampers and the heating and cooling coil control valves in sequence, without overlap, to maintain the discharge air temperature. Whenever the outdoor temperature is below 70°F, DDC controls shall have the ability to reset the discharge air temperature based on the percentage of VAV box reheat coils served by the unit requiring reheat.

Initial reset schedule shall be as follows:

Percentage of VAV Boxes Using Reheat	Discharge Air
15%	55°F
33%	56°F
45%	57°F
55%	58°F
65%	59°F
75%	60°F
85%	62°F

Reset schedule shall be easily adjustable from the operator's terminal.

a) Whenever the outside air is above 70°F or a space sensor senses a space temperature 4°F above setpoint, the supply air temperature reset shall be disabled, the supply air temperature shall be maintained at 55°F and an alarm shall be sent to the DDC control system.

13. A temperature sensor in the mixed air plenum shall override the outside, return, and relief dampers to prevent the mixed air temperature from dropping below 50°F (adjustable) unless additional outside air is required for ventilation as determined by the airflow monitoring station.

14. When the outdoor air temperature is 50°F (adjustable) or less, the DDC system shall operate the unit in the heating with energy recovery mode of operation. Controls shall be set to maintain the discharge air temperature through the reset schedule described above.

Heating with Energy Recovery Operation

a. In this mode, the speed energy recovery wheel shall be modulated and shall operate at all times the unit is operating. There shall be three stages of heating control.

b. First-stage heat: The energy recovery wheel will be turned on through the DDC control and the energy recovery wheel shall be modulated to run at minimum speed.

1. In this mode, with the wheel running at minimum speed, if the discharge air temperature rises above the set-point, the exhaust air bypass damper shall modulate open to maintain the discharge air temperature.

c. Second-stage heat: The energy recovery wheel continues to run speed modulates to maintain the discharge air temperature through the reset schedule described above.

d. Third-stage heat: The energy recovery wheel continues to run, at 100% speed and the heating coil control valve modulates to maintain the discharge air temperature through the reset schedule described above.

e. A DDC temperature sensor in the exhaust section downstream of the heat wheel shall monitor the exhaust temperature for frost control and modulate the heat wheel speed to keep the temperature no less than 35°F (adjustable) for exhaust air leaving the heat wheel.

f. The heat wheel speed shall be varied by a dedicated factory mounted VFD and DDC controls to control frosting. When the exhaust air temperature downstream of the heat wheel as sensed by a DDC temperature sensor in the outside air is 35°F or higher the heat wheel shall operate at full speed. Whenever the exhaust air temperature downstream of the heat wheel falls below 35°F the speed of the heat wheel shall be reduced to maintain a downstream temperature of 35°.

Once the VFD has reached the minimum factory preset speed and the leaving outside air temperature is below 35°F the DDC controls shall operate the electric radiant heater in the units outside air stream to prevent frost on the heat wheel. Once the exhaust air temperature downstream of the heat wheel is above 35°F (adjustable) for 5 minutes, the electric radiant heater shall be turned off and the heat wheel shall return to normal operation.

1.) Provide a current sensing relay on the heat wheel motor to provide an alarm whenever the belt fails on the heat wheel.

15. A low limit DDC temperature sensor downstream of the preheat coil shall override the discharge air control and modulate the preheat coil control valve as required to maintain minimum 55°F (adjustable) air temperature downstream of the preheat coil. This same sensor shall modulate the preheat coil control valve to maintain minimum 55°F (adjustable) temperature inside the air handling unit when the unit is OFF.

16. Heating Coil Circulating Pump Control (HWP-X)

a. An outdoor sensor, through the DDC control, shall start the hot water coil circulating pump serving the air handling unit, when the outdoor air temperature is below 38ºF (adjustable) and stop the pump when the outdoor temperature is above 42ºF (adjustable).

b. Current sensing relays shall be provided for proof of flow at pump. The DDC system shall provide an alarm at the operator's terminal upon detecting no flow when the pump is sequenced ON.

17. Install 2-pole manual reset low limit thermostat(s) downstream of the preheat coil to stop the fans, through the electrical control circuit, and close the outside air and relief air dampers upon sensing a discharge air temperature below 38°F (adjustable). The DDC system shall monitor the low limit thermostat and return the dampers to their normal unoccupied position and provide an alarm at the operator’s terminal when tripped.

The DDC system shall modulate the preheat coil control valve to maintain a 55°F temperature inside the unit when the low limit thermostat trips.

The DDC system shall start chilled water pump (P-X) supplying the air handling unit and open the cooling coil control valve when the low limit thermostat trips.

18. When the outdoor air temperature exceeds 75°F (adjustable) the DDC system shall operate the unit in the cooling with energy recovery mode of operation.

<u>Cooling with Energy Recovery Operation</u>

a. In this mode, the energy recovery wheel shall be operating at full speed.

b. The DDC system shall modulate the cooling coil control valve to maintain supply air temperature through the reset schedule described above.

19. Smoke detectors shall be provided by the Electrical Contractor in the return air ducts. Smoke control shall be as follows:

De-energize power to the supply and return fans through the fire alarm system.

20. The space humidity sensors shall also monitor the humidity through DDC control to avoid a high humidity occurrence. When the relative humidity reaches 60% (adjustable), the unit shall go into an occupied dehumidification cycle. During the occupied dehumidification cycle, the supply and return fans shall operate at their current speed, the cooling control valve shall be modulated to maintain a 53°F supply air temperature, and the VAV box reheat coil control valves shall modulate to maintain the space temperature setpoint. When the space humidity reaches 50% (adjustable), the unit shall return to the normal occupied operation.

20. Heating, Cooling and Dehumidification During the Unoccupied Cycle:

a. Unoccupied Heating Setback Mode (outside air higher than 38 degrees F.)

During the unoccupied mode when the outside air temperature is above 40 degrees F., the supply and return fans will be off. The outside and relief air dampers will be closed, return air damper open. Chilled water control valve will be closed and the hot water pre heat coil valve will modulate to maintain 55 degrees F as sensed by the mixed air temperature sensor.

The space temperature sensors will be sampled and if the temperature in any space drops below 62 degrees F (adjustable), the supply and return fans will start, and the unit will ramp slowly to meet the static pressure control set point. Outside and relief air dampers and chilled water valve will all remain closed, return damper fully open. The hot water control valve will modulate to maintain 80 degrees F. supply air temperature setpoint.

Once the space temperature rises above 65 degrees F. the supply and return fans will cycle off.

b. Unoccupied Heating Setback Mode (outside air less than 38 degrees F.)

During the unoccupied mode when the outside air temperature is less than 38 degrees F., the supply fan(s) will be off. The outside and relief air dampers will be closed, return air damper open. Chilled water control valve will be closed. The return fan will operate at 50% speed to pressurize the mixed air chamber and provide limited air flow

downstream. The hot water heating control valve will modulate to maintain a supply temperature of 63 degrees F.

The space temperature sensors will be sampled and if the temperature in the space drops below 62 degrees F. (adjustable), the supply and return fans will start, and the unit will ramp slowly to meet the static pressure control set point. Outside and relief air dampers, chilled water, and humidifier valve will all remain closed, return damper fully open. The hot water control valve will modulate to maintain 80 degrees F. Supply Air Temperature set point.

Once the space temperature rises above 65 degrees F. the supply fan(s) will cycle off.

c. Unoccupied Cooling Setback Mode

During the unoccupied mode the supply and return fans will be off. The outside and relief air dampers will be closed, return air damper open. Chilled water valve will be closed.

The space temperature sensors will be sampled and if the temperature in the space rises above 82 degrees F (adjustable), the supply and return fans will start, and the unit will ramp slowly to meet the static pressure control set point. Outside and relief air dampers, and hot water valve will all remain closed, return damper fully open. The chilled water control valve will modulate to maintain 55 degrees F. Supply Air Temperature set point.

Once the space temperature reaches 78 degrees F. the supply and return fans will cycle off.

d. Unoccupied Dehumidification Setback Mode

During the unoccupied mode the supply and return fans will be off. The outside and relief air dampers will be closed, return air damper open. Chilled water valve will be closed.
Whenever the unit is cycled “on” for cooling during the unoccupied cycle, a duct humidity sensor(s) shall be provided and monitored through DDC control to maintain a maximum 60% space humidity during the unoccupied cycle. During the night dehumidification cycle the supply and return fans shall operate, all dampers shall remain in their normal unoccupied position, the preheat coil control valve shall be closed, and the cooling coil control valve shall modulate to maintain a 55°F supply air temperature. When the space relative humidity reaches 55% (adjustable) and the space reaches 78ºF (adjustable) the unit shall shut off and the preheat coil and cooling coil valves shall return to their unoccupied operation.

21. Morning warm-up and cool down

The program shall be capable of morning warmup and cool down modes of operation as outlined below and operate only at the beginning of the occupied cycle. The function may be used as part of an optimization strategy with the normal occupied scheduling. Once the system enters the occupied mode, the warmup and/or cool down cycle will not be allowed to operate again during the current occupied period.

a. Morning Warmup

The AHU fans shall start and ramp slowly to meet the static pressure control set point. The Supply Air Temperature set point will be indexed to 90 degrees F. (adjustable). The outside and relief air dampers shall be fully closed and the return air damper fully open. Chilled water control valves will be closed. The VAV box control will switch to the morning warmup control settings (see VAV box sequence of operation for detail).

The unit will remain in this mode until the average space temperature reaches 68 degrees F. (return air temperature sensor may be used when appropriate). The program will then switch to the normal occupancy mode.

b. Morning Cool Down

The AHU fans shall start and ramp slowly to meet the static pressure control set point. The program will modulate the chilled water control valve to maintain a 55 degrees F. Supply Air Temperature set point. The outside and relief air dampers shall be fully closed and the return air damper fully open, unless the outside air temperature and humidity is such that the economizer cycle can be utilized. Hot water control valves will be closed. The VAV box control will switch to the normal occupied control settings (see VAV sequence of operation for detail).

The unit will remain in this mode until the average space temperature reaches 78 degrees F. The program will then switch to the normal occupancy mode.

22. Current sensing relays shall be provided for all supply and return fans to provide input for proof of fan operation in addition to speed drive contacts. The DDC system shall provide an alarm at the operator's terminal upon detecting no air flow from any fan when the system is sequenced ON.

23. Control of all dampers, valves and devices shall be from separate DDC outputs.

24. A dirty filter pressure switch on the primary filter banks shall be provided by the Temperature Control Contractor. The DDC System shall monitor the switch and provide an alarm at the operator's terminal when the filters are dirty.

C. High Pressure Variable Volume Air Handling Unit Control – AHU-2 & AHU-3.

1. All auto control dampers and control valves shall be provided with electric actuators. All damper and control valve actuators shall be controlled from separate outputs.

2. The air handling unit shall have an occupied and unoccupied sequence of operation as described herein. The Temperature Control Contractor shall be responsible for meeting with Miami University's Facility Manager to determine the appropriate "occupied" days and hours of operation.

   The return air fan shall operate through separate DDC contacts when the supply fans are operating during the occupied cycle. Return fan shall be OFF when the unit is operating in the "unoccupied" heating, cooling, or dehumidification cycle and the morning warm-up cycle.

3. Unit to run continually during the "occupied" cycle as determined through DDC control. When the unit is indexed ON, the DDC system shall slowly ramp the supply and return fans up to speed (60 seconds minimum) and after a 2 minute delay, to allow the dampers to modulate.

   When the unit is operating in the "occupied" cycle, the DDC system shall modulate the outside air damper to the position that is determined to provide the minimum outdoor air volume as scheduled on the Drawings. This position shall be determined in conjunction with the Air Balancing Contractor. The DDC system shall modulate the return air damper in sequence with the outside air damper. The return damper shall be full open when the outside air damper is at the minimum position and full closed when the outside air damper is full open.

4. The DDC system shall monitor relative space pressure of the building with respect to the outdoors. The return fans speed shall be modulated by the return fans AFD through DDC controls to keep areas under .05" w.c. (adjustable) positive pressure condition.

   The DDC system shall monitor the pressure of the return/relief air section of the air handler and modulate the relief air damper at the unit and at the mechanical room exterior wall open as required to maintain a constant return air plenum static pressure upstream of the return air damper. Static set point shall be field determined.

5. When the unit is indexed to the "unoccupied" cycle, the outdoor and relief air dampers shall be closed, the return air damper opened, and the supply and return fans shut off and the adjustable frequency drives returned to the lowest setting. A temperature sensor downstream of the preheat coil shall modulate the preheat coil control valve to maintain a 55°F (adjustable) temperature inside the air handling unit. Unit shall remain in this position, except for unoccupied heating, cooling, and dehumidification and morning warm-up cycles, until the next occupied cycle.

7. The DDC system shall modulate the return air damper opposite to the outside air and relief air dampers. The relief air dampers shall lag the return air damper by 10% (adjustable). The minimum outside air flow (scheduled on the drawings) will require the relief damper to be opened at some percentage during the ventilation cycle.

   Under minimum outside air heating and/or cooling occupied conditions, the DDC system shall modulate the outside air damper based on feedback from the measuring station to maintain the fixed minimum outside air volume at all times when the unit is operating. This is a fixed amount and does not vary with the units variable volume operation. The return air damper shall start in the open position and may modulate toward closed to maintain the required outside air CFM under full or reduced total flow conditions. A DDC control loop shall monitor the "mixed air static", the "measuring station CFM", and the return air damper position to prevent a high negative mixed air static in the mixed air plenum. Static setpoint shall be field determined. The DDC system shall close the outside air damper when the air handling unit is operating in morning warm-up or unoccupied heating, cooling or dehumidification cycles.

8. Carbon dioxide (CO_2) sensors shall be provided by the Temperature Control Contractor and located in the unit return air and in the building interior spaces as shown on the Drawings. The DDC system shall monitor the CO_2 sensors for the worst case situation in the area supplied by the unit and in the unit return air.

   If, during minimum outside air heating and/or cooling occupied conditions, the concentration of CO_2 reaches 900 parts per million (adjustable) at any interior CO_2 sensor within area served by the unit, or in the return air, then the DDC system shall increase the “minimum outside air damper” from the minimum open position to the maximum open position (as determined by the airflow measuring station). If the “minimum outside air damper” reaches 100% open without achieving the required outside air ventilation amount, then the return air damper shall start in the open position and shall be modulated toward close to achieve the required outside air amount. The same DDC control loop as described above, “return air damper position” to prevent a high negative mixed air static in the mixed air plenum. Static setpoint shall be field determined. If either concentration of the CO_2 falls below 700 PPM (adjustable) for 20 minutes at all the sensors, the DDC system shall return the minimum outside air damper to the minimum open position.

   The operator’s terminal shall be alarmed when any of the sensors exceeds 1200 PPM or falls below 100 PPM for more than 30 minutes. The high/low setpoint indicates that the sensor has most likely failed.

   The above CO_2 sequence applies to AHU-1 and AHU-2. The DDC system shall reset the outside airflow between the CO_2 Minimum and CO_2 Maximum airflows as shown in air handling schedule at all times for these units.

9. The DDC system shall provide indication at the operator’s workstation when the air handling unit is in economizer operation. Economizer operation shall be

"locked out" when outside air temperature is below 55ºF or above 75ºF at the building.

A global return air enthalpy setting is assumed by calculating a fixed return air enthalpy of 26 BTU/lb of dry air which equates to a temperature of 72 degrees F. and a humidity of 50% RH. When the outside air enthalpy is below this calculated value the economizer program is enabled. An outside air temperature high limit of 75 degrees F is provided to override the enthalpy economizer enable if outside air temperature is greater than 75 degrees F.

When the air handling unit is in economizer mode, the outside air dampers shall modulate and the return air damper shall modulate opposite to the outside air dampers, to control the discharge air temperature per the reset schedule. The mixed air sensor shall prevent the mixed air temperature from dropping below 50°F (adjustable). Dampers shall modulate in sequence with the heating and cooling coil valves to maintain the discharge air temperature. The relief air damper shall lag the return air damper by 10%.

10. A DDC static pressure sensor located approximately two-thirds down the length of the supply air duct run with the greatest static pressure shall maintain the minimum duct static pressure by modulating the adjustable frequency drive on the supply fans. The static pressure setpoint shall be reset based on zone damper position and airflow requirements as described below.

    a. The initial duct static pressure setpoint shall be 1.0" (adjustable).
    b. The AHU controller shall monitor the damper position of all associated VAV terminal units and determined each VAV AHU's Critical Zone (CZ), which is the VAV terminal unit that has the lowest percentage of actual airflow compared to its current operating airflow setpoint.
    c. When the CZ damper is fully open and actual/setpoint airflow ratio is greater than 95%, (excess airflow/static) the duct static pressure setpoint shall be incrementally reset down by 10% of previous setpoint at a frequency of 5 minutes to a minimum of 0.75" (adjustable) or the supply fan VFD has reached its lowest operating speed limit.
    d. When the CZ damper is fully open and actual/setpoint airflow ratio is less than 90% (insufficient airflow/static) and space temperature is not satisfied, the reverse shall occur and the duct static pressure setpoint shall incrementally reset up to a maximum of 1.5" (adjustable). Monitor and alarm to DDC system if any zone cannot maintain at least 90% of actual/setpoint airflow ratio for more than 30 minutes (adjustable) if duct static pressure is at maximum setpoint.
    e. Static pressure sensor location shall be recorded on the "Record" control drawings and noted on the graphic display.

    A static pressure sensor in the mixed air plenum shall provide an alarm at the operator's terminal if the mixed air plenum pressure exceeds negative 0.75 inches (adjustable).

Install a manual reset low limit static pressure switch in the mixed air plenum to stop the fans, through the electrical control circuit, upon sensing a mixed air static pressure that exceeds negative 1.0 inches (adjustable). The DDC system shall monitor the mixed air pressure switch and provide an alarm at the operator's terminal when tripped.

Static pressure readout shall be provided at the operator's terminal for all duct static pressure sensors. The DDC system shall provide an alarm at the operator's workstation if the supply air duct static pressure falls 0.2 inches (adjustable) below setpoint.

11. Install a 2-pole manual reset high limit static pressure switch in the supply air discharge duct to stop the fans, through the electrical control circuit, upon sensing a discharge static pressure above 4.0 inches (adjustable). The DDC system shall monitor the high static pressure switch and provide an alarm at the operator's terminal when tripped.

12. The DDC system, with temperature sensors located in the outside air and supply air, shall modulate the outside, return and relief air dampers and the heating and cooling coil control valves in sequence, without overlap, to maintain the discharge air temperature. DDC controls shall have the ability to reset the discharge air temperature based on the percentage of VAV box reheat coils, served by the unit, requiring reheat whenever the outdoor temperature is below 70°F. Initial reset schedule shall be as follows:

Percentage of VAV Boxes Using Reheat	Discharge Air
15%	55°F
33%	56°F
45%	57°F
55%	58°F
65%	59°F
75%	60°F
85%	62°F

Reset schedule shall be easily adjustable from the operator's terminal.

a) Whenever the outside air is above 70°F or a space sensor senses a space temperature 4°F above setpoint, the supply air temperature reset shall be disabled, the supply air temperature shall be maintained at 55°F and an alarm shall be sent to the DDC control system.

13. A temperature sensor in the mixed air plenum shall override the outside, return, and relief dampers to prevent the mixed air temperature from dropping below 50°F (adjustable) unless additional outside air is required for ventilation as determined by the airflow monitoring station.

15. A low limit DDC temperature sensor downstream of the preheat coil shall override the discharge air control and modulate the preheat coil control valve as required to maintain minimum 55°F (adjustable) air temperature downstream of the preheat coil. This same sensor shall modulate the preheat coil control valve to maintain minimum 55°F (adjustable) temperature inside the air handling unit when the unit is OFF.

16. Install 2-pole manual reset low limit thermostat(s) downstream of the preheat coil to stop the fans, through the electrical control circuit, and close the outside air and relief air dampers upon sensing a discharge air temperature below 38°F (adjustable). The DDC system shall monitor the low limit thermostat and return the dampers to their normal unoccupied position and provide an alarm at the operator's terminal when tripped.

    The DDC system shall modulate the preheat coil control valve to maintain a 55°F temperature inside the unit when the low limit thermostat trips.

    The DDC system shall start chilled water pump (P-X) supplying the air handling unit and open the cooling coil control valve when the low limit thermostat trips.

17. Smoke detectors shall be provided by the Electrical Contractor in the return air ducts. Smoke control shall be as follows:

    De-energize power to the supply and return fans through the fire alarm system.

18. The space humidity sensors shall also monitor the humidity through DDC control to avoid a high humidity occurrence. When the relative humidity reaches 60% (adjustable), the unit shall go into an occupied dehumidification cycle. During the occupied dehumidification cycle, the supply and return fans shall operate at their current speed, the cooling control valve shall be modulated to maintain a 53°F supply air temperature, and the VAV box reheat coil control valves shall modulate to maintain the space temperature setpoint. When the space humidity reaches 50% (adjustable), the unit shall return to the normal occupied operation.

19. Heating, Cooling and Dehumidification During the Unoccupied Cycle:

    a. Unoccupied Heating Setback Mode (outside air higher than 38 degrees F.)

       During the unoccupied mode when the outside air temperature is above 40 degrees F., the supply and return fans will be off. The outside and relief air dampers will be closed, return air damper open. Chilled water control valve will be closed and the hot water pre heat coil valve will modulate to maintain 55 degrees F as sensed by the mixed air temperature sensor.

       The space temperature sensors will be sampled and if the temperature in any space drops below 62 degrees F (adjustable), the supply and return

fans will start, and the unit will ramp slowly to meet the static pressure control set point. Outside and relief air dampers and chilled water valve will all remain closed, return damper fully open. The hot water control valve will modulate to maintain 80 degrees F. supply air temperature setpoint.

Once the space temperature rises above 65 degrees F. the supply and return fans will cycle off.

b. Unoccupied Heating Setback Mode (outside air less than 38 degrees F.)

During the unoccupied mode when the outside air temperature is less than 38 degrees F., the supply fan(s) will be off. The outside and relief air dampers will be closed, return air damper open. Chilled water control valve will be closed. The return fan will operate at 50% speed to pressurize the mixed air chamber and provide limited air flow downstream. The hot water heating control valve will modulate to maintain a supply temperature of 63 degrees F.

The space temperature sensors will be sampled and if the temperature in the space drops below 62 degrees F. (adjustable), the supply and return fans will start, and the unit will ramp slowly to meet the static pressure control set point. Outside and relief air dampers, chilled water, and humidifier valve will all remain closed, return damper fully open. The hot water control valve will modulate to maintain 80 degrees F. Supply Air Temperature set point.

Once the space temperature rises above 65 degrees F. the supply fan(s) will cycle off.

c. Unoccupied Cooling Setback Mode

During the unoccupied mode the supply and return fans will be off. The outside and relief air dampers will be closed, return air damper open. Chilled water valve will be closed.

The space temperature sensors will be sampled and if the temperature in the space rises above 82 degrees F (adjustable), the supply and return fans will start, and the unit will ramp slowly to meet the static pressure control set point. Outside and relief air dampers, and hot water valve will all remain closed, return damper fully open. The chilled water control valve will modulate to maintain 55 degrees F. Supply Air Temperature set point.

Once the space temperature reaches 78 degrees F. the supply and return fans will cycle off.

d. Unoccupied Dehumidification Setback Mode

During the unoccupied mode the supply and return fans will be off. The outside and relief air dampers will be closed, return air damper open. Chilled water valve will be closed.
Whenever the unit is cycled "on" for cooling during the unoccupied cycle, a duct humidity sensor(s) shall be provided and monitored through DDC control to maintain a maximum 60% space humidity during the unoccupied cycle. During the night dehumidification cycle the supply and return fans shall operate, all dampers shall remain in their normal unoccupied position, the preheat coil control valve shall be closed, and the cooling coil control valve shall modulate to maintain a 55°F supply air temperature. When the space relative humidity reaches 55% (adjustable) and the space reaches 78ºF (adjustable) the unit shall shut off and the preheat coil and cooling coil valves shall return to their unoccupied operation.

20. Morning warm-up and cool down

The program shall be capable of morning warmup and cool down modes of operation as outlined below and operate only at the beginning of the occupied cycle. The function may be used as part of an optimization strategy with the normal occupied scheduling. Once the system enters the occupied mode, the warmup and/or cool down cycle will not be allowed to operate again during the current occupied period.

a. Morning Warmup

The AHU fans shall start and ramp slowly to meet the static pressure control set point. The Supply Air Temperature set point will be indexed to 90 degrees F. (adjustable). The outside and relief air dampers shall be fully closed and the return air damper fully open. Chilled water control valves will be closed. The VAV box control will switch to the morning warmup control settings (see VAV box sequence of operation for detail).

The unit will remain in this mode until the average space temperature reaches 68 degrees F. (return air temperature sensor may be used when appropriate). The program will then switch to the normal occupancy mode.

b. Morning Cool Down

The AHU fans shall start and ramp slowly to meet the static pressure control set point. The program will modulate the chilled water control valve to maintain a 55 degrees F. Supply Air Temperature set point. The outside and relief air dampers shall be fully closed and the return air damper fully open, unless the outside air temperature and humidity is such that the economizer cycle can be utilized. Hot water control valves will be closed. The VAV box control will switch to the normal occupied control settings (see VAV sequence of operation for detail).

The unit will remain in this mode until the average space temperature reaches 78 degrees F. The program will then switch to the normal occupancy mode.

21. Current sensing relays shall be provided for all supply and return fans to provide input for proof of fan operation in addition to speed drive contacts. The DDC system shall provide an alarm at the operator's terminal upon detecting no air flow from any fan when the system is sequenced ON.

22. Control of all dampers, valves and devices shall be from separate DDC outputs.

23. A dirty filter pressure switch on the primary filter banks shall be provided by the Temperature Control Contractor. The DDC System shall monitor the switch and provide an alarm at the operator's terminal when the filters are dirty.

D. DDC Controlled Variable Volume Box with Hot Water Reheat Control (VVR)

1. The room temperature sensor and associated box mounted controller and damper actuator shall be provided by the Temperature Control Contractor. Box controllers and actuators shall be shipped to the box manufacturer for factory installation.

   The campus set point standard is currently 70 degrees Fahrenheit for heating and 74 degrees for cooling.

   The heating water control valve shall also be provided by the Temperature Control Contractor and furnished to the HVAC Contractor for installation.

2. The terminal box shall have an occupied and unoccupied sequence of operation as described herein. Each terminal box shall be indexed between the occupied and unoccupied cycle in conjunction with the air handling unit supplying the terminal box.

3. Occupied and Standby Modes

   a. Occupied Mode

      During the occupied mode the VAV box damper will modulate between minimum and maximum air flow settings to maintain the space temperature cooling set point. As the space temperature begins to decrease, the VAV box damper will modulate towards the cooling minimum air flow setting (as scheduled). If the space temperature continues to decrease, reaching the heating set point, the damper will control to maintain the minimum air flow setting, and the reheat control valve will begin to open. Once the discharge temperature reaches the scheduled discharge temperature (adjustable), the damper will begin to open and allow more air into the space. The damper will open until the reheat maximum cfm (as scheduled) is reached, and the control valve will open to maintain the adjustable discharge temperature. Once the

damper reaches the reheat maximum cfm, the valve will continue to open towards 100% as needed to maintain the space temperature heating set point.

b. Unoccupied Standby Mode

Standby mode requires the use of an occupancy sensor, mounted in the space, and connected to an input on the VAV controller.

During normal occupancy when the air handler is in operation, but the space is empty, as sensed by the occupancy sensor, the VAV will enter a standby mode. During the standby mode, the minimum air flow setting will be 10% of the cooling maximum airflow, and the heating-cooling set points will be 68 degrees F. and 78 degrees F. respectively.

1.) The status of occupancy can be obtained by the installation of a relay in the lighting occupancy sensor (provided by the electrical contractor) or a separate occupancy sensor. Both the relay and the separate occupancy sensor shall be provided by this Contractor.

c. Provide averaging temperature sensors when the box serves multiple spaces.

4. Heating, Cooling and Dehumidification During the Associated Air Handling Unit Unoccupied Cycle:

During the unoccupied mode, the air handling unit will be off. The VAV box unoccupied heating and cooling set points will be 62 degrees F. and 82 degrees F. respectively.

Heating mode: If a temperature in the space drops below 62 degrees F. the air handler will start and the VAV box will control to maintain the unoccupied heating set point. When the temperature in the space reaches 65 degrees F., the air handler will stop.

Cooling mode: If a temperature in the space exceeds 82 degrees F., the air handler will start and the VAV box will control to maintain the unoccupied cooling set point. When the temperature in the space reaches 78 degrees F, the air handler will stop.

See VAV air handler sequence of operation for a detailed narrative of the setback control.

All set points to be fully adjustable

Dehumidification Cycle: The DDC system shall monitor the space humidity sensors and cycle the air handling unit supplying the terminal box through the air handling unit controller to maintain a maximum space humidity (see AHU

sequences for relative humidity setpoints). When the air handling unit is operating in the unoccupied dehumidification cycle, the terminal box controller shall modulate the primary air damper to maintain 75% of the maximum volume of airflow as scheduled on the Drawings and the reheat coil control valve shall be modulated.

a. Provide averaging temperature sensors when the box serves multiple spaces.

5. Heating During the Associated Air Handling Unit Morning Warm-Up Cycle:

The DDC system shall initiate the air handling unit to a timed morning warm-up cycle prior to the start of the scheduled occupied cycle. When the air handling unit is operating in the warm-up cycle, the terminal box controller shall modulate the primary air damper to maintain 75% of the maximum volume of airflow as scheduled on the Drawings and the reheat coil control valve shall be modulated. When the DDC system indexes the air handling unit from the warm-up cycle to the occupied cycle, the terminal box shall also be indexed to occupied cycle control.

6. The terminal box damper actuator and heating coil control valve shall fail to last position on a loss of power to the controller.

7. Each terminal box shall have a separate space temperature sensor unless otherwise shown on the drawings.

8. Terminal boxes serving more than one space shall average the inputs from all sensors and use the average value to control the box. In areas with occupancy sensors, when it is determined the space is not occupied, the inputs from the space sensor of the unoccupied zones shall not be used.

9. Temperature Control Contractor shall connect to 120V junction boxes as shown on the drawings and provided by the Electrical Contractor and provide transformers as required for box power. All wiring and transformers from the junction boxes to the terminal boxes shall be by the Temperature Control Contractor.

10. Box controller shall provide supply air volume in CFM, discharge temperature, space temperature, and space temperature setpoint at the operator's terminal.

E. Boiler System Control:

1. The boiler system shall be enabled to run whenever the heating water loop pumps are operating (year round).

2. To prevent short cycling, each boiler shall run for and be off for minimum adjustable times (both user definable), unless shutdown on safeties or outside air conditions

3. Each boiler shall run subject to its own internal safeties and controls.

4. The ~~four~~ **two** boilers shall operate from the boiler management system controls furnished with the boilers. The boiler management system shall be set to operate the boilers in parallel mode.

   a. The boiler management system shall modulate the boilers together in order to maximize energy efficiency.

   b. On failure of any boiler, the functional boilers shall be staged to satisfy the heating load and The BAS shall indicate a boiler alarm condition.

5. The BAS shall monitor the heating water supply temperature. The heating water supply temperature setpoint shall vary linearly as a function of the outside air temperature via 4-20mA or 0-10VDC signal from the BAS Controller to the boiler management system. The hot water supply temperature setpoint shall vary in accordance with the following schedule, which shall be adjustable:

Outside Air Temperature	Hot Water Supply setpoint
20°F or lower	160°F
65°F or higher	~~100~~**120**°F

6. A flow switch shall be furnished by the BAS Contractor and installed by the HVAC contractor in each boiler's water outlet piping. BAS contractor shall provide control interlocks to the boiler controls in a manner approved by the boiler manufacturer to require proof of flow in order to enable the burner to fire.

F. Boiler Pumps Control (HWP-~~1~~ **3** through HWP-~~2~~**4**):

1. The boiler pumps shall be interlocked to operate whenever the associated boiler is operating.

2. Pump status indication shall be via the flow switch installed in the piping near each pump.

G. Secondary Heating Water Pump Control (HWP-~~3~~ **1** & HWP-~~4~~**2**)

1. The BAS shall permit the lead variable speed secondary pump to operate year round. Two new pumps are being provided. One of the new pumps and one of the existing pumps will serve as the "lead" pump and of the new pumps and one of the existing pumps will serve as the "lag" pump. The BAS shall determine which pump is the "Lead" pump. The BAS shall automatically alternate the "Lead" pump to the "lag" pump at the beginning of each month.

2. The BAS upon sensing failure of the "Lead" pump shall automatically start the "lag" pump and send an alarm to the operator's terminal.

3. The BAS Contractor shall furnish one (1) differential pressure sensor for heating water secondary pumps. The preferred location is the lower level mechanical room. This location shall be confirmed with the A/E and University before installation. The sensors shall be installed by the HVAC contractor and wired by the BAS Contractor. Piping shall be as shown on the drawings.

4. The BAS shall modulate the speed of the lead heating water pump via a 0-10v signal to the VFD as required to maintain the differential pressure setpoint (adjustable). **If the pump reaches its minimum balanced speed and the differential pressure rises above it's set-point, the BAS shall modulate open the heating water bypass control valve to achieve the differential pressure set-point.**

    a. Provide start/stop output and alarm inputs for the variable frequency drive (VFD) for each secondary heating water pump.

5. Alarm contacts from the pump VFDs shall be wired to the DDC system by the BAS Contractor to provide an alarm signal at the central control console.

6. Current sensing relays shall be provided for proof of flow at each pump. The DDC system shall provide an alarm at the operator's terminal upon detecting pump failure when the pump is sequenced ON.

H. Air Cooled Chillers (Chiller #1 & Chiller #2)

1. The two chillers shall be controlled in a lead/lag arrangement. The lead chiller shall be operational whenever the outside air temperature is above 40°F and any of the following conditions are met:

    a. Any air handler is in the occupied or cool-down mode.

    b. Any air handler is operating due to night setup high temperature or high humidity, and economizer is not available.

2. The lag chiller shall be started when the secondary chilled water supply temperature rises above the setpoint for 15 minutes (adj.).

3. The lead chiller system shall stop when outside air temperature is below 40°F, or when all air handlers and zoned areas have entered the unoccupied mode.

4. Each chiller has an automatic control isolation valve that only permits water to flow through the chiller when the chiller is called to operate. ~~The BAS Contractor shall furnish new control valves to replace the existing control valves. The HVAC Contractor shall install the valves and they shall be wired by the BAS Contractor.~~ The BAS shall open the valve when the associated chiller is called top operate. Valves shall be provided with end switches and the chiller shall not be permitted to operate until the end switch is proven open. The sequence of operation shall only allow chilled water flow through a chiller if that chiller is operating. Each pump is capable of pumping water through either chiller or both

chillers simultaneously.

5. The chilled water temperature set point shall be adjustable through the BAS. The BAS controller shall initially be programmed to provide a leaving chilled water temperature set point signal of 42.0°F (adj.).

6. A flow switch in the chilled water supply main shall prove flow before the compressor actually operates. The flow switch shall be furnished and wired by the BAS Contractor and installed by the HVAC Contractor. Furnish all necessary auxiliary contacts and external relays, and all wiring (including flow switches), required to accomplish the described start-up, operating and safety sequence described. All chiller control device installation and set-up shall be provided under this contract.

7. When the chiller system's operational conditions are no longer satisfied, the chiller shall be stopped first. After a 5 minute time delay, the operating chilled water pump shall be stopped.

8. Provide temperature sensors where shown on piping schematics as well as all other sensors necessary for a complete and working system.

9. The BAS Contractor shall provide the necessary inputs, outputs and programming to utilize and display all of the control options listed above. The chilled water temperature setpoint shall be adjustable through the BAS.

10. The required BACnet Chiller interface shall be provided by the equipment manufacturer as an integral component. The BAS Contractor shall perform all integration with assistance from the equipment manufacturer. All remote sensors furnished as part of this control system shall be installed and wired by the BAS Contractor.

I. Chilled Water Pumps (CWP-1 & CWP-2)

1. One of the chilled water supply pumps shall operate whenever the Chiller is running and the outdoor temperature is above 40°F. The pumps shall be arranged in a lead / lag configuration.

3. A DDC differential pressure sensor provided by the Temperature Control Contractor shall be located in the chilled water piping system in the basement Mechanical room. The sensor shall maintain the differential pressure setpoint (adjustable) by modulating the speed of the operating pump through its associated variable frequency drive. The operating chilled water pump shall modulate up to 100% speed to maintain the differential pressure setpoint. Once the lead chilled water pump reaches 95% the lag pump shall be started and shall run at the same speed as the lead pump to maintain the differential pressure set point. Once the demand has been met the pumps shall modulate down until the pump speed is less than 30% (adjustable). Once the pump speed is below 30% the lag pump shall stop. **If the lead pump reaches its minimum balanced speed and the differential pressure rises above it's set-point, the BAS shall**

modulate open the chilled water bypass control valve to achieve the differential pressure set-point. The chilled water pumps shall alternate as the lead pump at a time determined by the University (adjustable).

4. The DDC system, upon sensing failure of the chilled water lead pump, which has been indexed on, shall then operate the chilled water lag pump to maintain the differential setpoint and send an alarm to the operator's terminal.

5. The DDC system upon sensing failure of the operating chilled water pump, which has been indexed on, shall then operate the standby chilled water pump to maintain the differential setpoint and send an alarm to the operator's terminal.

7. Current sensing relays shall be provided for proof of flow at each pump. The DDC system shall provide an alarm at the operator’s terminal upon detecting pump failure when the pump is sequenced ON.

8. Alarm contacts from the pump VFDs shall be wired to the DDC system by the Temperature Control Contractor to provide an alarm signal at the central control console.

J. Fan Coil Unit Control - Mechanical Rooms

1. A space temperature sensor shall, through DDC control, start and stop the unit fan and actuate the 2-position control valves furnished with the fan coil units on the chilled water piping and the heating hot water piping to maintain space temperature. Note: Fan coil units with "Cooling Only" designation are cooling only and do not have a heating coil.

2. An alarm shall be sent to the operator’s terminal whenever the space temperature exceeds 82°F or falls below 55°F.

3. Some units are provided with condensation pumps. The Temperature Control Contractor shall provide an alarm at the operator’s terminal whenever condensation pump high level is exceeded and shall stop the associated fan coil unit until the alarm is cleared.

4. The DDC controls shall have the capability to control the following functions of the fan coils units:
   a. Chilled water control valve position.
   b. Heating water control valve position.
   c. Provide a 3°F deadband between heating and cooling setpoints.
   d. Supply air (discharge) temperature.

K. Unit Heater and Cabinet Unit Heater Control:

1. Wall mounted DDC sensors and DDC controllers shall be provided for each cabinet unit heater. Unit heaters shall have DDC sensors mounted at units. The BAS shall "start" and "stop" the fan motors and open the 2-way heating control valve to maintain proper space temperatures.

2. Slow operating electric auto control shutoff valves furnished by the BAS Contractor shall be provided at each unit heater. The valves shall be wired to open when the sensor calls for the heater fan to start and shall close when the heater fan shuts off.

3. Unit heaters sensors in the attic shall provide a low temperature alarm at the operator's station whenever the temperature drops below 45ºF.

4. Cabinet unit heaters in the entry vestibules shall be controlled by the same temperature sensor as the VAV terminal boxes that serve the vestibules and shall operate as the final stage of heat to prevent simultaneous heating and cooling.

L. Domestic Hot Water Return Pump - HWRP-1

1. Domestic hot water return pump (HWRP-1) shall run continuously. Two (2) DDC temperature sensors in the hot water return lines shall indicate the hot water return temperature in each branch. Location of sensors as shown the plumbing drawings.

2. Current sensing relays shall be provided for proof of flow at the pump. The DDC system shall provide an alarm at the operator's terminal upon detecting no flow when the pump is sequenced ON.

M. Mechanical Room Water Sensors

1. Water sensors shall be located one quarter (1/4) inch (adjustable) above the floor in each mechanical room. There shall be four sensors per room, located approximately at opposite corners in the following rooms:

a. ~~Lower Level Mechanical Rooms~~**Mechanical Room 154**
b. Mechanical Room 182

2. The sensors shall, through DDC control, provide alarms at the operator's terminal.

N. Domestic Water System and Gas Meter

1. Domestic cold water temperature.

2. Domestic hot water temperature.

a. An alarm shall be provided if the domestic hot water temperature falls below 120°F for more than fifteen minutes.

3. Gas meter-monitor cubic feet usage.

O. Generator

1. The BAS shall monitor the status and summary alarm of the natural gas generator located in the equipment yard.

P. Transfer Switches

1. Three (3) binary inputs shall be provided by the BAS for monitoring the contacts within each of two automatic transfer switches. Points to be monitored from the switches are emergency loads on normal power, emergency loads on emergency power, and switch failure.

Q. Power System

1. The BAS shall monitor power generated (KWH) and peak power (KW) of the solar array through the solar system controller's BACnet interface.

2. The BAS shall monitor building power consumption (KWH) and demand (KW) through a communications interface with the distribution panel.

R. Laboratory Airflow Controls System

1. The laboratory airflow control system shall be integrated with the Building Automation System. Refer to Specification Section 23 36 16.

S. Exhaust Air Terminal Boxes

1. The BAS shall control the damper position of all exhaust air terminal boxes. The damper position shall be controlled to provide a fixed airflow offset when compared to the airflow of the supply air VAV serving the space. Design airflow offsets are shown on the room pressurization diagrams on the drawings.

2. The BAS shall provide an alarm if the airflow offset varies from the set-point by over 10% for 15 minutes.

3.06 ON-SITE TESTING / SYSTEM COMMISSIONING

A. Provide Owner-approved operation and acceptance testing of the complete system. Provide necessary personnel as required to assist the Engineer and Owner in providing complete system operational testing. Provide all labor necessary to fine tune the control sequences until they operate to the satisfaction of the Engineer and Owner.

B. Field Test: When installation of the system is complete, calibrate equipment and verify transmission media operation before the system is placed on-line. All testing, calibrating, adjusting and final field tests shall be completed by the installer. Provide a detailed cross-check of each sensor within the system by making a comparison between the reading at the sensor and a standard traceable to the National Bureau of Standards. Provide a cross-check of each control point within the system by making a comparison between the control command and the field-controlled device. Verify that all systems are

operable from local controls in the specified failure mode upon panel failure or loss of power. Submit the results of functional and diagnostic tests and calibrations to the Engineer for final system acceptance.

3.07 SERVICE AND GUARANTEE

A. General Requirements: Provide all services, materials and equipment necessary for the successful operation of the entire DDC system for a period of one year after completion of successful performance test. Provide necessary material required for the work. Minimize impacts on facility operations when performing scheduled adjustments and non-scheduled work.

B. Description of Work: The adjustment and repair of the system includes all computer equipment, software updates, transmission equipment and all sensors and control devices. Provide the manufacturer's required adjustments and all other work necessary.

C. Personnel: Provide qualified personnel to accomplish all work promptly and satisfactorily. The Construction Manager shall be advised in writing of the name of the designated service representative, and of any changes in personnel.

D. Systems Modifications: Provide any recommendations for system modification in writing to the Construction Manager. Do not make any system modifications, including operating parameters and control settings, without prior approval of the Construction Manager. Any modifications made to the system shall be incorporated into the operations and maintenance manuals, and other documentation affected.

E. Software: Provide all software updates and verify operation in the system. These updates shall be accomplished in a timely manner, fully coordinated with the system operators, and shall be incorporated into the operations and maintenance manuals, and software documentation.

3.08 TRAINING

A. All training shall be by the BAS manufacturer and shall utilize specified manuals, as built documentation and online help utility. Operator training shall include a minimum of (20) hours of training encompassing, but not limited to, the following:

1. Sequence of Operation Review
2. Sign on – Sign off
3. Selection of all displays and reports
4. Commanding of points, keyboard and mouse mode
5. Modifying English text
6. Use all dialogue boxes and menus
7. Modifying warning limits, alarm limits and start-stop times
8. System initiation
9. Download and initiation of all stand-alone DDC panels and ASCs
10. Troubleshooting of sensors
11. System Maintenance Procedures

END OF SECTION

SECTION 263213 - NATURAL GAS GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes packaged engine-generator sets for emergency power supply with the following features:

1. Natural Gas engine.
2. Unit-mounted cooling system.
3. Unit-mounted control and monitoring.
4. Generator overcurrent and fault protection.
5. Generator, exciter, and voltage regulator.
6. Outdoor sound-attenuated enclosure.
7. Vibration isolation devices.
8. Finishes

B. Related Sections include the following:

1. Division 26 Section "Automatic Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:

1. Thermal damage curve for generator.
2. Time-current characteristic curves for generator protective device.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
2. Wiring Diagrams: Power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Source quality-control test reports.

1. Certified summary of prototype-unit test report.
2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.

3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
5. Report of sound generation.
6. Report of exhaust emissions showing compliance with applicable regulations.
7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

B. Field quality-control test reports.

C. Warranty: Special warranty specified in this Section.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

1. Maintenance Proximity: Not more than 1 hour normal travel time from Installer's place of business to Project site.
2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 60 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

C. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL), and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

D. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

F. Comply with ASME B15.1.

G. Comply with NFPA 37.

H. Comply with NFPA 70.

I. Comply with NFPA 99.

J. Comply with NFPA 110 requirements for emergency power supply system.

K. Comply with UL 2200.

L. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

M. Noise Emission: Provide sound-attenuated housing with a minimum sound level of 75 dBA at 7 meters when operating at full load, with exhaust silencer. dBA shall be a maximum and not an average.

1.8 PROJECT CONDITIONS

A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: 104 degrees F.
2. Relative Humidity: 0 to 95 percent.
3. Altitude: Sea level to 1000 feet.

1.9 COORDINATION

A. Coordinate size and location of concrete bases for packaged engine generators per manufacturer’s requirements. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 5 years from date of start-up.

1.11 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product is Kohler Power Systems model KG200.

B. Equal Manufacturer: Cummins Power Generation, Caterpillar Power Systems.

2.2 ENGINE-GENERATOR SET

A. Factory-assembled and -tested, engine-generator set.

B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.

1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

C. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated on the drawings, capable of **200kVA** starting at 35% maximum voltage dip.
2. Output Connections: As indicated on the drawings.
3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

D. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.

5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.3 ENGINE

A. Fuel: Natural Gas

B. Rated Engine Speed: 1800 rpm.

C. Lubrication System: The following items are mounted on engine or skid:

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

D. Engine Fuel System: Water cooled inline or Vee-type, four-stroke cycle, spark ignited combustion. It shall meet specifications when operating on natural gas. The engine shall be equipped with lube oil, intake air filters, lube oil cooler, and gear-driven water pump, differential gas regulator, natural gas strainer and natural gas pressure gauge.

E. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

F. Governor: Adjustable isochronous, with speed sensing.

G. Cooling System: Liquid cooled, with engine mounted radiator and integral engine-driven coolant pump.

1. Configuration: Vertical air discharge.
2. Radiator Core Tubes: Aluminum
3. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
4. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
5. Fan: Driven by multiple belts from engine shaft.
6. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.

7. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

H. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Minimum sound attenuation of 25 dB at 500 Hz.
2. Sound level measured at a distance of 23 feet (7 m) from exhaust discharge after installation is complete shall be 75 dBA or less (under full load).

I. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

J. Starting System: 12-V electric, with negative ground.

1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Cranking Cycle: As required by NFPA 110 for system level specified - 60 seconds.
4. Battery: Adequate capacity within ambient temperature range specified to provide specified cranking cycle at least three times without recharging.
5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified. Include accessories required to support and fasten batteries in place.
7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:

    a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
    b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
    c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
    d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
    e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either

condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.

f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.4 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

C. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.

D. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common wall-mounted control and monitoring panel.

E. Indicating and Protective Devices and Controls:

1. AC voltmeter.
2. AC ammeter.
3. AC frequency meter.
4. DC voltmeter (alternator battery charging).
5. Engine-coolant temperature gage.
6. Engine lubricating-oil pressure gage.
7. Running-time meter.
8. Ammeter-voltmeter, phase-selector switch(es).
9. Generator-voltage adjusting rheostat.
10. Start-stop switch.
11. Overspeed shutdown device.
12. Coolant high-temperature shutdown device.
13. Coolant low-level shutdown device.
14. Oil low-pressure shutdown device.

F. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

G. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.

1. Overcrank shutdown.
2. Coolant low-temperature alarm.
3. Control switch not in auto position.
4. Battery-charger malfunction alarm.
5. Battery low-voltage alarm.

H. Common Remote Audible Alarm: Signal the occurrence of any events listed below without differentiating between event types. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset.

1. Engine high-temperature shutdown.
2. Lube-oil, low-pressure shutdown.
3. Overspeed shutdown.
4. Remote emergency-stop shutdown.
5. Engine high-temperature prealarm.
6. Lube-oil, low-pressure prealarm.
7. Low coolant level.

I. Remote Alarm Annunciator: Comply with NFPA 99. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.

J. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

K. Generator Paralleling Capability: The onboard generator controller shall be capable of providing full paralleling capability to all generators on site connected to a generator bus (standard switchboard). The design of the system shall the first generator that reaches rated voltage and frequency to close its electronically operated circuit breaker and connect to the generator bus. Additional generators, upon sensing generator bus voltage, synchronize and parallel to the generator bus. The controller shall provide load-shed capability to the Priority 2 loads (ATS-SB2) based on a comparison of the number of generators on-line and the connected load requirements. Controller shall be Kohler APM603 or equal.

2.5 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with UL 489, size and quantity as noted on the drawings. ~~Provide separate barrier between emergency and standby branch breakers.~~

B. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.

C. Standby breaker shall be electronically operated to close upon isolated RS-485 communication signal from generator controllers.

2.6 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H or Class F. Actual temperature rise measured by resistance method at full load shall not exceed 105 degrees C.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

F. Enclosure: Drip-proof.

G. Instrument Transformers: Mounted within generator enclosure.

H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.

1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.

I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

2.7 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Vandal-resistant, weatherproof, sound attenuated, steel housing, wind resistant up to 100 mph (160 km/h) and sound attenuation rating of 75dBA at 7 meters. Multiple panels shall be keyed-lockable (all locks keyed alike) and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.

B. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.

1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.

2.8 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of

sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

1. Material: Standard neoprene separated by steel shims.
2. Shore A Scale Durometer Rating: 75, or as designed and tested by manufacturer for applicable load.
3. Number of Layers: as designed and tested by manufacturer for applicable load.
4. Minimum Deflection: 0.1 inch or as recommended by manufacturer.

2.9 FINISHES

A. Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.10 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.

B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:

1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
2. Full load run.
3. Maximum power.
4. Voltage regulation.
5. Transient and steady-state governing.
6. Single-step load pickup.
7. Safety shutdown.
8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
9. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

C. Install packaged engine generator with spring isolators having a minimum on concrete base. Secure sets to anchor bolts installed in concrete bases.

D. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

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

C. Tests and Inspections:

1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
3. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
4. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.

D. Coordinate tests with tests for transfer switches and run them concurrently.

E. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.

F. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

G. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

H. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

I. Remove and replace malfunctioning units and re-teset as specified above.

J. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

K. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

L. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each power wiring termination and each bus connection. Remove all access panels so terminations and connections are accessible to portable scanner.
   1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   2. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

END OF SECTION 263213

SECTION 263623 – AUTOMATIC TRANSFER SWITCHES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes transfer switches rated 600 V and less, including the following:

1. Automatic Transfer Switches for Code-Required Emergency and Legally Required Loads

1.3 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Dimensioned plans, sections, and elevations showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

1. Wiring Diagrams: Single-line diagram. Show connections between transfer switch, power sources, and load; and show interlocking provisions for each combined transfer switch.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section “Operation and Maintenance Data," include the following:

1. Features and operating sequences, both automatic and manual.

2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.

B. Source Limitations: Obtain switches through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, for emergency service under UL 1008, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NEMA ICS 1, 2.

E. Comply with NFPA 70.

F. Comply with NFPA 110.

G. Comply with UL 1008 unless requirements of these Specifications are stricter.

1.5 WARRANTY

A. Provide a no deductible warranty. Warranty shall cover all parts, labor and travel. It shall be for a period of 2 years from the date of system start-up. Keep a log of all repair work performed.

1.6 MAINTENANCE

A. Provide preventive maintenance on products installed as work of this section for a period of 12 months from the date of substantial completion. Maintain appropriate records of PMS work as well as repair work. See WARRANTY.

PART 2 PRODUCTS

2.1 MANUFACTURERS

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

1. Contactor Transfer Switches:

a. Kohler
b. Cummins
c. Caterpillar
d. Russelectric, Inc.
e. ASCO

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

1. Testing and Approval

As a condition for approval, the manufacturer of the automatic transfer switches shall verify that his switches are listed by Underwriters Laboratories, Inc., Standard UL-1008 with 1.5 cycle short circuit closing and withstand as follows:

RMS Symmetrical Amperes @ 208 VAC	
Amperes	1.5 Cycle Closing & Withstand
100 - 150	30,000
225 - 800	42,000

2. During the 1.5 cycle closing and withstand tests, there shall be no contact welding or damage. The 1.5 cycle tests shall be performed without the use of current limiting fuses or circuit breakers, and oscillograph traces across the main contacts shall be furnished to verify that contact separation has not occurred, and there is contact continuity across all phases after completion of testing. Test procedures shall be in accordance with UL-1008, and testing shall be certified by Underwriters' Laboratories Inc.

3. When conducting temperature rise tests to UL-1008, the manufacturer shall include post-endurance temperature rise tests to verify the ability of the transfer switch to carry full rated current after completing the overload and endurance tests.

4. Manufacturer shall provide copies of test reports upon request.

C. Solid-State Controls: Repetitive accuracy of all settings is plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

E. Neutral Terminal: Solid and fully rated, unless otherwise indicated.

F. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

G. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by numbered or lettered wire and cable tape markers at terminations.

1. Designated Terminals: Pressure type suitable for types and sizes of field wiring indicated.

2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.

3. Control Wiring: Equipped with insulated fork connectors suitable for connection to terminal strips.

H. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

I. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.

2. Switch Action: Double throw; mechanically held in both directions.

3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

2.3 AUTOMATIC TRANSFER SWITCHES

A. Comply with Level 1 equipment according to NFPA 110.

B. Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

C. Manual Switch Operation: Under load, with door or subpanel barrier closed and with either or both sources energized. Transfer time is same as for electrical operation. Switches which allow contact "teasing" are not acceptable. Contact speed shall be independent of handle speed.

D. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

E. Standard Open Transition Switch (Emergency ~~and Optional Standby~~)

1. The normal and emergency contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Designs relying on electrical interlocks only are not acceptable. Main contacts shall be mechanically locked in position in both the normal and emergency positions without the use of hooks, latches, magnets, or springs, and shall be silver-tungsten alloy. Main contacts on all size switches shall be segmented, and shall have separate arcing contacts with magnetic blowouts for positive arc-quenching and maximum contact life. Interlocked molded case circuit breakers or contacts are not acceptable.

2. The automatic transfer switch shall be double throw, actuated by one or two electrical operators, momentarily energized and connected to the transfer mechanism by a simple over-center type linkage, providing inherent "quick-break", "quick-make" operation when operated electrically or manually, with a total transfer time not to exceed one-half second.

3. Obtain voltage for main contact operating solenoid from source to which load is being transferred

F. Programmed Neutral Switch Position (Optional Standby): Switch operator has a programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint

during transfer. Pause is adjustable from 0.5 to 30 seconds minimum and factory set for 0.5 second. Time delay occurs for both transfer directions. Pause is disabled unless both sources are live. Unless otherwise directed the following transfer delays shall be set in the field;

1. Loss of Utility Source Time Delay:

a. Unless otherwise noted or directed, all transfers shall be set for 2 second delay when the utility source is lost.

b. Standby time delay on neutral shall be 10 seconds.

c. Life safety time delay on neutral shall be 0 seconds

2. Utility Source Restored Time Delay:

a. Unless otherwise noted or directed, all transfers shall be set for 600 second delay when the utility source is restored.

b. Standby time delay on neutral shall be 3 seconds.

c. Life safety time delay on neutral shall be 0 seconds.

G. Load Shedding: Provide control wiring and programming for load shedding capability. Priority 2 optional standby transfer switch ATS-SB2 shall disengage if one of the two generators fails to start and parallel to the generator bus.

2.4 AUTOMATIC TRANSFER-SWITCH FEATURES

A. General

All timing and adjustable level setpoints shall be digitally determined and user adjustable via LCD display and keypad adjustment. Provide display and keypad. Analog devices shall not be acceptable.

B. Undervoltage Sensing for Each Phase of Normal and emergency source: Senses low phase-to-ground voltage on each phase. Pickup voltage is adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.

C. Time delay for override of normal-source voltage sensing delays transfer and engine start signals. Adjustable from zero to six seconds, and factory set for two seconds.

D. Voltage/Frequency Lockout Relay: Prevents premature transfer to generator. Pickup voltage is adjustable from 85 to 100 percent of nominal on all three phases. Factory set for pickup at 90 percent. Pickup frequency is adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.

E. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes. Provides automatic defeat of delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.

F. Test Switch: Simulates normal-source failure.

G. Load/No Load Test Selector Switch.

H. Switch-Position Pilot Lights: Indicate source to which load is connected. Lamps shall be LED type.

I. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits. Lamps shall be LED type.

1. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."

2. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

J. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.

K. Pretransfer Contact: One normally open dry contact to close 50 to 60 seconds prior to transfer onto standby power when performing test under load or back to normal power. This contact shall change state immediately after transfer.

L. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.

M. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.

N. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.

2.5 FINISHES

A. Enclosures: Manufacturer's standard enamel over corrosion-resistant pretreatment and primer.

2.6 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 EXECUTION

3.1 APPLICATION

A. Three-pole Switches: Where three-pole switches are indicated use solid neutral.

B. Single motor operator switches: Use for life safety transfer switches.

3.2 INSTALLATION

A. Install where shown. Arrange for normal, emergency and load connections coordinated with manufacturer's specific layout requirements. Provide code required working clearances. Make straight and level.

B. Floor-Mounted Switch: Anchor to floor by bolting.

1. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 2 inches (50 mm) in all directions beyond the maximum dimensions of switch, unless otherwise indicated. Cast anchor-bolt inserts into bases. Comply with Division 3 Section "Cast-in-Place Concrete."

C. Wall Mounted Switch. Anchor to wall with anchor bolts and 1/4 inch thick spacers.

D. Identify components according to Division 26 Section “Electrical Identification."

3.3 WIRING TO REMOTE COMPONENTS

A. Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

3.4 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding."

B. Connect wiring according to Division 26 Section "Wire and Cable." All wiring shall be identified at each termination within the enclosure with numbered plastic sleeve type labels.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B. Provide insulated fork type compression connectors on all control and monitor wiring. All in and out wiring shall be landed on terminal strips.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.

2. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

    a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
    c. Verify time-delay settings.
    d. Test functional modes and related automatic transfer-switch operations.
    e. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

C. Coordinate tests with tests of generator and run them concurrently.

D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

E. Remove and replace malfunctioning units and retest as specified above.

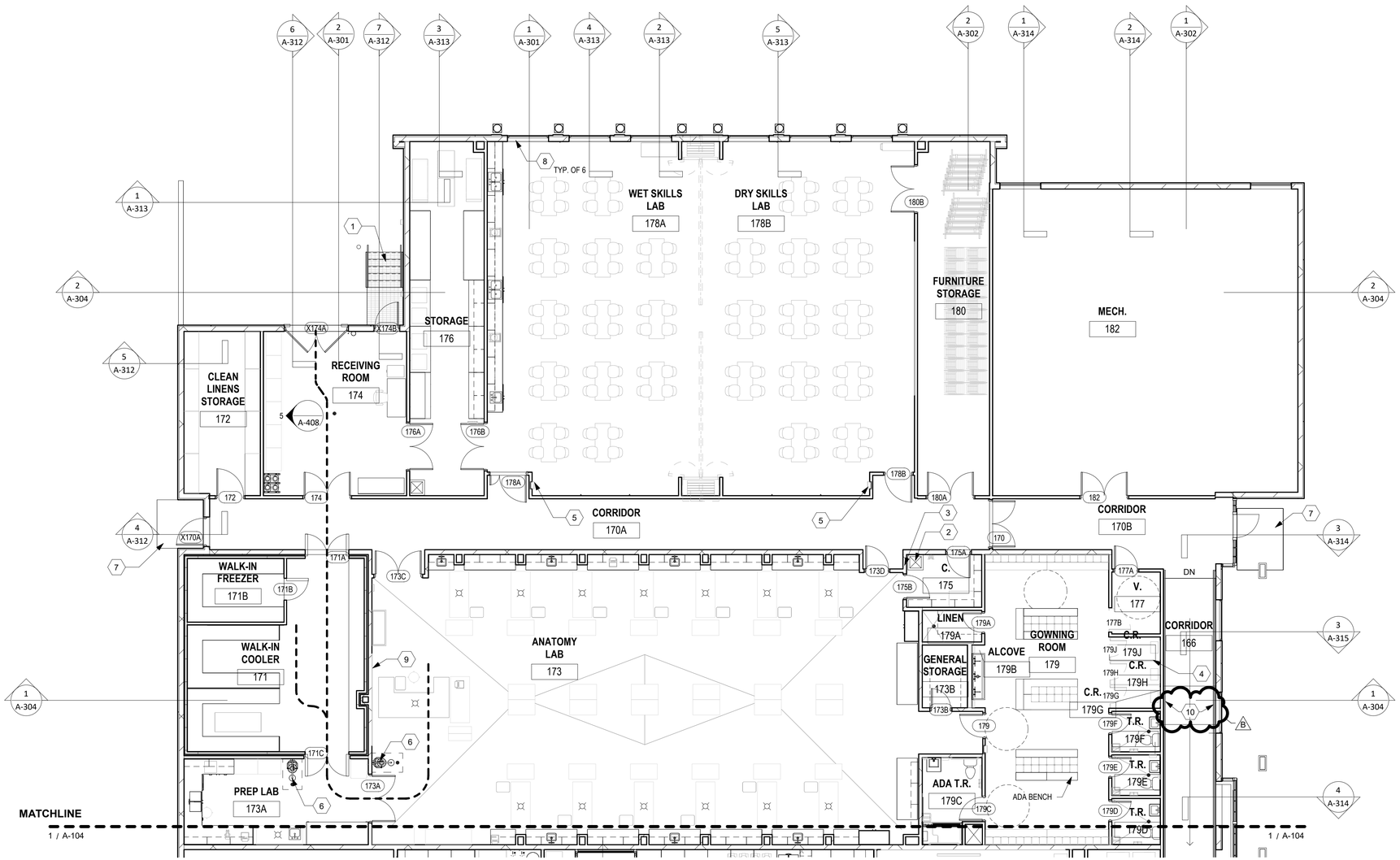
3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to demonstrate operation along with engine generator for code official and to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below.

    1. Coordinate this training with that for generator equipment.

END OF SECTION 263623

1/16" = 1'-0" 0 4' 8' 16'
1/8" = 1'-0" 0 2' 4' 8'
3/16" = 1'-0" 0 2' 4' 8'
1/4" = 1'-0" 0 1' 2' 4'
3/8" = 1'-0" 0 1' 2' 4'
1/2" = 1'-0" 0 6" 1' 2'
3/4" = 1'-0" 0 3" 6" 1' 2'
1" = 1'-0" 0 3" 6" 1' 2'
1 1/2" = 1'-0" 0 3" 6" 1'
3" = 1'-0" 0 1" 2" 3" 6" 1'
6" = 1'-0" 0 1" 2" 3" 6"



1 FLOOR PLAN - NORTH
1/8" = 1'-0"

GENERAL NOTES

A. REFER TO SHEET A-520 FOR INTERIOR PARTITION TYPES.

B. INTERIOR PARTITIONS ARE TYPE 1 UON.

C. REFER TO SPECIFICATIONS FOR MARKERBOARD, TACKBOARD AND PROJECTION SCREEN TYPES.

D. PROVIDE 48" HIGH CORNER GUARDS AT ALL EXTERIOR CORNERS OF INTERIOR PARTITION WALLS.

E. FIRE EXTINGUISHERS ARE TYPE FE-1 UON REFER TO SPECIFICATIONS FOR FIRE EXTINGUISHER TYPES. PAINT FIRE EXTINGUISHER CABINET, COLOR TBD BY A/E.

F. REFER TO SHEET A-610 FOR WINDOW ELEVATIONS.

G. REFER TO SHEET A-001 FOR FIXTURE MOUNTING HEIGHTS AND TYPES.

H. REFER TO SHEETS IN A-400 SERIES FOR ENLARGED PLANS AND INTERIOR ELEVATIONS.

I. ALL FLOOR DRAINS TO BE LOCALLY RECESSED UON.

CODED NOTES (X)

1	PROVIDE LOADING DOCK STAIR AND RAMP SYSTEM.
2	PROVIDE MOP SINK, REFER TO PLUMBING DRAWINGS.
3	PROVIDE MOP HOLDER.
4	PROVIDE DRESSING COMPARTMENTS, SEE SPECIFICATIONS.
5	PROVIDE FIRE EXTINGUISHER (FE-1) AND SEMI-RECESSED CABINET.
6	PROVIDE SAFETY SHOWER, SEE SPECIFICATIONS.
7	PROVIDE FROST SLAB. REFER TO STRUCTURAL DRAWINGS.
8	PROVIDE ROLLER SHADES, RS-3
9	PROVIDE MKBD. REFER TO ELEVATIONS FOR SIZE AND LOCATIONS.
10	PROVIDE WALL MOUNTED METAL HANDRAIL, PAINT.

Thomas W. Gates
11100069
12/31/2025

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DESIGNED BY: JB
DRAWN BY: TD/MF
CHECKED BY: JB

DATE: 04/01/2025
REVISIONS: ADDENDUM 02

VET TEACHING CENTER
4025 EAST LAGRANGE ROAD, JEFFERSON COUNTY, INDIANA
HANOVER COLLEGE

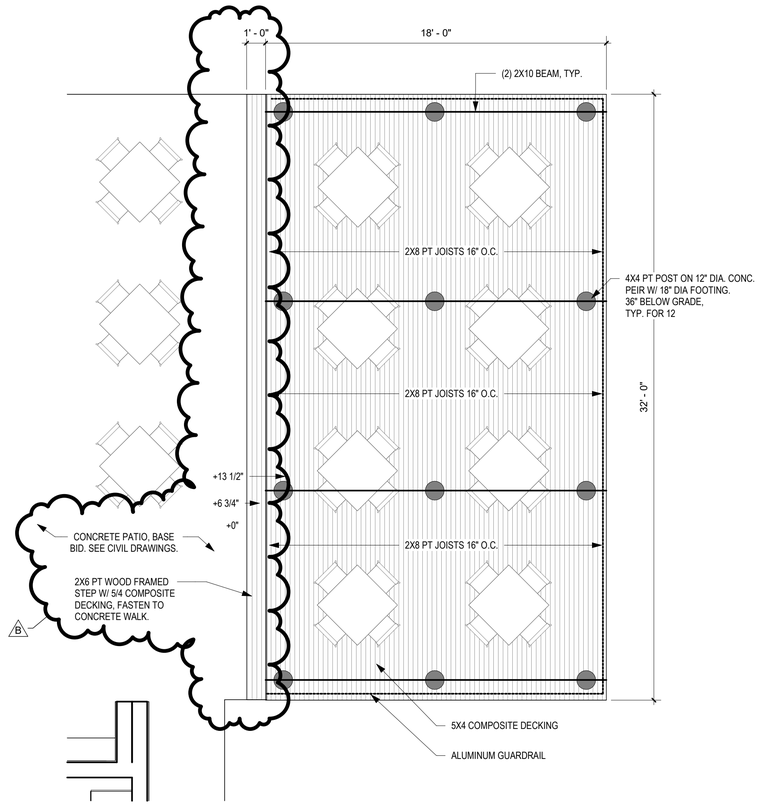
FLOOR PLAN - NORTH

SCALE: 1/8" = 1'-0"

A-103

JOB NO.: 23009
DATE: 03.07.2025

1/16" = 1'-0" 0 4' 8' 16'
1/8" = 1'-0" 0 2' 4' 8'
3/16" = 1'-0" 0 2' 4' 8'
1/4" = 1'-0" 0 1' 2' 4'
3/8" = 1'-0" 0 1' 2' 4'
1/2" = 1'-0" 0 6" 1' 2'
3/4" = 1'-0" 0 3" 6" 1' 2'
1" = 1'-0" 0 3" 6" 1' 2'
1 1/2" = 1'-0" 0 3" 6" 1'
3" = 1'-0" 0 1" 2" 3" 6" 1'
6" = 1'-0" 0 1" 2" 3" 6"



1 BREAK ROOM DECK - BID ALT
1/4" = 1'-0"

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DESIGNED BY:	MF
DRAWN BY:	MF
CHECKED BY:	MF

REVISIONS:	DATE:
ADDENDUM 02	04/01/2025

VET TEACHING CENTER
4025 EAST LAGRANGE ROAD, JEFFERSON COUNTY, INDIANA
HANOVER COLLEGE

BID ALT.

SCALE: 1/4" = 1'-0"

A-702

JOB NO.: 23009
DATE: 03.07.2025

1/16" = 1'-0" 0 4' 8' 16'

1/8" = 1'-0" 0 2' 4' 8'

3/16" = 1'-0" 0 2' 4' 8'

1/4" = 1'-0" 0 1' 2' 4'

3/8" = 1'-0" 0 1' 2' 4'

1/2" = 1'-0" 0 6" 1' 2'

3/4" = 1'-0" 0 3" 6" 1' 2'

1" = 1'-0" 0 3" 6" 1' 2'

1 1/2" = 1'-0" 0 3" 6" 1'

3" = 1'-0" 0 1" 2" 3" 6" 1'

6" = 1'-0" 0 1" 2" 3" 6"

042000 CONCRETE UNIT MASONRY

1. SPECIFICATIONS AND STANDARDS: DESIGN OF MASONRY SHALL BE GOVERNED BY THE APPLICABLE VERSION OF:
   A. TMS 402, TMS 403, AND TMS 404.
2. COMPRESSIVE STRENGTH OF MASONRY (f'm) 2,500 PSI, DETERMINED BY UNIT STRENGTH OR PRISM METHOD.
3. MASONRY MATERIALS:
   A. HOLLOW AND SOLID LOAD BEARING CONCRETE MASONRY UNITS: ASTM C90, NORMAL WEIGHT. NET COMPRESSIVE STRENGTH OF CMU = 3,250 PSI.
   B. CONCRETE BRICK: ASTM C55, GRADE N1.
   C. MORTAR: ASTM C270, TYPE S.
   D. COARSE MASONRY GROUT: ASTM C476.
      - 28-DAY COMPRESSIVE STRENGTH TO MATCH F'M GIVEN IN ITEM 2.
      - PROVIDE GROUT WITH A SLUMP OF 8-11 INCHES AS MEASURED ACCORDING TO ASTM C143.
      - TESTING - PROVIDE ONE SET OF TESTS FOR EACH 5,000 SF OF WALL WITH A MINIMUM OF ONE TEST PER DAY. TESTS SHALL CONSIST OF EITHER (2) 6"X12" CYLINDERS, (3) 4"X8" CYLINDERS OR A GROUT TEST PER ASTM C1019.
   E. MASONRY REINFORCEMENT:
      - HORIZONTAL JOINT REINFORCEMENT: 9 GA DEFORMED WIRE, LADDER TYPE REINFORCEMENT.
        a. IN EVERY SECOND BLOCK COURSE, FULL HEIGHT, AND WHERE SHOWN ON DRAWINGS.
        b. IN FIRST BED JOINT ABOVE AND BELOW OPENINGS EXTENDING 24" BEYOND OPENING.
        c. LAP REINFORCEMENT A FULL WIDTH AT CORNERS AND INTERSECTIONS.
      - VERTICAL REINFORCEMENT: ASTM A615, GRADE 60.
4. BEARING POINTS:
   A. BEAMS: 3 COURSES x 24" WIDE SOLID OR GROUTED SOLID MASONRY.
   B. JOISTS & LINTELS: 2 COURSES x 16" WIDE SOLID OR GROUTED SOLID MASONRY.
5. REINFORCED MASONRY:
   A. INSTALL REINFORCING BARS IN LOCATIONS SHOWN. SEE TABLE BELOW FOR LAP SPLICE REQUIREMENTS.

CMU LAP SPLICE SCHEDULE (f'm≥2000 PSI):

BAR SIZE	8" CMU - CENTERED	12" CMU - CENTERED	8" CMU - EDGE	12" CMU - EDGE
#4	13"	N/A	22"	N/A
#5	20"	13"	35"	34"
#6	38"	24"	64"	64"
#7	52"	33"	87"	87"
#8	79"	50"	131"	131"
#9	N/A	64"	N/A	166"

NOTES: CENTERED & EDGE REFER TO THE REINFORCING BAR POSITION IN MASONRY WALL. FOR EDGE CONDITIONS, PROVIDE 2" OF COVER FROM EXTERIOR FACE OF CMU TO EDGE OF REINFORCING BAR.

   B. GROUT BLOCK WITH COARSE MASONRY GROUT VIBRATED IN PLACE TO FILL ALL VOIDS AND INTERSECTIES. FOLLOW RECOMMENDATIONS OF NCMA TEK NO. 3-2.
6. CONTROL JOINTS:
   A. INSTALL CONTROL JOINTS IN ALL MASONRY WALLS AS INDICATED ON PLAN AND AT A SPACING NOT TO EXCEED THE LESSER OF THREE TIMES THE WALL HEIGHT OR 24 FEET ON CENTER.
   B. INSTALL CONTROL JOINTS AT THE FOLLOWING LOCATIONS:
      - CHANGE IN WALL HEIGHT.
      - CHANGE IN WALL THICKNESS.
      - TRANSITION FROM INTERIOR WALL TO EXTERIOR WALL.
      - TRANSITION FROM WALL BEARING ON FOUNDATION TO WALL BEARING ON FLOOR SLAB
   C. STOP ALL HORIZONTAL REINFORCING AT CONTROL JOINTS UNLESS NOTED OTHERWISE.
7. POST-INSTALLED WEDGE ANCHORS: (FOR USE IN GROUT-FILLED CONCRETE MASONRY):
   A. THE ENTIRE ANCHOR SHALL BE CARBON STEEL (INTERIOR) OR STAINLESS STEEL/GALVANIZED (EXTERIOR).
   B. THE ENTIRE ANCHOR SYSTEM SHALL BE EVALUATED TO COMPLY WITH THE APPLICABLE VERSION OF IBC AND BE CERTIFIED BY AN ICC-ES EVALUATION REPORT SHOWING SUITABILITY WITH GROUT-FILLED CONCRETE MASONRY.
   C. SUBJECT TO COMPLIANCE REQUIREMENTS, PROVIDE THE PRODUCT INDICATED ON DRAWINGS OR COMPARABLE PRODUCT CAPABLE OF RESISTING LOADS EQUIVALENT TO THE BASIS OF DESIGN PRODUCT WHEN USED WITH THE SAME EMBEDMENT, ORIENTATION, EDGE DISTANCE, AND SPACING. SUBMIT PROPOSED SUBSTITUTION FOR APPROVAL WITH ACCOMPANYING ICC-ES REPORT.
8. POST-INSTALLED SCREW ANCHORS: (FOR USE IN GROUT-FILLED CONCRETE MASONRY):
   A. THE ENTIRE ANCHOR SHALL BE CARBON STEEL WITH ZINC PLATING EQUIVALENT TO DIN EN ISO 4042 (8um MIN). (INTERIOR USE ONLY)
   B. THE ENTIRE ANCHOR SYSTEM SHALL BE EVALUATED TO COMPLY WITH THE APPLICABLE VERSION OF IBC AND BE CERTIFIED BY AN ICC-ES EVALUATION REPORT SHOWING SUITABILITY WITH GROUT-FILLED CONCRETE MASONRY.
   C. PRE-DRILL HOLES WITH STANDARD AISI DRILL BIT PER THE MANUFACTURER'S INSTALLATION GUIDELINES. INSTALL THE ANCHOR WITH AN IMPACT WRENCH.
   D. PROVIDE ANCHORS WITH A DIAMETER AND LENGTH MARKING ON THE HEAD AS INDICATED ON THE DRAWINGS.
   E. SUBJECT TO COMPLIANCE REQUIREMENTS, PROVIDE THE PRODUCT INDICATED ON DRAWINGS OR COMPARABLE PRODUCT CAPABLE OF RESISTING LOADS EQUIVALENT TO THE BASIS OF DESIGN PRODUCT WHEN USED WITH THE SAME EMBEDMENT, ORIENTATION, EDGE DISTANCE, AND SPACING. SUBMIT PROPOSED SUBSTITUTION FOR APPROVAL WITH ACCOMPANYING ICC-ES REPORT.
9. POST-INSTALLED ADHESIVE ANCHORS: (FOR USE IN HOLLOW OR GROUT-FILLED CONCRETE MASONRY)
   A. THE ENTIRE ANCHOR SHALL BE ASTM A36.
   B. THE ENTIRE ANCHOR SYSTEM SHALL BE EVALUATED TO COMPLY WITH THE APPLICABLE VERSION OF IBC AND BE CERTIFIED BY AN ICC-ES EVALUATION REPORT SHOWING SUITABILITY WITH GROUT-FILLED CONCRETE MASONRY.
   C. PLASTIC MESH SCREEN TUBES SHALL BE PROVIDED AT ALL HOLLOW MASONRY APPLICATIONS.
   D. SUBJECT TO COMPLIANCE REQUIREMENTS, PROVIDE THE PRODUCT INDICATED ON DRAWINGS OR COMPARABLE PRODUCT CAPABLE OF RESISTING LOADS EQUIVALENT TO THE BASIS OF DESIGN PRODUCT WHEN USED WITH THE SAME EMBEDMENT, ORIENTATION, EDGE DISTANCE, AND SPACING. SUBMIT PROPOSED SUBSTITUTION FOR APPROVAL WITH ACCOMPANYING ICC-ES REPORT.
10. POST-INSTALLED SLEEVE ANCHORS: (FOR USE IN HOLLOW OR GROUT-FILLED CONCRETE MASONRY):
    A. THE ENTIRE ANCHOR SHALL BE CARBON STEEL (INTERIOR) OR STAINLESS STEEL/GALVANIZED (EXTERIOR).
    B. SUBJECT TO COMPLIANCE REQUIREMENTS, PROVIDE THE PRODUCT INDICATED ON DRAWINGS OR COMPARABLE PRODUCT CAPABLE OF RESISTING LOADS EQUIVALENT TO THE BASIS OF DESIGN PRODUCT WHEN USED WITH THE SAME EMBEDMENT, ORIENTATION, EDGE DISTANCE, AND SPACING. SUBMIT PROPOSED SUBSTITUTION FOR APPROVAL WITH ACCOMPANYING ICC-ES REPORT.
11. COORDINATE BLOCK-OUTS, REVEALS, OPENINGS AND ALL OTHER BUILT-IN ITEMS WITH ALL CONTRACT DOCUMENTS AND TRADES.

051200 - STRUCTURAL STEEL FRAMING

1. SPECIFICATIONS AND STANDARDS:
   UNLESS SPECIFICALLY SHOWN OTHERWISE, DESIGN, FABRICATION AND ERECTION SHALL BE GOVERNED BY:
   A. ANSI/AISC 360 - SPECIFICATION FOR STRUCTURAL STEEL BUILDINGS. ASD
   B. AISC 303 - CODE OF STANDARD PRACTICE FOR STEEL BUILDINGS AND BRIDGES.
   C. AWS STANDARD WELDING SYMBOLS.
   D. AWS D1.1 STRUCTURAL WELDING CODE - STEEL. WELDING SHALL BE PERFORMED ONLY BY OPERATORS QUALIFIED, BY THE AWS STANDARD QUALIFICATION PROCEDURE, TO PERFORM THE PARTICULAR TYPE OF WORK REQUIRED.
   E. RCSC - SPECIFICATION FOR STRUCTURAL JOINTS USING HIGH-STRENGTH BOLTS.
2. MAY MATERIALS:
   A. "W" SHAPES: ASTM A992 Fy = 50 KSI, ASTM A572 Fy = 50 KSI.
   B. CHANNELS: ASTM A36.
   C. ANGLES, PLATES AND BARS: ASTM A36.
   D. RECTANGULAR HOLLOW STRUCTURAL SECTIONS: ASTM A500 GR C, Fy = 50 KSI, ASTM A1085, Fy = 50 KSI.
   E. ROUND HOLLOW STRUCTURAL SECTIONS: ASTM A500, GRADE C, Fy = 50 KSI.
   F. WELDING ELECTRODES: AWS A5.1 OR A5.5 SERIES E70.
   G. BOLTS: ASTM F3125 GRADE A325, TYPE I, HEAVY-HEX STEEL STRUCTURAL BOLTS.
   H. ANCHOR RODS: ASTM F1554 GRADE 36.
   I. NUTS AND WASHERS: ASTM A563, GRADE DH, HEAVY-HEX CARBON-STEEL NUTS; AND ASTM F436, TYPE 1, HARDENED CARBON-STEEL WASHERS.
   J. SHEAR CONNECTORS: ASTM A108, AWS D1.1, TYPE B, HEADED STUD TYPE.
   K. PAINT AND PROTECTION - NONE EXCEPT AS NOTED BELOW:
      - INTERIOR MEMBERS EXPOSED TO VIEW IN THE FINISHED STRUCTURE - PRIME COAT, TOUCH UP AFTER ERECTION.
      - MEMBERS EXPOSED TO WEATHER IN FINISHED STRUCTURE, SHELF ANGLES AND LINTELS IN EXTERIOR WALLS - GALVANIZED PER ASTM A123 AFTER FABRICATION.
   L. SHRINKAGE-RESISTANT GROUT: ASTM C1107, NON-METALLIC AGGREGATE, NON-CORROSIVE, NON-STAINING. F'C= 5,000 PSI MIN.
3. LINTELS:
   A. LINTELS FOR EXTERIOR WALL OPENINGS - HOT DIPPED GALVANIZED.
   B. 8" BEARING EACH SIDE OF OPENINGS UNLESS NOTED.
   C. UNLESS SHOWN OTHERWISE, PROVIDE 1 ANGLE FOR EACH 4" WALL THICKNESS AS FOLLOWS:

MASONRY OPENING	ANGLE SIZE
3'-6" OR LESS	L3 1/2X3 1/2X1/4
3'-7" TO 5'-0"	L4X3 1/2X1/4 LLV
5'-1" TO 8'-0"	L5X3 1/2X5/16 LLV
8'-1" TO 10'-0"	L6X3 1/2X5/16 LLV

4. CONNECTION REQUIREMENTS:
   A. DESIGN CONNECTIONS FOR VERTICAL REACTIONS SHOWN ON DRAWINGS OR FOR FULL CAPACITY OF MEMBER WHERE NO REACTION IS SHOWN.
   B. DESIGN MOMENT BEAM CONNECTIONS FOR VALUES SHOWN OR FOR FULL MOMENT CAPACITY OF MEMBER.
   C. CONNECTIONS SHOWN AND DETAILED ON THE DRAWINGS MAY BE REDESIGNED BY THE STRUCTURAL STEEL CONTRACTOR FOR EQUAL FORCES PROVIDED THE SAME ARRANGEMENT OF MEMBERS IS USED AND THE OVERALL SIZE OF THE CONNECTION DOES NOT EXCEED THAT OF THE CONNECTION DETAILED.
   D. OBTAIN APPROVAL FROM STRUCTURAL ENGINEER FOR TYPES OF CONNECTIONS BEFORE FABRICATION.
   E. ALL BOLTED CONNECTIONS TO BE SHEAR/BEARING TYPE WITH BOLTS IN THE SNUG TIGHT CONDITION UNLESS NOTED OTHERWISE.
5. MISCELLANEOUS REQUIREMENTS:
   A. ROUND PENETRATIONS ARE PERMITTED IN THE WEB OF WIDE-FLANGE MEMBERS THAT MEET ALL OF THE FOLLOWING CRITERIA. CONTACT SMBH FOR PENETRATIONS THAT DO NOT MEET THESE CRITERIA.
      - OPENING DIAMETER IS LESS THAN OR EQUAL TO 0.15 TIMES THE DEPTH OF THE BEAM.
      - EDGE OF OPENING IS A MINIMUM OF 0.15 TIMES THE DEPTH OF THE BEAM FROM THE TOP AND BOTTOM OF THE BEAM.
      - OPENINGS ARE NOT PERMITTED WITHIN 1.0 TIMES THE DEPTH OF THE BEAM AWAY FROM THE ENDS.
      - OPENINGS ARE NOT PERMITTED WITHIN 0.5 TIMES THE DEPTH OF THE BEAM AWAY FROM AN INFILL BEAM CONNECTION.
      - EDGES OF ADJACENT OPENINGS ARE AT LEAST 2X THE LARGEST OPENING DIAMETER APART.
   B. STEEL FRAMING INTENDED TO SUPPORT EQUIPMENT OR MECHANICAL/ELECTRICAL/PLUMBING OPENINGS IS SHOWN FOR BIDDING PURPOSES ONLY. CONTRACTOR SHALL COORDINATE SIZES AND LOCATIONS WITH MECHANICAL AND OTHER REQUIREMENTS BEFORE PROCEEDING WITH THE WORK. CONTRACTOR SHALL COORDINATE SIZES AND LOCATIONS OF STEEL ANGLE FRAMES FOR OPENINGS THAT ARE SHOWN ON THE MECHANICAL AND ARCHITECTURAL DRAWINGS.
   C. STEEL BELOW GRADE TO BE PROTECTED BY A MINIMUM OF 3" OF CONCRETE OR 4" OF MASONRY.
   D. 1/4" THICK SETTING PLATES FOR ALL BEAMS BEARING ON MASONRY OR CONCRETE WHICH DO NOT REQUIRE A BEARING PLATE. ANCHOR THE SETTING PLATE TO THE WALL WITH TWO 1/2"x6" HEADED STUDS.
   E. DO NOT PAINT THE BACK FACE OF EMBED PLATES THAT ARE EMBEDED IN CONCRETE.
   F. PROVIDE ANGLE SUPPORTS FOR METAL DECK RIBS AT COLUMNS WHEN THE COLUMN SIZE PREVENTS THE RIBS FROM CONTINUING TO THE BEAMS THAT ARE SUPPORTING THE DECK AT COLUMN LINES.
   G. UNLESS NOTED OTHERWISE, FIREPROOFING IS NOT SHOWN ON THE STRUCTURAL DRAWINGS. REFER TO ARCHITECTURAL DRAWINGS FOR FIRERATING REQUIREMENTS, METHODS AND MATERIALS.
   H. SUBMIT SHOP DRAWINGS TO STRUCTURAL ENGINEER FOR REVIEW PRIOR TO FABRICATION.

052100 - STEEL JOIST FRAMING

1. DESIGN, MANUFACTURING, AND ERECTION: ACCORDING TO THE STANDARD SPECIFICATIONS, LOAD TABLES & WEIGHT TABLES FOR STEEL JOISTS & JOIST GIRDERS ADOPTED BY THE STEEL JOIST INSTITUTE.
2. PAINT ALL JOISTS WITH MANUFACTURERS STANDARD SHOP PRIMER UNLESS OTHERWISE SPECIFIED BY THE ARCHITECT.
3. PROVIDE ADDITIONAL WEB MEMBERS AS REQUIRED AT CONCENTRATED LOADS THAT DO NOT OCCUR AT PANEL POINTS. SEE TYPICAL DETAIL.
4. BRIDGING:
   A. BRIDGING QUANTITY AND SPACING AS REQUIRED BY SJI SPECIFICATION AND PER ERECTION DRAWINGS OF JOIST SUPPLIER.
   B. ANCHOR ALL BRIDGING TO INTERSECTING WALLS AND BEAMS UNLESS OTHERWISE SHOWN.
   C. HORIZONTAL TOP AND BOTTOM BRIDGING MAY BE USED INSTEAD OF DIAGONAL BRIDGING ON LH, DLH AND SLH JOISTS WHERE REQUIRED FOR PASSAGE OF MECHANICAL DUCTS. NO MORE THAN TWO ADJACENT SPACES MAY HAVE HORIZONTAL BRIDGING.
5. CONNECTIONS TO SUPPORTING STEEL:
   A. WELDING:
      - 2 1/2" OF 1/8" FILLET EACH SIDE FOR K AND KCS JOISTS.
   B. BOLTING:
      - (2) 1/2" DIAMETER A307 FOR K & KCS JOISTS.
   C. BOLT JOISTS AT OR NEAREST TO COLUMNS, PER SJI SPECIFICATIONS.
   D. EXTEND BOTTOM CHORD OF JOISTS IN LINE WITH COLUMNS TO STABILIZER PLATES ON COLUMNS OR BEAMS.
6. MINIMUM BEARING REQUIREMENTS, UNLESS NOTED OTHERWISE:
   A. K SERIES: 2 1/2" ON STRUCTURAL STEEL, 4" ON MASONRY.
7. PROVIDE MATCHING HEIGHT SEATS ON JOISTS THAT HAVE COMMON BEARING. SHOE HEIGHTS TO MATCH SJI STANDARDS UNLESS NOTED OTHERWISE.
8. ADJACENT JOISTS OF THE SAME DEPTH ARE TO HAVE WEB MEMBERS IN LINE TO PERMIT PASSAGE OF MECHANICAL DUCTS.
9. JOIST SUPPLIER SHALL VERIFY THAT JOISTS AND BRIDGING ARE CAPABLE TO RESIST THE NET UPLIFT LOADS SPECIFIED.
10. JOIST SUPPLIER SHALL SUBMIT SHOP DRAWINGS TO STRUCTURAL ENGINEER FOR REVIEW PRIOR TO FABRICATION.
11. DEFLECTION CRITERIA FOR JOIST DESIGN (UNLESS NOTED OTHERWISE):
    - ROOF TOTAL LOAD: L/180
    - ROOF LIVE LOAD: L/240
12. JOIST SHOES AT ROOF DIAPHRAGMS SHALL BE CAPABLE OF TRANSMITTING THE BOUNDARY SHEAR (ROLL- OVER) TO THE SUPPORTING STRUCTURE. SEE ROOF PLAN FOR LOADS.

053100 - STEEL DECKING

1. SPECIFICATIONS AND STANDARDS:
   A. DESIGN FABRICATION AND ERECTION OF STEEL DECK SHALL BE GOVERNED BY THE CURRENT EDITION OF THE AMERICAN IRON AND STEEL INSTITUTE, SPECIFICATION FOR THE DESIGN OF COLD-FORMED STEEL STRUCTURAL MEMBERS.
   B. PROPERTIES OF THE STRUCTURAL STEEL DECK SHALL BE COMPUTED IN ACCORDANCE WITH THE REFERENCE STANDARD. THE PROPERTIES SHALL BE PUBLISHED IN THE MANUFACTURER'S CATALOG.
   C. AWS STANDARD WELDING SYMBOLS.
   D. AWS D1.3 SPECIFICATIONS FOR WELDING SHEET STEEL IN STRUCTURES.
   E. WELDING SHALL BE PERFORMED ONLY BY OPERATORS QUALIFIED, BY THE AWS STANDARD QUALIFICATION PROCEDURE, TO PERFORM THE PARTICULAR TYPE OF WORK REQUIRED.
2. PRODUCTS:
   A. WIDE RIB ROOF DECK:
      - PRIME-PAINTED STEEL DECK: ASTM A1008, STRUCTURAL STEEL (SS), GRADE 50 MIN.
      - GALVANIZED STEEL DECK: ASTM A653, GRADE 50 MIN, G60 ZINC COATING.
      - GALVANIZED AND PRIME-PAINTED DECK: ASTM A653, STRUCTURAL STEEL (SS), GRADE 50 MIN, G60 ZINC COATING.
3. CONNECTIONS:
   A. ROOF DECK
      - ANCHOR STEEL DECK TO STEEL SUPPORTING MEMBERS WITH 5/8" DIAMETER PUDDLE WELDS AT A MAXIMUM AVERAGE SPACING OF 12 INCHES CENTER TO CENTER (36/4 PATTERN) UNLESS SHOWN OTHERWISE.
      - ANCHOR STEEL DECK TO COLD FORMED METAL TRUSSES WITH #12 SCREWS AT 12 INCHES CENTER TO CENTER MAX UNLESS SHOWN OTHERWISE
      - FOR DECK SPANS GREATER THAN FIVE FEET, SIDE LAP FASTENERS SHALL BE SPACED AT INTERVALS NOT EXCEEDING 36 INCHES, UNLESS NOTED, USING #10 SCREWS, 5/8" DIAMETER PUDDLE WELDS, OR 1 1/2" LONG FILLET WELDS. MINIMUM (1) SIDELAP CONNECTION PER SPAN.
      - MECHANICAL FASTENERS MAY BE USED IN LIEU OF WELDING TO FASTEN DECK. SUBMIT SUBSTITUTION REQUEST WITH PRODUCT DATA, ATTACHMENT PATTERN AND PERFORMANCE DATA INDICATING DIAPHRAGM CAPACITY MEETS OR EXCEEDS THAT OF THE SPECIFIED WELD PATTERN.
   B. WELDING ELECTRODES: AWS A5.1, A5.5 OR A5.18 SERIES E60.
   C. WELDED WASHERS SHALL BE USED ON ALL DECK UNITS THINNER THAN 22 GAGE.
4. ERECTION AND FABRICATION:
   A. MINIMUM BEARING: 2 INCHES UNLESS OTHERWISE SHOWN.
   B. ROOF DECK MINIMUM LAP LENGTH: 4 INCHES UNLESS NOTED OTHERWISE.
   C. FABRICATE DECK UNITS IN LENGTHS TO SPAN THREE OR MORE SUPPORT SPACINGS.
   D. DO NOT SUSPEND POINT LOADS FROM DECK INCLUDING HANGERS FOR: CEILINGS, PIPES, DUCTS, EQUIPMENT, ETC. CONTRACTOR INSTALLING SUCH POINT LOADS SHALL PROVIDE SUB-FRAMING TO TRANSFER LOAD TO STRUCTURE SUPPORTING DECK.
5. OPENINGS IN STEEL DECK.
   A. OPENINGS CUT IN THE STEEL DECK SHALL BE REINFORCED OR SHALL BE SUPPORTED ON STEEL ANGLE FRAMES. COORDINATE SIZES AND LOCATIONS WITH THE MECHANICAL AND ARCHITECTURAL DRAWINGS.
   B. OPENINGS IN STEEL DECK EQUAL TO OR LESS THAN 12"x12" SHALL BE REINFORCED WITH A 24"x24" - 16 GAGE PLATE SCREWED OR WELDED TO THE DECK RIBS ON ALL SIDES OF THE OPENING.
   C. OPENINGS IN ROOF DECK GREATER THAN 12"x12" SHALL BE SUPPORTED ON STEEL ANGLE FRAMES.

054400 - COLD-FORMED METAL TRUSSES

1. SPECIFICATIONS AND STANDARDS: DESIGN; DETAILING, FABRICATION AND ERECTION OF PREFABRICATED TRUSSES SHALL BE IN ACCORDANCE WITH AISI "SPECIFICATIONS FOR THE DESIGN OF COLD FORMED STEEL STRUCTURAL MEMBERS.
2. SUBMIT, FOR APPROVAL, DETAILED SHOP DRAWINGS. THE SHOP DRAWINGS SHALL SHOW ALL DESIGN CRITERIA, LAYOUT, MEMBER SIZES, MATERIAL STRENGTH, DESIGN STRESSES, CONNECTION DETAILS AND BRACING REQUIREMENTS. THE SHOP DRAWINGS SHALL BEAR THE SEAL OF A PROFESSIONAL ENGINEER REGISTERED IN THE STATE OF THE PROJECT.
3. PROVIDE 33 MIL CONTINUOUS BENT PLATES AT ALL DECK DISCONTINUITIES INCLUDING HIPS, VALLEYS, RIDGES, ETC. ATTACH PLATE WITH #10 SCREWS @ 12" c/c TYPICAL @ EACH SIDE OF PLATE.
4. ERECTION:
   A. ALL TRUSSES SHALL BE BRACED DURING ERECTION. ERECTION BRACING SHALL HOLD TRUSSES STRAIGHT AND PLUMB UNTIL DECKING AND PERMANENT BRACING HAVE BEEN FASTENED. PROPER HANDLING AND ERECTION BRACING SHALL BE SOLELY THE RESPONSIBILITY OF THE CONTRACTOR.
   B. PROVIDE AND INSTALL PERMANENT BRACING OF TRUSS MEMBERS AS INDICATED ON THE APPROVED SHOP DRAWINGS.
5. MISCELLANEOUS REQUIREMENTS:
   A. TRUSS MANUFACTURER SHALL DESIGN AND SUPPLY ALL HANGERS AND CONNECTIONS FOR INTERSECTING TRUSSES.

B

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SMBH Job No. 022-554.008

DESIGNED BY:	MK
DRAWN BY:	CRP
CHECKED BY:	JN

REVISIONS:	DATE:
ADDENDUM 02	03/31/25

VET TEACHING CENTER
4025 EAST LAGRANGE ROAD, JEFFERSON COUNTY, INDIANA

HANOVER COLLEGE

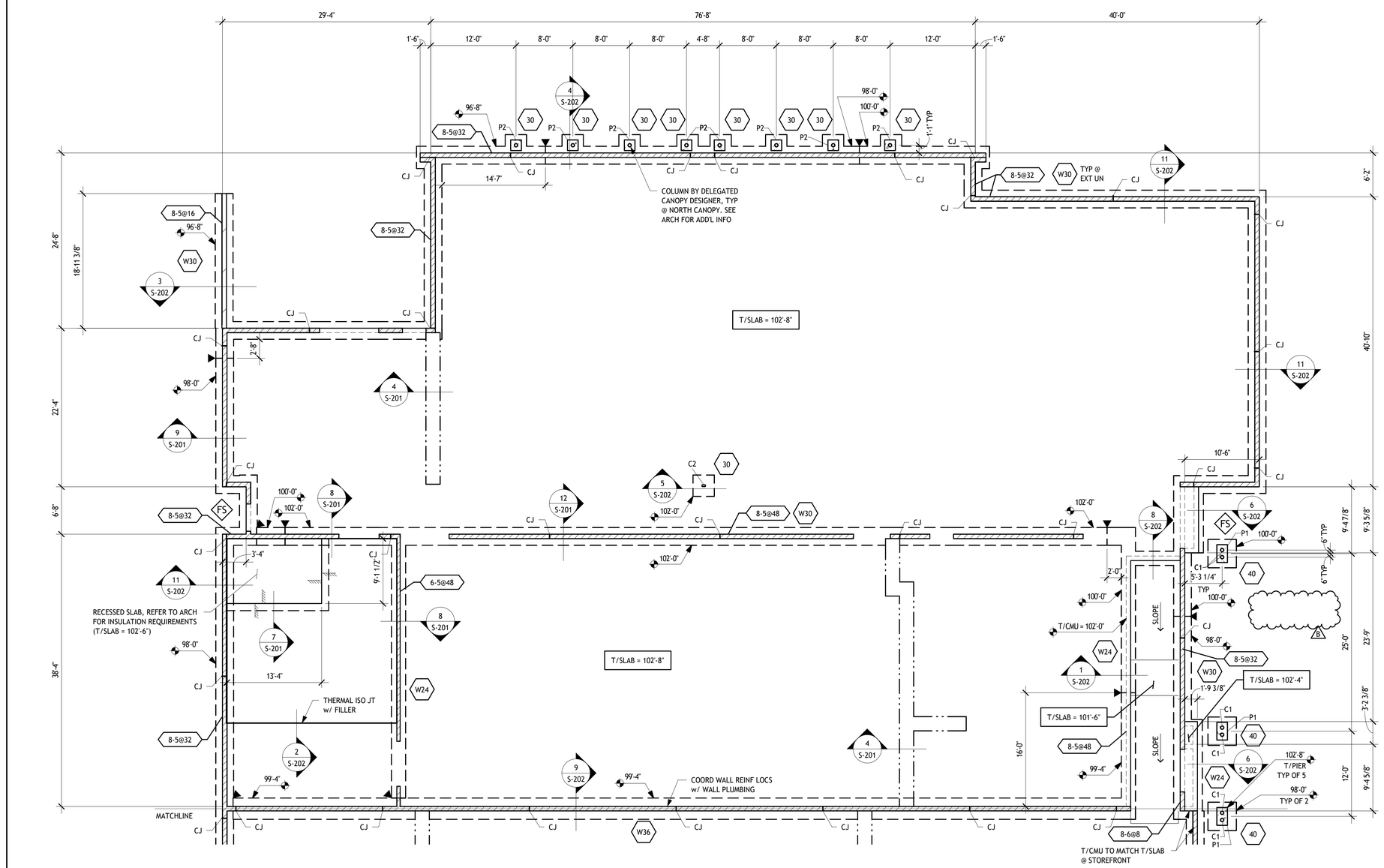
GENERAL NOTES

SCALE: 12" = 1'-0"

S-003

JOB NO.: 23009

DATE: 03/07/2025



PARTIAL FOUNDATION PLAN - NORTH

1/8" = 1'-0"

NORTH

1. VERIFY LOCATIONS OF COLUMNS, WALLS, OPENINGS, ETC. WITH ARCHITECTURAL DRAWINGS BEFORE PLACING FOUNDATIONS.
2. 4" SLAB ON GRADE WITH 6x6-W1.4xW1.4 WWR. TYPICAL EXCEPT AS NOTED. PROVIDE 6" OF GRANULAR SUBGRADE BELOW SLAB UNLESS NOTED OTHERWISE IN THE REFERENCED GEOTECHNICAL REPORT. REFER TO ARCHITECTURAL DRAWINGS FOR SLAB SLOPE & DRAIN LOCATIONS.
3. TOP OF SLAB ELEVATION 100'-0" EXCEPT AS NOTED. SEE CIVIL DRAWINGS FOR REFERENCE SITE ELEVATION.
4. DESIGN SOIL BEARING PRESSURE 3,000 PSF. ANY SOFT SPOTS OR VARIATIONS IN SUBSURFACE CONDITIONS SHALL BE REPORTED IMMEDIATELY TO THE ENGINEER. THE DESIGN BEARING CAPACITY SHALL BE FIELD VERIFIED BY AN INDEPENDENT TESTING AGENCY SPECIALIZING IN SOILS INVESTIGATIONS. GEOTECHNICAL INFORMATION INCLUDED IN THE CONSTRUCTION DOCUMENTS WAS OBTAINED FROM A REPORT ISSUED BY ATLAS TECHNICAL CONSULTANTS, LLC, PROJECT NUMBER LOUGE24066, DATED 07/02/2024.
5. CONTRACTOR SHALL VERIFY ALL RELEVANT CONDITIONS AND DIMENSIONS OF EXISTING CONSTRUCTION BEFORE PROCEEDING WITH THE WORK.
6. ELEVATIONS SHOWN ON PLAN ARE TOP OF THE FOOTING OR SLAB.
7. SEE PLAN FOR TOP OF FOOTING ELEVATIONS.
8. FOOTINGS TO CENTER UNDER COLUMN OR WALL UNLESS NOTED.
9. CONTRACTOR SHALL PROVIDE FLOOR CONTROL AND CONSTRUCTION JOINTS IN SLAB ON GRADE IN ACCORDANCE WITH SECTIONS 1/S-201, 2/S-201 & 6/S-201.
10. ALL EXTERIOR FOOTINGS ARE TO EXTEND A MINIMUM OF 2'-6" BELOW FINISHED GRADE OR TO LOCALLY RECOGNIZED FROST DEPTH.
11. REFERENCE: GENERAL STRUCTURAL NOTES - S-002 & S-003; COLUMN SCHEDULE - S-006.

12. SYMBOL LEGEND:

- INDICATES TOP OF FOOTING ON PLAN.
- INDICATES FOOTING MARK. SEE SCHEDULE ON THIS SHEET.
- INDICATES APPROXIMATE LOCATION OF STEP IN FOOTING ON PLAN. SEE SECTION 3/S-201.
- INDICATES THICKENED SLAB ON PLAN. SEE SECTION 4/S-201.
- FS — INDICATES FROST SLAB. SEE SECTIONS 10/S-201 FOR MORE INFORMATION.
- A - B @ C — INDICATES CMU BEARING WALL MARK;
  "A" -INDICATES WALL THICKNESS IN INCHES.
  "B" -INDICATES REINFORCING BAR SIZE.
  "C" -INDICATES REINFORCING SPACING IN INCHES.
  REINFORCING BAR SIZE AND SPACING IS FROM TOP OF FOUNDATION TO TOP OF WALL. PROVIDE DOWELS FROM FOOTING TO MATCH VERTICAL REINFORCING SIZE AND SPACING.

  PROVIDE ADDITIONAL REINFORCING AS SHOWN IN SECTION 5/S-201.
- C# P# — INDICATES COLUMN (OR PIER) ON PLAN. SEE SCHEDULE ON THIS SHEET.

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HANOVER COLLEGE

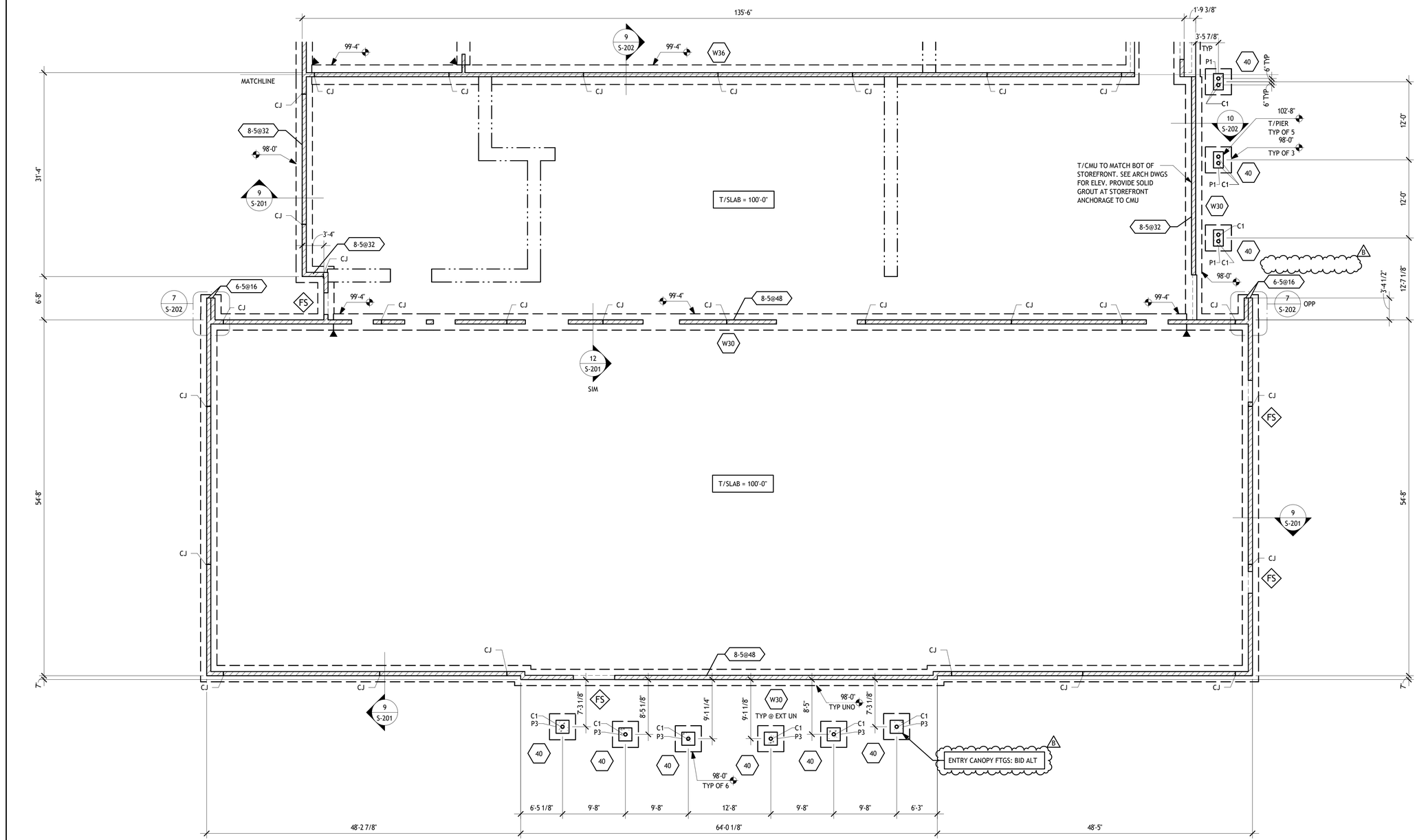
PARTIAL FOUNDATION PLAN - NORTH

SCALE: As indicated

S-101

JOB NO.: 23009

DATE: 03/07/2025



PARTIAL FOUNDATION PLAN - SOUTH

1/8" = 1'-0"

NORTH

1. SEE SHEET S-101 FOR BALANCE OF FOUNDATION PLAN INFORMATION.
2. REFER TO ARCHITECTURAL DRAWINGS FOR SLAB SLOPE & DRAIN LOCATIONS.

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ADDENDUM 02	03/31/25

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PARTIAL FOUNDATION PLAN - SOUTH

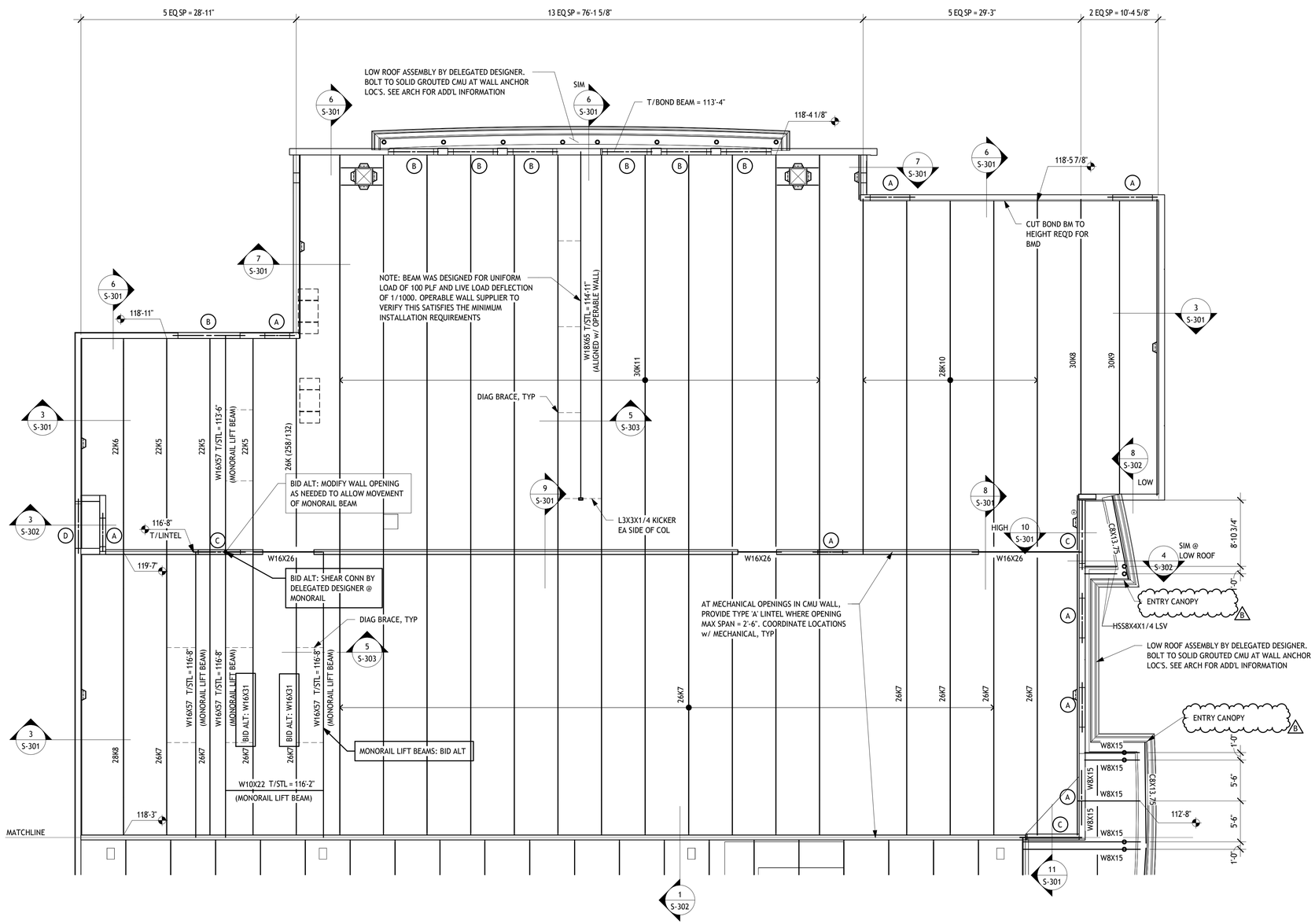
SCALE: As indicated

S-102

JOB NO.: 23009

DATE: 03/07/2025

1/16" = 1'-0" | 1/8" = 1'-0" | 3/16" = 1'-0" | 1/4" = 1'-0" | 3/8" = 1'-0" | 1/2" = 1'-0" | 3/4" = 1'-0" | 1" = 1'-0" | 1 1/2" = 1'-0" | 3" = 1'-0" | 6" = 1'-0"



PARTIAL ROOF FRAMING PLAN - NORTH

1/8" = 1'-0"

NORTH

1. DESIGN LIVE LOADS: ROOF LIVE LOAD = 20 PSF (REDUCIBLE). SEE GENERAL STRUCTURAL NOTES FOR ROOF SNOW LOAD.
2. ROOF CONSTRUCTION: 1 1/2"x20 GAGE TYPE B GALVANIZED METAL DECK.
3. SOLAR ALLOWANCE: THE ROOF HAS BEEN DESIGNED TO ACCOMMODATE A FUTURE SOLAR ALLOWANCE OF 7 PSF. THIS DESIGN ASSUMES THAT FUTURE SOLAR PV PANELS ARE FLAT AND LOW-PROFILE PANELS THAT WILL NOT INDUCE SNOW DRIFT OR INDUCE ADDITIONAL LATERAL WIND FORCE ON THE BUILDING. THE FUTURE SOLAR PV PANEL LOAD ALLOWANCE HAS BEEN CONSIDERED ON THE ENTIRE ROOF.
4. JOISTS & BEAMS ARE UNIFORMLY SPACED BETWEEN COLUMNS OR WALLS UNLESS NOTED OTHERWISE.
5. SEE FOUNDATION PLAN FOR REINFORCING IN CMU BEARING WALLS NOT SHOWN ON PLAN.
6. FOR NON-LOADING BEARING CMU WALLS, SEE SECTIONS 4/S-301 & 5/S-301.
7. VERIFY ALL CFMF TRUSS DIMENSIONS AND GEOMETRIES WITH ARCHITECTURAL AND STRUCTURAL DRAWINGS PRIOR TO DESIGNING AND FABRICATING TRUSSES.
8. (B) CFMF TRUSSES SHALL BE DESIGNED FOR THE FOLLOWING LOADS:

LOAD	BOTTOM CHORD	TOP CHORD
DEAD	10 PSF	25 PSF
LIVE		20 PSF
WIND		15 PSF (NET UPLIFT)

SEE PLAN FOR ADDITIONAL LOADS. TRUSSES SHALL BE DESIGNED FOR UNBALANCED AND DRIFTED SNOW IN ACCORDANCE WITH THE GOVERNING BUILDING CODE. LOADS SHALL BE COMBINED USING LOAD COMBINATIONS IN ACCORDANCE WITH THE GOVERNING BUILDING CODE. GIRDER TRUSSES SHALL BE DESIGNED FOR REACTIONS FROM SUPPORTED MEMBERS.

9. CFMF TRUSSES SHALL BE DESIGNED FOR THE FOLLOWING MAXIMUM DEFLECTION TOTAL LOAD = SPAN/240; LIVE LOAD = SPAN/360.
10. REFERENCES: GENERAL STRUCTURAL NOTES - S-002 & S-003; COLUMN SCHEDULE - S-006; LINTEL SCHEDULE- S-006.
11. SYMBOL LEGEND:
    - • INDICATES BOTTOM OF METAL DECK ELEVATION, UNLESS NOTED OTHERWISE.
    - 20K • INDICATES BEAM REACTION IN KIPS (ASD). SAME BOTH ENDS EXCEPT AS SHOWN. DESIGN CONNECTION FOR A MINIMUM OF 17 KIPS WHERE NO REACTION IS SHOWN.
    - □ • INDICATES BEAM BEARING IN INCHES. SAME BOTH ENDS EXCEPT AS SHOWN.
    - ☒ • INDICATES FRAMED OPENING - PROVIDE FRAME USING L5X3 1/2X1/4 LLV ON ALL SIDES. REFER TO SECTION 1/S-301 FOR ADDITIONAL INFORMATION. CONTRACTOR COORDINATE OPENING SIZES WITH MECHANICAL AND ARCHITECTURAL REQUIREMENTS. FRAMES ARE REQUIRED AT ROOF DRAINS. SEE ARCHITECTURAL AND MECHANICAL DRAWINGS FOR NUMBERS AND LOCATIONS.
    - (A) • INDICATES LINTEL TYPE. SEE SCHEDULE ON SHEET S-006.

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VET TEACHING CENTER
4025 EAST LAGRANGE ROAD, JEFFERSON COUNTY, INDIANA
HANOVER COLLEGE

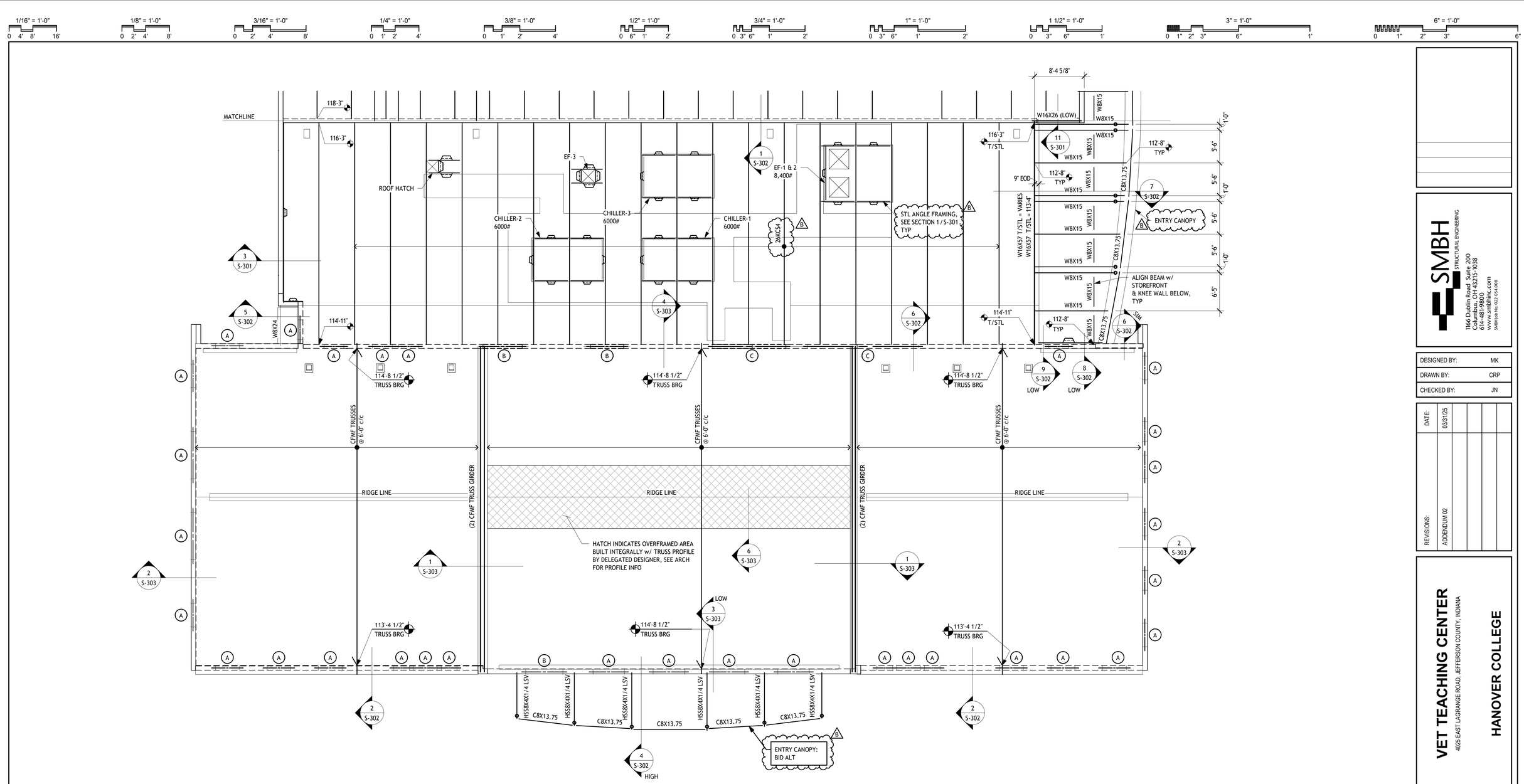
PARTIAL ROOF FRAMING PLAN - NORTH

SCALE: As indicated

S-103

JOB NO.: 23009

DATE: 03/07/2025



PARTIAL ROOF FRAMING PLAN - SOUTH

1/8" = 1'-0"

1. SEE SHEET S-103 FOR BALANCE OF ROOF FRAMING PLAN INFORMATION.

SMBH STRUCTURAL ENGINEERING
7166 Dublin Road Suite 200
Columbus, OH 43215-1038
614.481.8800
www.smbhinc.com
SMBH Job No. 022-554.008

DESIGNED BY:	MK
DRAWN BY:	CRP
CHECKED BY:	JN

REVISIONS:	DATE:
ADDENDUM 02	03/31/25

VET TEACHING CENTER
4025 EAST LAGRANGE ROAD, JEFFERSON COUNTY, INDIANA

HANOVER COLLEGE

PARTIAL ROOF FRAMING PLAN - SOUTH

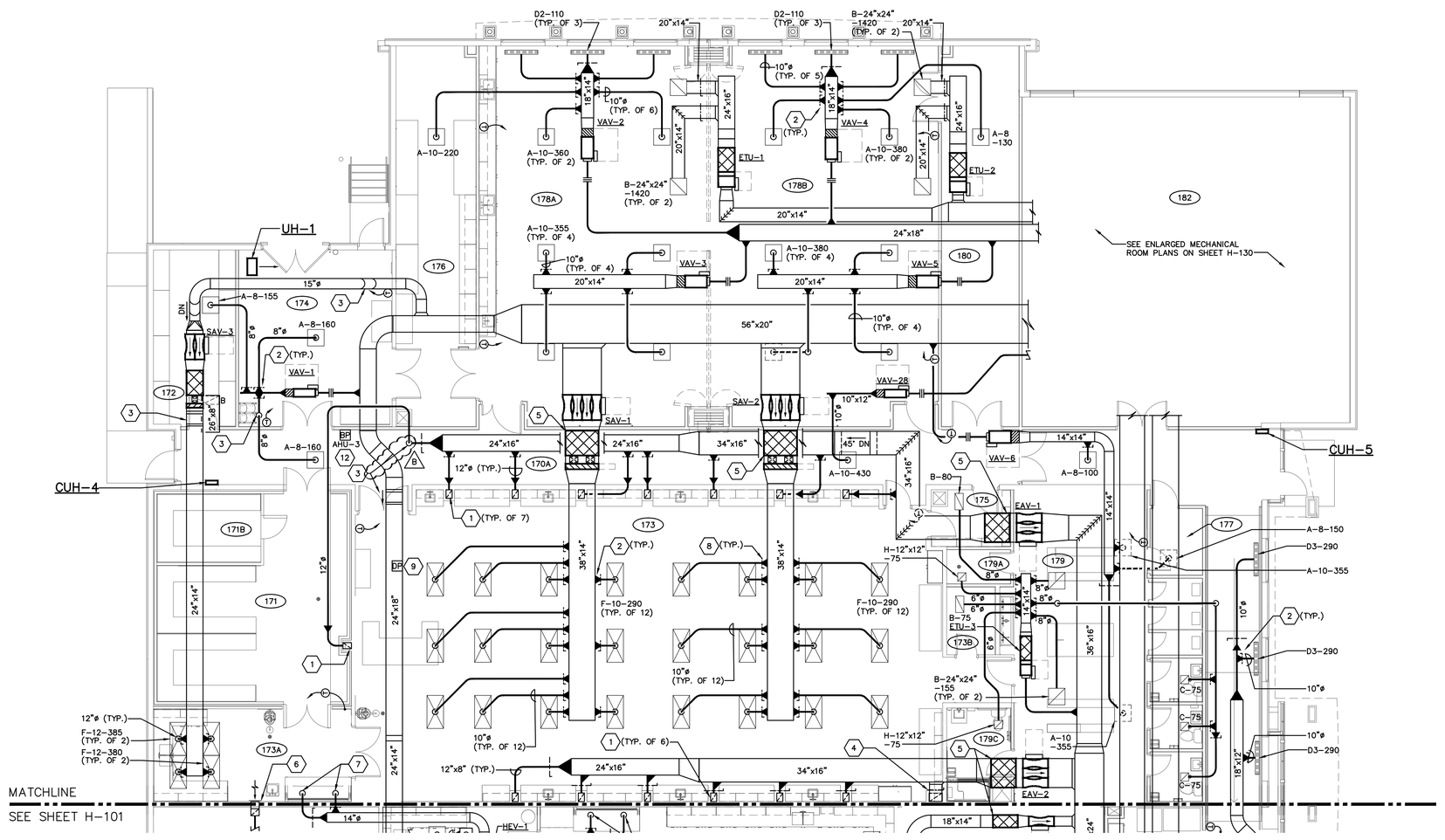
SCALE: As indicated

S-104

JOB NO.: 23009

DATE: 03/07/2025

1/16" = 1'-0" | 1/8" = 1'-0" | 3/16" = 1'-0" | 1/4" = 1'-0" | 3/8" = 1'-0" | 1/2" = 1'-0" | 3/4" = 1'-0" | 1" = 1'-0" | 1 1/2" = 1'-0" | 3" = 1'-0" | 6" = 1'-0"



FIRST FLOOR HVAC PLAN – NORTH

SCALE: 1/8"=1'-0"

CODED NOTES ⬡

1. EXTEND 8"x12" EXHAUST DUCT DOWN IN MASONRY CHASE AND TERMINATE WITH 6"x26" TYPE "G" AIR DEVICE MOUNTED WITH BOTTOM AT +/– 12" A.F.F.. COORDINATE FINAL GRILLE ELEVATION WITH GENERAL CONTRACTOR PRIOR TO ROUGH IN. BALANCE TO 450 CFM UNLESS OTHERWISE NOTED.
2. SPIN–IN FITTING WITH MANUAL BALANCE DAMPER.
3. OFFSET DUCTWORK UP AND ROUTE IN TRUSS SPACE.
4. EXTEND 18"x12" EXHAUST DUCT DOWN IN MASONRY CHASE AND TERMINATE WITH 16"x26" TYPE "G" AIR DEVICE MOUNTED WITH BOTTOM AT +/– 12" A.F.F.. COORDINATE FINAL GRILLE ELEVATION WITH GENERAL CONTRACTOR PRIOR TO ROUGH IN. BALANCE TO 745 CFM.
5. PROVIDE 3'–0" LONG SOUND ATTENUATOR AS SCHEDULED.
6. EXTEND 12"x12" EXHAUST DUCT DOWN ALONG MECHANICAL ROOM WALL AND TERMINATE WITH 12"x24" TYPE "G" AIR DEVICE MOUNTED WITH BOTTOM AT +/– 12" A.F.F.. COORDINATE FINAL GRILLE ELEVATION WITH GENERAL CONTRACTOR PRIOR TO ROUGH IN. BALANCE TO 640 CFM.
7. PROVIDE BLAST–GATE DAMPERS AND EXTEND 12"ø WELDED TYPE 316 STAINLESS STEEL EXHAUST DUCT DOWN TO FUME HOOD CONNECTION. BALANCE EACH CONNECTION TO 615 CFM.
8. GROUP TAPS AND BALANCE DAMPERS CLOSE TOGETHER TO MINIMIZE ACCESS DOORS REQUIRED IN DRYWALL CEILING. COORDINATE FINAL LOCATIONS AND SIZES OF CEILING ACCESS DOORS WITH GENERAL CONTRACTOR.
9. PROVIDE DUCT STATIC PRESSURE SENSOR AT THIS APPROXIMATE LOCATION.

T.M. PRATER REGISTERED No. PE10302274 STATE OF OHIO PROFESSIONAL ENGINEER
3/7/2025

H-100-23357.DWG

PRATER
Engineering Associates, Inc.
6130 Wilcox Road
Dublin, Ohio 43016
(614) 766 4896
praterengineering.com

JOB NUM. 23357 | CHECKED BY | DRAWN BY JDA | DESIGNED BY J. AHMANN

DESIGNED BY:	PEA
DRAWN BY:	PEA
CHECKED BY:	PEA

REVISIONS:	DATE:
ADDENDUM 02	04/01/25

VET TEACHING CENTER
HANOVER COLLEGE
4025 STATE ROUTE 56, HANOVER, IN 47243

FIRST FLOOR HVAC PLAN NORTH

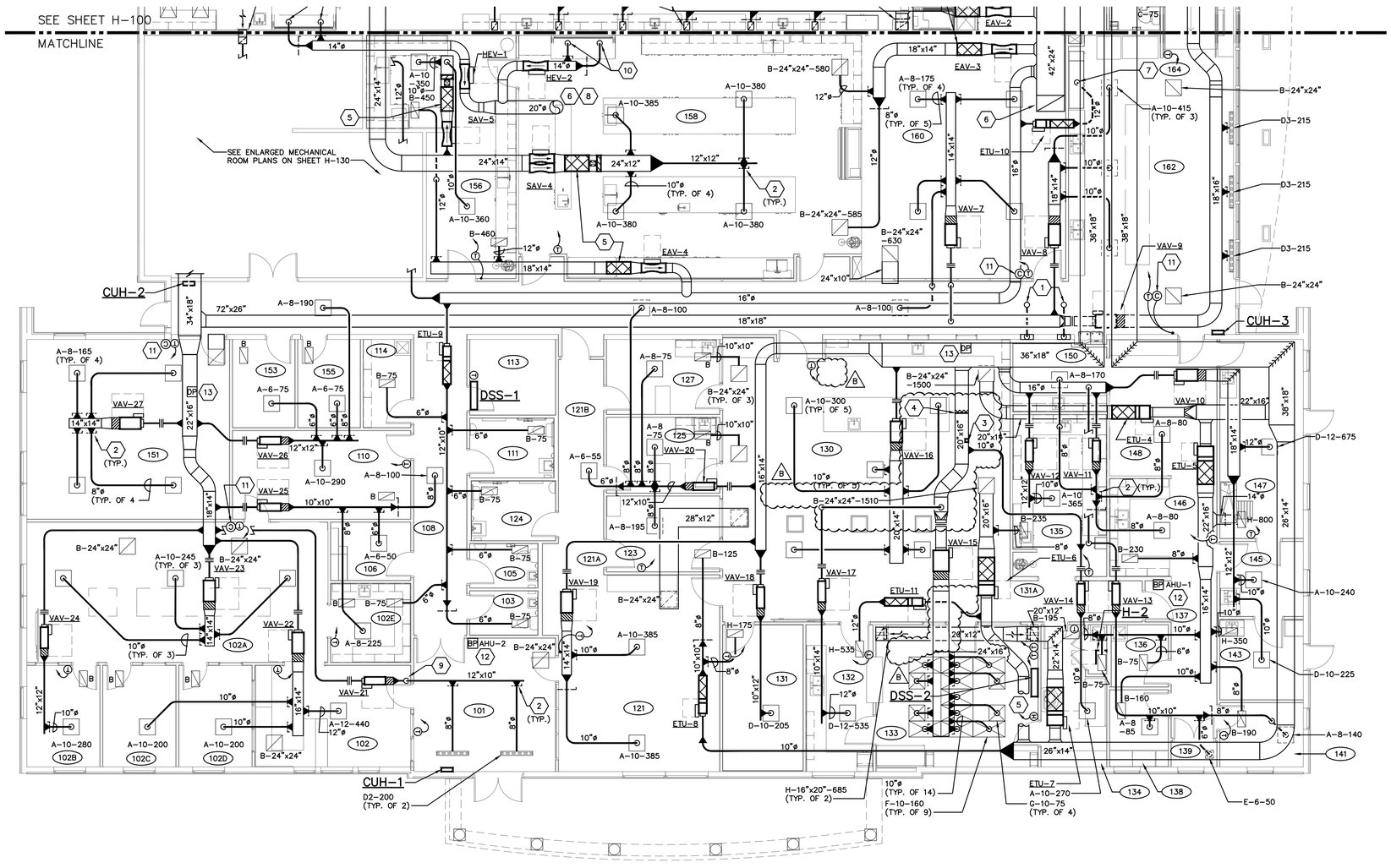
SCALE: As indicated

H-100

JOB NO.: 23009

DATE: 03.07.2025

1/16" = 1'-0" 0 4' 8' 16'
1/8" = 1'-0" 0 2' 4' 8'
3/16" = 1'-0" 0 2' 4' 8'
1/4" = 1'-0" 0 1' 2' 4'
3/8" = 1'-0" 0 1' 2' 4'
1/2" = 1'-0" 0 6" 1' 2'
3/4" = 1'-0" 0 3" 6" 1' 2'
1" = 1'-0" 0 3" 6" 1' 2'
1 1/2" = 1'-0" 0 3" 6" 1'
3" = 1'-0" 0 1" 2" 3" 1'
6" = 1'-0" 0 1" 2" 3" 6"



FIRST FLOOR HVAC PLAN – SOUTH
SCALE: 1/8"=1'-0"

CODED NOTES

1. PROVIDE DRYER BOX AND EXTEND 4"ø CLOTHES DRYER EXHAUST DUCT UP IN STUD CAVITY TO ROOF. REFER TO SHEET H403 FOR ADDITIONAL DETAILS.
2. SPIN-IN FITTING WITH MANUAL BALANCE DAMPER.
3. AIRFLOW/HIGH HUMIDITY LIMIT SWITCH FURNISHED BY HUMIDIFIER MANUFACTURER, INSTALLED BY HVAC CONTRACTOR. ALL 24V CONTROL WIRING BY HVAC CONTRACTOR. SWITCH SHALL BE MOUNTED A MINIMUM OF 2' DOWNSTREAM OF HUMIDIFIER DISTRIBUTER.
4. DUCT MOUNTED SHORT ABSORPTION MANIFOLD FURNISHED WITH HUMIDIFIER. REFER TO HUMIDIFIER DISTRIBUTOR DUCT DETAIL ON SHEET H-403.
5. PROVIDE HUMIDISTAT AT LOCATION SHOWN FOR HUMIDIFIER H-2.
6. EXHAUST DUCTWORK DOWN FROM FAN LOCATED ON ROOF ABOVE.
7. 12"ø DOWN TO MICROWAVE CABINET CONNECTION. COORDINATE CONNECTION WITH CASEWORK. BALANCE TO 500 CFM.
8. EF-3 DUCTWORK SYSTEM SHALL BE ENTIRELY WELDED TYPE 316 STAINLESS STEEL.
9. EXTEND DUCTWORK UP AND ROUTE IN TRUSS SPACE.
10. PROVIDE BLAST-GATE DAMPERS AND EXTEND 12"ø WELDED TYPE 316 STAINLESS STEEL EXHAUST DUCT DOWN TO FUME HOOD CONNECTION. BALANCE EACH CONNECTION TO 615 CFM.
11. PROVIDE CO2 SENSOR FOR DEMAND CONTROL VENTILATION.
12. PROVIDE BUILDING PRESSURE SENSOR MOUNTED 6" BELOW FINISHED CEILING.
13. PROVIDE DUCT STATIC PRESSURE SENSOR AT THIS APPROXIMATE LOCATION.

H-101 23357-10.DWG

TIM PRATER REGISTERED No. PE10302274 STATE OF OHIO PROFESSIONAL ENGINEER
3/7/2025

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praterengineering.com

JOB NUM. 23357 | CHECKED BY | DRAWN BY JDL | DESIGNED BY J. AHMANN

DESIGNED BY:	PEA
DRAWN BY:	PEA
CHECKED BY:	PEA

REVISIONS:	DATE:
ADDENDUM 02	04/01/25

VET TEACHING CENTER
HANOVER COLLEGE
4025 STATE ROUTE 56, HANOVER, IN 47243

FIRST FLOOR HVAC PLAN SOUTH

SCALE: As indicated

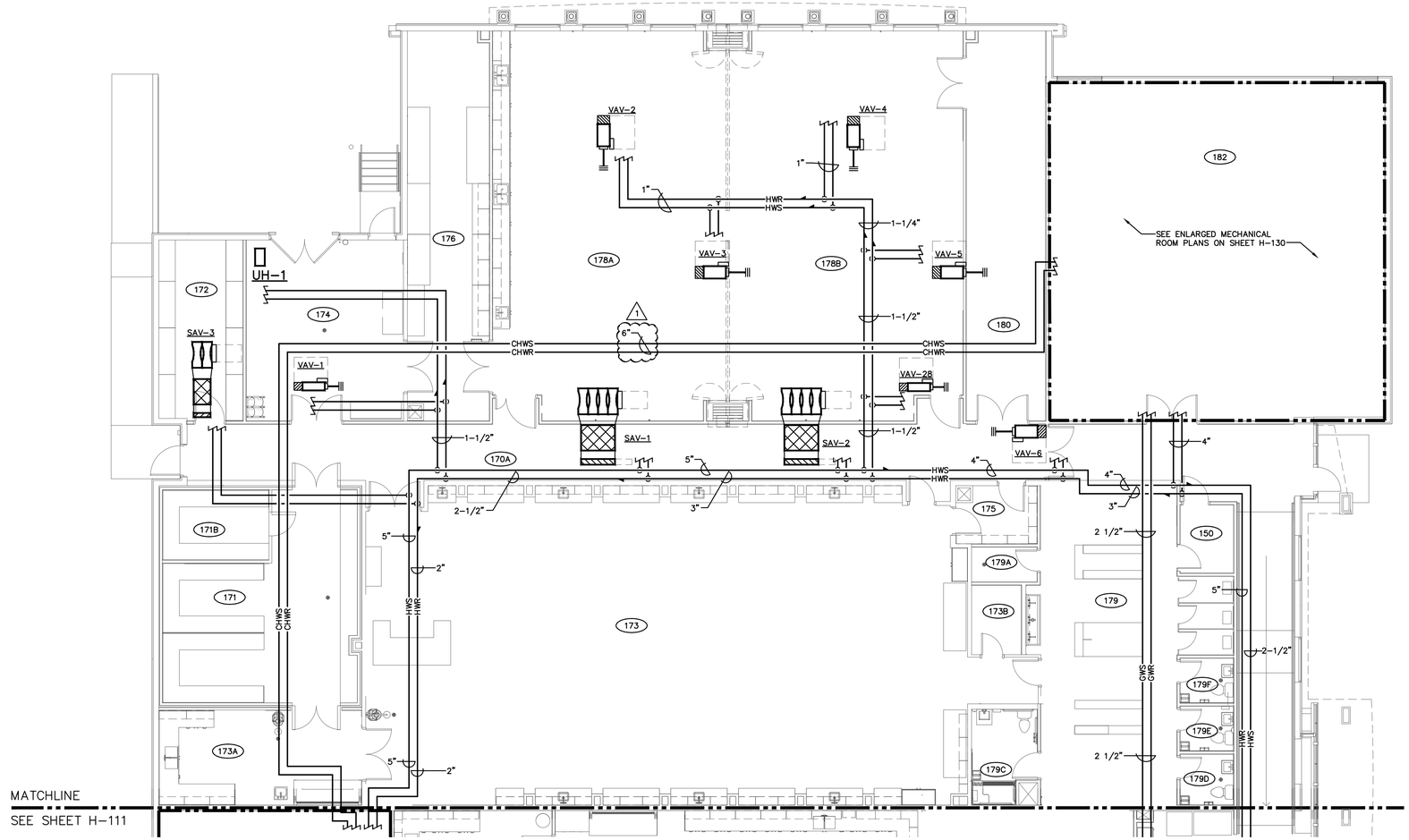
H-101

JOB NO.: 23009
DATE: 03.07.2025

1/16" = 1'-0" | 1/8" = 1'-0" | 3/16" = 1'-0" | 1/4" = 1'-0" | 3/8" = 1'-0" | 1/2" = 1'-0" | 3/4" = 1'-0" | 1" = 1'-0" | 1 1/2" = 1'-0" | 3" = 1'-0" | 6" = 1'-0"

CODED NOTES ⬡

1. PROVIDE 2" MINIMUM FLOW BYPASS CONTROL VALVE AT THIS LOCATION. BALANCE TO 45 GPM.



FIRST FLOOR HVAC PIPING PLAN – NORTH

SCALE: 1/8"=1'-0"

T.M. PRATER REGISTERED No. PE10302274 STATE OF OHIO PROFESSIONAL ENGINEER
3/7/2025

H-110-23357.DWG

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JOB NUM. 23357 | CHECKED BY | DRAWN BY JDA | DESIGNED BY J. AHMANN

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DRAWN BY:	PEA
CHECKED BY:	PEA

REVISIONS:	DATE:
ADDENDUM 02	04/01/25

VET TEACHING CENTER
HANOVER COLLEGE
4025 STATE ROUTE 56, HANOVER, IN 47243

FIRST FLOOR HVAC PIPING PLAN NORTH

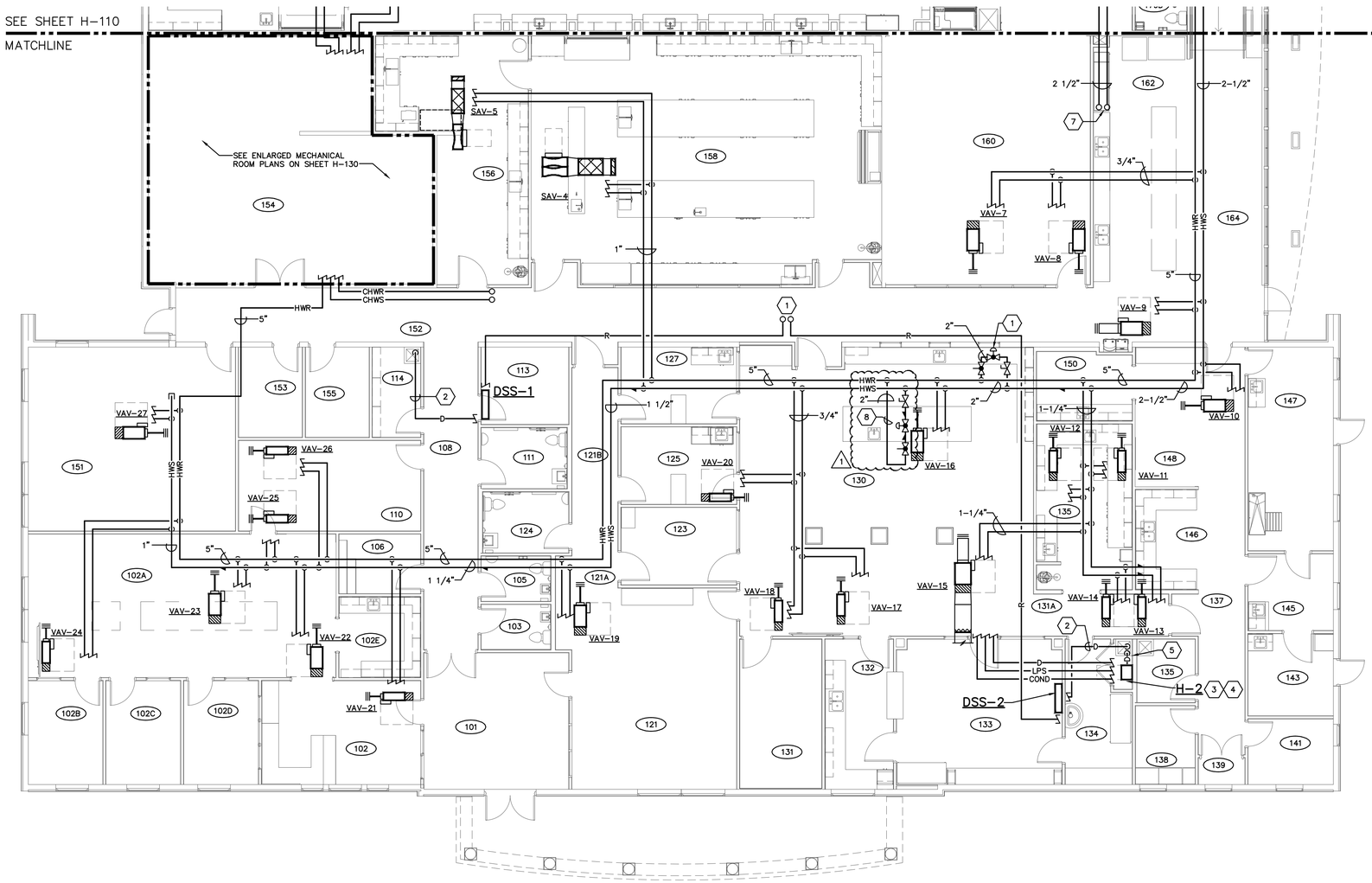
SCALE: As indicated

H-110

JOB NO.: 23009

DATE: 03.07.2025

1/16" = 1'-0" | 1/8" = 1'-0" | 3/16" = 1'-0" | 1/4" = 1'-0" | 3/8" = 1'-0" | 1/2" = 1'-0" | 3/4" = 1'-0" | 1" = 1'-0" | 1 1/2" = 1'-0" | 3" = 1'-0" | 6" = 1'-0"



FIRST FLOOR HVAC PIPING PLAN – SOUTH

SCALE: 1/8"=1'-0"

CODED NOTES ⬡

1. EXTEND REFRIGERANT PIPING AND CONTROL WIRING UP THROUGH ROOF PIPE CURB. SIZE REFRIGERANT LINES PER MANUFACTURER'S RECOMMENDATIONS.
2. EXTEND 3/4" CONDENSATE DRAIN PIPING FROM UNIT CONNECTION TO MOP SINK AS SHOWN. PROVIDE DRAINAGE TEES AND CLEANOUT PLUGS IN CHANGES OF DIRECTION.
3. MOUNT HUMIDIFIER ON WALL. PROVIDE ADDITIONAL SUPPORT STEEL AS REQUIRED. REFER TO PLUMBING DRAWINGS FOR MAKE-UP WATER.
5. INSTALL HUMIDIFIER NOZZLE DISTRIBUTOR KIT, LOW PRESSURE STEAM AND CONDENSATE PIPING, BETWEEN HUMIDIFIER AND SHORT ABSORPTION MANIFOLDS, PER MANUFACTURER'S RECOMMENDATIONS. HUMIDIFIER PIPE SIZES, ROUTE, AND SLOPE SHALL BE PER MANUFACTURER'S RECOMMENDATIONS. COVER W/ 1" INSULATION.
6. EXTEND DRAIN LINE FROM HUMIDIFIER AS SHOWN TO FLOOR DRAIN LOCATED IN THIS ROOM. SIZE DRAIN PER MANUFACTURER'S RECOMMENDATIONS. UNIT SHALL HAVE INTEGRAL AFTER COOLER FOR CONDENSATION. 3/4" MAKE-UP WATER LINE PROVIDED BY PLUMBING CONTRACTOR AS MAKE-UP WATER AND AFTER COOLER WATER.
7. EXTEND GLYCOL PIPING UP TO HEAT RECOVERY COIL IN FAN PLENUM ABOVE. PROVIDE HEAT TRACE ON ALL EXTERIOR PIPING.
1. 8. PROVIDE 2" HEATING WATER MINIMUM FLOW BYPASS WITH 2-WAY MODULATING CONTROL VALVE. BALANCE TO 50 GPM.

T.M. PRATER REGISTERED No. PE10302274 STATE OF OHIO PROFESSIONAL ENGINEER
3/7/2025

H-111-23357.DWG

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JOB NUM. 23357 | CHECKED BY | DRAWN BY T. | DESIGNED BY J. AHMANN

DESIGNED BY:	PEA
DRAWN BY:	PEA
CHECKED BY:	PEA

REVISIONS:	DATE:
ADDENDUM 02	04/01/25

VET TEACHING CENTER
HANOVER COLLEGE
402S STATE ROUTE 56, HANOVER, IN 47243

FIRST FLOOR HVAC PIPING PLAN SOUTH

SCALE: As indicated

H-111

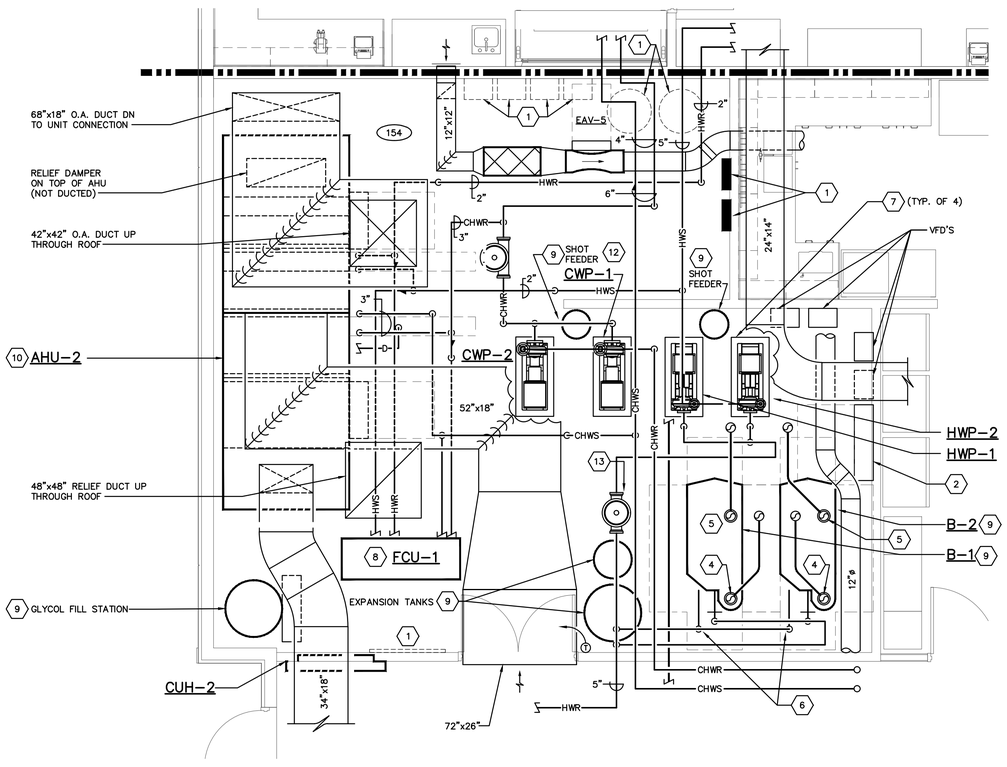
JOB NO.: 23009

DATE: 03.07.2025

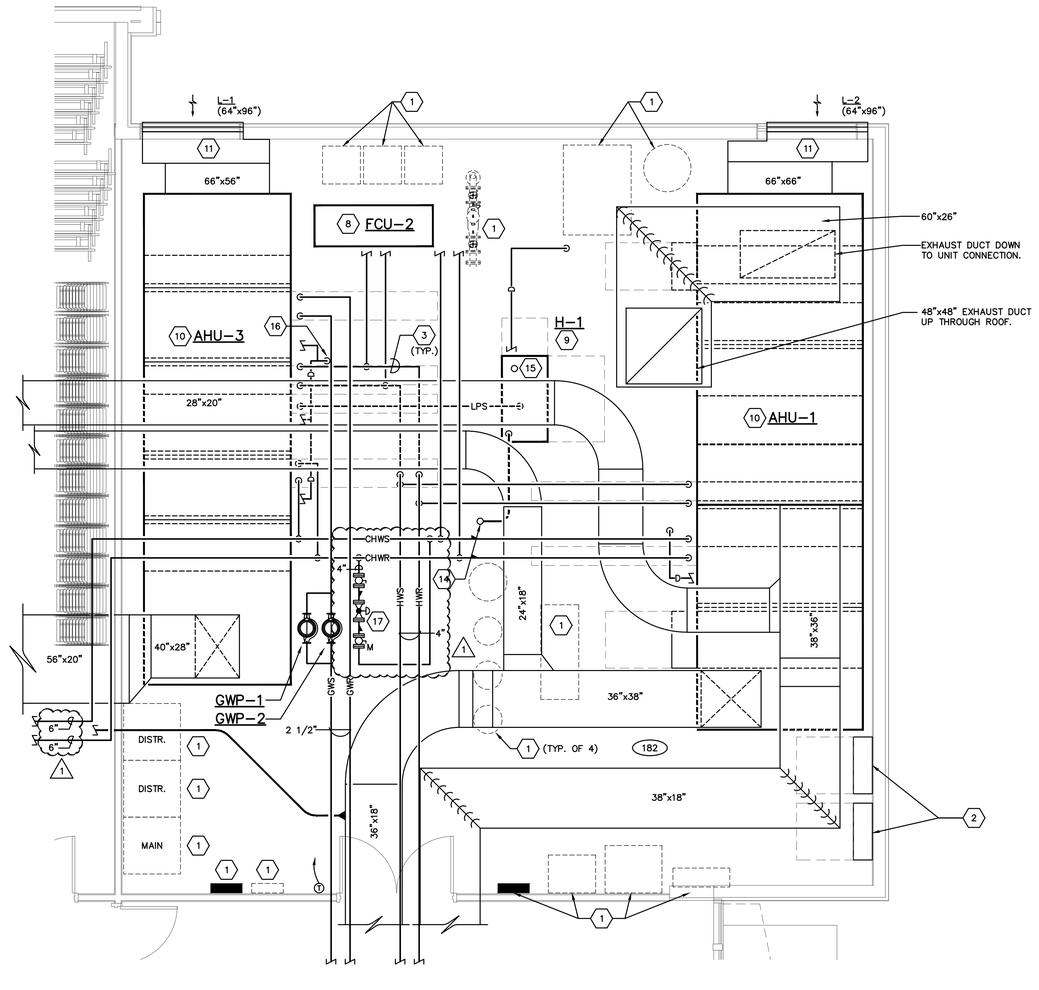
1/16" = 1'-0" | 1/8" = 1'-0" | 3/16" = 1'-0" | 1/4" = 1'-0" | 3/8" = 1'-0" | 1/2" = 1'-0" | 3/4" = 1'-0" | 1" = 1'-0" | 1 1/2" = 1'-0" | 3" = 1'-0" | 6" = 1'-0"

CODED NOTES

1. APPROXIMATE LOCATION OF EQUIPMENT PROVIDED BY ELECTRICAL, PLUMBING, AND FIRE PROTECTION CONTRACTORS. SEE ASSOCIATED SHEETS FOR ADDITIONAL DETAILS.
2. BAS PANELS.
3. MECHANICAL EQUIPMENT CLEARANCE.
4. BOILER FLUE PIPE TO BE EXTENDED UP AND OUT THROUGH ROOF AT LOCATION SHOWN. COORDINATED TERMINATION WITH THE BOILER MANUFACTURER. REFER TO MANUFACTURER'S RECOMMENDATIONS FOR CLEARANCES BETWEEN EXHAUST AND INTAKE DUCTS.
5. BOILER COMBUSTION PIPE TO BE EXTENDED UP AND OUT THROUGH ROOF AT LOCATION SHOWN. COORDINATED TERMINATION WITH THE BOILER MANUFACTURER. REFER TO MANUFACTURER'S RECOMMENDATIONS FOR CLEARANCES BETWEEN EXHAUST AND INTAKE DUCTS.
6. BOILER CIRCULATION PUMPS HWP-3 AND HWP-4 LOCATED IN VERTICAL RISER. SEE SCHEMATIC ON SHEET H-400.
7. PUMP TO BE MOUNTED ON INERTIA BASE.
8. FAN COIL UNIT SUPPORTED FORM OVERHEAD STRUCTURE WITH VIBRATION ISOLATORS.
9. FLOOR MOUNTED EQUIPMENT SHALL BE LOCATED ON 6" TALL CONCRETE HOUSEKEEPING PADS. REFER TO SHEET H400 FOR PIPING ARRANGEMENT.
10. PROVIDE TRAP AND EXTEND CONDENSATE AIR HANDLING UNIT FROM UNIT CONNECTION TO NEAREST FLOOR DRAIN AS SHOWN.
11. EXTEND OUTSIDE AIR DUCT FROM PLENUM BEHIND LOUVER TO UNIT CONNECTION.
12. PROVIDE CENTRIFUGAL TYPE AIR DIRT SEPARATOR.
13. PROVIDE COALESCING TYPE AIR DIRT SEPARATOR WITH MAGNET.
14. GAS FIRED HUMIDIFIER AIR INLET UP THROUGH ROOF. COORDINATE TERMINATION THROUGH ROOF WITH HUMIDIFIER MANUFACTURER. REFER TO MANUFACTURER'S RECOMMENDATIONS FOR CLEARANCES BETWEEN EXHAUST AND INTAKE DUCTS.
15. GAS FIRED HUMIDIFIER EXHAUST UP THROUGH ROOF. COORDINATE TERMINATION THROUGH ROOF WITH HUMIDIFIER MANUFACTURER.
16. PROVIDE DRAIN TEMPERING KIT EQUAL TO COOL DRAIN FLOW, INC. MODEL DTV120-SV WITH 3/4" DCW INLET, 1-1/4" ALL BRASS FITTINGS, AND INTEGRAL DOUBLE CHECK VALVE IN 1-1/4" DRAIN PIPING DROP. EXTEND DRAIN PIPING FROM TEMPERING KIT OUTLET INDIRECT TO FLOOR DRAIN IN THIS ROOM.
17. PROVIDE 4" CHILLED WATER MINIMUM FLOW BYPASS WITH 2-WAY MODULATING CONTROL VALVE. BALANCE TO 149 GPM.



ENLARGED MECHANICAL ROOM – WEST
SCALE: 1/4"=1'-0"



ENLARGED MECHANICAL ROOM – EAST
SCALE: 1/4"=1'-0"

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3/7/2025

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JOB NUM. 23357 | CHECKED BY | DRAWN BY JGA | DESIGNED BY J. AHMANN

H-130-23357.DWG

DESIGNED BY:	PEA
DRAWN BY:	PEA
CHECKED BY:	PEA

REVISIONS:	DATE:
ADDENDUM 02	04/01/25

VET TEACHING CENTER
HANOVER COLLEGE
4025 STATE ROUTE 56, HANOVER, IN 47243

ENLARGED MECHANICAL PLANS

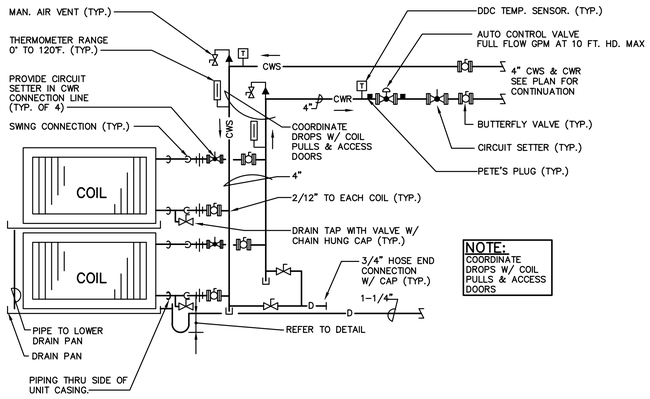
SCALE: As indicated

H-130

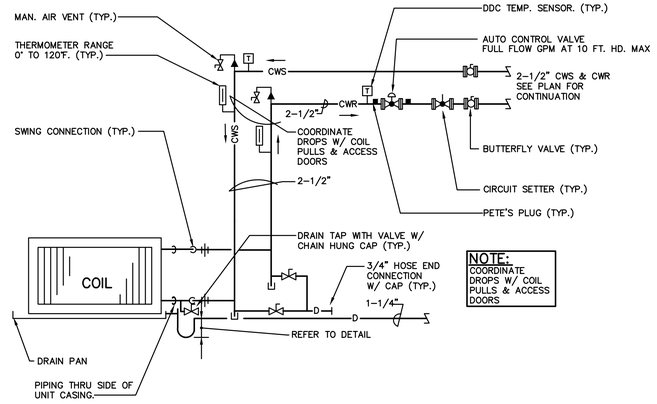
JOB NO.: 23009

DATE: 03.07.2025

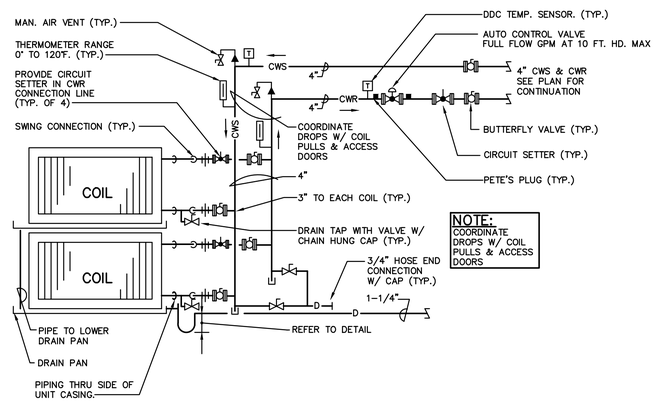
1/16" = 1'-0" 0 4' 8' 16' | 1/8" = 1'-0" 0 2' 4' 8' | 3/16" = 1'-0" 0 2' 4' 8' | 1/4" = 1'-0" 0 1' 2' 4' | 3/8" = 1'-0" 0 1' 2' 4' | 1/2" = 1'-0" 0 6" 1' 2' | 3/4" = 1'-0" 0 3" 6" 1' 2' | 1" = 1'-0" 0 3" 6" 1' 2' | 1 1/2" = 1'-0" 0 3" 6" 1' | 3" = 1'-0" 0 1" 2" 3" 6" 1' | 6" = 1'-0" 0 1" 2" 3" 6"



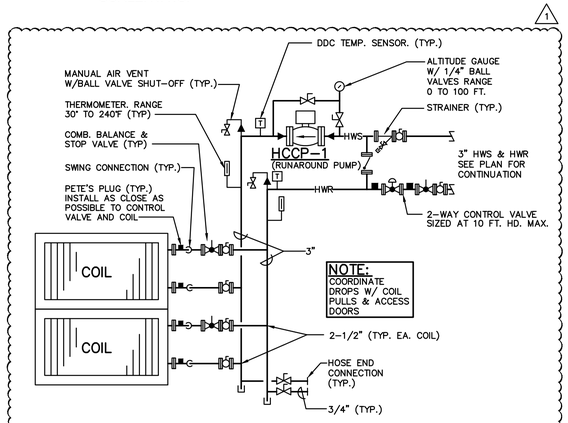
AHU–1 COOLING COIL PIPING DETAIL
SCALE: N.T.S.



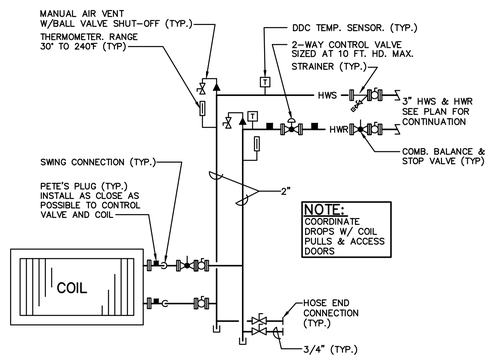
AHU–2 COOLING COIL PIPING DETAIL
SCALE: N.T.S.



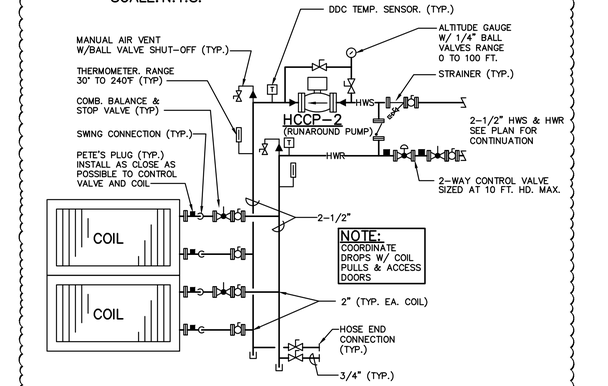
AHU–3 COOLING COIL PIPING DETAIL
SCALE: N.T.S.



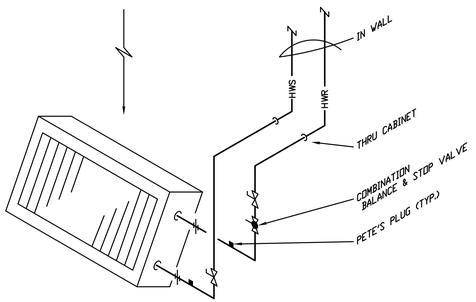
AHU–1 PREHEAT COIL PIPING DETAIL
SCALE: N.T.S.



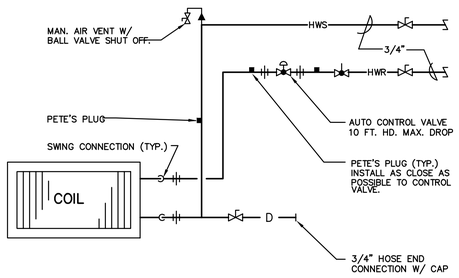
AHU–2 PREHEAT COIL PIPING DETAIL
SCALE: N.T.S.



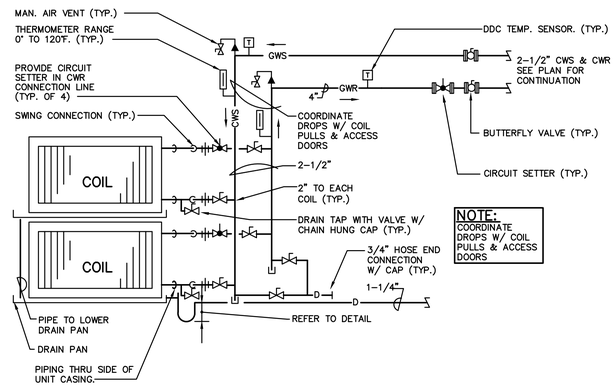
AHU–3 PREHEAT COIL PIPING DETAIL
SCALE: N.T.S.



CABINET UNIT HEATER PIPING
SCALE: N.T.S.



VAV/SAV REHEAT COIL PIPING
2 WAY CONTROL VALVE



AHU–3 HEAT RECOVERY COIL PIPING DETAIL
SCALE: N.T.S.

T.M. PRATER REGISTERED No. PE10302274 STATE OF OHIO
3/7/2025

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JOB NUM. 23357
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DRAWN BY JDA
DESIGNED BY J. AHMANN

H-402-23357.DWG

DESIGNED BY: PEA
DRAWN BY: PEA
CHECKED BY: PEA

REVISIONS: ADDENDUM 02 DATE: 04/01/25

VET TEACHING CENTER

HANOVER COLLEGE
4025 STATE ROUTE 56, HANOVER, IN 47243

HVAC DETAILS

SCALE: As indicated

H-402

JOB NO.: 23009

DATE: 03.07.2025

1/16" = 1'-0" 0 4' 8' 16'
1/8" = 1'-0" 0 2' 4' 8'
3/16" = 1'-0" 0 2' 4' 8'
1/4" = 1'-0" 0 1' 2' 4'
3/8" = 1'-0" 0 1' 2' 4'
1/2" = 1'-0" 0 6" 1' 2'
3/4" = 1'-0" 0 3" 6" 1' 2'
1" = 1'-0" 0 3" 6" 1' 2'
1 1/2" = 1'-0" 0 3" 6" 1'
3" = 1'-0" 0 1" 2" 3" 6" 1'
6" = 1'-0" 0 1" 2" 3" 6"

EQUIPMENT NOTES

DSS-1/DHP-1 & DSS-2/DHP-2

HIGHWALL DUCTLESS SPLIT HYPER-HEATING HEAT PUMP SYSTEM WITH DC INVERTER DRIVEN COMPRESSOR – MITSUBISHI MODEL TPKA0A0301KA70A INDOOR UNIT & MODEL TRUZA0301HA70NA OUTDOOR UNIT. 27,775.1 BTUH TOTAL COOLING CAPACITY, 20,128 BTUH SENSIBLE COOLING CAPACITY, 17,032 BTUH HEATING CAPACITY RANGE, 775 CFM (HIGH FAN SPEED) AIRFLOW, 19.8 SEER, 9.9 HSPF, 3.81 COP AT 47°F, 2.96 COP AT 17°F. CAPACITIES BASED ON 80°F/67°F DB/WB INDOOR EAT & 92°F OUTDOOR AMBIENT FOR COOLING, 70°F INDOOR EAT & -0.8°F OUTDOOR AMBIENT FOR HEATING. FURNISH WITH WND BAFFLE AND LOW AMBIENT CONTROLS, UNIT MOUNTED MICROPROCESSOR CONTROLS, AND BUILT-IN CONDENSATE LIFT MECHANISM. ALL CONTROLS SHALL BE UNIT MOUNTED. THIS SYSTEM WILL NOT HAVE A WALL MOUNTED THERMOSTAT / CONTROLLER. SYSTEM SHALL BE RATED FOR A VERTICAL HEIGHT DIFFERENCE OF 95 FT AND TOTAL PIPING LENGTH OF 165 FT BETWEEN INDOOR AND OUTDOOR UNITS (OUTDOOR UNIT ABOVE INDOOR UNIT). HVAC CONTRACTOR SHALL INSTALL ALL CONTROL & POWER WIRING BETWEEN THE INDOOR AND OUTDOOR UNITS. COORDINATE REQUIRED REFRIGERANT PIPE SIZES WITH THE UNIT MANUFACTURER BASED ON TOTAL VERTICAL RISE AND TOTAL EQUIVALENT PIPE LENGTH.

INDOOR UNIT: 208V/1ø/60HZ POWER, 1.0 MCA, POWERED FROM OUTDOOR UNIT.

OUTDOOR UNIT: 208V/1ø/60HZ POWER, 19 MCA, 26 MOCP, 0.40 FAN FLA.

AIR COOLED CHILLER – CHILLER-1 AND CHILLER-2

OUTDOOR AIR-COOLED CHILLER, TRANE MODEL CGAM 90, 85.35 TONS CAPACITY, 56°F ENTERING WATER TEMPERATURE, 44°F LEAVING WATER TEMPERATURE, 186.0 GPM WATER FLOW, 12.3 FT W.P.D., 0.0001 HR-SQFT-DEG-F/BTU FOULING FACTOR. CHILLER SHALL BE CHARGED TO 30% PROPYLENE GLYCOL. 208V, 3Ø POWER, 101.7 KW, 396A MCA, 500A MOP, ACROSS THE LINE COMPRESSOR STARTER. PROVIDE WITH "SUPER QUIET" SOUND ATTENUATION PACKAGE, LOW SOUND CONDENSER FANS, AND CONDENSER HAIL GUARDS. CHILLER EFFICIENCY TO HAVE MINIMUM EER OF 10.13 AND MINIMUM IPLV OF 16.23. FURNISH CHILLER WITH 2" DEFLECTION RESTRAINED SPRING VIBRATION ISOLATORS. ALL ALTERNATE CHILLERS SHALL MEET OR EXCEED THESE REQUIREMENTS TO BE ACCEPTABLE.

UNIT HEATER – UH-1

HOT WATER HORIZONTAL PROJECTION UNIT HEATER – STERLING MODEL HS-204, 14.9 GPM, 142.6 MBH, 160°F EWT, 60°F EAT, 2900 CFM, 1/3 HP FAN MOTOR, 120V, 1ø, 4.5 FLA, 15 MOCP. FURNISH W/ INTEGRAL THERMOSTAT & CEILING MOUNTING BRACKET W/ VIBRATION ISOLATORS.

AIR HANDLING UNIT SCHEDULE

MANUFACTURER'S MODEL NUMBER BASED ON TEMTROL UNLESS OTHERWISE NOTED.

FW – FAN WALL; MZ – MULTI-ZONE; H & A/C – HEATING AND AIR CONDITIONING; H & V – HEATING & VENTILATING; F.C. – FORWARD CURVED; A.F. – AIR FOIL; A.T.L. – ACROSS THE LINE; VAV – VARIABLE AIR VOLUME; VFD – VARIABLE FREQUENCY DRIVE

UNIT				SUPPLY FAN DATA					SUPPLY FAN MOTOR DATA					RETURN/EXH. FAN DATA					RETURN/EXH. FAN MOTOR DATA					GEN. INFORMATION			
UNIT NUMBER	LOCATION	MFGR & MODEL NUMBER	TYPE	CFM	TOTAL S.P. "W.G.	EXT. S.P. "W.G.	RPM	WHEEL QTY. & SIZE	MOTOR H.P.	B.H.P. REQ'D.	FLA	VOLTS / PHASE	TYPE MOTOR STARTING	CFM	TOTAL S.P. "W.G.	EXT. S.P. "W.G.	RPM	WHEEL QTY. & SIZE	MOTOR H.P.	B.H.P. REQ'D.	FLA	VOLTS / PHASE	TYPE MOTOR STARTING	FILTER EFFICIENCY (MERV)	FILTER AREA	MIN. O.A. CFM BASED ON CO2	MAX. O.A. CFM BASED ON CO2
AHU-1	MECH. ROOM	TEMTROL	VAV	13,500	5.87	2.25	3,024	(3)x16"	(3)x8.5	18.3	63.0	208 / 3	V.F.D.	13,200	4.11	2.0	2,610	(3)x16"	(3)x7.0	12.91	51.0	208 / 3	V.F.D.	PREFILTER: 8 FINAL: 14	27 SF 28 SF	100%	100%
AHU-2	MECH. ROOM	TEMTROL	VAV	7,500	4.42	1.75	2,690	(2)x16"	(2)x5.5	7.56	26.0	208 / 3	V.F.D.	6,750	0.58	0.5	1,012	(2)x20"	(2)x4.0	1.15	11.4	208 / 3	V.F.D.	PREFILTER: 8 FINAL: 14	16 SF	1,500	2,750
AHU-3	MECH. ROOM	TEMTROL	VAV	12,500	4.48	2.50	2,784	(4)x16"	(4)x4.5	13.93	44.0	208 / 3	V.F.D.	–	–	–	–	–	–	–	–	– / –	–	PREFILTER: 8 FINAL: 14	30 SF	100%	100%

UNIT	COOLING COIL DATA (COOLING COIL SELECTIONS BASED ON 44°F ENTERING FLUID (30% PROPYLENE GLYCOL) WITH A 12°F RISE.)											HEATING COIL DATA (2) HEATING COIL SELECTIONS BASED ON 160°F ENTERING WATER WITH A 30°F DROP.								REMARKS
									ENT. AIR TEMP.		LVG. AIR TEMP.								AIR TEMP.		
UNIT NUMBER	CFM	ROWS & FINS PER INCH	GPM	MIN. CONTROL VALVE CV	WTR. P.D. FT. HD.	AIR P.D. " W.G.	COIL F.A. SQ. FT.	SENS. CAP. MBH	TOTAL CAP. MBH	D.B. (°F)	W.B (°F)	D.B. (°F)	W.B (°F)	CFM	ROWS & FINS PER INCH	GPM	MIN. CONTROL VALVE CV	WTR. P.D. FT. HD.	AIR P.D. " W.G.	COIL F.A. SQ. FT.	HTG. CAP. MBH	ENT (°F)	LVG (°F)	
AHU-1	13,500	8 ROW 14 FPI	120.0	–	12.71	0.90	38.94	477.4	679.9	85.0	68.9	51.9	51.9	13,500	2 ROW 12 FPI	76.0	–	6.90	0.21	33.38	1,121.5	33.1	104.5	1 2 3 4 5 6 8 9 10 11
AHU-2	7,500	8 ROW 14 FPI	59.3	–	11.24	0.74	25.33	229.4	336.3	80.0	67.0	51.7	51.7	7,500	2 ROW 10 FPI	29.7	–	5.97	0.14	20.00	437.5	55.0	107.4	1 2 3 4 5 6 9 11
AHU-3	12,500	8 ROW 14 FPI	137.3	–	11.73	0.79	39.77	558.2	889.7	95.0	75.0	52.6	52.6	12,500	2 ROW 10 FPI	72.5	–	4.86	0.12	39.77	1,275.6	0	85.5	1 2 3 4 5 6 7 11 12

(1) UNIT MANUFACTURER SHALL FURNISH AND INSTALL A VAPOR TIGHT, LED, GUARDED, SERVICE LIGHT IN EACH SECTION HAVING AN ACCESS DOOR.
(2) UNIT TO HAVE AIRFLOW MONITORING STATIONS FOR OUTSIDE, RETURN AND SUPPLY AIR. SUPPLY AND RETURN AIR PIEZO MONITORING STATIONS AND TRANSDUCER SHALL BE PROVIDED BY UNIT MANUFACTURER. OUTSIDE AIR THERMAL DISPERSION MONITOR TO BE PROVIDED BY TEMPERATURE CONTROLS CONTRACTOR.
(3) UNIT TO BE MOUNTED ON MINIMUM 6" THICK CONCRETE PAD. THIS CONTRACTOR TO DETERMINE EXACT PAD THICKNESS BASED ON REQUIRED HEIGHT OF CONDENSATE TRAP AND EXISTING/NEW STRUCTURE HEIGHTS.
(4) PROVIDE CONVENIENCE OUTLET IN SUPPLY FAN SECTION
(5) COOLING COILS SIZED WITH 30% PROPYLENE GLYCOL SOLUTION
(6) ACCESS DOORS ON SUPPLY AIR PLENUM SHALL OPEN INWARD
(7) FURNISH WITH HUMIDIFIER SECTION.
(8) FURNISH WITH TOTAL ENTHALPY ENERGY RECOVERY WHEEL.
(9) FURNISH WITH 100% MODULATING ECONOMIZER. BAS SHALL STOP HEAT WHEEL DURING ECONOMIZER.
(10) FURNISH WITH RETURN AIR DAMPER FOR UNOCCUPIED RECIRCULATION MODE.
(11) FURNISH WITH UV LIGHT SECTION.
(12) FURNISH WITH HEAT RECOVERY COIL. 8 ROWS, 10 FPI, 30 GPM

STEAM HUMIDIFIER SCHEDULE

UNIT	MODEL NO.	GAS INPUT (MBH)	CAPACITY (STEAM OUTPUT)	VOLTS / PHASE	AMPS	MOCP	ASSOCIATED AHU	DISPERSION TUBES	ABSORPTION DISTANCE (FT)	REMARKS
H-01	GS 450-CS	558	356 #/HR	120 / 1	7.0	15	AHU-3	SAM-e SHORT ABSORPTION MANIFOLD	0.69	1 2 3 4 5 6
H-02	EL-075	ELECTRIC	56 #/HR	208 / 3	77.9	100	AHU-1 (SURGERY)	SAM-e SHORT ABSORPTION MANIFOLD	1.74	1 3 4 5 6

(1) HUMIDIFIER BASED ON CONDAIR (2) COORDINATE MANIFOLD SIZE WITH WITH AHU MANUFACTURER. (3) PROVIDE ADDITIONAL SUPPORTS FOR DUCT MOUNTED MANIFOLD PER MANUFACTURERS RECOMMENDATIONS.
(4) FURNISH WITH MODULATING CONTROLLER (5) ROOM HUMIDITY SETPOINT SHALL BE 35% RH (ADJUSTABLE) (6) FURNISH WITH FIELD MOUNTED HIGH HUMIDITY LIMIT SENSOR

AHU HEAT RECOVERY WHEEL SCHEDULE

UNIT NUMBER	SIZE	OUTSIDE AIR CFM	EXHAUST AIR CFM	SUMMER CONDITIONS							WINTER CONDITIONS						HEAT WHEEL MOTOR DATA			
				OUTSIDE AIR					EXH. AIR		OUTSIDE AIR					EXH. AIR				
				ENT. TEMP.		LVG. TEMP.		AIR P.D. " W.G.	ENT TEMP		ENT. TEMP.		LVG. TEMP.		AIR P.D. " W.G.	ENT TEMP (°F)	HP	FLA AMPS	VOLTS / PHASE	REMARKS
				D.B.(°F)	W.B(°F)	D.B.(°F)	W.B(°F)		D.B.(°F)	W.B(°F)	D.B.(°F)	W.B(°F)	D.B.(°F)	W.B(°F)						
AHU-1	78"	13,670	13,370	95.0	75.0	84.9	69.4	1.05	75.0	62.5	0.0	-1.0	31.3	27.8	1.10	70.0	0.5	2.1	208 / 3	1 2 3 4

(1) FURNISH WITH ONE EXTRA SET OF BELTS FOR ATTIC STOCK. (2) FURNISH WHEEL MOTOR WITH VFD. (3) BAS SHALL MODULATE WHEEL SPEED FOR FROST PREVENTION. (4) ENERGY RECOVERY WHEEL SHALL HAVE SEGMENTED CONSTRUCTION.

PUMP SCHEDULE

MANUFACTURER'S MODEL NUMBER BASED ON BELL & GOSSETT UNLESS OTHERWISE NOTED.
KEY: CC-CLOSE COUPLED END SUCTION; F.C.-FLEXIBLE COUPLED END SUCTION; A.T.L.-ACROSS THE LINE H.S.C.-FLEXIBLE COUPLED HORIZONTAL SPLIT CASE; I.L.-IN LINE; V.F.D-VARIABLE FREQUENCY DRIVE

NOTE: ALL PUMPS ARE 1750 RPM UNLESS OTHERWISE NOTED.

PUMP NO.	FUNCTION	LOCATION	MFGR. MODEL NUMBER	TYPE	GPM	FT. HD.	EFF. %	SUCT. SIZE	DISCH. SIZE	MOTOR H.P.	BHP REQ'D.	VOLT / PHASE	TYPE MOTOR STARTING	REMARKS
CWP-1	CHILLED WATER PUMP	MECHANICAL ROOM	e-1510 3EB	F.C.	372	80	74	4"	3"	15	10.5	208 / 3	V.F.D.	OPERATING (1)
CWP-2	CHILLED WATER PUMP	MECHANICAL ROOM	e-1510 3EB	F.C.	372	80	74	4"	3"	15	10.5	208 / 3	V.F.D.	STANDBY (1)
HWP-1	HEATING WATER HEATING	MECHANICAL ROOM	E-1510 2EB	F.C.	192	75	71.3	3"	2"	7.5	5.08	208 / 3	V.F.D.	LEAD (1) (3)
HWP-2	HEATING WATER HEATING	MECHANICAL ROOM	E-1510 2EB	F.C.	192	75	71.3	3"	2"	7.5	5.08	208 / 3	V.F.D.	LAG (1) (3)
GWP-1	GLYCOL WATER PUMP	MECHANICAL ROOM	e-80 1.5x1.5x9.5B	I.L.	60	40	45.5	1 1/2"	1 1/2"	3	1.36	208 / 3	A.T.L.	OPERATING (2)
GWP-2	GLYCOL WATER PUMP	MECHANICAL ROOM	e-80 1.5x1.5x9.5B	I.L.	60	40	45.5	1 1/2"	1 1/2"	3	1.36	208 / 3	A.T.L.	STANDBY (2)
1 HCCP-1	RUNAROUND PUMP (AHU-1)	MECHANICAL ROOM	e-90 1.5AB	I.L.	76	25	56.4	1 1/2"	1 1/2"	1.5	0.939	208 / 3	A.T.L.	(3)
HCCP-2	RUNAROUND PUMP (AHU-3)	MECHANICAL ROOM	e-90 1.5AB	I.L.	72.5	25	56.1	1 1/2"	1 1/2"	1.5	0.857	208 / 3	A.T.L.	(3)

(1) START/STOP/SPEED CONTROL BY BAS. (2) START/STOP BY BAS. (3) START/STOP BY BAS. PUMP SHALL RUN ON ANY CALL FOR HEATING OR WHENEVER OUTDOOR AIR TEMPERATURE IS BELOW 35°F.

LOUVER SCHEDULE

MANUFACTURER'S MODEL NUMBER BASED ON GREENHECK UNLESS OTHERWISE NOTED.

UNIT NO.	MODEL NUMBER	LOCATION	WIDTH (INCHES)	HEIGHT (INCHES)	DEPTH (INCHES)	FREE AREA (SF)	REMARKS
L-1	ESD-635	MECH ROOM 182	78	66	6	21.98	(1) (2)
L-2	ESD-635	MECH ROOM 182	78	66	6	21.98	(1) (2)

(1) OPENING IN WALL BY G.C. (2) PROVIDE WITH KYNAR FINISH. COLOR SELECTION BY ARCHITECT.

HEAT RECOVERY COIL SCHEDULE

UNIT NUMBER	SIZE (HxL)	OUTSIDE AIR CFM	EXHAUST AIR CFM	ROWS	FPI	GPM	FLUID PRESSURE DROP (FT HEAD.)	SUMMER CONDITIONS								WINTER CONDITIONS								REMARKS
								OUTSIDE AIR					EXH. AIR		GLYCOL		OUTSIDE AIR					EXH. AIR	GLYCOL		
								ENT. TEMP.		LVG. TEMP.		AIR P.D. " W.G.	ENT TEMP		EWT	LWT	ENT. TEMP.		LVG. TEMP.		AIR P.D. " W.G.	ENT TEMP(°F)	EWT	LWT	
								D.B.(°F)	W.B(°F)	D.B.(°F)	W.B(°F)		D.B.(°F)	W.B(°F)	(°F)	(°F)	D.B.(°F)	W.B(°F)	D.B.(°F)	W.B(°F)			(°F)	(°F)	
AHU-1	34.5x83	12,500	–	8	14	50	7.6	95.0	75.0	85.1	72.3	0.55	–	–	84.0	89.5	0.0	-1.0	26.7	19.6	0.74	–	39.0	21.4	(1)
EF-1/2	(2) ø 45x60	–	11,550	6	10	50	15.1	–	–	–	–	0.43	75	62.5	90.0	83.0	–	–	–	–	0.43	72	21.0	40.0	(1)

(1) COILS SIZED WITH 30% PROPYLENE GLYCOL AS THE HEAT TRANSFER FLUID.

ELECTRIC CABINET UNIT HEATER SCHEDULE

MANUFACTURER'S MODEL NUMBER BASED ON TRANE UNLESS OTHERWISE NOTED.

UNIT NO.	FRAME TYPE	MFGR. MODEL NUMBER	KW	MBH	AMPS	VOLT / PHASE	REMARKS
CUH-1	SURFACE MOUNTED	UHWA-053	5.0	17.1	13.9	208 / 3	(1) (2)
CUH-2	SURFACE MOUNTED	UHWA-053	5.0	17.1	13.9	208 / 3	(1) (2)
CUH-3	SURFACE MOUNTED	UHWA-053	5.0	17.1	13.9	208 / 3	(1) (2)
CUH-4	SURFACE MOUNTED	UHWA-053	5.0	17.1	13.9	208 / 3	(1) (2)
CUH-5	SURFACE MOUNTED	UHWA-053	5.0	17.1	13.9	208 / 3	(1) (2)

(1) FURNISH WITH INTEGRAL THERMOSTAT AND TAMPER RESISTANT COVER. (2) FURNISH WITH CIRCUIT BREAKER.

AIR TERMINAL SCHEDULE

ROUND AND SQUARE DIFFUSERS: TYPE OF OUTLET → A – 8 – 300 ← AIR QUANTITY IN C.F.M. (DIFF. & REG. ONLY)
SIZE OF OUTLET (NECK SIZE DIAMETER FOR DIFFUSERS)
ARCHITECT SHALL SELECT AIR DEVICE COLOR.

LINEAR DIFFUSERS: TYPE OF OUTLET → C4 – 300 ← AIR QUANTITY IN C.F.M. (DIFF. & REG. ONLY)
NUMBER OF SLOTS

TYPE	DESCRIPTION
A	SUPPLY AIR DIFFUSER, LAY-IN, 24"x24", PRICE MODEL SCDA: DIFFUSERS SHALL HAVE ADJUSTABLE HORIZONTAL-TO-VERTICAL PATTERN WITH EQUALIZING GRID
B	RETURN/EXHAUST AIR GRILLE, LAY-IN, PRICE MODEL 530: 24"x12" UNLESS OTHERWISE NOTED. FURNISH WITH BLADES PARALLEL TO "LONG" DIMENSION.
C	LINEAR SUPPLY AIR DIFFUSER, LAY-IN, PRICE MODEL SDS75, 3/4" SLOTS, 4'-0" LONG UNLESS OTHERWISE NOTED. FURNISH W/ MODEL UP INSULATED PLENUM W/ INLET CONNECTION SIZE EQUAL TO BRANCH DUCT SIZE.
D	SUPPLY AIR DIFFUSER, SURFACE MOUNTED, 24"x24", PRICE MODEL SCDA: DIFFUSERS SHALL HAVE ADJUSTABLE HORIZONTAL-TO-VERTICAL PATTERN WITH EQUALIZING GRID
E	SUPPLY AIR DIFFUSER, SURFACE MOUNTED, 12"x12", PRICE MODEL SCDA: DIFFUSERS SHALL HAVE ADJUSTABLE HORIZONTAL-TO-VERTICAL PATTERN WITH EQUALIZING GRID. FURNISH WITH MODEL AMF ALUMINUM MOUNTING FRAME.
F	VERTICAL LAMINAR FLOW DIFFUSER, SURFACE MOUNTED, 48"x24" UNLESS OTHERWISE NOTED, PRICE MODEL LFD: FURNISH WITH 4.75" DEEP STAINLESS STEEL PLENUM AND STAINLESS STEEL FACE. FURNISH WITH HOSPITAL GRADE MOUNTING FRAME.
G	HEAVY DUTY RETURN AIR GRILLE, PRICE MODEL 93: FURNISH WITH HORIZONTAL BLADES, 1/2" BLADE SPACING, AND 45° DEFLECTION. REFER TO FLOOR PLANS FOR SIZES.

NOTES: 1. PROVIDE A SHEET METAL PLENUM ABOVE/BEHIND EACH DUCTED GRILLE OR REGISTER FOR MAKING A CONNECTION TO THE BRANCH DUCT. PAINT THE INSIDE OF ALL UNLINED PLENUMS FLAT BLACK.
2. COORDINATE THE GRID FACE DIMENSION OF ALL LAY-IN TYPE CEILING SUSPENSION SYSTEMS WITH THE GENERAL CONTRACTOR. PROVIDE NARROW TEE TYPE DEVICES WHERE REQUIRED.

T.M. PRATER REGISTERED No. PE10302274 STATE OF OHIO PROFESSIONAL ENGINEER
3/7/2025

PRATER Engineering Associates, Inc.
6130 Wilcox Road
Dublin, Ohio 43016
(614) 766 4896
praterengineering.com

JOB NUM. 23357 | CHECKED BY | DRAWN BY JGA | DESIGNED BY J. AHMANN

H-500-23357.DWG

DESIGNED BY: PEA
DRAWN BY: PEA
CHECKED BY: PEA

DATE: 04/01/25
REVISIONS: ADDENDUM 02

VET TEACHING CENTER
HANOVER COLLEGE
4025 STATE ROUTE 56, HANOVER, IN 47243

HVAC SCHEDULES

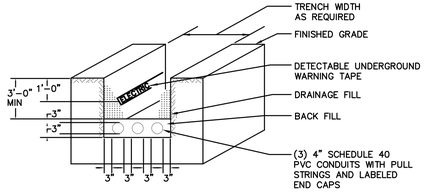
SCALE: As indicated

H-500

JOB NO.: 23009

DATE: 03.07.2025

1/16" = 1'-0" 0 4' 8' 16'
1/8" = 1'-0" 0 2' 4' 8'
3/16" = 1'-0" 0 2' 4' 8'
1/4" = 1'-0" 0 1' 2' 4'
3/8" = 1'-0" 0 1' 2' 4'
1/2" = 1'-0" 0 6" 1' 2'
3/4" = 1'-0" 0 3" 6" 1' 2'
1" = 1'-0" 0 3" 6" 1' 2'
1 1/2" = 1'-0" 0 3" 6" 1'
3" = 1'-0" 0 1" 2" 3" 6" 1'
6" = 1'-0" 0 1" 2" 3" 6"

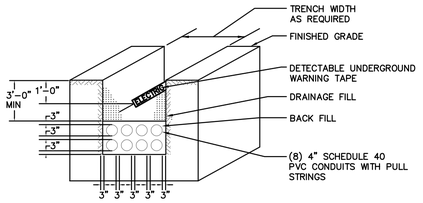


PRIMARY DUCT BANK DETAIL

A E-000

SCALE: NONE

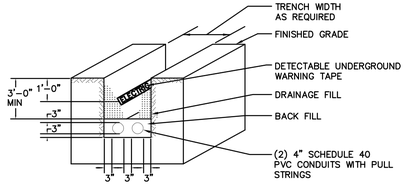
EC TO PROVIDE UNDER OWNER'S PAVED SURFACES ONLY. ALL OTHER PRIMARY DUCT BY POWER COMPANY.



SECONDARY DUCT BANK DETAIL

B E-000

SCALE: NONE



COMMUNICATIONS DUCT BANK DETAIL

C E-000

SCALE: NONE

CODED NOTES

1. PROVIDE AN 8'-0" X 8'-0" (NOMINAL) CONCRETE TRANSFORMER PAD PER POWER COMPANY'S SPECIFICATIONS. REFER TO DUKE ENERGY CUSTOMER-INSTALLED TRANSFORMER PAD DETAIL, SHEET E-501, AND VERIFY ALL FINAL REQUIREMENTS PRIOR TO WORK.
2. POWER COMPANY TO MOUNT METER ON SIDE OF TRANSFORMER, SHOWN FOR REFERENCE ONLY.
3. PROVIDE NATURAL GAS GENERATOR PER SPECIFICATIONS. PROVIDE REINFORCED CONCRETE PAD CONSTRUCTED PER MANUFACTURER'S RECOMMENDATIONS. FIELD COORDINATE WITH PLUMBING CONTRACTOR FOR NATURAL GAS LINE SHUT-OFF SEPARATE FROM BUILDING NATURAL GAS LINE, AND PROVIDE CLEAR LABELING DELINEATING THE TWO. UNDER BASE BID, PROVIDE ONLY 1 GENERATOR AS NOTED ABOVE. UNDER ALTERNATE, PROVIDE BOTH. REFER TO ONE-LINE DIAGRAM FOR ADDITIONAL INFORMATION.
4. INTERCEPT UNDERGROUND DUCTS STUBBED BY COLLEGE NEAR PROPERTY LINE AND EXTEND TO MAIN TELECOMMUNICATIONS BACKBOARD. UTILIZE LONG SWEEP BENDS AT ALL TURNS.
5. UNDER ALTERNATE WORK ONLY, PROVIDE TWO (2) DEDICATED 208V-1ø, 40A BRANCH CIRCUITS TO DUAL-PORT ELECTRIC VEHICLE CHARGING STATION PER MANUFACTURER'S INSTRUCTIONS. PROVIDE CHARGEPOINT CT4023-GW1 BOLLARD MOUNTED CHARGER WITH CELLULAR GATEWAY MODULE, OR EQUAL. UNDER BASE BID ONLY, PROVIDE TWO (2) DEDICATED 1" CONDUITS WITH PULL STRING FROM SOURCE PANEL TO FUTURE DUAL-PORT ELECTRIC VEHICLE CHARGING STATION LOCATION. TERMINATE CONDUITS IN 18"X24" FLUSH IN-GRADE PULL BOX. LABEL BOTH ENDS "FUTURE EV CHARGING STATION".
6. PROVIDE AN RV STYLE, UNMETERED POWER PEDESTAL EQUAL TO MILBANK #U5953-o-55, 120/240V-ø, 100A BUS, NEMA-3R, DIRECT BURIAL, WITH THE FOLLOWING NEMA RECEPTACLE AND BREAKER CONFIGURATIONS:
   (1) 14-50R 50A/2P
   (1) 5-20R GFCI 20A/1P
   INSTALL IN CROSS-HATCHED PARKING SURFACE WITH PAD ANCHORS PER MANUFACTURER'S RECOMMENDATIONS. SEE ONE-LINE DIAGRAM FOR FEEDER.
7. PROVIDE A DEDICATED 20 AMP, 120V BRANCH CIRCUIT WITH 2-#8 & #8 GROUND IN 1" CONDUIT TO BLUE LIGHT EMERGENCY CALL STATION, PROVIDED BY COLLEGE. PROVIDE 1" COMMUNICATION CONDUIT WITH PULL STRING BACK TO MAIN TELECOMMUNICATION BACKBOARD. LABEL BOTH ENDS "EMERGENCY CALL STATION".
8. FIELD-AIM FIXTURES TO ILLUMINATE MONUMENT SIGNAGE. FIELD COORDINATE FINAL FIXTURE PLACEMENT WITH SURROUNDING LANDSCAPING TO AVOID BLOCKAGE OF LIGHT BEAM.
9. PROVIDE FIRE ALARM DEVICE INSIDE FIRE SERVICE METER VAULT. REFER TO CIVIL SHEETS C601 AND C703 FOR ADDITIONAL INFORMATION.
10. PROVIDE 120V CONNECTION TO CONTROL PANEL OF PACKAGED SANITARY LIFT STATION, 3HP, 208V-3ø, 19.6 AMPS. REFER TO CIVIL SHEET C601 FOR ADDITIONAL INFORMATION.
11. ROUTE EXTERIOR LIGHTING BRANCH CIRCUIT THROUGH EXTERIOR LIGHTING CONTROL. SEE EXTERIOR LIGHTING CONTROL DIAGRAM, SHEET E5.00.
12. (B) IF GENERATOR ALTERNATE DESCRIBED IN CODED NOTE 3 IS NOT ACCEPTED, PROVIDE 18"X24" FLUSH IN GRADE PULL BOX TO HOUSE CONDUIT STUBS FOR FUTURE GENERATOR UNDER BASE BID. ROUTE THE FOLLOWING CONDUITS WITH PULL STRING TO PULL BOX, CAP, AND LABEL BOTH ENDS:
   -STANDBY POWER CONDUIT(S) FROM MAIN ELEC ROOM (SEE ONE-LINE)
   -EMERGENCY CONDUIT(S) FROM MAIN ELEC ROOM (SEE ONE-LINE)
   -(4) 1" CONTROL AND SYNC WIRING BETWEEN GENERATORS
   -(2) 1" JACKET HEATER AND BATTERY CHARGER FROM PANEL SB1

GENERAL NOTES

A. COORDINATE WITH THE SITE CIVIL ENGINEERING DRAWINGS AND ALL UTILITY COMPANIES PRIOR TO BIDDING. THE ELECTRICAL SITE PLAN IS DIAGRAMMATIC ONLY AND REPRESENTS GENERAL LOCATIONS OF EQUIPMENT AND UTILITY SPECIFICATIONS. THE SEPARATE UTILITY COMPANIES SHALL PROVIDE DETAILED SPECIFICATIONS AND EQUIPMENT SIZES UPON REQUEST.

UTILITY COMPANIES:
ELECTRIC: DUKE ENERGY
CONTACT: JOSH LICHLYTER, (812) 292-4256

B. THE SITE ELECTRICAL PLAN DOES NOT SHOW ALL EXISTING UTILITIES, OR EXISTING UNDERGROUND EQUIPMENT, OR NEW UNDERGROUND SERVICES. THIS CONTRACTOR SHALL COORDINATE WITH ALL TRADES AND EXISTING CONDITIONS PRIOR TO THE START OF WORK. PRIOR TO EXCAVATING, LOCATE ALL UNDERGROUND SERVICES AND CLEARLY INDICATE LOCATIONS.

C. REFER TO STRUCTURAL DRAWINGS AND FIELD COORDINATE FINAL ROUTING OF ALL CONDUITS UNDER BUILDING WITH BUILDING FOOTINGS, CANOPY/SCREENWALL FOOTINGS AND FOUNDATIONS, ETC.

D. UNDERGROUND LIGHTING BRANCH CIRCUITS BETWEEN LUMINAIRES SHALL BE A MINIMUM OF 2-#10 AND 1-#10 GROUND IN 1" CONDUIT. LIGHTING BRANCH CIRCUIT HOME RUNS TO BE 2-#8 AND 1#8 GROUND IN 1" CONDUIT. PROVIDE MINIMUM BURIAL DEPTH AS REQUIRED IN NEC TABLE 300.5, COLUMN 3.

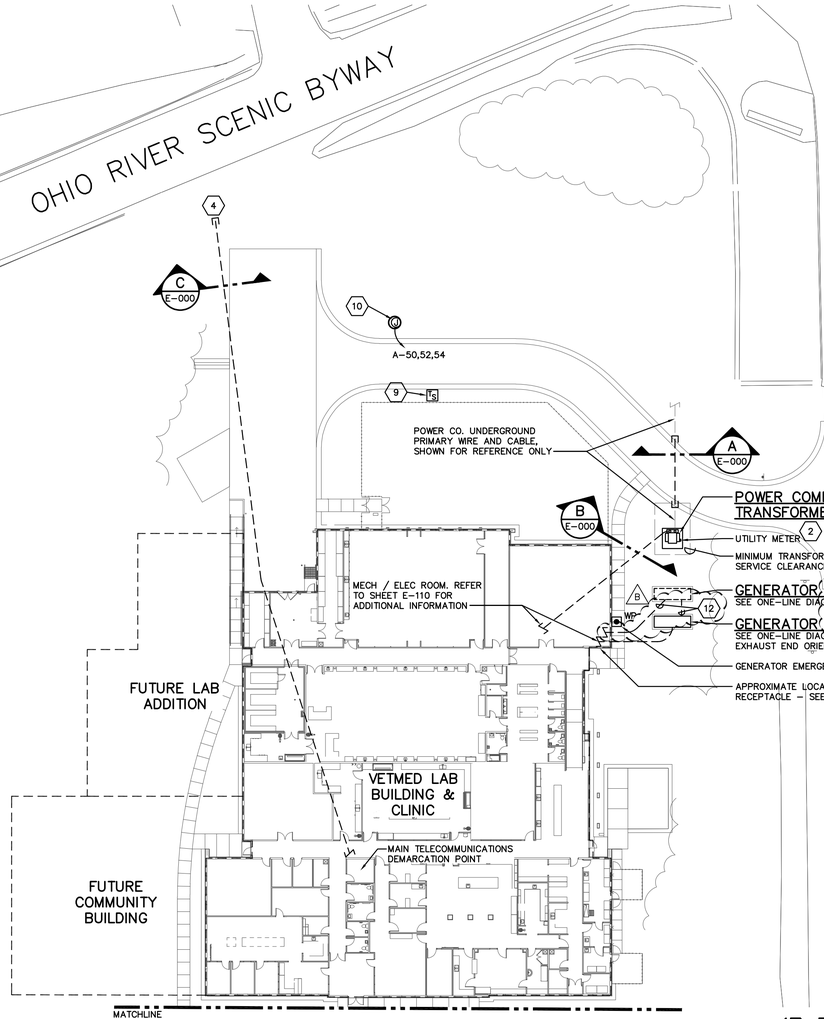
E. PROVIDE GRADE-LEVEL PULL BOXES AS NECESSARY PER THE SPECIFICATIONS AND IN-GROUND BOX DETAIL, SHEET E-501. THIS CONTRACTOR SHALL SIZE BOX AS REQUIRED PER NEC 314.28.

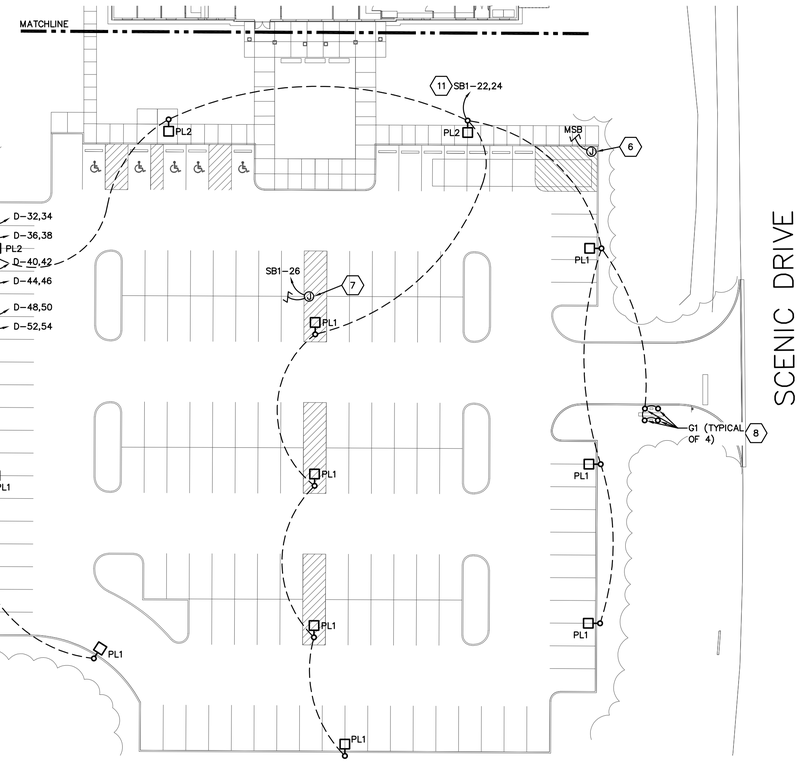
F. POWER COMPANY SHALL PROVIDE ALL PRIMARY VOLTAGE CONDUIT AND CONDUCTORS, AND ALL SECONDARY VOLTAGE CONDUCTORS TO CT CABINET. POWER COMPANY PROVIDES CT CABINET. THIS CONTRACTOR SHALL PROVIDE ALL PRIMARY SLEEVES UNDER PAVED SURFACES, ALL SECONDARY CONDUITS AND SECONDARY CONDUCTORS FROM CT CABINET TO MAIN DISTRIBUTION PANEL AS SCHEDULED.

G. PROVIDE A 2'X4' WOODEN STAKE AT EACH CONDUIT SLEEVE ENDPOINT (DUCT BANK "A") TO ASSIST POWER COMPANY IN LOCATING FOR THEIR PRIMARY CABLE PULL. STAKE SHALL BE BURIED MINIMUM OF 2'-0" BELOW FINISHED GRADE AND EXTEND 3'-0" MINIMUM ABOVE FINISHED GRADE AND BE LABELED "DUKE".

I. SEE SHEETS E100 AND E101 FOR ALL BUILDING-MOUNTED EXTERIOR LIGHTING.

J. ELECTRICAL SERVICE FOR FUTURE BEAN FIELD DEVELOPMENT TO BE PROVIDED AT THE TIME OF THAT PROJECT.





SITE ELECTRICAL PLAN

SCALE: 1"=30'-0"

DOUGLAS L. POWELL REGISTERED No. PE11900479 STATE OF INDIANA PROFESSIONAL ENGINEER

3/7/2025

PRATER Engineering Associates, Inc.
6130 Wilcox Road
Dublin, Ohio 43016
(614) 766 4896
praterengineering.com

JOB NUM. 23357
DESIGNED BY D. STAFFORD
DRAWN BY D. STAFFORD
CHECKED BY D. POWELL

E-000-23357.DWG

DESIGNED BY:	PEA
DRAWN BY:	PEA
CHECKED BY:	PEA

REVISIONS:	DATE:
ADDENDUM 02	04/01/25

VET TEACHING CENTER
HANOVER COLLEGE
4025 STATE ROUTE 56, HANOVER, IN 47243

SITE ELECTRICAL PLAN

SCALE: As indicated

E-000

JOB NO.: 23009

DATE: 03.07.2025

1/16" = 1'-0" 0 4' 8' 16'
1/8" = 1'-0" 0 2' 4' 8'
3/16" = 1'-0" 0 2' 4' 8'
1/4" = 1'-0" 0 1' 2' 4'
3/8" = 1'-0" 0 1' 2' 4'
1/2" = 1'-0" 0 6" 1' 2'
3/4" = 1'-0" 0 3" 6" 1' 2'
1" = 1'-0" 0 3" 6" 1' 2'
1 1/2" = 1'-0" 0 3" 6" 1'
3" = 1'-0" 0 1" 2" 3" 6" 1'
6" = 1'-0" 0 1" 2" 3" 6"

GENERAL NOTES

A. DEVICES LABELED WITH AN "A" SHALL BE MOUNTED ABOVE COUNTERTOP/ BACKSPLASH. FIELD COORDINATE EXACT MOUNTING HEIGHT WITH CONDITIONS PRIOR TO ROUGH-IN.

B. ALL RECEPTACLES MOUNTED ABOVE COUNTERTOPS AND LOCATED WITHIN SIX (6) FEET OF A SINK SHALL BE GROUND FAULT CIRCUIT INTERRUPTER (GFCI) TYPE RECEPTACLES. ALL RECEPTACLES IN BREAK ROOMS, KITCHENETTES, ETC. SHALL BE GFCI PROTECTED. RECEPTACLES WHICH ARE NOT READILY ACCESSIBLE AND REQUIRE GFCI PROTECTION SHALL BE SO AT THE CIRCUIT BREAKER.

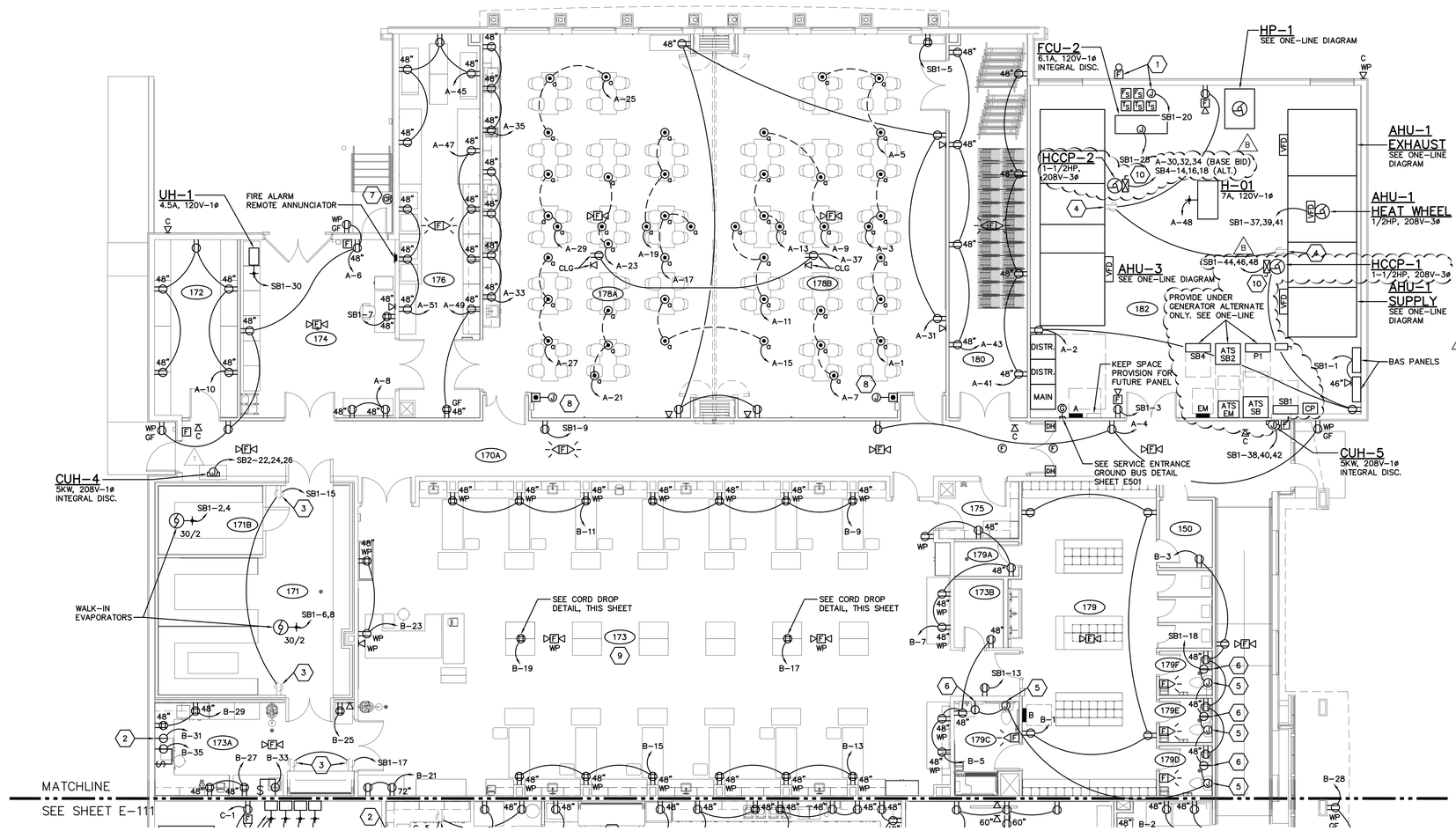
C. RECEPTACLES NOTED AT 48" ADJACENT TO STRIKE SIDE OF ENTRY DOOR (UTILITY, STORAGE, ETC.) SHALL BE GANGED WITH LIGHT SWITCH UNDER 1 COMMON WALL PLATE. REFER TO RESPECTIVE LIGHTING PLAN FOR SWITCH LOCATIONS.

D. RECEPTACLES DESIGNATED AS WEATHERPROOF IN BUILDING INTERIOR SHALL HAVE FLIP STYLE NOT-IN-USE COVERS SIMILAR TO HUBBELL WP26.

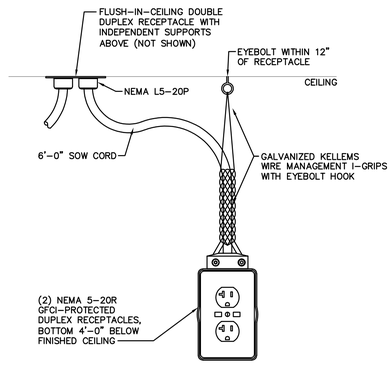
E. LOCATIONS OF MECHANICAL EQUIPMENT CONNECTIONS AND DEVICES ARE DIAGRAMMATIC ONLY. FIELD COORDINATE WITH THE RESPECTIVE CONTRACTORS FOR EXACT LOCATIONS.

CODED NOTES ⬡

1. PROVIDE 120V CONNECTION TO FIRE PROTECTION MASTER FLOW SWITCH AND WIRE COMPLETE TO FP ALARM BELL PER MANUFACTURER'S RECOMMENDATIONS.
2. MOUNT RECEPTACLE FLUSH IN BASE CABINET FOR UNDERCOUNTER EQUIPMENT IN ACCESSIBLE LOCATION ADJACENT TO EQUIPMENT TO ALLOW DISCONNECTION BEFORE REMOVAL OF EQUIPMENT.
3. LIGHT LINE WEIGHT OF RECEPTACLE INDICATES INTEGRAL DEVICE FURNISHED WITH EQUIPMENT, WIRED BY E.C. PROVIDE ALL CONCEALED BRANCH CIRCUITRY WITHIN EQUIPMENT PER MANUFACTURER'S RECOMMENDATIONS, AND CONTINUE CONCEALED BACK TO SOURCE PANEL.
4. AHU SERVICE RECEPTACLE FURNISHED WITH EQUIPMENT WIRED BY THIS CONTRACTOR PER MANUFACTURER'S DETAILS. EXTEND CIRCUIT TO INTERNAL LIGHTING AND SWITCH (OMITTED FOR DRAWING CLARITY). FIELD COORDINATE EXACT DEVICE LOCATIONS.
5. PROVIDE 120V CONNECTION TO TRANSFORMER FURNISHED BY PLUMBING CONTRACTOR FOR AUTOMATIC FLUSH VALVE SENSOR(S). FIELD COORDINATE FINAL LOCATION OF TRANSFORMER IN ACCESSIBLE BUT INCONSPICUOUS LOCATION, AND PROVIDE CONCEALED CONDUITS FROM TRANSFORMER TO RESPECTIVE PLUMBING FIXTURES. ALL LOW VOLTAGE WIRING AND CONNECTIONS BY P.C.
6. PROVIDE SIMPLEX RECEPTACLE BELOW SINK FOR AUTOMATIC SENSOR AC ADAPTER. FIELD COORDINATE FINAL LOCATION TO REMAIN FULLY ACCESSIBLE BUT INCONSPICUOUS FROM VIEW.
7. PROVIDE DEDICATED 1" CONDUIT WITH PULL STRING FROM IT ROOM 113 TO DOOR ACCESS CONTROL READER OUTLET BOX. FIELD VERIFY FINAL OUTLET BOX HEIGHT AND LOCATION. ALL ACCESS CONTROL DEVICES AND WIRING PROVIDED BY THE OWNER.
8. PROVIDE 120V CONNECTION TO MOTORIZED CEILING-RECESSED PROJECTION SCREEN AND ASSOCIATED WALL CONTROL DEVICE. FIELD COORDINATE FINAL LOCATIONS PRIOR TO WORK.
9. ALL POWER AND DATA DEVICES IN THIS ROOM SHALL HAVE FLIP STYLE, DIE CAST ALUMINUM, WEATHERPROOF NOT-IN-USE COVER PLATES WITH NEOPRENE GASKET.
10. PROVIDE A HP-RATED COMBINATION MAGNETIC MOTOR STARTER WITH 30 AMP DISCONNECT SWITCH, NEMA SIZE 00 WITH TWO NORMALLY OPEN AND TWO NORMALLY CLOSED AUXILIARY DRY CONTACTS, 1-1/2HP RATED OVERLOADS, HAND/OFF/AUTO SELECTOR SWITCH WITH PILOT LIGHT, AND 24V CONTROL TRANSFORMER. PUMPS SHALL BE CONTROLLED BY BAS VIA LOW VOLTAGE WIRING PROVIDED BY H.C.



FIRST FLOOR POWER PLAN – NORTH
SCALE: 1/8"=1'-0"



CORD DROP DETAIL
SCALE: NONE
PROVIDE ONE COMPLETE ASSEMBLY PER EACH RECEPTACLE IN THE DOUBLE DUPLEX CONFIGURATION

DOUGLAS L. POWELL REGISTERED No. PE11900479 STATE OF INDIANA PROFESSIONAL ENGINEER
3/7/2025

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JOB NUM. 23357 | CHECKED BY D. POWELL | DRAWN BY D. STAFFORD | DESIGNED BY D. STAFFORD

E-110-23357.DWG

DESIGNED BY:	PEA
DRAWN BY:	PEA
CHECKED BY:	PEA

REVISIONS:	DATE:
ADDENDUM 02	04/01/25

VET TEACHING CENTER
HANOVER COLLEGE
4025 STATE ROUTE 56, HANOVER, IN 47243

FIRST FLOOR POWER PLAN NORTH

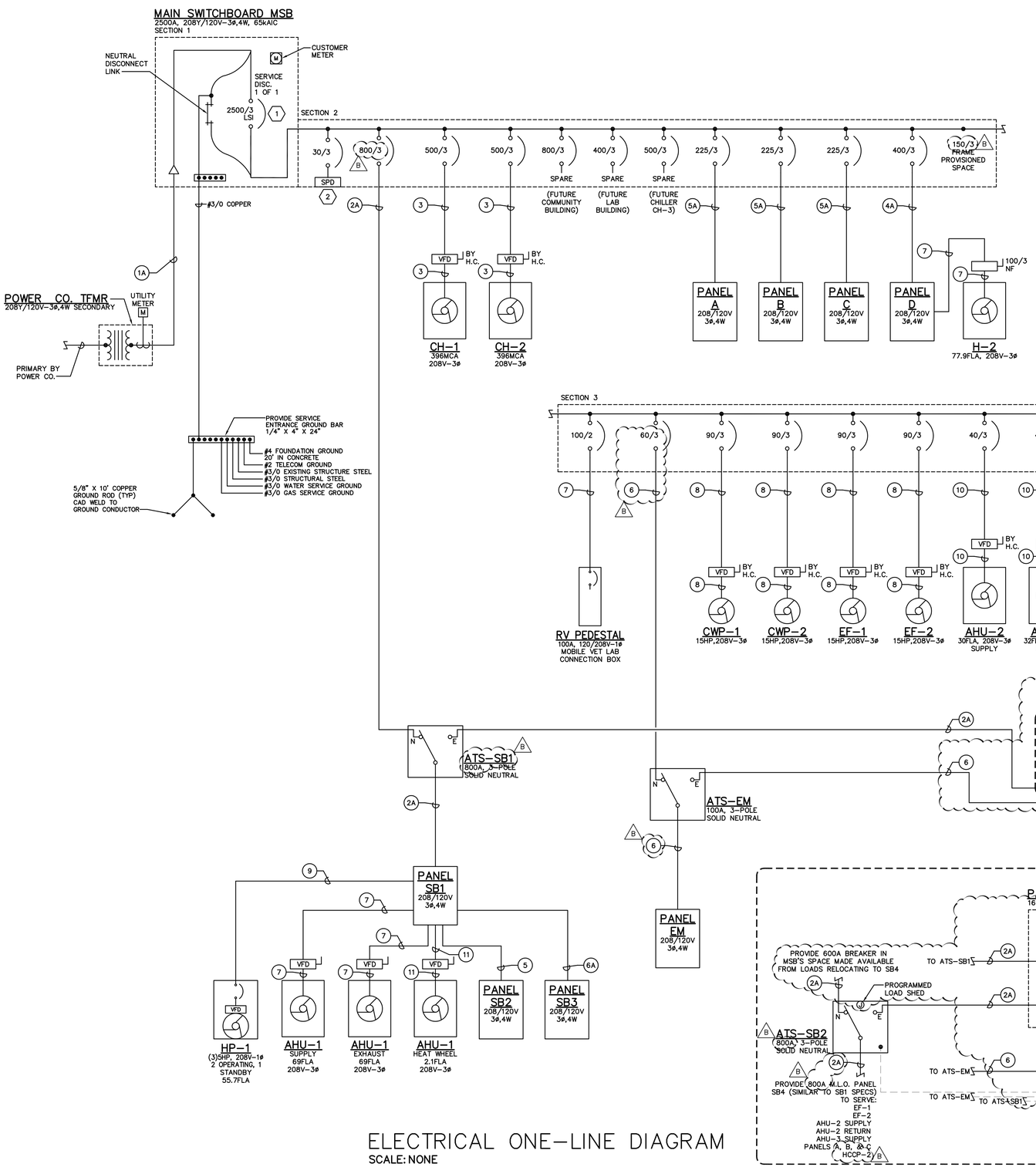
SCALE: As indicated

E-110

JOB NO.: 23009

DATE: 03.07.2025

1/16" = 1'-0" 0 4' 8' 16' | 1/8" = 1'-0" 0 2' 4' 8' | 3/16" = 1'-0" 0 2' 4' 8' | 1/4" = 1'-0" 0 1' 2' 4' | 3/8" = 1'-0" 0 1' 2' 4' | 1/2" = 1'-0" 0 6" 1' 2' | 3/4" = 1'-0" 0 3" 6" 1' 2' | 1" = 1'-0" 0 3" 6" 1' 2' | 1 1/2" = 1'-0" 0 3" 6" 1' | 3" = 1'-0" 0 1" 2" 3" 6" 1' | 6" = 1'-0" 0 1" 2" 3" 6"



ELECTRICAL ONE–LINE DIAGRAM

SCALE: NONE

GENERAL NOTES

A. LINE AND LOAD SIDE CONDUCTORS FOR EACH VFD SHALL BE INSTALLED IN SEPARATE, DEDICATED METALLIC CONDUITS.

CODED NOTES ⬡

1. PROVIDE SERVICE ENTRANCE DISCONNECT PLACARD PER 2017 NEC 230.2(E).
2. SPD SHALL HAVE DISCONNECTING MEANS FOR MAINTENANCE/REPLACEMENT. DISCONNECT TYPE, SIZE, AND RATING PER MANUFACTURER'S REQUIREMENTS.
3. UNDER BASE BID, PROVIDE SINGLE GENERATOR, ATS–SB, ATS–EM, AND ALL ASSOCIATED WORK AS SHOWN IN MAIN ELECTRICAL ONE–LINE DIAGRAM. (THIS GENERATOR SHALL HAVE ELECTRICALLY OPERATED BREAKER AND PARALLELING–CAPABLE CONTROL PANEL. UNDER ALTERNATE PRICING, PROVIDE 2ND GENERATOR WITH ALL NEW WIRING AND EQUIPMENT AS SHOWN IN ALTERNATE GENERATOR SCOPE BOX FOR A COMPLETE PARALLELED EMERGENCY/STANDBY GAS GENERATOR SYSTEM.

FEEDER SCHEDULE

DESIG.	C.B. OR FUSE SIZE	FEEDER SIZE
1A	2,500	7 SETS (4 – 700 – 3–1/2") COMPACT ALUMINUM
2A	800	3 SETS (4 – 400 & 3/0 – 3") COMPACT ALUMINUM
3	500	2 SETS (3 – 250 & 2 – 2") COPPER
4A	400	2 SETS (4 – 250 & 1 – 2–1/2") COMPACT ALUMINUM
5A	225	4 – 300 & 2 – 2–1/2" COMPACT ALUMINUM
6	60	4 – 4 & 10 – 1–1/4" COPPER
7	100	3 – 1 & 8 – 1–1/4" COPPER
7A	100	3 – 1 & 6 – 1–1/4" COMPACT ALUMINUM
8	90	3 – 2 & 8 – 1–1/4" COPPER
9	70	3 – 4 & 8 – 1" COPPER
10	40	3 – 8 & 10 – 3/4" COPPER
11	20	3 – 12 & 12 – 3/4" COPPER

WIRING LEGEND

4 – 350 + 350 – 3"

4 = NO. OF CONDUCTORS; SIZE OF CONDUCTORS
350 + 350 = SIZE OF CONDUIT; SIZE OF GROUND CONDUCTOR
3 = SIZE OF CONDUIT

MSB LOAD TABULATION

SECTION	DESCRIPTION	CONNECTED KVA	NEC DEMAND KVA	NOTE
1or2	SURGE PROTECTIVE DEVICE	–	–	
2	ATS–SB	183.6	178.5	1,3,4
2	CHILLER CH–1	119.0	119.0	1
2	CHILLER CH–2	119.0	119.0	1
2	FUTURE COMM BLDG FEEDER	230.4	0.0	5
2	FUTURE LAB BLDG FEEDER	115.2	0.0	5
2	FUTURE CHILLER CH–3	119.0	0.0	5
2	PANEL A	45.8	184.3	1,3,4
2	PANEL B	30.0		
2	PANEL C	49.5		
2	PANEL D	117.7		
2	600A PROVISIONED SPACE			
3	RV PEDESTAL	–	–	4
3	ATS–EM	5.0	4.0	4
3	CHILLED WATER PUMP CWP–1	17.4	17.4	1
3	CHILLED WATER PUMP CWP–2	17.4	17.4	1
3	GENERAL EXHAUST EF–1	17.4	21.7	2
3	GENERAL EXHAUST EF–2	17.4	17.4	1
3	AHU–2 SUPPLY	10.8	10.8	1
3	AHU–2 RETURN	11.5	11.5	1
3	AHU–3 SUPPLY	18.6	18.6	1
3	100A SPARE			
3	100A SPARE			

VOLTAGE: 208Y/120V–3ø,4W

CONN. LOAD: 1,244.8 KVA
CONN. AMPS: 3,455.1 AMPS
DEMAND LOAD: 719.6 KVA
DEMAND AMPS: 1,997.4 AMPS

1. 1.00 x CONTINUOUS LOADS
2. 1.25 x LARGEST MOTOR
3. 50% RECEPTACLES OVER 10KVA
4. LARGEST OF NON–COINCIDENTAL LOADS
5. FUTURE LOADS SHOWN FOR OWNER'S PLANNING PURPOSES ONLY. ACTUAL FUTURE LOAD DATA WILL BE ENGINEERED UNDER SEPARATE PROJECT WITH NEC 220.87(1) EXISTING DEMAND DATA.

DOUGLAS L. POWELL REGISTERED No. PE11900479 STATE OF INDIANA PROFESSIONAL ENGINEER
3/7/2025

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JOB NUM. 23357 | CHECKED BY D. POWELL | DRAWN BY D. STAFFORD | DESIGNED BY D. STAFFORD

E–400–23357.DWG

DESIGNED BY:	PEA
DRAWN BY:	PEA
CHECKED BY:	PEA

REVISIONS:	DATE:
ADDENDUM 02	04/01/25

VET TEACHING CENTER
HANOVER COLLEGE
4025 STATE ROUTE 56, HANOVER, IN 47243

ELECTRICAL ONE–LINE DIAGRAM

SCALE: As indicated

E–400

JOB NO.: 23009

DATE: 03.07.2025

1/16" = 1'-0" 0 4' 8' 16'
1/8" = 1'-0" 0 2' 4' 8'
3/16" = 1'-0" 0 2' 4' 8'
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1/2" = 1'-0" 0 6" 1' 2'
3/4" = 1'-0" 0 3" 6" 1' 2'
1" = 1'-0" 0 3" 6" 1' 2'
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3" = 1'-0" 0 1" 2" 3" 6" 1'
6" = 1'-0" 0 1" 2" 3" 6"

Panel ID: EM **Location:** MECH/ELEC 182 **Mounting:** SURFACE **Main Type:** M.L.O. **Voltage:** 208 / 120 **Phase:** 3 **Wire:** 4 **Main Size:** 100 Amps **Panel Type:** SELECTIVE COORD. EM PANEL **Enclosure:** NEMA-1

PANEL MUST BE FUSIBLE TYPE OR LISTED FOR FULL SELECTIVE COORDINATION PER 2008 NEC 700.27
For fusible panel, "circuit breaker size" column indicates minimum switch ampacity and actual fuse size.
Fire alarm control panel switch shall have red-colored marking

GND SIZE	WIRE SIZE	BRANCH CIRCUIT DESCRIPTION	CKT BKR SIZE	CKT BKR OPTION	CONN. LOAD (KVA)	CKT NO.	PHASE	CKT NO.	CONN. LOAD (KVA)	CKT BKR OPTION	CKT BKR SIZE	BRANCH CIRCUIT DESCRIPTION	WIRE SIZE	GND SIZE
10	10	N. INTERIOR LIGHTING	20/1	--	0.624	1	A	2	0.500	LO	20/1	FIRE ALARM CNTL PNL	12	12
10	10	N-MID INTERIOR LIGHTING	20/1	--	0.669	3	B	4	0.500	LO	20/1	FUTURE ERRS EQUIPMENT	12	12
10	10	S-MID INTERIOR LIGHTING	20/1	--	0.624	5	C	6	0.000	--	20/1	SPARE	-	-
10	10	SW INTERIOR LIGHTING	20/1	--	0.542	7	A	8	0.000	--	20/1	SPARE	-	-
10	10	SE INTERIOR LIGHTING	20/1	--	0.557	9	B	10	0.000	--	20/1	SPARE	-	-
10	10	N. EXTERIOR LIGHTING	20/1	--	0.599	11	C	12	0.405	--	20/1	S. EXTERIOR LIGHTING	10	10

Demand Load Panel Summary
4.0 KVA
11.1 AMPS

Connected Load Panel Summary
Phase A: 1.7 KVA 13.9 AMPS
Phase B: 1.7 KVA 14.4 AMPS
Phase C: 1.6 KVA 13.6 AMPS
Total: 5.0 KVA

Breaker Options (If Used):
TC - Time Clock Control
LO - Lock-On Device
GF - GND Fault CKT Interrupter

Note: Minimum breaker AIC to be 22,000 amps symmetrical (fully rated).

Panel ID: SB1 **Location:** UTILITY 182 (B) **Mounting:** SURFACE **Main Type:** M.L.O. **Voltage:** 208 / 120 **Phase:** 3 **Wire:** 4 **Main Size:** 800 Amps (B) **Panel Type:** STANDBY LTG & PWR PANEL **Enclosure:** NEMA-1

All circuit breakers shall be standard bolt-on type, unless noted otherwise.
** = Refer to one line diagram or floor plan for wire sizes.

GND SIZE	WIRE SIZE	BRANCH CIRCUIT DESCRIPTION	CKT BKR SIZE	CKT BKR OPTION	CONN. LOAD (KVA)	CKT NO.	PHASE	CKT NO.	CONN. LOAD (KVA)	CKT BKR OPTION	CKT BKR SIZE	BRANCH CIRCUIT DESCRIPTION	WIRE SIZE	GND SIZE
12	12	BUILDING AUTO SYS PNLS	20/1	--	0.500	1	A	2	0.936	--	20/2	WALK-IN EVAPORATOR 1	12	12
12	12	UTILITY RM REC @ PANEL	20/1	--	0.180	3	B	4	0.936	--	-	-	12	-
12	12	DRY SKILL CHARG STATION	20/1	--	0.360	5	C	6	0.936	--	20/2	WALK-IN EVAPORATOR 2	12	12
12	12	RECEIVING DESK REC	20/1	--	0.360	7	A	8	0.936	--	-	-	12	-
12	12	N. CORRIDOR CONV REC	20/1	--	0.180	9	B	10	0.840	--	20/2	WALK-IN CONDENSER 1	12	12
12	12	E. CORRIDOR CONV REC	20/1	--	0.180	11	C	12	0.840	--	-	-	12	-
12	12	ANATOMY LAB CONV REC	20/1	GF	0.180	13	A	14	0.840	--	20/2	WALK-IN CONDENSER 2	12	12
12	12	WALK-IN CONV REC	20/1	--	0.360	15	B	16	0.840	--	-	-	12	-
12	12	ANATOMY PREP HOOD REC	20/1	--	0.360	17	C	18	0.400	GF	20/1	PLUMBING SENSORS NE.	12	12
12	12	BREAK ROOM REFRIG	20/1	--	1.000	19	A	20	0.500	LO	20/1	FP MASTER FLOW SW	12	12
12	12	BREAK ROOM REFRIG	20/1	--	1.000	21	B	22	0.248	--	20/2	PARKING LOT LTG	10	10
-	-	SPARE	20/1	--	0.000	23	C	24	0.248	--	-	-	10	-
-	-	SPARE	20/1	--	0.000	25	A	26	0.500	--	20/1	BLUE LIGHT CALL STATION	10	10
-	-	SPARE	20/1	--	0.000	27	B	28	0.732	--	20/1	FCU-2	12	12
-	-	SPARE	20/1	--	0.000	29	C	30	0.540	--	15/1	UH-1	12	12
**	**	HP-1 BOOSTER PUMP	70/3	--	6.684	31	A	32	1.667	--	20/3	CUH-4	12	12
-	**	-	-	--	6.684	33	B	34	1.667	--	-	(PROVIDE NEUTRAL)	12	-
-	**	-	-	--	6.684	35	C	36	1.667	--	-	-	12	-
**	**	AHU-1 HEAT WHEEL	15/3	--	0.252	37	A	38	1.667	--	20/3	CUH-5	12	12
-	**	-	-	--	0.252	39	B	40	1.667	--	-	(PROVIDE NEUTRAL)	12	-
-	**	-	-	--	0.252	41	C	42	1.667	--	-	-	12	-
**	**	AHU-1 SUPPLY	100/3	--	8.286	43	A	44	0.794	--	15/3	HCCP-1	12	12
-	**	-	-	--	8.286	45	B	46	0.794	--	-	-	12	-
-	**	-	-	--	8.286	47	C	48	0.794	--	-	-	12	-
**	**	AHU-1 RETURN	100/3	--	8.286	49	A	50	1.200	--	20/1	GEN 1 BATTERY CHARGER	12	12
-	**	-	-	--	8.286	51	B	52	1.500	--	20/1	GEN 1 BLOCK HEATER	12	12
-	**	-	-	--	8.286	53	C	54	1.140	--	20/1	ANATOMY LOAD LTG	12	12
**	**	PANEL SB3	100/3	--	8.037	SUBFEED	A	SUBFEED	21.577	--	225/3	PANEL SB2	**	**
-	**	(SUBFEED BREAKER)	-	--	6.987		B		22.019	--	-	(SUBFEED BREAKER)	**	-
-	**	-	-	--	8.181		C		20.307	--	-	-	**	-

Demand Load Panel Summary
183.6 KVA
509.7 AMPS

Connected Load Panel Summary
Phase A: 64.2 KVA 535.0 AMPS
Phase B: 63.5 KVA 528.8 AMPS
Phase C: 61.0 KVA 508.6 AMPS
Total: 188.7 KVA

Breaker Options (If Used):
TC - Time Clock Control
LO - Lock-On Device
GF - GND Fault CKT Interrupter
SH - Shunt Trip Breaker

Note: Minimum breaker AIC to be 22,000 amps symmetrical (fully rated).

ALTERNATE

Panel ID: SB4 **Location:** UTILITY 182 **Mounting:** SURFACE **Main Type:** M.L.O. **Voltage:** 208 / 120 **Phase:** 3 **Wire:** 4 **Main Size:** 800 Amps **Panel Type:** STANDBY LTG & PWR PANEL **Enclosure:** NEMA-1

ALL LOADS ON THIS PANEL SHALL BE RELOCATED FROM THEIR BASE BID SOURCES, WHERE APPLICABLE

All circuit breakers shall be standard bolt-on type, unless noted otherwise.
** = Refer to one line diagram or floor plan for wire sizes.

GND SIZE	WIRE SIZE	BRANCH CIRCUIT DESCRIPTION	CKT BKR SIZE	CKT BKR OPTION	CONN. LOAD (KVA)	CKT NO.	PHASE	CKT NO.	CONN. LOAD (KVA)	CKT BKR OPTION	CKT BKR SIZE	BRANCH CIRCUIT DESCRIPTION	WIRE SIZE	GND SIZE
**	**	AHU-2 SUPPLY	40/3	--	3.600	1	A	2	5.800	--	90/3	EF-1	**	**
-	**	-	-	--	3.600	3	B	4	5.800	--	-	-	**	-
-	**	-	-	--	3.600	5	C	6	5.800	--	-	-	**	-
**	**	AHU-2 RETURN	40/3	--	3.833	7	A	8	5.800	--	90/3	EF-2	**	**
-	**	-	-	--	3.833	9	B	10	5.800	--	-	-	**	-
-	**	-	-	--	3.833	11	C	12	5.800	--	-	-	**	-
**	**	AHU-3 SUPLY	70/3	--	6.200	13	A	14	0.794	--	15/3	HCCP-2	12	12
-	**	-	-	--	6.200	15	B	16	0.794	--	-	-	12	-
-	**	-	-	--	6.200	17	C	18	0.794	--	-	-	12	-
-	-	SPARE	20/1	--	0.000	19	A	20	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	21	B	22	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	23	C	24	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	25	A	26	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	27	B	28	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	29	C	30	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	31	A	32	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	33	B	34	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	35	C	36	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	37	A	38	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	39	B	40	1.200	--	20/1	GEN 2 BATTERY CHARGER	12	12
-	-	SPARE	20/1	--	0.000	41	C	42	1.500	--	20/1	GEN 2 BLOCK HEATER	12	12
**	**	PANEL A	225/3	--	15.700	SUBFEED	A	SUBFEED	17.100	--	225/3	PANEL C	**	**
-	**	-	-	--	15.000		B		15.700	--	-	-	**	-
-	**	-	-	--	15.100		C		16.500	--	-	-	**	-
**	**	PANEL B	225/3	--	10.000		A		0.000					
-	**	-	-	--	10.700		B		0.000					
-	**	-	-	--	9.300		C		0.000					

Demand Load Panel Summary
171.1 KVA
474.9 AMPS

Connected Load Panel Summary
Phase A: 68.8 KVA 573.6 AMPS
Phase B: 68.6 KVA 571.9 AMPS
Phase C: 68.4 KVA 570.2 AMPS
Total: 205.9 KVA

Breaker Options (If Used):
TC - Time Clock Control
LO - Lock-On Device
GF - GND Fault CKT Interrupter
SH - Shunt Trip Breaker

Note: Minimum breaker AIC to be 22,000 amps symmetrical (fully rated).

Panel ID: SB2 **Location:** UTILITY 154 **Mounting:** SURFACE **Main Type:** M.L.O. **Voltage:** 208 / 120 **Phase:** 3 **Wire:** 4 **Main Size:** 225 Amps **Panel Type:** STANDBY LTG & PWR PANEL **Enclosure:** NEMA-1

All circuit breakers shall be standard bolt-on type, unless noted otherwise.
** = Refer to one line diagram or floor plan for wire sizes.

GND SIZE	WIRE SIZE	BRANCH CIRCUIT DESCRIPTION	CKT BKR SIZE	CKT BKR OPTION	CONN. LOAD (KVA)	CKT NO.	PHASE	CKT NO.	CONN. LOAD (KVA)	CKT BKR OPTION	CKT BKR SIZE	BRANCH CIRCUIT DESCRIPTION	WIRE SIZE	GND SIZE
12	12	UTILITY RM REC @ PANEL	20/1	--	0.180	1	A	2	2.100	--	35/3	EF-3 BIO FUME HOOD	10	10
12	12	BIO FUME HOOD REC	20/1	GF	0.360	3	B	4	2.100	--	-	EXHAUST	10	-
12	12	CLASS CHARG. STATION	20/1	--	0.360	5	C	6	2.100	--	-	-	10	-
12	12	S. CORRIDOR CONV REC	20/1	--	0.180	7	A	8	1.800	--	25/2	DSS-1 / DHP-1	10	10
12	12	IT ROOM WALL REC	20/1	--	0.540	9	B	10	1.800	--	-	-	10	-
12	12	TELECOM QUAD REC 1	20/1	--	0.360	11	C	12	1.800	--	25/2	DSS-2 / DHP-2	10	10
12	12	TELECOM QUAD REC 2	20/1	--	0.360	13	A	14	1.800	--	-	-	10	-
12	12	SMALL CONF WALL REC	20/1	--	0.900	15	B	16	0.690	--	20/1	ROOF WORK LTG & REC	12	12
12	12	SMALL CONF FLR/TV REC	20/1	--	0.540	17	C	18	0.400	--	20/1	PLUMBING SENSORS SW.	12	12
12	12	FACULTY OFFICE REC	20/1	--	0.720	19	A	20	0.250	--	20/1	BAS PANEL	12	12
12	12	BIO PREP REFRIGERATOR	20/1	GF	0.960	21	B	22	1.667	--	20/3	CUH-4	12	12
12	12	BIO PREP FREEZER	20/1	GF	0.960	23	C	24	1.667	--	-	(PROVIDE NEUTRAL)	12	-
12	12	B PREP ULTRACOLD FRZR	20/1	GF	1.400	25	A	26	1.667	--	-	-	12	-
12	12	B PREP ULTRACOLD FRZR	20/2	GF	1.150	27	B	28	0.732	--	15/1	FCU-1	12	12
-	12	-	-	--	1.150	29	C	30	0.350	--	15/1	GWH-1	12	12
12	12	BIO REFRIGERATOR N.	20/1	GF	1.000	31	A	32	0.350	--	15/1	GWH-1	12	12
12	12	BIO REFRIGERATOR S.	20/1	GF	1.000	33	B	34	0.350	--	15/1	GWH-1	12	12
-	-	SPARE	20/1	--	0.000	35	C	36	0.850	--	15/1	GWH-1 & RCP-1	12	12
-	-	SPARE	20/1	--	0.000	37	A	38	0.360	--	15/3	BOILERS B-1 & B-2	12	12
-	-	SPARE	20/1	--	0.000	39	B	40	0.360	--	-	-	12	-
-	-	SPARE	20/1	--	0.000	41	C	42	0.360	--	-	-	12	-
12	12	CUH-1	20/3	--	1.667	43	A	44	3.038	--	50/3	HWP-1 HEATING WATER	6	10
-	12	(PROVIDE NEUTRAL)	-	--	1.667	45	B	46	3.038	--	-	PUMP (LEAD)	6	-
-	12	-	-	--	1.667	47	C	48	3.038	--	-	-	6	-
12	12	CUH-2	20/3	--	1.667	49	A	50	3.038	--	50/3	HWP-2 HEATING WATER	6	10
-	12	(PROVIDE NEUTRAL)	-	--	1.667	51	B	52	3.038	--	-	PUMP (LAG)	6	-
-	-	-	-	--	1.667	53	C	54	3.038	--	-	-	6	-

Demand Load Panel Summary
62.2 KVA
172.8 AMPS

Connected Load Panel Summary
Phase A: 21.6 KVA 179.8 AMPS
Phase B: 22.0 KVA 183.5 AMPS
Phase C: 20.3 KVA 169.2 AMPS
Total: 63.9 KVA

Breaker Options (If Used):
TC - Time Clock Control
LO - Lock-On Device
GF - GND Fault CKT Interrupter
SH - Shunt Trip Breaker

Note: Minimum breaker AIC to be 22,000 amps symmetrical (fully rated).

Panel ID: SB3 **Location:** CORRIDOR 131A **Mounting:** RECESSED **Main Type:** M.L.O. **Voltage:** 208 / 120 **Phase:** 3 **Wire:** 4 **Main Size:** 225 Amps **Panel Type:** STANDBY LTG & PWR PANEL **Enclosure:** NEMA-1

All circuit breakers shall be standard bolt-on type, unless noted otherwise.
** = Refer to one line diagram or floor plan for wire sizes.

GND SIZE	WIRE SIZE	BRANCH CIRCUIT DESCRIPTION	CKT BKR SIZE	CKT BKR OPTION	CONN. LOAD (KVA)	CKT NO.	PHASE	CKT NO.	CONN. LOAD (KVA)	CKT BKR OPTION	CKT BKR SIZE	BRANCH CIRCUIT DESCRIPTION	WIRE SIZE	GND SIZE
12	12	KENNEL RECEPTACLES	20/1	--	0.720	1	A	2	0.360	--	20/1	SURGERY SUITE REC 1	12	12
12	12	KENNEL CORRIDOR REC	20/1	--	0.540	3	B	4	0.540	--	20/1	SURGERY SUITE REC 2	12	12
12	12	PATHOLOGY REC W.	20/1	--	0.540	5	C	6	0.360	--	20/1	SURGERY SUITE CLG REC1	12	12
12	12	PATHOLOGY REC E.	20/1	--	0.540	7	A	8	0.360	--	20/1	SURGERY SUITE CLG REC2	12	12
12	12	PATHOLOGY REFRIG REC	20/1	--	0.540	9	B	10	0.540	--	20/1	SURG SUITE S. REC 1	12	12
12	12	TREATMENT UC REFRIG	20/1	--	1.000	11	C	12	0.540	--	20/1	SURG SUITE S. REC 2	12	12
12	12	TREATMENT COMPUTR REC	20/1	--	0.600	13	A	14	0.360	--	20/1	SURGERY PREP REC	12	12
12	12	TREATMENT REFRIG REC	20/1	--	0.540	15	B	16	0.360	--	20/1	SURGERY PREP REC	12	12
12	12	TREATMENT TABLE REC	20/1	--	1.000	17	C	18	1.150	--	20/2	SURG PREP AUTOCLAVE	12	12
12	12	TREATMENT REC S.	20/1	--	0.360	19	A	20	1.150	--	-	-	12	-
12	12	S. EXAM ROOM REC	20/1	--	0.900	21	B	22	1.000	--	20/1	SURG PREP AUTOCLAVE	12	12
12	12	ULTRASOUND RM REC 2	20/1	--	0.720	23	C	24	1.364	--	20/1	SURG SUITE & EXAM LTG	12	12
12	12	CLINIC RECEPTION REC	20/1	--	0.720	25	A	26	1.000	GF	20/1	OFFICE BREAK REFRIG	12	12
12	12	PLUMB SENSORS CLINIC	20/1	--	0.360	27	B	28	0.000	--	20/1	SPARE	-	-
12	12	PLUMB SENS PATH/GOWN	20/1	--	0.200	29	C	30	0.000	--	20/1	SPARE	-	-
12	12	CUH-3	20/3	--	0.200	31	A	32	0.000	--	20/1	SPARE	-	-
-	12	(PROVIDE NEUTRAL)	-	--	1.667	33	B	34	0.000	--	20/1	SPARE	-	-
-	-	-	-	--	1.667	35	C	36	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	1.667	37	A	38	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	39	B	40	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	41	C	42	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	43	A	44	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	45	B	46	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	47	C	48	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	49	A	50	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	51	B	52	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	53	C	54	0.000	--	20/1	SPARE	-	-

Demand Load Panel Summary
19.8 KVA
54.9 AMPS

Connected Load Panel Summary
Phase A: 8.0 KVA 67.0 AMPS
Phase B: 7.0 KVA 58.2 AMPS
Phase C: 8.2 KVA 68.2 AMPS
Total: 23.2 KVA

Breaker Options (If Used):
TC - Time Clock Control
LO - Lock-On Device
GF - GND Fault CKT Interrupter
SH - Shunt Trip Breaker

Note: Minimum breaker AIC to be 22,000 amps symmetrical (fully rated).

GENERAL NOTES

A. THE ELECTRICAL CONTRACTOR SHALL PROVIDE TYPEWRITTEN PANEL DIRECTORIES WHICH COMPLY WITH THE NATIONAL ELECTRICAL CODE ARTICLE 408.4(A) – CIRCUIT DIRECTORY OR CIRCUIT IDENTIFICATION.

B. BY USE OF THE TYPEWRITTEN PANEL DIRECTORY, EVERY CIRCUIT SHALL BE IDENTIFIED AS TO ITS CLEAR, EVIDENT, AND SPECIFIC PURPOSE OR USE. THE IDENTIFICATION SHALL INCLUDE SUFFICIENT DETAIL TO ALLOW EACH CIRCUIT TO BE DISTINGUISHED FROM ALL OTHERS. NO CIRCUIT SHALL BE DESCRIBED IN A MANNER THAT DEPENDS ON TRANSIENT CONDITIONS.

C. THIS REQUIREMENT IS SPECIFIC FOR DISTRIBUTION PANELS AS WELL AS LIGHTING AND APPLIANCE TYPE PANELS, HOWEVER, THE IDENTIFICATION REQUIREMENTS OF NEC 110.22 APPLY TO ALL DISCONNECTING MEANS.

(B) D. PROVIDE GENERATOR BATTERY CHARGER AND BLOCK HEATER BRANCH CIRCUITS NOTED ON PANEL SCHEDULES SB1 (BASE BID AND ALTERNATE) AND SB4 (ALTERNATE ONLY). THESE CIRCUITS ARE OMITTED FROM SITE PLAN FOR DRAWING CLARITY ONLY.

DOUGLAS L. POWELL REGISTERED No. PE11900479 STATE OF INDIANA PROFESSIONAL ENGINEER
3/7/2025

PRATER Engineering Associates, Inc.
6130 Wilcox Road
Dublin, Ohio 43016
(614) 766 4896
praterengineering.com

JOB NUM. 23357
CHECKED BY: D. POWELL
DRAWN BY: D. STAFFORD
DESIGNED BY: D. STAFFORD
E-401-23357.DWG

DESIGNED BY: PEA
DRAWN BY: PEA
CHECKED BY: PEA

DATE: 04/01/25
REVISIONS: ADDENDUM 02

VET TEACHING CENTER
HANOVER COLLEGE
4025 STATE ROUTE 56, HANOVER, IN 47243

ELECTRICAL PANEL SCHEDULES

SCALE: As indicated

E-401

JOB NO.: 23009
DATE: 03.07.2025

1/16" = 1'-0" 0 4' 8' 16'

1/8" = 1'-0" 0 2' 4' 8'

3/16" = 1'-0" 0 2' 4' 8'

1/4" = 1'-0" 0 1' 2' 4'

3/8" = 1'-0" 0 1' 2' 4'

1/2" = 1'-0" 0 6" 1' 2'

3/4" = 1'-0" 0 3" 6" 1' 2'

1" = 1'-0" 0 3" 6" 1' 2'

1 1/2" = 1'-0" 0 3" 6" 1'

3" = 1'-0" 0 1" 2" 3" 6" 1'

6" = 1'-0" 0 1" 2" 3" 6"

GENERAL NOTES

A. THE ELECTRICAL CONTRACTOR SHALL PROVIDE TYPEWRITTEN PANEL DIRECTORIES WHICH COMPLY WITH THE NATIONAL ELECTRICAL CODE ARTICLE 408.4(A) – CIRCUIT DIRECTORY OR CIRCUIT IDENTIFICATION.

B. BY USE OF THE TYPEWRITTEN PANEL DIRECTORY, EVERY CIRCUIT SHALL BE IDENTIFIED AS TO ITS CLEAR, EVIDENT, AND SPECIFIC PURPOSE OR USE. THE IDENTIFICATION SHALL INCLUDE SUFFICIENT DETAIL TO ALLOW EACH CIRCUIT TO BE DISTINGUISHED FROM ALL OTHERS. NO CIRCUIT SHALL BE DESCRIBED IN A MANNER THAT DEPENDS ON TRANSIENT CONDITIONS.

C. THIS REQUIREMENT IS SPECIFIC FOR DISTRIBUTION PANELS AS WELL AS LIGHTING AND APPLIANCE TYPE PANELS. HOWEVER, THE IDENTIFICATION REQUIREMENTS OF NEC 110.22 APPLY TO ALL DISCONNECTING MEANS.

DOUGLAS L. POWELL REGISTERED No. PE11900479 STATE OF INDIANA PROFESSIONAL ENGINEER
3/7/2025

Panel ID: A | **Location: MECH/ELEC 182** | **Mounting: SURFACE** | **Main Type: M.L.O.** | **Voltage: 208 / 120** | **Phase: 3** | **Wire: 4** | **Main Size: 225 Amps** | **Panel Type: LTG & PWR PANEL** | **Enclosure: NEMA-1**

All circuit breakers shall be standard bolt-on type, unless noted otherwise.
** = Refer to one line diagram or floor plan for wire sizes.

GND SIZE	WIRE SIZE	BRANCH CIRCUIT DESCRIPTION	CKT BKR SIZE	CKT BKR OPTION	CONN. LOAD (KVA)	CKT NO.	PHASE	CKT NO.	CONN. LOAD (KVA)	CKT BKR OPTION	CKT BKR SIZE	BRANCH CIRCUIT DESCRIPTION	WIRE SIZE	GND SIZE
12	12	DRY SKILLS FLRBOX REC	20/1	GF	1.440	1	A	2	0.900	--	20/1	UTILITY ROOM RECEPT	12	12
12	12	DRY SKILLS FLRBOX REC	20/1	GF	1.440	3	B	4	0.540	--	20/1	N. CORRIDOR REC	12	12
12	12	DRY SKILLS FLRBOX REC	20/1	GF	1.440	5	C	6	0.900	--	20/1	RECEIVING/EXTER REC	12	12
12	12	DRY SKILLS FLRBOX REC	20/1	GF	1.440	7	A	8	0.360	--	20/1	RECEIVING WORK BENCH	12	12
12	12	DRY SKILLS FLRBOX REC	20/1	GF	1.440	9	B	10	0.900	--	20/1	LINENS STORAGE REC	12	12
12	12	DRY SKILLS FLRBOX REC	20/1	GF	1.440	11	C	12	0.000	GF	20/1	SPARE	-	-
12	12	DRY SKILLS FLRBOX REC	20/1	GF	1.440	13	A	14	0.000	GF	20/1	SPARE	-	-
12	12	WET/DRY FLR BOX REC	20/1	GF	1.440	15	B	16	0.000	GF	20/1	SPARE	-	-
12	12	WET SKILLS FLRBOX REC	20/1	GF	1.440	17	C	18	0.000	GF	20/1	SPARE	-	-
12	12	WET SKILLS FLRBOX REC	20/1	GF	1.440	19	A	20	0.000	GF	20/1	SPARE	-	-
12	12	WET SKILLS FLRBOX REC	20/1	GF	1.440	21	B	22	0.000	GF	20/1	SPARE	-	-
12	12	WET SKILLS FLRBOX REC	20/1	GF	1.440	23	C	24	0.000	GF	20/1	SPARE	-	-
12	12	WET SKILLS FLRBOX REC	20/1	GF	1.440	25	A	26	0.000	GF	20/1	SPARE	-	-
12	12	WET SKILLS FLRBOX REC	20/1	GF	1.440	27	B	28	0.000	GF	20/1	SPARE	-	-
12	12	WET SKILLS FLRBOX REC	20/1	GF	1.440	29	C	30	0.794	--	15/3	HCCP-2	12	12
12	12	WET/DRY PERIMETER REC	20/1	GF	0.900	31	A	32	0.794	--	-	-	12	-
12	12	WET SKILLS COUNTER REC	20/1	GF	0.720	33	B	34	0.794	--	-	-	12	-
12	12	WET SKILLS COUNTER REC	20/1	GF	0.540	35	C	36	0.595	--	20/1	N. EXTERIOR LIGHTING	10	10
12	12	WET/DRY PROJECTORS	20/1	--	1.000	37	A	38	0.465	--	20/1	S. EXTERIOR LIGHTING	10	10
12	12	WET/DRY PROJ. SCREENS	20/1	--	0.540	39	B	40	1.533	--	20/1	MECH/DRY SKILLS LTG	12	12
12	12	DRY SKILLS STORAGE REC	20/1	--	0.720	41	C	42	1.380	--	20/1	WET SKILL/RECEIVING LTG	12	12
12	12	DRY SKILLS STORAGE REC	20/1	--	0.720	43	A	44	1.311	--	20/1	N CORRIDOR / BREAK LTG	12	12
12	12	WET SKILL STORAGE REC	20/1	--	0.720	45	B	46	0.000	--	15/1	FCU-2	12	12
12	12	WET SKILL STORAGE REC	20/1	--	0.540	47	C	48	0.840	--	15/1	H-01 HUMIDIFIER	12	12
12	12	WET SKILL STORAGE REC	20/1	--	0.540	49	A	50	2.352	--	30/3	SANITARY LIFT STATION	10	10
12	12	WET SKILL STORAGE REC	20/1	--	0.540	51	B	52	2.352	--	-	-	10	-
-	-	SPARE	20/1	--	0.000	53	C	54	2.352	--	-	-	10	-

Demand Load Panel Summary: 36.8 KVA; 102.3 AMPS

Connected Load Panel Summary:

Phase A:	16.5 KVA	137.4 AMPS
Phase B:	15.8 KVA	132.0 AMPS
Phase C:	15.9 KVA	132.2 AMPS
Total:	48.2 KVA	

Breaker Options (If Used): TC - Time Clock Control; LO - Lock-On Device; GF - GND Fault CKT Interrupter; SH - Shunt Trip Breaker

Note: Minimum breaker AIC to be 22,000 amps symmetrical (fully rated).

Panel ID: B | **Location: GOWNING 179** | **Mounting: SURFACE** | **Main Type: M.L.O.** | **Voltage: 208 / 120** | **Phase: 3** | **Wire: 4** | **Main Size: 225 Amps** | **Panel Type: LTG & PWR PANEL** | **Enclosure: NEMA-1**

All circuit breakers shall be standard bolt-on type, unless noted otherwise.
** = Refer to one line diagram or floor plan for wire sizes.

GND SIZE	WIRE SIZE	BRANCH CIRCUIT DESCRIPTION	CKT BKR SIZE	CKT BKR OPTION	CONN. LOAD (KVA)	CKT NO.	PHASE	CKT NO.	CONN. LOAD (KVA)	CKT BKR OPTION	CKT BKR SIZE	BRANCH CIRCUIT DESCRIPTION	WIRE SIZE	GND SIZE
12	12	GOWNING ROOM REC	20/1	GF	0.720	1	A	2	1.200	GF	20/1	BREAM RM MICROWAVE	12	12
12	12	GOWNING TOILET RM REC	20/1	GF	0.900	3	B	4	1.200	GF	20/1	BREAM RM MICROWAVE	12	12
12	12	ANATOMY SE. / TR REC	20/1	GF	0.720	5	C	6	1.200	GF	20/1	BREAM RM MICROWAVE	12	12
12	12	ANATOMY NE. / LINEN REC	20/1	GF	0.900	7	A	8	1.200	GF	20/1	BREAM RM MICROWAVE	12	12
12	12	ANATOMY NE. BENCH REC	20/1	GF	1.440	9	B	10	1.200	GF	20/1	BREAK RM DISHWASHER	12	12
12	12	ANATOMY NW. BENCH REC	20/1	GF	1.080	11	C	12	1.200	GF	20/1	BREAK RM DISHWASHER	12	12
12	12	ANATOMY SE. BENCH REC	20/1	GF	1.080	13	A	14	1.200	GF	20/1	BREAK RM DISHWASHER	12	12
12	12	ANATOMY SW. BENCH REC	20/1	GF	1.080	15	B	16	1.080	GF	20/1	BREAK RM CNTR REC	12	12
12	12	ANATOMY E. CEILING REC	20/1	GF	0.360	17	C	18	0.720	GF	20/1	BREAK RM CNTR REC	12	12
12	12	ANATOMY W. CEILING REC	20/1	GF	0.360	19	A	20	0.720	GF	20/1	BREAK RM ISLAND REC	12	12
12	12	FORMALIN DISP. REC	20/1	GF	0.360	21	B	22	0.720	GF	20/1	BREAK RM ISLAND REC	12	12
12	12	ANATOMY INSTR. REC	20/1	GF	0.720	23	C	24	0.540	GF	20/1	BREAK AREA EXTER REC	12	12
12	12	ANATOMY AV CABINET	20/1	GF	0.360	25	A	26	0.756	GF	20/1	BREAK RM DISPOSER 1	12	12
12	12	ANATOMY PREP REC S.	20/1	GF	0.720	27	B	28	0.756	GF	20/1	BREAK RM DISPOSER 2	12	12
12	12	ANATOMY PREP REC N.	20/1	GF	0.720	29	C	30	0.000	GF	20/1	SPARE	-	-
12	12	ANATOMY PREP WASHER	20/1	GF	0.600	31	A	32	0.000	GF	20/1	SPARE	-	-
12	12	ANATOMY PREP DISPOSER	20/1	GF	0.756	33	B	34	0.000	GF	20/1	SPARE	-	-
12	12	ANATOMY PREP DISPOSER	20/1	GF	0.756	35	C	36	0.000	GF	20/1	SPARE	-	-
-	-	SPARE	20/1	GF	0.000	37	A	38	0.000	GF	20/1	SPARE	-	-
-	-	SPARE	20/1	GF	0.000	39	B	40	0.000	GF	20/1	SPARE	-	-
-	-	SPARE	20/1	GF	0.000	41	C	42	0.000	GF	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	43	A	44	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	45	B	46	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	47	C	48	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	49	A	50	0.856	--	20/1	GOWNING LIGHTING	12	12
-	-	SPARE	20/1	--	0.000	51	B	52	0.500	--	20/1	WALK-IN LIGHTING	12	12
-	-	SPARE	20/1	--	0.000	53	C	54	1.311	--	20/1	ANATOMY & PREP LTG	12	12

Demand Load Panel Summary: 22.8 KVA; 63.4 AMPS

Connected Load Panel Summary:

Phase A:	10.0 KVA	82.9 AMPS
Phase B:	10.7 KVA	89.3 AMPS
Phase C:	9.3 KVA	77.7 AMPS
Total:	30.0 KVA	

Breaker Options (If Used): TC - Time Clock Control; LO - Lock-On Device; GF - GND Fault CKT Interrupter; SH - Shunt Trip Breaker

Note: Minimum breaker AIC to be 22,000 amps symmetrical (fully rated).

Panel ID: C | **Location: UTILITY 154** | **Mounting: SURFACE** | **Main Type: M.L.O.** | **Voltage: 208 / 120** | **Phase: 3** | **Wire: 4** | **Main Size: 225 Amps** | **Panel Type: LTG & PWR PANEL** | **Enclosure: NEMA-1**

ALL CIRCUITS TO BE IN SINGLE 84 CIRCUIT, 20 INCH WIDE TUB.
All circuit breakers shall be standard bolt-on type, unless noted otherwise.
** = Refer to one line diagram or floor plan for wire sizes.

GND SIZE	WIRE SIZE	BRANCH CIRCUIT DESCRIPTION	CKT BKR SIZE	CKT BKR OPTION	CONN. LOAD (KVA)	CKT NO.	PHASE	CKT NO.	CONN. LOAD (KVA)	CKT BKR OPTION	CKT BKR SIZE	BRANCH CIRCUIT DESCRIPTION	WIRE SIZE	GND SIZE
12	12	UTIL RM/AHU/GLYCOL REC	20/1	--	0.900	1	A	2	0.540	--	20/1	CLASSROOM REC SW.	12	12
12	12	BIO PREP CONV. RECEPT	20/1	GF	0.720	3	B	4	0.360	--	20/1	CLASSROOM REC NW.	12	12
12	12	BIO PREP GLASSWASHER	20/1	GF	0.600	5	C	6	0.720	--	20/1	CLASSROOM REC N.	12	12
12	12	BIO PREP AUTOCLAVE	20/2	GF	1.150	7	A	8	0.540	--	20/1	CLASSROOM REC NE.	12	12
-	12	-	-	--	1.150	9	B	10	0.360	--	20/1	CLASSROOM REC SE.	12	12
12	12	BIO PREP CO2 INCUBATOR	20/1	GF	0.500	11	C	12	0.900	--	20/1	CORRIDOR RECEPT	12	12
12	12	BIO PREP COUNTER REC	20/1	GF	0.360	13	A	14	0.720	--	20/1	LG CONF RM CONV REC N	12	12
12	12	BIO PREP COUNTER REC	20/1	GF	0.360	15	B	16	0.720	--	20/1	LG CONF RM CONV REC S	12	12
12	12	BIO CO2 BENCH INCUB.	20/1	GF	0.500	17	C	18	0.900	--	20/1	LG CONF RM FLR/TV REC	12	12
12	12	BIO N. COUNTER REC 1	20/1	GF	0.540	19	A	20	0.900	--	20/1	MEDITATION RM REC	12	12
12	12	BIO N. COUNTER REC 2	20/1	GF	0.720	21	B	22	0.900	--	20/1	TOILET RM/CORRIDOR REC	12	12
12	12	BIO EAST COUNTER REC	20/1	GF	0.720	23	C	24	0.960	GF	20/1	LACTATION ROOM REC	12	12
12	12	BIO SAFETY CABINET REC	20/1	GF	0.360	25	A	26	0.360	GF	20/1	OFF BREAK CNTR REC N.	12	12
12	12	BIO S. COUNTER REC 1	20/1	GF	0.540	27	B	28	0.360	GF	20/1	OFF BREAK CNTR REC E.	12	12
12	12	BIO S. COUNTER REC 2	20/1	GF	0.720	29	C	30	0.360	GF	20/1	OFF BREAK CNTR REC S.	12	12
12	12	BIO STUDENT BENCH REC1	20/1	GF	1.080	31	A	32	1.200	GF	20/1	OFF BREAK DISHWASHER	12	12
12	12	BIO STUDENT BENCH REC2	20/1	GF	1.080	33	B	34	1.200	GF	20/1	OFF BREAK MICROWAVE	12	12
12	12	BIO STUDENT BENCH REC3	20/1	GF	1.080	35	C	36	0.756	GF	20/1	OFFICE BREAK DISPOSER	12	12
12	12	BIO STUDENT BENCH REC4	20/1	GF	1.080	37	A	38	0.900	--	20/1	OFFICE LOBBY REC	12	12
12	12	BIO INSTR BENCH REC	20/1	GF	0.720	39	B	40	1.000	--	20/1	OFFICE COPIER	12	12
12	12	BIO INSTR WALL REC	20/1	GF	0.720	41	C	42	0.720	--	20/1	OFFICE 102C/102D REC	12	12
12	12	BIO CEILING MONITORS	20/1	GF	0.840	43	A	44	0.900	--	20/1	OFFICE 102B/102C REC	12	12
-	-	SPARE	20/1	--	0.000	45	B	46	1.080	--	20/1	FACULTY FLOOR REC	12	12
-	-	SPARE	20/1	--	0.000	47	C	48	0.900	--	20/1	FACULTY SUITE REC W.	12	12
-	-	SPARE	20/1	--	0.000	49	A	50	0.900	--	20/1	FACULTY SUITE REC E.	12	12
-	-	SPARE	20/1	--	0.000	51	B	52	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	53	C	54	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/2	--	0.000	55	A	56	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	57	B	58	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	59	C	60	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	61	A	62	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	63	B	64	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	65	C	66	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	67	A	68	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	69	B	70	0.000	--	20/1	SPARE	-	-
-	-	SPARE	20/1	--	0.000	71	C	72	0.000	--	20/1	SPARE	-	-
-	-	GWP-1 (OPERATING)	20/3	--	1.320	73	A	74	0.000	--	20/1	SPARE	-	-
-	-	-	-	--	1.320	75	B	76	0.000	--	20/1	SPARE	-	-
-	-	-	-	--	1.320	77	C	78	1.402	--	20/1	MECH/BIOLOGY LIGHTING	12	12
-	-	GWP-2 (STANDBY)	20/3	--	1.320	79	A	80	1.196	--	20/1	CLASSRM/CORRIDOR LTG	12	12
-	-	-	-	--	1.320	81	B	82	1.779	--	20/1	OFFICE SUITE LIGHTING	12	12
-	-	-	-	--	1.320	83	C	84	1.398	--	20/1	LOBBY/RR/EXAM LTG	12	12

Demand Load Panel Summary: 32.9 KVA; 91.4 AMPS

Connected Load Panel Summary:

Phase A:	17.1 KVA	142.6 AMPS
Phase B:	15.7 KVA	130.7 AMPS
Phase C:	16.5 KVA	137.5 AMPS
Total:	49.3 KVA	

Breaker Options (If Used): TC - Time Clock Control; LO - Lock-On Device; GF - GND Fault CKT Interrupter; SH - Shunt Trip Breaker

Note: Minimum breaker AIC to be 22,000 amps symmetrical (fully rated).

Panel ID: D | **Location: CORRIDOR 121A** | **Mounting: RECESSED** | **Main Type: M.L.O.** | **Voltage: 208 / 120** | **Phase: 3** | **Wire: 4** | **Main Size: 400 Amps** | **Panel Type: LTG & PWR PANEL** | **Enclosure: NEMA-1**

All circuit breakers shall be standard bolt-on type, unless noted otherwise.
** = Refer to one line diagram or floor plan for wire sizes.

GND SIZE	WIRE SIZE	BRANCH CIRCUIT DESCRIPTION	CKT BKR SIZE	CKT BKR OPTION	CONN. LOAD (KVA)	CKT NO.	PHASE	CKT NO.	CONN. LOAD (KVA)	CKT BKR OPTION	CKT BKR SIZE	BRANCH CIRCUIT DESCRIPTION	WIRE SIZE	GND SIZE
12	12	TREATMENT REC E.	20/1	GF	0.540	1	A	2	1.080	GF	20/1	DOG KENNEL/EXTER REC	12	12
12	12	GOWNING REC	20/1	GF	0.540	3	B	4	1.080	GF	20/1	CAT / ISO / ANTEROOM REC	12	12
12	12	PHARMACY COUNTER REC	20/1	GF	0.540	5	C	6	0.900	--	20/1	CUST / FLEX / CLOSET REC	12	12
12	12	PHARMACY ISLAND REC	20/1	GF	0.720	7	A	8	0.540	GF	20/1	CLINIC PREP COUNTER REC	12	12
12	12	TREATMENT TABLE REC E.	20/1	GF	0.360	9	B	10	0.360	GF	20/1	CLINIC PREP COUNTER REC	12	12
12	12	TREATMENT TABLE REC W.	20/1	GF	0.360	11	C	12	1.200	GF	20/1	CLINIC PREP DISHWASHER	12	12
12	12	TREATMENT REC W.	20/1	GF	0.900	13	A	14	0.756	--	20/1	CLINIC PREP DISPOSER	12	12
12	12	N. EXAM ROOM REC	20/1	GF	0.720	15	B	16	1.080	GF	20/1	LAUNDRY/STORAGE REC	12	12
12	12	ULTRASOUND RM REC 1	20/1	GF	0.540	17	C	18	2.000	GF	30/2	LAUNDRY DRYER REC	10	10
12	12	X-RAY ROOM REC 1	20/1	GF	0.540	19	A	20	2.000	--	-	-	10	-
12	12	X-RAY ROOM REC 2 / EPO	20/1	GF	0.540	21	B	22	2.000	GF	30/2	LAUNDRY DRYER REC	10	10
12	12	CLINIC RECEPTION REC	20/1	GF	0.900	23	C	24	2.000	--	-	-	10	-
12	12	CLINIC ALCOVE/TR REC	20/1	GF	0.900	25	A	26	1.200	GF	20/1	LAUNDRY WASHER REC	12	12
12	12	LOBBY / FRONT ENTRY REC	20/1	GF	1.080	27	B	28	1.200	GF	20/1	LAUNDRY WASHER REC	12	12
12	12	PATHOLOGY REC W.	20/1	GF	0.540	29	C	30	1.642	--	20/1	*TREAT/PATH/LNDRY LTG	12	12
12	12	PATHOLOGY REC E.	20/1	GF	0.540	31	A	32	4.992	--	60/2	EV CHARGER 1	4	10
12	12	EWC	20/1	GF	0.500	33	B	34	4.992	--	-	(ALTERNATE)	4	-
-	-	SPARE	20/1	GF	0.000	35	C	36	4.992	--	60/2	EV CHARGER 1	4	10
-	-	SPARE	20/1	GF	0.000	37	A	38	4.992	--	-	(ALTERNATE)	4	-
-	-	SPARE	20/1	GF	0.000	39	B	40	4.992	--	60/2	EV CHARGER 2	4	10
-	-	SPARE	20/1	GF	0.000	41	C	42	4.992	--	-	(ALTERNATE)	4	-
-	-	SPARE	20/1	GF	0.000	43	A	44	4.992	--	60/2	EV CHARGER 2	4	10
-	-	SPARE	20/1	GF	0.000	45	B	46	4.992	--	-	(ALTERNATE)	4	-
-	-	SPARE	20/1	--	0.000	47	C	48	4.992	--	60/2	EV CHARGER 3	4	10
**	**	H-02 ELECTRIC	100/3	--	9.344	49	A	50	4.992	--	-	(ALTERNATE)	4	-
-	**	HUMIDIFIER	-	--	9.344	51	B	52	4.992	--	60/2	EV CHARGER 3	4	10
-	**	-	-	--	9.344	53	C	54	4.992	--	-	(ALTERNATE)	4	-

Demand Load Panel Summary: 109.0 KVA; 302.6 AMPS

Connected Load Panel Summary:

Phase A:	39.0 KVA	325.2 AMPS
Phase B:	38.8 KVA	323.1 AMPS
Phase C:	39.9 KVA	332.8 AMPS
Total:	117.7 KVA	

Breaker Options (If Used): TC - Time Clock Control; LO - Lock-On Device; GF - GND Fault CKT Interrupter; SH - Shunt Trip Breaker

Note: Minimum breaker AIC to be 22,000 amps symmetrical (fully rated).

PRATER Engineering Associates, Inc.
6130 Wilcox Road
Dublin, Ohio 43016
(614) 766 4896
praterengineering.com

JOB NUM. 23357 | CHECKED BY D. POWELL | DRAWN BY D. STAFFORD | DESIGNED BY D. STAFFORD

E-402-23357.DWG

DESIGNED BY: PEA
DRAWN BY: PEA
CHECKED BY: PEA

REVISIONS:	DATE:
ADDENDUM 02	04/01/25

VET TEACHING CENTER
HANOVER COLLEGE
4025 STATE ROUTE 56, HANOVER, IN 47243

ELECTRICAL PANEL SCHEDULES

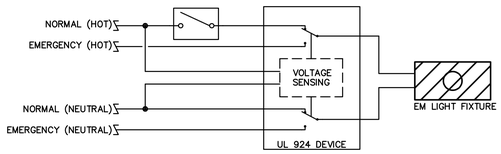
SCALE: As indicated

E-402

JOB NO.: 23009

DATE: 03.07.2025

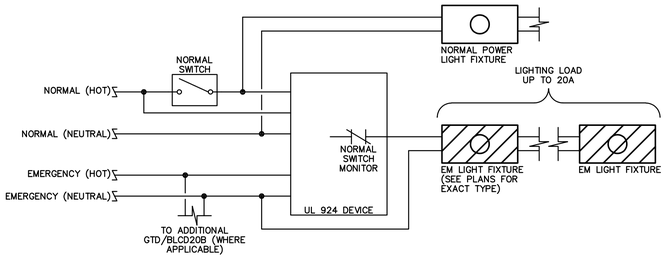
1/16" = 1'-0" 0 4' 8' 16' | 1/8" = 1'-0" 0 2' 4' 8' | 3/16" = 1'-0" 0 2' 4' 8' | 1/4" = 1'-0" 0 1' 2' 4' | 3/8" = 1'-0" 0 1' 2' 4' | 1/2" = 1'-0" 0 6" 1' 2' | 3/4" = 1'-0" 0 3" 6" 1' 2' | 1" = 1'-0" 0 3" 6" 1' 2' | 1 1/2" = 1'-0" 0 3" 6" 1' | 3" = 1'-0" 0 1" 2" 3" 6" 1' | 6" = 1'-0" 0 1" 2" 3" 6"



GENERATOR TRANSFER DEVICE WIRING DIAGRAM

SCALE: NONE

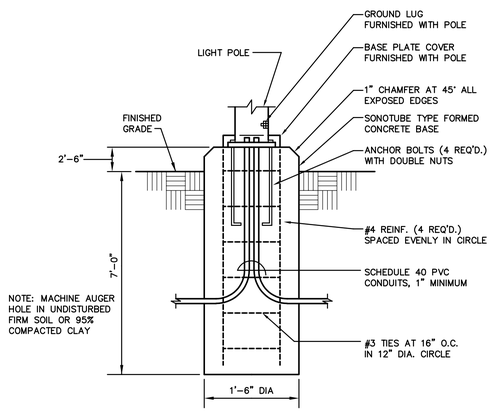
DETAIL SHOWN TO CONVEY DESIGN INTENT BASED ON BODINE #GTD, EQUALS ALLOWED. VERIFY EXACT WIRING WITH MANUFACTURER'S WIRING DIAGRAMS. DEVICE MUST BE UL 924, 1008 LISTED.



20 AMP GENERATOR TRANSFER DEVICE WIRING DIAGRAM

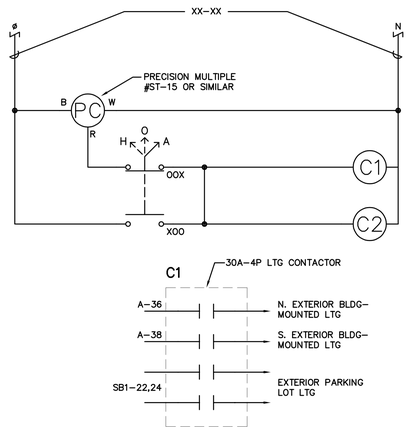
SCALE: NONE

DETAIL SHOWN TO CONVEY DESIGN INTENT BASED ON BODINE #BLCD-20B, EQUALS ALLOWED. VERIFY EXACT WIRING WITH MANUFACTURER'S WIRING DIAGRAMS. DEVICE MUST BE UL 924, 1008 LISTED.



LIGHT POLE BASE DETAIL

SCALE: NONE



EXTERIOR LIGHTING CONTROL DIAGRAM

SCALE: NONE

MOUNT DEVICES IN NEMA-1 ENCLOSURE(S).

FLOOR DEVICE LEGEND

SYMBOL	DESCRIPTION	MODEL #	CONDUIT SIZE
a	4" PVC CAST-IN-PLACE, POWER-ONLY FLOOR BOX WITH (4) SINGLE 20 AMP RECEPTACLES (QUAD OUTLET CONFIGURATION)	CFBS1R4PFB S1R4SPQUAD	(1)3/4" POWER
b	4" PVC CAST-IN-PLACE, DUAL SERVICE FLOOR BOX WITH (1) 20 AMP DUPLEX RECEPTACLE AND (2) KEYSTONE DATA JACKS	CFBS1R4PFB S1R4SP2X2D	(1)3/4" POWER (1)1-1/4" COMM

1. ROUTE ALL CONDUITS IN SLAB OVER TO NEAREST FULL HEIGHT WALL AND TRANSITION TO CEILING SPACE TO CONTINUE HOME RUN, UNLESS NOTED OTHERWISE.
2. PROVIDE PULL STRINGS IN ALL EMPTY CONDUITS.
3. BASIS OF DESIGN FLOOR DEVICES LISTED ABOVE ARE HUBBELL. EQUALS BY WIREMOLD AND MONOSYSTEMS MAY BE FURNISHED AT THE CONTRACTORS OPTION.
4. ALL COVERS SHALL BE FLUSH ALUMINUM WITH GASKETED CABLE HOLE. VERIFY ALL FINISHES AND FLOORING TYPES FOR EACH SPACE WITH ARCHITECT PRIOR TO ORDERING.

LIGHT FIXTURE SCHEDULE

FIXTURE TAG PREFIX INDICATES TYPE OF MOUNTING AS FOLLOWS:
CH-CHAIN MOUNTED; CL-CEILING SURFACE; CV-COVE MOUNTED; EX-EXIT (UNIVERSAL MOUNT U.N.O.); G-GROUND; H-MOUNTED IN HOOD; P-POLE MOUNTED; R-CEILING RECESSED; S-SUSPENDED; T-TRACK MOUNTED; UC-UNDER CABINET; W-WALL MOUNTED; WR-WALL RECESSED.

FIXTURE TAG	DESCRIPTION	B MANUFACTURER	PRODUCT SERIES	LIGHT SOURCE	DRIVER/ CONTROLS	VOLTAGE	REMARKS
CL1	CEILING MOUNTED ARTICULATING EXAM LIGHT WITH INTEGRAL ON/OFF/ INTENSITY CONTROL ON HANDLE	MEDICAL ILLUMINATION MORTECH AMICO	MI550	65W LED (INCLUDED) 55,000 LUX @ 1 METER 4300K, 97CRI	INTEGRAL 2-LEVEL DIMMING	UNIVERSAL	FURNISH AND INSTALL LIGHT UNDER BID ALTERNATE, PROVIDE ROUGH-IN ONLY UNDER BASE BID
CL2	SIMILAR TO CL1, HIGHER LUMEN	MEDICAL ILLUMINATION MORTECH AMICO	MI750	65W LED (INCLUDED) 75,000 LUX @ 1 METER 4300K, 97CRI	INTEGRAL 3-LEVEL DIMMING	UNIVERSAL	FURNISH AND INSTALL LIGHT UNDER BID ALTERNATE, PROVIDE ROUGH-IN ONLY UNDER BASE BID
CL3	SIMILAR TO CL1, HIGHER LUMEN, DUAL HEAD	MEDICAL ILLUMINATION MORTECH AMICO	MI1000	100W LED (INCLUDED) 100,000 LUX @ 1 METER 4300K, 97CRI	INTEGRAL 5-LEVEL DIMMING	UNIVERSAL	FURNISH AND INSTALL LIGHT UNDER BID ALTERNATE, PROVIDE ROUGH-IN ONLY UNDER BASE BID
CV1	0.5" WIDE LINEAR LED TAPE IN EXTRUDED ALUMINUM CHANNEL, CLEAR LENS	LUMINII BEAMEVER –	K45M RGB42HO BELA	6W/FT LED (INCLUDED) 83, 168, 47 LUMENS/FT R,G,B	1% DMX DIMMING AND CONTROL	120V-24V POWER SUPPLY	SEE ARCHITECTURAL DETAILS AND RCPS FOR MOUNTING AND EXACT COVE LENGTHS
G1	3" WIDE FLOOD LED GRADE LIGHT WITH 110° OPTICS, BRONZE FINISH	FC LIGHTING GVA LIGHTING –	FCF1103 FL25	7W LED (INCLUDED) 885 LUMENS, 3000K 80 CRI	NON-DIM	UNIVERSAL (208V-1Ø USED)	PROVIDE CONCRETE BASE IN GRADE PER MFGR'S RECOMMENDATIONS. MOUNT 3'-0" BACK FROM FACE OF SIGNAGE
P1	24" DIAMETER X 15" TALL PENDANT SMOOTH WHITE ACRYLIC LENS	ANP LIGHTING BASELITE	MDS24LED PEY	29W LED (INCLUDED) 3500K, 2000 LUMEN 90 CRI	1% 0-10V DIMMING	UNIVERSAL	SEE ARCH SHEETS FOR SUSPENSION HEIGHT
PL1	25" X 13" X 7" TALL LED AREA LIGHT W/ 16'-0" ROUND ALUMINUM POLE, TYPE IV DISTRIBUTION	LSI LUMARK –	MRS PREVAIL DISCRETE	39W LED (INCLUDED) 6000 LUMENS, 3000K 80 CRI	NON-DIM	UNIVERSAL (208V-1Ø USED)	MOUNT ON 10'-0" POLE, TOP OF FIXTURE @ 12'-6" W/ CONCRETE BASE. HOUSE-SIDE SHIELD ON PERIMETER FIX.
PL2	SIMILAR TO PL1, TYPE V DISTR. – –	LSI LUMARK –	MRS PREVAIL DISCRETE	39W LED (INCLUDED) 6000 LUMENS, 3000K 80 CRI	NON-DIM	UNIVERSAL (208V-1Ø USED)	MOUNT ON 10'-0" POLE, TOP OF FIXTURE AT 12'-6" WITH CONCRETE BASE
R1	2X2 ARCHITECTURAL TROFFER WITH CURVED FLOATING CENTER BASKET, ACRYLIC LENS	WILLIAMS METALUX –	AT122 22CZ2	37W LED (INCLUDED) 4000 LUMENS, 3500K 80 CRI	1% 0-10V DIMMING	UNIVERSAL	
R2	SIMILAR TO R1, WARMER CCT	WILLIAMS METALUX –	AT122 22CZ2	37W LED (INCLUDED) 4000 LUMENS, 3000K 80 CRI	1% 0-10V DIMMING	UNIVERSAL	
R3	2X4 ARCHITECTURAL TROFFER WITH CURVED FLOATING CENTER BASKET, ACRYLIC LENS	WILLIAMS METALUX –	AT124 22CZ4	48W LED (INCLUDED) 5500 LUMENS, 3500K 80 CRI	1% 0-10V DIMMING	UNIVERSAL	
R4	2X4 LOW PROFILE TROFFER WITH SMOOTH POLYCARBONATE LENS, WET LISTED	FAILSAFE – –	FLR2	41W LED (INCLUDED) 5500 LUMENS, 4000K 80 CRI	1% 0-10V DIMMING	UNIVERSAL	
R5	SIMILAR TO R4, LOWER LUMENS WARMER CCT	FAILSAFE – –	FLR2	30W LED (INCLUDED) 4000 LUMENS, 3500K 80 CRI	1% 0-10V DIMMING	UNIVERSAL	
R6	36" DIAMETER RECESSED DOWNLIGHT WITH OPAL WHITE LENS	PICASSO LIGHTING – –	JULIETTE 3	42W LED (INCLUDED) 3700 LUMENS, 3500K 80 CRI	10% 0-10V DIMMING	UNIVERSAL	
R7/R7W	6" APERTURE RECESSED LED DOWNLIGHT, SEMI SPEC. REFLECTOR, WHITE TRIM	WILLIAMS HALO –	6DR TL WW HC6	9W LED (INCLUDED) 1000 LUMENS, 3500K 80 CRI	10% 0-10V DIMMING	UNIVERSAL	FOR FIXTURES TAGGED R7W, PROVIDE WALL WASH LENS. ORIENT TO WASH NEAREST WALL
R8	6" APERTURE RECESSED LED DOWNLIGHT, SEMI SPEC. REFLECTOR, WHITE TRIM, WET LISTED LENS	WILLIAMS HALO –	6DR TL HC6	19W LED (INCLUDED) 2000 LUMENS, 3500K 80 CRI	10% 0-10V DIMMING	UNIVERSAL	
R9	4" WIDE RECESSED LINEAR LED ASYMMETRIC (MARKER BOARD) WASH, LENGTH AS SHOWN ON PLANS	BIRCHWOOD LUMENWERX NEORAY	JAK-LED-WW-350 VIA 4 S124DR	9W/FT LED (INCLUDED) 670 LUMENS/FT, 3500K 80 CRI	10% 0-10V DIMMING	UNIVERSAL	
S1	4' LONG INDUSTRIAL LED STRIP W/ DIFFUSE ACRYLIC LENS, CHAIN OR SURFACE MOUNT	WILLIAMS METALUX –	75R SNX	33W LED (INCLUDED) 5000 LUMENS, 3500K 80 CRI	10% 0-10V DIMMING	UNIVERSAL	SURFACE OR SUSPEND MOUNT 8'-0". COORDINATE LOCATION & MOUNTING TO AVOID CONFLICT WITH ALL TRADES
W1	16" TALL 7" WIDE GEORGIAN COACH LIGHT, WALL MOUNT, GRAPHITE FINISH	ELA LIGHTING VISUAL COMFORT & CO –	4411 8824-12	(1)10W E26 LED RETROFIT 1200 LUMENS, 3000K 80 CRI	NON-DIM	UNIVERSAL	SEE ARCHITECTURAL ELEVATIONS FOR MOUNTING HEIGHT ABG AT EACH LOCATION
W2	ARCHITECTURAL WALL PACK WITH TYPE II DISTRIBUTION, WET LISTED	WILLIAMS MCGRAW EDISON –	VWPH T2 GWC T2	49W LED (INCLUDED) 6000 LUMENS, 3500K 80 CRI	NON-DIM	UNIVERSAL	SEE ARCHITECTURAL ELEVATIONS FOR MOUNTING HEIGHT ABG AT EACH LOCATION
W3	SIMILAR TO W2, TYPE III DISTRIBUTION LOWER LUMENS	WILLIAMS MCGRAW EDISON –	VWPH T3 GWC T3	27W LED (INCLUDED) 3000 LUMENS, 3500K 80 CRI	NON-DIM	UNIVERSAL	SEE ARCHITECTURAL ELEVATIONS FOR MOUNTING HEIGHT ABG AT EACH LOCATION
W4	SIMILAR TO W2, TYPE IV DISTRIBUTION	WILLIAMS MCGRAW EDISON –	VWPH TFT GWC T4FT	49W LED (INCLUDED) 6000 LUMENS, 3500K 80 CRI	NON-DIM	UNIVERSAL	SEE ARCHITECTURAL ELEVATIONS FOR MOUNTING HEIGHT ABG AT EACH LOCATION
W5	SIMILAR TO W2, TYPE IV DISTRIBUTION HIGHER LUMENS	WILLIAMS MCGRAW EDISON –	VWPH TFT GWC T4FT	72W LED (INCLUDED) 8500 LUMENS, 3500K 80 CRI	NON-DIM	UNIVERSAL	SEE ARCHITECTURAL ELEVATIONS FOR MOUNTING HEIGHT ABG AT EACH LOCATION
W6	24" WALL MOUNTED DIRECT/INDIRECT DECORATIVE BATHROOM VANITY WALL SCONCE	ARTEMIDE LUMENWERX LIGHTWAY	LINEA FLAT 24 DUAL WALO VTLV-LED	42W LED (INCLUDED) 1835 LUMENS, 3500K 80 CRI	NON-DIM	UNIVERSAL	WALL MOUNT ABOVE MIRROR PER ARCHITECTURAL PLANS
W7	43" LONG ART LAMP WITH 4.5" X 17.75" BACK PLATE	HOUSE OF TROY – –	DSLEDZ43	13.5W LED (INCLUDED) 2700K, 1080 LUMENS 90 CRI	TRIAC DIMMING	120V	SEE ARCHITECTURAL ELEVATIONS FOR MOUNTING HEIGHT ABOVE WALL ART
EX1	UNIVERSAL MOUNT/FACE LED EXIT SIGN, RED LETTERS, WHITE THERMO-PLASTIC HOUSING, 90 MIN BATTERY	SURE-LITES CHLORIDE	LPX CLX	3W LED (INCLUDED)	NON-DIM	UNIVERSAL	SEE PLANS FOR NUMBER OF FACES, ARROWS, AND CEILING/WALL MOUNT

ADDITIONAL SPECIFICATIONS:

ALL COLORS AND FINISHES SHALL BE SELECTED/VERIFIED BY ARCHITECT/OWNER PRIOR TO ORDERING.

ALL HATCHED EMERGENCY LIGHT FIXTURES (EXAMPLE: R4) SHOWN WITH LIGHTING CONTROL SHALL BE PROVIDED WITH A UL924 / UL 1008 (AS APPLICABLE) GENERATOR TRANSFER DEVICE (GTD) TO BE INSTALLED ABOVE THE ACCESSIBLE CEILING OR IN THE FIXTURE'S DRIVER COMPARTMENT. FIXTURES LOCATED WITHIN THE SAME SPACE AND CONTROLLED BY A COMMON DEVICE OR ON THE SAME SWITCH LEG MAY SHARE A COMMON GTD RATED FOR SUCH USE AT THIS CONTRACTOR'S OPTION. COORDINATE FINAL DEVICE AND WIRING WITH EACH FIXTURE/ CONTROL COMBINATION USED SO THAT LIGHTING FIXTURES AUTOMATICALLY ILLUMINATE TO FULL OUTPUT UPON LOSS OF NORMAL POWER REGARDLESS OF PREVIOUS CONTROLLED STATE.

LIGHT FIXTURES LISTED ON TOP LINE ARE BASIS OF DESIGN. EQUIVALENT FIXTURES LISTED ON LINES 2 AND 3 MAY BE SUBMITTED FOR OWNER AND A/E APPROVAL, PENDING THE CONTRACTOR TO ENSURES ALL EQUIVALENT FEATURES MATCH THE BASIS OF DESIGN IN APPEARANCE, PERFORMANCE, MOUNTING TYPE, DIMENSIONS, ETC.

DOUGLAS L. POWELL REGISTERED No. PE11900479 STATE OF INDIANA PROFESSIONAL ENGINEER
3/7/2025

PRATER Engineering Associates, Inc.
6130 Wilcox Road
Dublin, Ohio 43016
(614) 766 4896
praterengineering.com

JOB NUM. 23357 | CHECKED BY D. POWELL | DRAWN BY D. STAFFORD | DESIGNED BY D. STAFFORD

E-500-23357.DWG

DESIGNED BY:	PEA
DRAWN BY:	PEA
CHECKED BY:	PEA

REVISIONS:	DATE:
ADDENDUM 02	04/01/25

VET TEACHING CENTER
HANOVER COLLEGE
4025 STATE ROUTE 56, HANOVER, IN 47243

ELECTRICAL SCHEDULES AND DETAILS

SCALE: As indicated

E-500

JOB NO.: 23009

DATE: 03.07.2025