

2.11 AIR FILTRATION

- A. Unit shall be equipped with a 6" filter rack upstream of the evaporator:
 - 1. 2" deep, MERV 8
 - 2. 12" deep, MERV 13
- B. Minimum arresance and MERV according to ASHRAE 52.2.

2.12 ELECTRIC RESISTANCE HEAT

- A. Heaters shall meet the requirements of the National Electrical Code and shall be listed by Underwriters Laboratories for zero clearance to combustible surfaces and for use with heat pumps and air conditioning equipment.
- B. Heating elements shall be open coil, 80 percent nickel, 20 percent chromium, Grade A resistance wire. Type C alloys containing iron or other alloys are not acceptable.
- C. Coils shall be machine crimped into stainless steel terminals extending at least 1 inch into the air stream and all terminal hardware shall be stainless steel.
- D. Coils shall be supported by ceramic bushings staked into supporting brackets.
- E. Heater frames and terminal boxes shall be corrosion resistant steel. Unless otherwise indicated, the terminal box shall be NEMA 1 construction and shall be provided with a hinged, latching cover.
- F. Heaters shall be furnished with a disc type, automatic reset thermal cutout for primary over temperature protection.
- G. All heaters shall also be furnished with disc type, load-carrying manual reset thermal cutouts, factory wired in series with heater stages for secondary protection. Heat limiters or other fusible over temperature devices are not acceptable.
- H. Control will be SCR type.

2.13 DAMPERS

- A. Refer to Section 233300 "Air Duct Accessories" for damper product data and additional requirements. Dampers shall be provided by the air-handing unit manufacturer. Actuators shall be provided by the BAS provider.
- B. Return-, and Relief-Air Control Dampers:
 - 1. Type: Opposed-blade.
 - 2. Material: Galvanized steel. Provide extruded-aluminum in units with aluminum inside casing wall.
 - 3. Leakage: Class IA.
 - 4. Damper Operators: Comply with requirements in Section 230900 "Building Automation and Temperature Control System."
- C. Backdraft Dampers:
 - 1. Type: Parallel-blade.
 - 2. Material: Galvanized steel. Provide extruded-aluminum in units with aluminum inside casing wall.

3. Damper Operators: Gravity.
- D. Smoke Dampers:
1. Type: Opposed-blade.
 2. Material: Galvanized steel. Provide extruded-aluminum in units with aluminum inside casing wall.
 3. Leakage: Class I.
 4. Damper Motor: Two-position action, as required.
- E. Isolation Dampers:
1. Type: Opposed-blade.
 2. Material: Galvanized steel. Provide extruded-aluminum in units with aluminum inside casing wall.
 3. Leakage: Class I.
 4. Damper Operators: Comply with requirements in Section 230900 "Building Automation and Temperature Control System."
- F. Outdoor Airflow Measuring and Control Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. TAMCO/EBTRON AIR-IQ
 - b. Greenheck AMD-TD
 2. Type: Factory assembled, damper mounted electronic thermal dispersion airflow and temperature measurement device.
 3. Mounting: The suitable for horizontal or vertical airflow applications, as required.
 4. Performance:
 - a. Leakage: Class 1A.
 - b. Operating Temperature Limits: -20°F to 160°F.
 - c. Temperature Accuracy: $\pm 0.14^\circ\text{F}$ over the entire operating temperature range.
 - d. Airflow Accuracy: $\pm 2\%$ of reading.
 - e. Airflow Rates: 0 to 5,000 FPM.
 5. Damper and Sleeve:
 - a. Frame: Galvanized steel 5" x 1" structural hat channel, minimum 16 gauge.
 - b. Blades: Heavy gauge extruded aluminum, airfoil shape.
 - c. Blade Orientation: Horizontal.
 - d. Blade Operation: Opposed blade or parallel.
 - e. Seals:
 - 1) Blade Edge: Silicon or extruded EPDM, mechanically fastened to each blade.
 - 2) Frame: Extruded silicon.
 - f. Linkage: Concealed in frame out of the airstream, plated steel material.
 - g. Axles: Minimum $\frac{1}{2}$ inch dia. stainless steel or aluminum. Removable control shaft shall extend 6" beyond the damper frame.
 - h. Bearings: 304 stainless steel or celcon acetal copolymer.
 - i. Sleeve: 18-inch, minimum 20 gauge sleeve with air straightener.
 6. Airflow/Temperature Measurement Devices
 - a. Probes: Each sensor probe shall consist of one to eight independent sensor nodes in a gold anodized, aluminum 6063 alloy tube with 304 stainless steel mounting brackets.
 - b. Sensor Node: Each sensor node shall consist of two hermetically sealed bead-in-glass thermistors. Chip thermistors of any type or packaging are not acceptable.
 - c. Sensor Density Requirements: Number of individual sensor nodes provided for each damper location shall be detailed in published documentation by the manufacturer.
 - d. Wiring: All internal wiring between thermistors and probe connecting cables shall be Kynar jacketed.

- 1) Manufacturer shall provide UL listed, FEP jacketed, plenum rated cable(s) between sensor probes and the remote transmitter.
7. Transmitter:
- a. Supplied by the same manufacturer as the measuring station.
 - b. Input power shall be 24VAC/24VDC. Include over-voltage and over-current protection, and ensure continuous operation following power failures and/or brown-outs.
 - c. Analog output shall be field configurable as linear 0-5 VDC, 0-10 VDC or 4-20mA signals.
 - d. Two isolated and fused analog output signals and one RS-485 network connection
 - 1) One analog output signal shall provide the average airflow rate.
 - 2) One analog output signal shall be field configurable to output the average temperature, the velocity weighted temperature or a binary airflow alarm.
 - 3) The RS-485 network connection shall be field configurable as BACnet MS/TP.
 - e. The RS-485 connection shall transmit the average airflow rate, average temperature, individual airflow rates of each sensor node, and individual temperatures of each sensor node and system status.
 - f. High visibility backlit LCD for display of either the averaged or individual sensor airflow and temperature measurements, in user selectable units of measure.

2.14 ELECTRICAL POWER CONNECTIONS

- A. AHU shall have a single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.
 1. SCCR rating shall be a minimum of 65kA.
- B. Field wiring access shall be provided thru unit base into isolated enclosure with removable cover.
- C. All low voltage field wiring connections shall be made at factory installed low voltage terminal strip.

2.15 CONTROLS

- A. Control equipment and sequence of operation are specified in Section 230900 "Building Automation and Temperature Control System" and indicated on the drawings.
- B. AHU DDC controller shall be by the unit manufacturer and unit configuration shall be coordinated with contract documents.
- C. Unit System Control Points:
 1. Outdoor Air Temperature Sensor
 2. Outdoor Air Humidity Sensor
 3. Outdoor Air Flow Measuring Station
 4. Outdoor Air Modulating Damper and Actuator
 5. Return Air/Mixed Air Modulating Damper and Actuator
 6. Filter Differential Pressure Switch - Status
 7. 0-10 vDc Input for Dual Compressor Capacity Modulation
 8. Evaporator Leaving Air Temperature Sensor
 9. 0-10 vDc Input for Hot Gas Reheat Modulation
 10. Supply Fan Status
 11. Supply Fan Piezometer Air Flow Measuring Station

12. Supply Fan VFD Control
13. 0-10vDc Input for Natural Gas Heater Modulation
14. Relief Air Damper and Actuator
15. Relief Fan VFD Control
16. Return Air Enthalpy Sensor – Humidity and Temperature
17. Space Static Pressure Sensor – Building Pressure Control
18. Discharge Temperature Sensor
19. Duct Static Pressure Sensor – Supply Fan VFD Control

D. System Control shall include:

1. Anti-cycle timing.
2. Minimum compressor run/off-times.

E. Interface Requirements for Building Automation and Temperature Control System:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.
3. Provide compatible interface for central HVAC control workstation for the following:
 - a. Adjusting set points.
 - b. Monitoring supply fan start, stop, and operation.
 - c. Inquiring data to include outdoor-air damper position, supply- and room-air temperature and humidity.
 - d. Monitoring occupied and unoccupied operations.
 - e. Monitoring constant and variable motor loads.
 - f. Monitoring variable-frequency drive operation.
 - g. Monitoring cooling load.
 - h. Monitoring economizer cycles.
 - i. Monitoring air-distribution static pressure and ventilation air volume.

2.16 ACCESSORIES

- A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.
- B. Low-ambient kit using for operation down to 25 deg F.
- C. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.
- D. Remote potentiometer to adjust minimum economizer damper position.
- E. Return-air bypass damper.
- F. Factory- or field-installed demand-controlled ventilation.
- G. Safeties:
 1. Smoke detector.
 2. Condensate overflow switch.
 3. Phase-loss reversal protection.
 - a. Phase Unbalance Protection: Factory set 2%
 - b. Over/Under/Brown Out Voltage Protection: +/-10% of nameplate voltage
 - c. Phase Loss/Reversal.
 4. High and low pressure control.

- 5. Electric coil airflow-proving switch.
- H. Coil guards of painted, galvanized-steel wire.
- I. Hail guards of galvanized steel, painted to match casing.
- J. Door switches to disable heating or reset set point when open.
- K. Outdoor air intake weather hood with moisture eliminator.
- L. Service Lights and Switch: Factory installed in each accessible section with weatherproof cover. Factory wire lights to a single-point field connection.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of AHUs.
- B. Examine roughing-in for AHUs to verify actual locations of piping and duct connections before equipment installation.
- C. Examine roofs for suitable conditions where AHUs will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Equipment Mounting:
 - 1. Install AHUs on cast-in-place concrete equipment bases.
 - 2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

3.3 CONNECTIONS

- A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.
- B. Comply with duct installation requirements specified in other HVAC Sections. Drawings indicate general arrangement of ducts. The following are specific connection requirements:
 - 1. Connect supply ducts to AHUs with flexible duct connectors specified in Section 233300 "Air Duct Accessories."
- C. Connect electrical wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

- E. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplate shall be laminated acrylic or melamine plastic signs as layers of black with engraved white letters at least 1/2 inch high.
 - 2. Locate nameplate where easily visible.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections with the assistance of a factory-authorized service representative.
- C. Tests and Inspections:
 - 1. After installing AHUs and after electrical circuitry has been energized, test units for compliance with requirements.
 - 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. AHU will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Inspect for visible damage to unit casing.
 - 3. Inspect for visible damage to furnace combustion chamber.
 - 4. Inspect for visible damage to compressor, coils, and fans.
 - 5. Inspect internal insulation.
 - 6. Verify that labels are clearly visible.
 - 7. Verify that clearances have been provided for servicing.
 - 8. Verify that controls are connected and operable.
 - 9. Verify that filters are installed.
 - 10. Clean condenser coil and inspect for construction debris.
 - 11. Clean furnace flue and inspect for construction debris.
 - 12. Connect and purge gas line.
 - 13. Remove packing from vibration isolators.
 - 14. Verify lubrication on fan and motor bearings.
 - 15. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
 - 16. Adjust fan belts to proper alignment and tension.
 - 17. Start unit according to manufacturer's written instructions.
 - a. Start refrigeration system.
 - b. Do not operate below recommended low-ambient temperature.
 - c. Complete startup sheets and attach copy with Contractor's startup report.
 - 18. Inspect and record performance of interlocks and protective devices; verify sequences.
 - 19. Operate unit for an initial period as recommended or required by manufacturer.
 - 20. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency:

- a. Measure gas pressure on manifold.
 - b. Inspect operation of power vents.
 - c. Measure combustion-air temperature at inlet to combustion chamber.
 - d. Measure flue-gas temperature at furnace discharge.
 - e. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
 - f. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
21. Calibrate thermostats.
 22. Adjust and inspect high-temperature limits.
 23. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
 24. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:
 - a. Coil leaving-air, dry- and wet-bulb temperatures.
 - b. Coil entering-air, dry- and wet-bulb temperatures.
 - c. Outdoor-air, dry-bulb temperature.
 - d. Outdoor-air-coil, discharge-air, dry-bulb temperature.
 25. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
 26. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
 - a. Supply-air volume.
 - b. Return-air volume.
 - c. Relief-air volume.
 - d. Outdoor-air intake volume.
 27. Simulate maximum cooling demand and inspect the following:
 - a. Compressor refrigerant suction and hot-gas pressures.
 - b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.
 28. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
 - a. High-temperature limit on gas-fired heat exchanger.
 - b. Low-temperature safety operation.
 - c. Filter high-pressure differential alarm.
 - d. Economizer to minimum outdoor-air changeover.
 - e. Relief-air fan operation.
 - f. Smoke alarms.
 29. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.6 CLEANING AND ADJUSTING

- A. After completing system installation and testing, adjusting, and balancing AHU and air-distribution systems, clean filter housings and install new filters.

3.7 DEMONSTRATION

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

END OF SECTION 237416.13

SECTION 238126 – SPLIT SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied color finishes.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
 - 1. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and

Section 7 - "Construction and System Start-up."

- C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

1.7 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Division 03.
- B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.8 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period:
 - a. For Compressor: Five year(s) from date of Substantial Completion.
 - b. For Parts: Five year(s) from date of Substantial Completion.
 - c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Mitsubishi PKFY/PUMY multi-zone heat pump system or comparable product by one of the following:
 - 1. Carrier Corporation; Home Comfort and HVAC Building & Industrial Systems.
 - 2. Mitsubishi Electric & Electronics USA, Inc.; HVAC Advanced Products Division.
 - 3. Trane; a business of American Standard companies.
 - 4. YORK; a Johnson Controls company.
 - 5. Daikin Applied

2.2 INDOOR UNITS (5 TONS OR LESS)

- A. Wall-Mounted, Evaporator-Fan Components:
 - 1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
 - 2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
 - 3. Fan: Direct drive, centrifugal.
 - 4. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.

- c. Enclosure Type: Totally enclosed, fan cooled.
 - d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
 - e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
 - f. Mount unit-mounted disconnect switches on exterior or interior of unit.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
6. Condensate Drain Pans:
- a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
 - 1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
 - 2) Depth: A minimum of 1 inch deep.
 - b. Insulated, stainless-steel sheet.
 - c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
 - 1) Minimum Connection Size: NPS 1.
 - d. Drain pan level sensor.
7. Air Filtration Section:
- a. General Requirements for Air Filtration Section:
 - 1) Comply with NFPA 90A.
 - 2) Minimum MERV according to ASHRAE 52.2.
 - 3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
 - b. Disposable Panel Filters:
 - 1) Factory-fabricated, viscous-coated, flat-panel type.
 - 2) Thickness: 1 inch.
 - 3) MERV according to ASHRAE 52.2: 5.
 - 4) Media: Interlaced glass fibers sprayed with nonflammable adhesive.
 - 5) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

2.3 OUTDOOR UNITS (5 TONS OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

- 1. Capable of providing variable refrigerant flow control for multiple indoor units.
- 2. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
- 3. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload

devices, start capacitor, relay, and contactor.

- a. Compressor Type: Scroll.
 - b. Refrigerant: R-410A.
 - c. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
4. Fan: Aluminum-propeller type, directly connected to motor.
 5. Motor: Permanently lubricated, with integral thermal-overload protection.
 6. Low Ambient Kit: Permits operation down to 45 deg F.
 7. Mounting Base: Polyethylene.

2.4 ACCESSORIES

- A. Thermostat: Low voltage with subbase to control compressor and evaporator fan with the following features:
 1. 24-hour time control of system stop and start.
 2. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
 3. Fan-speed selection including auto setting.
- B. Automatic-reset timer to prevent rapid cycling of compressor.
- C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Equipment Mounting:
 1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Division 03.
 2. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
 3. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Mechanical Vibration, Sound and Seismic Controls."
- D. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

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

- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

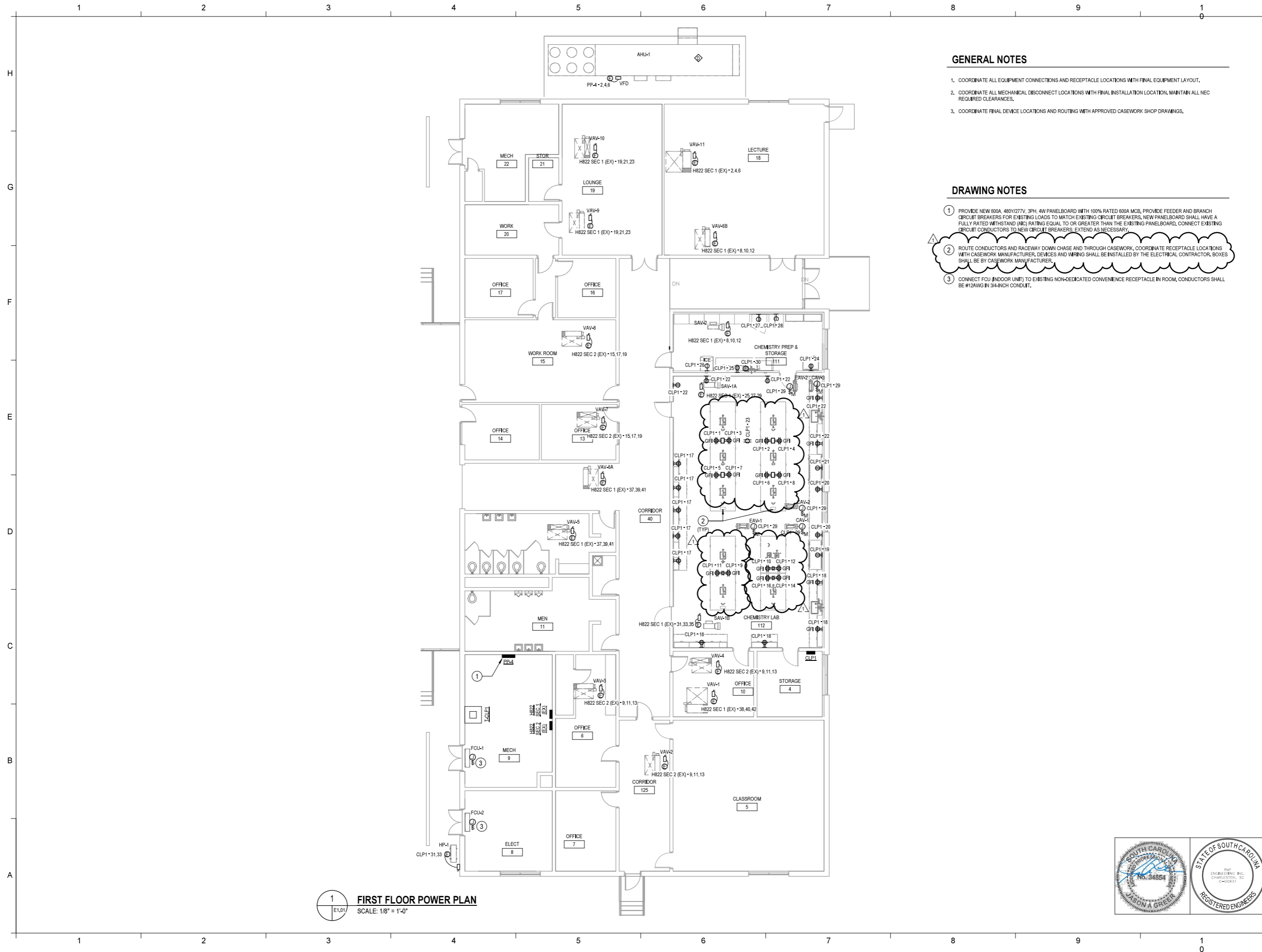
3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126



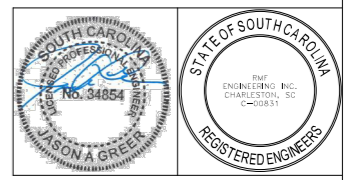
GENERAL NOTES

- COORDINATE ALL EQUIPMENT CONNECTIONS AND RECEPTACLE LOCATIONS WITH FINAL EQUIPMENT LAYOUT.
- COORDINATE ALL MECHANICAL DISCONNECT LOCATIONS WITH FINAL INSTALLATION LOCATION. MAINTAIN ALL NEC REQUIRED CLEARANCES.
- COORDINATE FINAL DEVICE LOCATIONS AND ROUTING WITH APPROVED CASEWORK SHOP DRAWINGS.

DRAWING NOTES

- PROVIDE NEW 600A, 480Y/277V, 3PH, 4W PANELBOARD WITH 100% RATED 600A MCB, PROVIDE FEEDER AND BRANCH CIRCUIT BREAKERS FOR EXISTING LOADS TO MATCH EXISTING CIRCUIT BREAKERS. NEW PANELBOARD SHALL HAVE A FULLY RATED WITHSTAND (AIC) RATING EQUAL TO OR GREATER THAN THE EXISTING PANELBOARD, CONNECT EXISTING CIRCUIT CONDUCTORS TO NEW CIRCUIT BREAKERS. EXTEND AS NECESSARY.
- ROUTE CONDUCTORS AND RACEWAY DOWN CHASE AND THROUGH CASEWORK. COORDINATE RECEPTACLE LOCATIONS WITH CASEWORK. MANUFACTURER, DEVICES AND WIRING SHALL BE INSTALLED BY THE ELECTRICAL CONTRACTOR. BOXES SHALL BE BY CASEWORK MANUFACTURER.
- CONNECT FCU (INDOOR UNIT) TO EXISTING NON-DEDICATED CONVENIENCE RECEPTACLE IN ROOM. CONDUCTORS SHALL BE #12AWG IN 3/4-INCH CONDUIT.

1 FIRST FLOOR POWER PLAN
SCALE: 1/8" = 1'-0"



101 E. Washington Street, Suite 200
Greenville, SC 29601
T 864.527.0460
GMCNETWORK.COM

ISSUE FOR BID	ISSUE DATE
ADDENDUM 1	11/13/18
	12/19/18

DRAWN BY: BWT
CHECKED BY: JAG

USC Sumter - Science Building
Renovation
200 Miller Road Sumter, SC
RMF # 316434.E0
OSE # H39-9520
ISSUE FOR BID

mf Engineering
14 SEVEN FARMS DRIVE
CHARLESTON, SC 29402

SUITE D
843.971.9639

**ELECTRICAL POWER
PLAN - FIRST FLOOR**

E1.01

PANELBOARD: PP-4														
LOCATION: Surface				MAINS: MCB				AMPS: 600						
MOUNTING: Surface				VOLTS: 480/277 Wye										
ENCL NEMA: Type 1				PHASE: 3										
MIN AIC: 65,000				WIRES: 4										
PANEL NOTES: PROVIDE GROUND BUS PROVIDE FULL SIZE NEUTRAL BUS UNLESS NOTED OTHERWISE PANEL SHALL BE SERVICE ENTRANCE RATED WITH 100% RATED MCB														
WIRE SIZE	LOAD DESCRIPTION	P	TRIP AMPS	TYPE	CKT	A	B	C	CKT	TYPE	TRIP AMPS	P	LOAD DESCRIPTION	WIRE SIZE
EXISTING	H822 SEC 1 (EXISTING - 22)	3	400 A		1	26.94	48.67		2		225 A	3	AHU-1	(4)4/0, #4G, 2-1/2" C
					3		26.94	48.67	4					
					5			26.94	48.67	6				
					7	0.00	14.23		8					
					9			0.00	13.57	10				
					11				10.44	12				
					13	0.00	0.00			14				
					15			0.00	0.00	16				
					17				0.00	18				
					19	0.00	0.00			20				
					21			0.00	0.00	22				
					23				0.00	24				
					25	0.00	0.00			26				
					27			0.00	0.00	28				
					29				0.00	30				
					31	0.00	0.00			32				
					33			0.00	0.00	34				
					35				0.00	36				
					37	0.00	0.00			38				
					39			0.00	0.00	40				
					41				0.00	42				
					43	0.00	0.00			44				
					45			0.00	0.00	46				
					47				0.00	48				
TOTAL LOAD:						89.84 kVA	89.18 kVA	86.05 kVA						
BREAKER TYPE KEYS: LO - INDICATES C.B. EQUIPPED WITH "LOCK-ON" DEVICE GF - INDICATES C.B. IS GROUND FAULT TYPE (5mA FOR PERSONNEL) ST - INDICATES C.B. EQUIPPED WITH SHUNT TRIP DEVICE HT - INDICATES C.B. EQUIPPED WITH 30mA GROUND FAULT FOR EQUIPMENT														
Load Classification				Connected Load	Demand Factor	Estimated Demand	Panel Totals							
Power				0.00	0.00%	0.00								
REC				24.06	70.78%	17.03	Total Conn. Load: 265.07 kVA							
Equipment				95.01	100.00%	95.01	Total Est. Demand: 258.04 kVA							
HVAC				146.00	100.00%	146.00	Total Conn. Current: 318.83 A							
							Total Est. Demand Current: 310.37 A							

PANELBOARD: CLP1															
LOCATION: STORAGE 4				MAINS: MCB				AMPS: 150							
MOUNTING: Surface				VOLTS: 208/120 Wye											
ENCL NEMA: Type 1				PHASE: 3											
MIN AIC: 10,000				WIRES: 4											
PANEL NOTES: PROVIDE GROUND BUS PROVIDE FULL SIZE NEUTRAL BUS UNLESS NOTED OTHERWISE															
WIRE SIZE	LOAD DESCRIPTION	P	TRIP AMPS	TYPE	CKT	A	B	C	CKT	TYPE	TRIP AMPS	P	LOAD DESCRIPTION	WIRE SIZE	
#12, 3/4"	REC CHEMISTRY LAB 112	1	20 A		1	1.50	1.50		2		20 A	1	REC CHEMISTRY LAB 112	#12, 3/4"	
#12, 3/4"	REC CHEMISTRY LAB 112	1	20 A		3		1.50	1.50	4		20 A	1	REC CHEMISTRY LAB 112	#12, 3/4"	
#12, 3/4"	REC CHEMISTRY LAB 112	1	20 A		5			1.50	1.50	6	20 A	1	REC CHEMISTRY LAB 112	#12, 3/4"	
#12, 3/4"	REC CHEMISTRY LAB 112	1	20 A		7	1.50	1.50		1.50	8	20 A	1	REC CHEMISTRY LAB 112	#12, 3/4"	
#12, 3/4"	REC CHEMISTRY LAB 112	1	20 A		9			1.50	1.50	10	20 A	1	REC CHEMISTRY LAB 112	#12, 3/4"	
#12, 3/4"	REC CHEMISTRY LAB 112	1	20 A		11			1.50	1.50	12	20 A	1	REC CHEMISTRY LAB 112	#12, 3/4"	
	SPARE	1	20 A		13	0.00	1.50			14	20 A	1	REC CHEMISTRY LAB 112	#12, 3/4"	
	SPARE	1	20 A		15			0.00	1.50	16	20 A	1	REC CHEMISTRY LAB 112	#12, 3/4"	
	SPARE	1	20 A		17				0.90	18	20 A	1	REC CHEMISTRY LAB 112	#12, 3/4"	
#12, 3/4"	REC CHEMISTRY LAB 112	1	20 A		19	1.20	0.36			20	20 A	1	REC CHEMISTRY LAB 112	#12, 3/4"	
#12, 3/4"	REC CHEMISTRY LAB 112	1	20 A		21		1.20	0.90		22	20 A	1	REC CHEMISTRY LAB 112	#12, 3/4"	
#12, 3/4"	REC CHEMISTRY LAB 112	1	20 A		23			0.18	1.20	24	20 A	1	REC CHEMISTRY LAB 112	#12, 3/4"	
#12, 3/4"	REC CHEMISTRY PREP &...	1	20 A	GF	25	1.50	1.80			26	GF	20 A	1	REC CHEMISTRY PREP &...	#12, 3/4"
#12, 3/4"	REC CHEMISTRY PREP &...	1	20 A	GF	27		0.50	1.50		28	GF	20 A	1	REC CHEMISTRY PREP &...	#12, 3/4"
#12, 3/4"	EAV - 1, CAV - 1, 2, 3, 4 RM...	1	20 A		29			0.00	1.44	30	GF	20 A	1	IWH-1 CHEMISTRY PREP ...	#12, 3/4"
(2)#10, #10G, 3/4"	HP-1	2	25 A		31	1.87	0.00			32		20 A	1	SPARE	
					33		1.87	0.00		34		20 A	1	SPARE	
	SPARE	1	20 A		35			0.00	0.00	36		20 A	1	SPARE	
	SPARE	1	20 A		37	0.00	0.00			38		20 A	1	SPARE	
	SPARE	1	20 A		39			0.00	0.00	40		20 A	1	SPARE	
	SPARE	1	20 A		41			0.00	0.00	42		20 A	1	SPARE	
TOTAL LOAD:						14.23 kVA	13.57 kVA	10.44 kVA							
BREAKER TYPE KEYS: LO - INDICATES C.B. EQUIPPED WITH "LOCK-ON" DEVICE GF - INDICATES C.B. IS GROUND FAULT TYPE (5mA FOR PERSONNEL) ST - INDICATES C.B. EQUIPPED WITH SHUNT TRIP DEVICE HT - INDICATES C.B. EQUIPPED WITH 30mA GROUND FAULT FOR EQUIPMENT															
Load Classification				Connected Load	Demand Factor	Estimated Demand	Panel Totals								
REC				24.06	70.78%	17.03	Total Conn. Load: 38.24 kVA								
Equipment				14.18	100.00%	14.18	Total Est. Demand: 31.21 kVA								
HVAC				0.00	0.00%	0.00	Total Conn. Current: 106.14 A								
							Total Est. Demand Current: 86.63 A								

GENERAL NOTES

- PANELBOARD SCHEDULES SHOW NEW LOADS ONLY.
- CONTRACTOR SHALL FIELD VERIFY BREAKERS TO BE DEMOLISHED AS PART OF EQUIPMENT DEMOLITION.
- AT COMPLETION OF PROJECT, CONTRACTOR SHALL UPDATE PANELBOARD DIRECTORIES TO REFLECT AS-BUILT CONDITION.

PANELBOARD: H822 SEC 1 (EX)														
LOCATION: Surface				MAINS: MCB				AMPS: 400						
MOUNTING: Surface				VOLTS: 480/277 Wye										
ENCL NEMA: Type 1				PHASE: 3										
MIN AIC: EXISTING				WIRES: 4										
PANEL NOTES: PROVIDE GROUND BUS PROVIDE FULL SIZE NEUTRAL BUS UNLESS NOTED OTHERWISE														
WIRE SIZE	LOAD DESCRIPTION	P	TRIP AMPS	TYPE	CKT	A	B	C	CKT	TYPE	TRIP AMPS	P	LOAD DESCRIPTION	WIRE SIZE
					1	0.00	2.67		2		20 A	3	VAV - 13 LECTURE 18	#12, 3/4"
					3		0.00	2.67	4					
					5			0.00	2.67	6				
					7	0.00	3.00		8					
					9			0.00	3.00	10				
					11				3.00	12				
					13	0.00	0.00			14				
					15			0.00	0.00	16				
					17				0.00	18				
					19	2.83	0.00			20				
					21			2.83	0.00	22				
					23				2.83	24				
					25	3.00	0.00			26				
					27			3.00	0.00	28				
					29				3.00	30				
					31	3.00	0.00			32				
					33			3.00	0.00	34				
					35				3.00	36				
					37	3.33	2.50			38				
					39			3.33	2.50	40				
					41				3.33	42				
					43	6.61	0.00			44				
					45			6.61	0.00	46				
					47				6.61	48				
TOTAL LOAD:						26.94 kVA	26.94 kVA	26.94 kVA						
BREAKER TYPE KEYS: LO - INDICATES C.B. EQUIPPED WITH "LOCK-ON" DEVICE GF - INDICATES C.B. IS GROUND FAULT TYPE (5mA FOR PERSONNEL) ST - INDICATES C.B. EQUIPPED WITH SHUNT TRIP DEVICE HT - INDICATES C.B. EQUIPPED WITH 30mA GROUND FAULT FOR EQUIPMENT														
Load Classification				Connected Load	Demand Factor	Estimated Demand	Panel Totals							
Power				0.00	0.00%	0.00								
Equipment				80.83	100.00%	80.83	Total Conn. Load: 80.83 kVA							
							Total Est. Demand: 80.83 kVA							
							Total Conn. Current: 97.22 A							
							Total Est. Demand Current: 97.22 A							

PANELBOARD: H822 SEC 2 (EX)														
LOCATION: Surface				MAINS: MCB				AMPS: 400						
MOUNTING: Surface				VOLTS: 480/277 Wye										
ENCL NEMA: Type 1				PHASE: 3										
MIN AIC: EXISTING				WIRES: 4										
PANEL NOTES: PROVIDE GROUND BUS PROVIDE FULL SIZE NEUTRAL BUS UNLESS NOTED OTHERWISE														
WIRE SIZE	LOAD DESCRIPTION	P	TRIP AMPS	TYPE	CKT	A	B	C	CKT	TYPE	TRIP AMPS	P	LOAD DESCRIPTION	WIRE SIZE
					1	0.00			2					
					3			0.00	4		20 A	3	EXISTING LOAD	
					5				0.00	6				
					7	0.00	0.00		8					
					9			3.00	0.00	10				
					11				3.00	12				
					13	3.00	0.00			14				
					15			2.33	0.00	16				
					17				2.33	18				
					19	2.33	0.00			20				
					21			1.28	0.00	22				
					23				1.28	24				
					25	1.28	0.00			26				



101 E. Washington Street, Suite 200
 Greenville, SC 29601
 T 864.527.0460
 GMNETWORK.COM

ISSUE DATE	11/13/18
ISSUE FOR BID	
APPENDUM 1	12/19/18
DRAWN BY:	NEU
CHECKED BY:	CRB

USC Sumter - Science Building
 Renovation
 200 Miller Road Sumter, SC
 RMF # 316434.E0
 OSE # H39-9520
 ISSUE FOR BID



mf Engineering
 1000 W. Highway 101
 Charleston, SC 29405
 843.371.6699

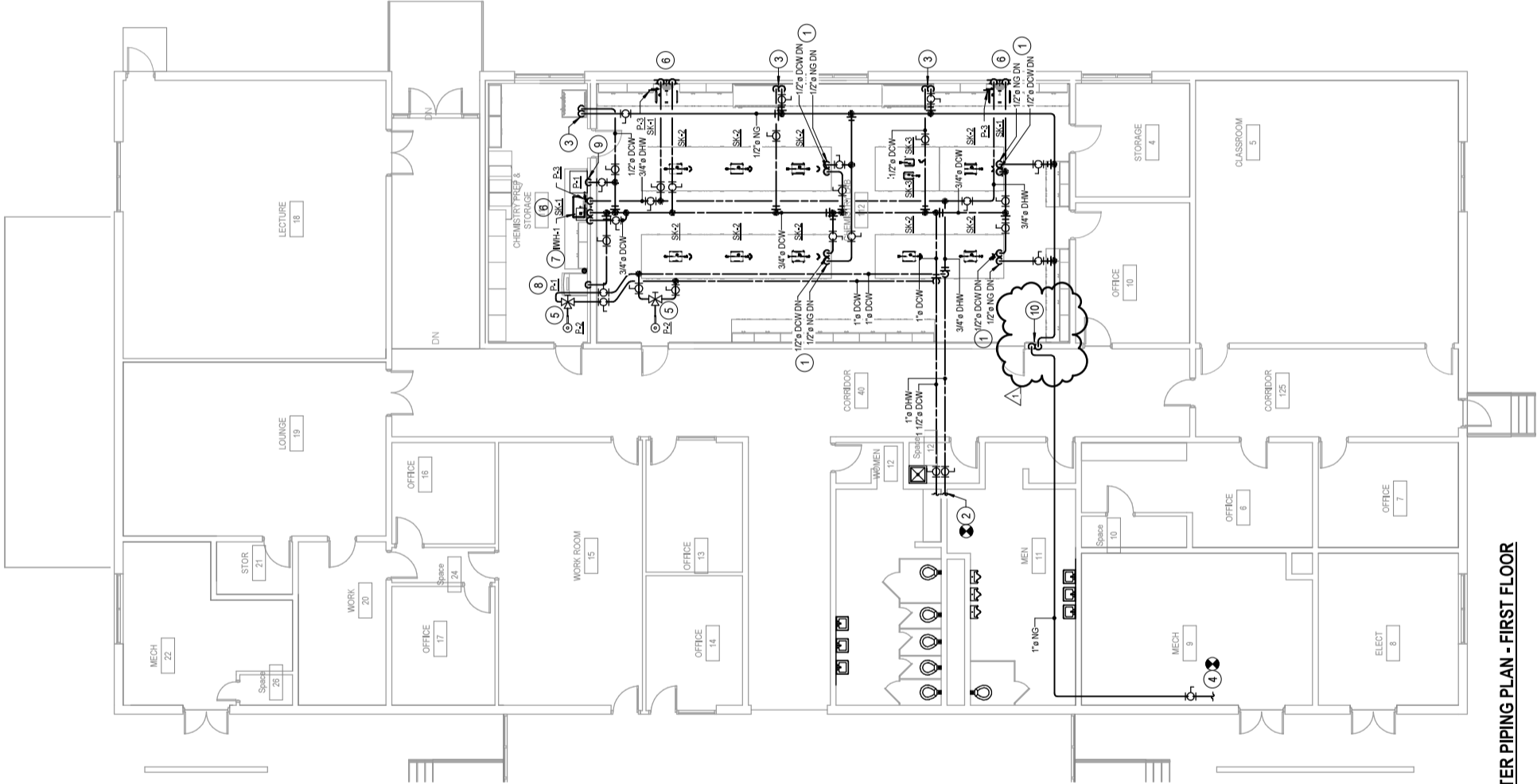
P2.01
 FLOOR
 PIPING PLAN - FIRST
 DOMESTIC WATER

GENERAL NOTES

- REFER TO P2.01 FOR GENERAL NOTES.

DRAWING NOTES

- ROUTE 1/2" DOMESTIC COLD WATER AND 1/2" NATURAL GAS PIPING DOWN THROUGH PIPING CHASE INTO MECH ROOMS. PROVIDE SHUT OFF VALVE IN MECH ROOM. PROVIDE SHUT OFF VALVE IN ACCESSIBLE AREA ABOVE CEILING. TEMPER WATER TO 90°F. ROUTE 1/2" NATURAL GAS TO GAS TUBES VALVES. SHUT OFF VALVES SHALL BE PROVIDED ON NATURAL GAS AND DOMESTIC COLD WATER PIPING WITHIN CASEWORK AND SHALL BE ACCESSIBLE THROUGH CABINETS.
- CONNECT NEW 1/2" DOMESTIC COLD WATER AND 1" DOMESTIC HOT WATER PIPING TO EXISTING PIPING AT REST ROOM.
- 1/2" DOMESTIC COLD WATER AND 1/2" NATURAL GAS PIPING DOWN TO FUME HOOD CONNECTIONS, COORDINATE CONNECTIONS WITH MANUFACTURER'S INSTRUCTIONS.
- CONNECT 1" NATURAL GAS PIPING TO EXISTING NATURAL GAS PIPING IN MECHANICAL ROOM.
- PROVIDE THERMOSTATIC MIXING VALVE IN ACCESSIBLE AREA ABOVE CEILING. TEMPER WATER TO 90°F. ROUTE 1" TEMPERED WATER TO EMERGENCY SHOWER.
- 3/4" DOMESTIC COLD AND HOT WATER DOWN TO LAB SINK AND EMERGENCY EYE WASH. PROVIDE THERMOSTATIC MIXING VALVE FOR EYE WASH. ACCESSIBLE BELOW LAB SINK. TEMPER WATER TO 90°F.
- CONNECT 3/4" DOMESTIC COLD WATER TO INSTANTANEOUS WATER HEATER. ROUTE HOT WATER PIPING FROM INSTANTANEOUS WATER HEATER TO DISHWASHER WATER INLET CONNECTION.
- PROVIDE WATER CONNECTION BOX FOR ICE MAKER WATER CONNECTION.
- PROVIDE WATER CONNECTION BOX FOR WATER DRINKER CONNECTION.
- PROVIDE EMERGENCY GAS SHUT OFF VALVE IN WALL MOUNTED VALVE BOX.



GRAPHIC SCALE
 0 4 8 16
 SCALE: 1/8" = 1'-0"
 UNIT OF MEASURE: FEET

PROJECT LOCATION

EXISTING

REGISTERED ENGINEER
 STATE OF SOUTH CAROLINA
 PROFESSIONAL ENGINEERING BOARD
 REGISTERED ENGINEER
 MICHAEL E. MELTZER
 LICENSE NO. 12033

1 DOMESTIC WATER PIPING PLAN - FIRST FLOOR
 SCALE: 1/8" = 1'-0"