# STATEMENT OF WORK

## Air Handling Units
## Procurement and Installation

### Building 170 Penthouse Air Handling Units

### Veterans Affairs
### North Little Rock, Arkansas

**January 6, 2014**

**TME Project No. 01-11-0014**

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# STATEMENT OF WORK

## HVAC Modifications Scope of Work

The project includes the demolition and replacement of four (4) variable volume penthouse air-handling units installed on the roof of Building 170 at the Fort Roots Department of Veterans Affairs, North Little Rock, Arkansas. The existing air handling units were installed in 1980 and currently serve four floors of patient rooms and nursing wings. Each air handling unit is located directly above chases containing the associated ductwork and piping. Each unit has a 6 ft. wide service vestibule for maintenance and all unit control panels are located in the vestibule.

The footprint of the new equipment will match the existing air handlings units so that the existing concrete curbs may be re-used. Air handling unit sections shall be constructed to match the concrete support structure of the existing air handling units. After existing air handling units are removed, contractor shall determine the size and location of all intermediate concrete supports and coordinate with the air handling unit manufacturer. If additional support is needed, contractor shall provide full-width beams or concrete to facilitate the air handling unit installation. The AHU discharge and inlet locations will be determined by the existing chase locations. New discharge and inlet ducts will reconnect to the existing duct risers.

Layouts of the existing air handling units are provided in the Appendix for reference only. Contractor shall verify all existing conditions prior to bid.

## Scheduling of Work

The patient wings are occupied and utilized throughout the entire year. Consequently, the work will have to be carefully sequenced in such a manner as to minimize the disruption of normal operations, temperature and humidity control. All utility system and equipment shutdowns will have to be scheduled in advance with VA personnel. Temporary space conditioning will have to be provided. Shutdowns involving the disruption of space heating or space cooling equipment will have to be scheduled when weather permits (heating systems may be shutdown during warm weather and cooling systems may be shutdown during cool weather). The contractor shall provide temporary roof-mounted air handling units for conditioning. Temporary supply and return ductwork will have to be routed from the temporary units and connected to the existing duct risers. The contractor shall coordinate the size and location of all openings required in the new air handling units for routing temporary ductwork to the existing duct risers. All openings shall be factory cut. The contractor shall be responsible for all general construction, electrical, plumbing and mechanical provisions required to maintain a tempered space condition. The method, capacity, and duration of temporary conditioning shall be approved by the Owner. Where coordinated with the Owner limited shutdowns may occur over weekend holidays and nights for areas where the building is not occupied during these timeframes.

## General Conditions

All materials and workmanship shall comply with all applicable codes, specifications, local ordinances, industry standards and utility company regulations. Where specific code

requirements apply, they shall be included in the job, whether or not specifically shown or elsewhere specified.

In case of difference between building codes, specifications, state laws, local ordinances, industry standards and utility company regulations and the Contract Documents, the most stringent shall govern.

All required fees, permits and inspections of all kind shall be obtained and paid for by the Contractor under the section of the specifications for which they are required.

This Contractor shall visit the site of the building before submitting a proposal on this work, and shall thoroughly familiarize himself with the existing conditions and operations. Failure on his part to do this will not be cause of extras after the contract is signed, by reason of unforeseen conditions.

The Contractor shall instruct the representative of the Owner in the proper operation and maintenance of all elements of the mechanical and electrical systems. A competent representative of the Contractor shall spend sufficient time in such formal instruction to fully prepare the Owner to operate and maintain the HVAC Systems.

The Contractor shall provide 2 sets of hardback loose leaf binders including catalog data of each manufactured item of equipment used in the HVAC work and shall furnish this booklet to the Engineer for transmittal to the Owner before final payment is made. Each maintenance catalog shall be provided a complete set of submittals on all HVAC equipment, descriptive data, installation data, operating instructions, parts lists, and maintenance instructions.

All materials shall be new and shall bear the manufacturer's name, trade name and the UL label in every case where a standard has been established for the particular material. The equipment to be furnished under each section of the specification shall be essentially the standard product of a manufacturer regularly engaged in the production of the required type of equipment, and shall be the manufacturer's latest approved design.

When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer. Equipment and materials of the same general type shall be of the same make throughout the work to provide uniform appearance, operation and maintenance. Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.

Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.

Equipment and materials shall be delivered to the site and stored in the original containers, suitably sheltered from the elements. Items subject to moisture damage (such as controls) shall be stored in dry, heated spaces

Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical injury and theft. At the completion of the work, fixtures, equipment, and materials shall be cleaned and polished thoroughly. Damage or defects developing before acceptance of the work shall be made good at the Contractor's expense.

It shall be the responsibility of the Contractor to insure that items to be furnished fit the space available. The Contractor shall make necessary field measurements to ascertain space requirements, including those for connections, and shall furnish and install such

sizes and shapes of equipment that the final installation shall suit the true intent of this Statement of Work.

Manufacturer's directions shall be followed completely in the delivery, storage, protection, and installation of all equipment and materials. Should the Contractor perform any work that does not comply with the manufacturer's directions, he shall bear all costs arising in correcting the deficiencies.

The Contractor shall furnish and install all equipment, accessories, connections, and incidental items necessary to fully complete the work, ready for use, occupancy and operation by the Owner.

The location of all components (fan coil unit, control panels, VFDs, lights, outlets, etc.) shall match the layout of the AHU-6A vestibule unless otherwise directed by the Owner.

## Fan Coil Units

Fan coil units will be used to condition the air handling unit vestibules. The fan coil units will be of the horizontal cabinet type with integral stamped louvers for discharge and return. Moisture detectors connected to the energy management system will be installed in the primary drain pans. Fan coil units will be equipped with 1 row heating water coil and 3 row chilled water coil. Fan coil units will be furnished with valve packages and fan contactors. Fan coil units will be as manufactured by Trane, International Environmental, McQuay, York, or approved equal.

## Chilled Water

The existing chilled water piping risers will be reused. New chilled water supply and return piping will be connected to the existing risers and routed under the vestibule floor to the air handling unit and fan coil unit chilled water coils. Automatic air vents will be installed at all high points with drain lines piped to the nearest floor drain. New chilled water piping will be sized to provide a maximum velocity of 7 feet per second and a maximum water pressure drop of 2 feet w.g. per 100 feet of piping.

Shut-off valves will be installed for each fan coil unit, air-handling unit, and also for each air handling unit coil. Shut-off valves 2-1/2” and smaller will be of the ball type. 3” shut-off valves will be gate type with non-rising stem. Shut-off valves 4” and larger will be of the butterfly type with gear operators.

Piping accessories shall be installed per the cooling coil connection detail included in the Appendix.

Condensate drain piping from the air-handling units and fan coil units will be trapped appropriately for the application and routed to existing condensate floor drains.

Chilled water piping 3” and larger will be Schedule 40 black steel with 150 lb. welded connections. Chilled water piping 2-1/2” and smaller will be Type “L” hard drawn copper with solder joint wrought copper tube fittings. Condensate drain and auxiliary drain piping 1-1/4” and larger will be DWV copper with cast brass drainage fittings. Condensate drain and auxiliary drain piping 1” and smaller will be Type “M” copper with solder joint wrought copper tube fittings.

## Steam

Medium pressure steam piping will be routed from existing piping risers to the air handling unit preheat coils and humidifiers. Low pressure steam return will be connected to the existing steam return riser. The existing steam return riser is shown as 1-1/2" on existing drawings. If existing steam return is less than 1-1/2", contractor shall remove and replace riser piping with new 1-1/2" piping down to flash tank.

Piping accessories shall be installed per the steam coil connection detail included in the Appendix.

Steam supply piping will be schedule 40 black steel with weld fittings and 150 lb. Weld fittings (3" and larger) or 150 lb. Malleable iron threaded fittings (2-1/2" and smaller). Steam return piping will be schedule 80 black steel with weld fittings and 300 lb. Weld fittings (3" and larger) or 300 lb. Malleable iron threaded fittings (2-1/2" and smaller).

Steam traps at drip traps will be of the inverted bucket type. Steam traps will be selected based upon the calculated steam flow requirement with an appropriate safety factor and pressure drop for the application.

## Heating Water

The existing heating water piping risers will be reused. New heating water supply and return piping will be connected to the existing risers and routed under the vestibule floor to the fan coil unit heating water coil. Automatic air vents will be installed at all high points with drain lines piped to the nearest floor drain. New heating water piping will be sized to provide a maximum velocity of 7 feet per second and a maximum water pressure drop of 2 feet w.g. per 100 feet of piping.

Piping accessories shall be installed per the heating coil connection detail included in the Appendix.

Shut-off valves will be installed for each fan coil unit. Shut-off valves 2-1/2" and smaller will be of the ball type.

Heating water piping 2-1/2" and smaller will be type "L" hard drawn copper with solder joint wrought copper tube fittings.

## Air Distribution

Smoke dampers will be provided with the air handling unit and located in the main supply and return air duct connections at chase penetrations in accordance with NFPA 90A and the Arkansas Fire Prevention Code.

Smoke dampers will be installed in accordance with SMACNA and NFPA 90A requirements. Smoke dampers will be as manufactured by Prefco or approved equal. Dampers will be furnished with electric actuators. Smoke dampers and actuators shall be accessible from within the AHU.

Duct mounted smoke detectors will be located in the main supply air and return air branch ducts at each floor. Duct mounted smoke detectors will be connected to the building fire alarm system. Existing smoke detectors may be reused.

Medium pressure supply air (air handling unit discharge) ducts will be rectangular and sized to match the existing supply duct configuration. Ducts will be fabricated from galvanized sheet metal. Sheet metal gages, reinforcing joints, seams, etc. will be in accordance with SMACNA standards for medium pressure ducts. All duct seams will be sealed with Hardcast IG-601 Iron Grip sealer or approved equal.

## Insulation

Insulation shall be manufactured in accordance with ASTM, UL and NFPA standards and meet the requirements of a flame spread rating of 25 or less and smoke developed rating of 50 or less.

Installer shall be a firm with at least 5 years of successful installation experience on projects with work similar to this project.

Steam supply and return piping will be insulated with fiberglass insulation. Steam piping where exposed will be additionally covered with canvas jacketing.

Chilled water piping will be insulated with fiberglass insulation. Chilled water piping where exposed will be covered with a PVC jacket.

Condensate drain piping will be insulated with fiberglass. Condensate drain piping where exposed will be covered with a PVC jacket. The waste p-traps below floor drains, where evaporator drains empty into floor drains, will be wrapped with closed cell elastomeric foam insulation.

Heating water piping will be insulated with fiberglass insulation. Heating water piping where exposed will be additionally covered with a canvas jacket.

Fiberglass (Mineral Fiber) Pipe Insulation: Thermal conductivity shall be no greater than 0.23 btu in/hr sq. ft degrees F at 75 F mean temperature per ASTM C547 and rated for 0 to 850 F. Pipe insulation shall be furnished with factory applied white all service (ASJ) vapor barrier jacket with self-sealing lap (ASJ-SSL). Fittings shall be pre-molded from same material. Fiberglass pipe insulation shall be equal to Owens-Corning "Fiberglas SSL II".

Pipe insulation thickness shall be as follows:

| | | |
|---|---|---|
| 1. | Chilled Water Supply & Return | 1" and Smaller; 1" Thick |
| 2. | Chilled Water Supply & Return | 1-1/4" to 4"; 1" Thick |
| 4. | Heating Water Supply & Ret. up to 200 deg | 1" and Smaller, 1" Thick |
| 5. | Heating Water Supply & Ret. up to 200 deg | 1-1/4" to 6", 1-1/2" Thick |
| 6. | Steam Supply & Ret. (0 to 15 psig) | 2" and Smaller, 1-1/2" Thick |
| 7. | Steam Supply & Ret. (0 to 15 psig) | 2-1/2" and Larger, 2" Thick |
| 8. | Steam Supply & Ret. (16 to 59 psig) | 1" and Smaller, 2" Thick |
| 9. | Steam Supply & Ret. (16 to 59 psig) | 1-1/4" to 4", 2-1/2" Thick |

Piping shall be protected by a smooth 20 mil PVC jacket. Jacket shall comply with ASTM D 1784, Class 14523-C. Jacket shall overlap not less than 2 inches at longitudinal and circumferential joints and shall be secured with a welding adhesive, recommended by the jacket manufacturer. All ells, tees and fitting covers shall be 2 piece, factory fabricated type. Jacket shall be equal to Ceel-Co model 55 Oz. Below 40 F and above 250 F provide double layer insert. Provide color matching, vapor barrier, pressure sensitive tape.

Provide semi-circular protection saddles of #18-gauge galvanized steel, 12" long, for insulated piping where hangers occur. On pipe sizes 3" and over, provide pressure treated wood blocking matching insulation thickness, at hangers. Steel protection saddles shall be used at steam piping. Space between pipe and roller hanger inside saddle shall be insulated.

Valves and fittings on all piping shall be completely insulated with fiberglass block insulation. Vapor retarders shall overlap a minimum of 2” at all seams and be sealed with appropriate pressure sensitive tape or mastic. All penetrations, facing damage, and mechanical fasteners shall be covered with a minimum 2” overlap to tape or mastic.

All cut openings or other penetrations on insulated pipes for pressure gauges, thermometers, pressure and temperature plugs, flow switches, pressure sensors, temperature sensors, etc. shall be sealed vapor tight. Sufficient layers of waterproof mastic shall be applied to avoid water ponding and damage to insulation

Unions, flexible connectors, control valves, PRVs, safety valves and discharge vent piping, vacuum breakers, thermostatic vent valves, steam traps 3/4" inch and smaller shall not be insulated. Insulate piping to within 3” inches of un-insulated devices.

All ductwork shall be insulated with 2 inch thickness fiberglass duct wrap. Thermal conductivity shall be no greater than 0.36 btu in/hr sq. ft degrees F at 75 F mean temperature per ASTM C177 at 25 percent compression. Insulation shall be rated for -20 to 450 F. Duct insulation shall be furnished with a 2 mil foil scrim kraft vapor barrier (FSK) and have a density of 0.75 pcf. Insulation wrap shall be equal to Knauf.

The application of all insulation shall be performed by experienced mechanics, regularly employed in the trade, in a neat and workmanlike manner, with jackets and facings drawn tight and smoothly cemented at all laps. All materials shall be installed in strict accordance with manufacturer's recommendations, building codes and industry standards.

On cold surfaces where a vapor barrier must be maintained, insulation shall be applied with a continuous, unbroken moisture and vapor seal. All hangers, supports, anchors, or other projections that are secured to cold surfaces shall be insulated and vapor sealed to prevent condensation.

Secure blanket insulation with adhesive and anchor pins and speed washers.

1. Install duct wrap to obtain specified R-value using maximum compression of 25%. Pull jacket tight and smooth. Install thickness in accordance with the specifications.
2. Impale insulation over anchors and attach speed washers. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
3. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2 inch staples, 1 inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
4. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches o.c.
5. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

6. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6 inch wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
7. All seams shall be sealed with pressure-sensitive tape matching the insulation facing. Seal all tears, punctures, and other penetrations of the duct wrap facing with tape or mastic to provide a vapor-tight system.
8. Pressure sensitive tapes shall be a minimum 3 inches wide and applied with a moving pressure using an appropriate tool as recommended by the manufacture.
9. On flat surfaces over 18 inches wide, duct wrap shall be additional secured to the bottom of the ductwork using mechanical fasteners on 18 inch centers, without over compression of the insulation.

## Automatic Temperature Controls

The new air handling units will be connected to the existing Siemens Control System. All controls points, wiring and devices shall be provided by the ATC contractor. The existing DDC control panels are located in the existing AHU vestibules and shall be reused. All control panels, field equipment panels, and VFDs shall be located in the new air handling unit vestibules.

Each supply and relief fan will have a dedicated variable frequency drive. Each variable frequency drive will be equipped with an input circuit breaker, input reactance, output reactance, EMS interface, and manual bypass. Variable frequency drives shall be able to be pad locked in the open position. Variable frequency drives will be as manufactured by ABB.

Building pressure transmitter(s) shall be located in the air handling unit vestibule. Provide Dwyer DM-2000 Pressure Transmitter or approved equal. Transmitters shall have an operating range of -1/4 to +1/4 inch w.g. and a control accuracy of +/- 0.001 inches w.g. Transmitters shall have an integral LCD readout for continuous display of current differential pressure. Building pressure sensors shall be centrally located on each floor.

All valve and damper actuators shall be provided by the ATC except smoke damper actuators. Actuators on new valves and dampers will be electronic type. All exposed control wiring will be installed in conduit. Control valves at new air handling units will be of the 2-way modulating type.

Contractor shall coordinate with VA maintenance personnel to ensure that all existing control points and sequences are included in the new air handling units installation. New sequences shall be provided for the operation of the relief fan array, supply fan array, and for emergency mode. The existing graphics display shall be updated to include all new control points.

Points shall include but are not limited to:

1. Chilled water supply temperature
2. Chilled water return temperature
3. Chilled water differential pressure

4. Heating water supply temperature
5. Heating water return temperature
6. Heating water differential pressure
7. Steam supply pressure
8. Steam return pressure
9. Steam flow
10. Return air temperature
11. Return air humidity
12. Outside airflow
13. Outside air temperature
14. Outside air humidity
15. Supply air temperature
16. Mixed air temperature
17. Preheat coil entering air temperature
18. Preheat coil leaving air temperature
19. Chilled water coil entering air temperature
20. Chilled water coil leaving air temperature
21. Humidifier status
22. Humidifier high limit
23. Supply fan status (each fan)
24. Supply fan speed (each fan)
25. Supply fan airflow (each fan)
26. Supply fan isolation damper status (each fan)
27. Relief fan status (each fan)
28. Relief fan speed (each fan)
29. Relief fan airflow (each fan)
30. Relief fan isolation damper status (each fan)
31. Safeties (freeze stat (individually monitored), high static, VFD alarms, smoke detector, etc.)
32. Chilled water valve position
33. Steam valve position
34. Filter differential pressure (each filter)
35. Filter alarm (each filter)
36. Photo Catalytic Air Cleaning System status
37. Duct static pressure

38. Smoke damper status (each damper)
39. Building Pressure (each transmitter)
40. Economizer damper position (each damper)
41. Relief damper position (each damper)

The fan array sequence of operation will be as indicated below:

Fans shall be sequenced to run only the number of fans required to maintain the control setpoint (duct static pressure, building differential pressure, airflow, etc.). When multiple fans are running, they shall be controlled by the same control signal. Fans shall run between 15% and 95% of maximum fan speed.

The relief fan sequence of operation will be as indicated below:

The relief fan(s) shall operate in sequence to maintain the building differential pressure setpoint. If one fan fails to start or shuts down, remaining fan shall continue to operate and a fan failure alarm is generated at the EMS.

The relief fan(s) shall be interlocked to run when air handling unit supply fan(s) are in operation. The relief fan variable frequency drives shall be modulated to maintain the building differential pressure at +0.02 inches water gauge (adjustable). The relief fan(s) shall stop if the differential pressure remains less than +0.01 and the variable frequency drive is at minimum for greater than 30 minutes.

The existing smoke purge sequence shall be modified to maintain -0.05" w.g. on any floor with a smoke detector in alarm condition.

The fan coil unit sequence of operation will be as indicated below:

Cooling: On an increase in return air temperature, the heating water control valve will be modulated closed, chilled water control valve will be modulated open, and the fan speed will be sequenced as required to maintain the return air temperature at the cooling setpoint of 80 deg. F (the chilled water control valve will be fully opened on low fan speed before the fan speed is changed from low speed to medium speed and from medium speed to high speed).

Heating: On a decrease in return air temperature, the chilled water control valve will be modulated closed, heating water control valve will be modulated open, and the fan speed will be sequenced as required to maintain the return air temperature at the heating setpoint of 60 deg. F (the heating water control valve will be fully opened on low fan speed before the fan speed is changed from low speed to medium speed and from medium speed to high speed).

## Electrical

1. Disconnect and remove existing conduits and cabling serving the following Air Handlers which are connected to existing Motor Control Centers:
    a. EMCC-P1:
        1) SF-4, SF-5, SF-6, SF-7 (existing cabling assumed to be 3#1/0 & 1#6- 1-1/2”C)
    b. EMCC-P2:
        1) SF-4A, SF-5A, SF-7A (existing cabling assumed to be 3#1/0 & 1#6- 1-1/2”C)
    c. MCC-P1:
        1) RF-4, RF-5 (existing cabling assumed to be 3#6 & 1#10-1”c)
        2) RF-6, RF-7 (existing cabling assumed to be 3#8 & 1#10-1"c)
    d. MCC-P2:
        1) RF-4A, RF-5A (existing cabling assumed to be 3#6 & 1#10-1”c)
        2) RF-7A (existing cabling assumed to be 3#8 & 1#10-1"c)

    Cabling to be returned to the Owner or if Owner directs remove the cabling from the site.
2. Disconnect existing motors and associated combination 2 speed motor starters for the above air handlers. Remove existing combination 2 speed motor starters and return to Owner. Remove existing starters from site if Owner directs.
3. Remove existing disconnect bucket and fuses in the associated Motor Control Centers serving the above air handlers. Remove from site.
4. Install new VFD’s dedicated per each new replacement fan. in new AHU (Total of 4 relief fans and four supply fans per each new AHU). See photo 4.1 below for example of installation in existing AHU-6A in POD#2.

Photo 4.1

5. Per each new AHU, provide two new 250Amps, 480/277V 3-phase, 4-wires, mains only, 30 space panelboard, and two new 8”X8”X6’ wireway with removable cover to serve as new AHU Relief Fan Distribution Panelboard and AHU Supply Fan Distribution Panelboard respectively. See photo 4.1 above for example of installation in existing AHU-6A in POD#2.

   Following is the description of the associated electrical work to each new panelboard:

   a. Install both new panels and wireways inside AHU vestibule.

   b. Furnish and Install four (4) new 3-pole circuit breakers in Relief Fan Distribution Panelboard. Each circuit breaker to serve one of the four new relief fans in the AHU through associated VFD. Label panel as “RFDP-AHU#” (AHU Relief Fan Distribution Panelboard) or as directed by owner. Size, provide and install circuit breakers per AHU manufacturer recommendations.

   c. Furnish and Install four (4) 3-pole circuit breakers. Each Circuit breaker to serve one of the four new supply fans in the AHU through associated VFD. Label panel as “SFDP-AHU#” or as directed by owner. Size, provide and install circuit breakers per AHU manufacturer recommendations.

   d. Each Relief Fan Distribution Panelboard in AHU will be fed from existing disconnect bucket in the normal power MCC located in its corresponding pod.

   e. Each Supply Fan Distribution Panelboard in AHU will be fed from existing disconnect bucket in the Emergency power MCC located in its corresponding pod.

f. Run new 90 C copper cables in new 2” RGS conduits between existing Emergency power EMCC and each new Supply Fan Distribution Panelboard in AHU.

g. Run new copper 90 C cables in new 1-1/2” RGS conduit between existing Normal power MCC and each new Relief Fan Distribution Panelboard in AHU.

h. Size cables per NFPA 70 article 430.24 for conductors supplying several motors and use NFPA 70 table 310.16 for cable ampacities. Use latest NFPA 70 version.

i. Run new 90 C copper cables between new Fan Distribution Panelboards in AHU (“RFDP-AHU#” and “SFDP-AHU#”) and each new VFD’s through new 8”x8”x6’ wireway, and run new 90 C copper cables in new RGS conduit between new VFD and its associated fan motor. Match existing VA cable color coding scheme.

j. Size cables per NFPA 70 article 430.22 for conductors supplying a single motor and use NFPA 70 table 310.16 for cable ampacities. Use latest NFPA 70 version.

k. Install new disconnect bucket and fuses in existing disconnect buckets spaces left in place in corresponding MCC and EMCC in each building pod to serve Relief and Supply Fan distribution Panels in each new AHU. Provide Disconnect bucket as required and size fuse per NFPA 70 article 430.53 for several motors connected to one branch circuit and select fuse type per manufacturer recommendations. Use latest NFPA 70 version. See photo 5.k.1 bellow for existing disconnects buckets in MCC and photo 5.k.2 for existing 200amp disconnects buckets in EMCC

Photo 5.k.1 (MCC-P#)

Photo 5.k.2 (EMCC-P#)

l. For continuity of maintenance and inventory all new electrical panels to be square-D manufacturer to match panels in existing AHU-6A.

6. The electrical work described in the items above will be scheduled to be executed for a selected AHU at a time. Contractor to coordinate schedule for AHU replacement with owner and execute all associated electrical work as described herein.

7. **Electrical work applicable only to the first AHU installed in Pod#1**:

Furnish one new TP-1 Energy efficient 75KVA, 480V Delta primary - 208/120V, Y secondary, 3-phase, 4-wire transformer, one new 200Amps, 3p heavy duty safety switch to serve as transformer primary disconnect and one new 225 amps MLO, 1208/208V ,3-phase, 4-wire, 42 space panelboard to serve all 120V and 208V loads associated with and all new AHU's to be replaced in Pod#1. See photo 7.1 below for example of existing installation in POD#2.

Photo 7.1 

Following is the corresponding electrical work related to this item:

a. Install new transformer, primary disconnect and 120/208V panelboard in centrally located penthouse in POD#1. Field coordinate transformer, primary disconnect and panelboard final exact location with owner. Coordinate with owner which AHU will be installed as first in and building section in pod#1. Below, '#' indicates corresponding building pod number where first AHU will be installed in that particular pod.

b. Label new transformer as "T-EAHUCP-P1" or as directed by owner

c. Label new panel as "EAHUCP-P1" (Emergency AHU Control Panel – Pod1) or as directed by owner

d. Run 90 C copper cables and conduit between EMCC-P1, new 200A transformer primary disconnect and primary side of new transformer "T-EAHUCP-P1".

e. Install new fuses in existing 200 amps disconnect bucket in corresponding "EMCC-P1" to serve new transformer "T-EAHUCP-P1" through new 200A transformer primary disconnect. Size fuses per transformer manufacturer standard published tables and recommendations and make all required connections to primary conductors.

f. Run 90 C copper cables and conduit between secondary side of transformer "T-EAHUCP-P1" and panelboard "EAHUCP-P1".

g. Size transformer primary and secondary cables and conduits per manufacturer standard published tables and recommendations.

h. For each new AHU being replaced, run 90 C copper cables and conduit from

"EAHUCP-P1" to 120V and 208V loads associated with each AHU as follows:

two(2) 20amps AHU control circuits, one(1) 20 amps, for AHU receptacles and general interior lights, one(1) 20 amps, for AHU general interior lights, and one(1) 60 amps, 2-pole for AHU UV-lights.

i. Contractor provide, and install control circuit breakers in panel "EAHUCP-P1" as follows:

   a. two(2) 20 amps, 1-pole for AHU control circuits, one(1) 20 amps, 1-pole for AHU receptacles and general interior lights, one(1) 20 amps, 1-pole for AHU general interior lights, and one(1) 60 amps, 2-pole for AHU UV-lights.

   b. Contractor to verify circuit breaker sizes with AHU manufacturer installation instructions and adjust accordingly.

j. For continuity of maintenance and inventory new electrical panel and transformer to be square-D manufacturer.

9. Install data as required for AHU control panels and manufacturer installation instructions and recommendations.,

## Fire Alarm System

Contractor to verify that all existing smoke detectors associated with the new air-handling units are connected to the building fire alarm system.

The fire alarm system wiring will be installed in conduit. The minimum size conduit required will be ¾" EMT and the minimum size fire alarm cable will be #14 AWG. All conduit terminations will be fitted with a plastic bushing to protect the exposed cable.

# EQUIPMENT PERFORMANCE DATA – AIR HANDLING UNIT

# EQUIPMENT SPECIFICATIONS – AIR HANDLING UNIT

PART 1 GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings, Schedules, and General Provisions of the Contract apply to work of this section.

B. Material standards shall be as specified or detailed hereinafter and as follows:

1. AMCA Publication 99 - Standards Handbook

2. AMCA Publication 311 - Certified Ratings Programmed - Product Rating Manual For Fan Sound Performance.

3. AMCA Standard 300 - Reverberant Method for Sound Testing of Fans.

4. AMCA Standard 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

5. AMCA Standard 500-D - Laboratory Methods of Testing Dampers for Rating.

6. AMCA Standard 500-L - Laboratory Methods of Testing Louvers for Rating.

7. ANSI/ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

8. ANSI/ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

9. ANSI/AMCA Standard 204 - Balance Quality and Vibration Levels for Fans.

10. ANSI/AMCA Standard 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

11. ANSI/ASHRAE 52.1 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

12. ANSI/NEMA MG 1 - Motors and Generators.

13. ARI Standard 260 - Sound Rating of Ducted Air Moving and Conditioning Equipment.

14. ARI Standard 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.

15. ASHRAE 84 - Method of Testing Air-to-air Heat Exchangers.

16. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.

17. ASTM E477 - Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.

18. NFPA 70 - National Electrical Code.

19. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilation Systems.

20. UL 555S - Standard for Safety Smoke Dampers.

21. UL 900 - Standard for Safety Air Filter Units.

22. UL 1995 - Standard for Safety Heating and Cooling Equipment.

1.2 DEFINITIONS

A. Class “A” thermal break shall be defined as a thermal break that ensures no member on the exterior of the unit, including fasteners, has through metal contact with any member on the interior of the unit, including fasteners.

B. Maximum operating pressure for negative sections shall be defined as the maximum negative pressure obtained in the unit during operation. Maximum operating pressure for positive sections shall be defined as the maximum positive pressure obtained in the unit during operation.

C. Wall assemblies shall include all unit wall panels around the air tunnel perimeter, all channels exposed to both the interior and exterior of the unit, and all removable wall access panels.

D. Door assemblies shall include interior and exterior unit door panels, door frames, and door channels.

E. Roof assemblies shall include exterior unit roof panels, interior unit ceiling panels, and all roof channels exposed to both the interior and exterior of the unit.

1.3 SCOPE OF WORK

A. The AHU Manufacturer's work shall include, but is not necessarily limited to the following:

1. Furnish a complete set of submittals as described hereinafter.

2. Provide AHUs fully factory assembled with the exception of unit splits as required for shipping or installation requirements as indicated on the schedule and drawings. Disassembled AHU components provided to the Mechanical Contractor for field assembly as built-up AHUs shall not be acceptable. As shipped from the AHU Manufacturer, AHUs shall meet the performance requirements shown on the equipment schedule. Units shall be for outdoor application and shall have all components and options as indicated on the schedule or drawings. Furthermore, units shall be constructed as detailed hereinafter. Field-provide components and options shall be unacceptable unless otherwise noted.

a. Provide all labor, materials, and equipment necessary for the complete engineering, production, factory assembly, factory testing, packaging, and delivery of the custom AHUs and their related equipment. Provide high voltage components, factory engineered, mounted and wired.

b. Permit the Owner and Engineer to inspect as herein described and to witness performance tests to insure good product quality and compliance with these specifications.

c. Factory test all AHUs as detailed herein and on the schedule.

d. Provide Owner's Manual, complete operating instructions.

e. All controls including Variable Frequency Drives will be provided by the ATC contractor.

3. The Contractor responsibility shall include but not limited to the following:

a. Receive and unload the custom AHUs. Inspect the unit sections as they arrive on the job site. Notify the trucking company, AHU Manufacturer, and Owner of any shipping damage immediately.

b. Coordinate all work associated with the AHU installation. Clear area where unit is to be set of any construction materials or debris. Ensure equipment curbs or support platforms are level prior to setting the units. Hoist and set units in their proper position. Use spreader bars to hoist the unit (sections) to avoid damaging units. If units ship in multiple sections, provide all labor and equipment for placing and field joining sections.

c. Provide all final chilled water, hot water, steam, and drain piping connections. Release the fan spring isolator shipping restraints.

d. Remove all foreign objects and thoroughly clean the interior and exterior surfaces of the units with a mild detergent (soap and water). Do not use any abrasives or solvents without first consulting the AHU Manufacturer.

e. Install filter media in filter frames. Operating units without filter media is strictly prohibited.

f. Perform unit start up as detailed herein.

1.4 BASIS OF DESIGN

A. The following are the basis of design for all air handling units.

1. The fans are selected for redundancy of N + I.

2. The dimensions between supply openings and return openings are fixed and shall not be modified.

3. The units are sized for 15 percent additional capacity.

4. The chilled water coil is sized for 100% outside air in the event of an emergency epidemic situation.

5. The sound power shown on Equipment Schedule are the sound power information for the unit as a system. The equipment manufacturer shall include sound attenuators for inlet and discharge as necessary to achieve the required sound power.

6. The unit vestibule roof shall be designed to support chilled water and steam piping and hanging supports shall be part of the unit structure.

7. The unit shall be designed for ease of access and maintenance.

1.5 SUBMITTALS

A. No equipment shall be fabricated or delivered until the receipt of approved shop drawings from the Engineers.

B. AHU Manufacturer shall provide the following information with each shop drawing/product data submission:

1. Dimensioned arrangement drawings for each AHU including a plan and elevation view of the assembled unit with overall dimensions, support locations, and weights. Drawings shall also indicate all electrical, piping, and ductwork requirements, including sizes, connection locations, and connection method recommendations. Each component of the unit shall be identified and shall include physical dimensions and material of construction.

2. Panel-to-panel joint and corner details and panel-to-roof details, all showing Class “A” thermal breaks.

3. All performance data, including capacities and airside and waterside pressure drops, for components. Fan curves shall be provided for fans with the design operating points indicated. Data shall be corrected to actual operating conditions, temperatures, and altitudes. Fan curves shall also provide at 75% of operating design and 50% of operating design.

4. Brand and model of fans, fan motors, coils, humidifiers, air filters, dampers, louvers, and silencers being furnished.

C. The AHU Manufacturer shall list any exceptions to the specification.

1.6 WARRANTY AND SERVICE

A. AHU Manufacturer shall provide a parts warranty extending 12 months from the date of owner's acceptance.

B. The AHU Manufacturer shall have a service department located within 100 miles of the job site.

PART 2 PRODUCTS

2.1 AHU MANUFACTURERS

A. The AHUs shall meet the performance and construction criteria as scheduled and specified.

B. All AHU Manufacturers that are not basis of design must obtain approval in writing from the Engineer no less than 2 weeks before the bid date. The Mechanical Contractor shall be responsible for all additional costs incurred by the Engineer during the submittal and re-submittal phases for any contract awarded to a manufacturer not on the approved list.

C. All AHU Manufacturers that are not basis of design shall deliver selection data to the bid examiner. Selection shall include the following:

1. Fan performance curves, coil performance, humidifier performance, and sound data.

2. A list of all exceptions and clarifications the AHU Manufacturer is taking to the specifications.

2.2 AGENCY LISTING

A. AHUs shall be agency listed by UL or ETL.

2.3 UNIT NAMEPLATES AND LABELS

A. Metal nameplates shall be provided on the units. All information contained on the nameplate shall be etched or burned into the surface to prevent fading. Information shall include:

1. Job name, sales order number, unit tagging, and service model number.

2. MCA, MOP, and maximum fuse/HACR circuit breaker size.

3. Voltage, frequency, phase, Hp, FLA, and inverter input current for all motors.

B. Labels for ARI Standard 410, ARI Standard 1060, and the listing agency, either UL or ETL, shall be provided on the units.

C. Labels shall be provided on the units for unit rigging and coil piping and connection instructions. Labels shall be provided on fans indicating direction of rotation. Warning labels shall be provided on appropriate components indicating hazardous voltage. For each section which must be assembled to another, matching steel identification tags shall be welded at each mating joint to ensure correct assembly order.

## 2.4 UNIT CONSTRUCTION

### A. Casing Performance

1. Unit air leakage shall not exceed 1.0% of design cfm at maximum operating pressure to a maximum of +12” w.g. in all positive-pressure sections and -12” w.g. in all negative-pressure sections. Leakage shall be calculated by totaling all leakage either in to or out of the unit. The unit shall be tested at the factory for leak test and test result shall be submitted to Architects/Engineers for review. Refer to paragraph 3.2 of this specification for more details.

2. Casing deflection shall not exceed L/200 at maximum operating pressure to a maximum of +12” w.g. in all positive-pressure sections and -12” w.g. in all negative-pressure sections, where L is defined as the panel span.

### B. Bases and Floors

1. Base shall be constructed from 8" welded structural aluminum channels around the perimeter and welded structural aluminum cross members. Formed channels are not acceptable. The structural aluminum base will be shot blasted, fully welded and then painted. The maximum cross-member spacing shall be 24" on center with members located adequately to support fan, coils, and other large components. The height of each base channel shall be no less than 8 inches. Each shipping section shall be provided with removable lifting lugs. Structural framework shall fully support the unit casing and all components during installation such that no section deflects more than L/1000 during rigging of that section, where L is defined as the distance between lifting lugs.

2. Floor shall be constructed from 3/16” aluminum safety tread plate surface. The floor surface shall be continuously welded with 2” turned up lip around the base perimeter and all floor penetrations. Caulk is not an acceptable sealing method for the floor. Floor deflection shall not exceed L/200 under a point load of 200 pounds, where L is defined as the floor span.

3. Insulation that meets a minimum R-value of 24 shall be provided underneath the entire unit floor. Insulation shall completely fill the panel cavity in all directions so that no voids exist. Base assemblies shall comply with NFPA 90 A.

4. The entire unit floor shall be turned up to a minimum of 2 inches inside the unit casing to act as an additional drain pan.

5. The vestibule floor shall have removable panels for access to under floor piping. Floor panels shall be fully gasketed and of the same

construction as non-removable flooring.

C. Walls

1. Wall assemblies shall be double-wall construction with solid aluminum exterior and interior. The entire unit shall have a solid wall liner on the interior. All spaces and joints of wall assemblies shall be completely sealed. Wall shall meet the casing deflection limits contained herein.

2. A Class “A” thermal break shall be provided throughout the entire wall assembly.

3. Insulation that meets a minimum R-value of 24 shall be provided throughout all unit wall assemblies. Insulation shall completely fill the panel cavity in all directions so that no voids exist and settling of insulation is prevented. Wall assemblies shall comply with NFPA 90 A.

4. Removable wall access panels shall be provided in coil and fan sections for service removal of components.

5. All walls shall be reverse panel construction to minimize penetrations inside air stream.

D. Access Doors

1. Access doors shall be provided throughout units as indicated on the schedules and drawings. Access doors shall be double wall construction. Interior and exterior door panels shall be of the same construction as the interior and exterior wall panels, respectively.

2. A Class “A” thermal break shall be provided on all door assemblies downstream of the cooling coil.

3. Insulation that meets a minimum R-value of 24 shall be provided throughout all door assemblies. Insulation shall completely fill the panel cavity in all directions so that no voids exist and settling of insulation is prevented. Door assemblies shall comply with NFPA 90 A.

4. All doors shall be a minimum of 60” high if sufficient height is available, or the maximum height allowed by the unit height. All doors shall open against pressure to ensure an airtight seal and to prevent a safety hazard.

5. Door hinges shall be stainless steel type. Door handles shall be Allegis design for minimized leakage and to provide a Class “A” thermal break. All handles shall fasten against the door frame with a roller cam to eliminate wear of the door frame. Ventlok handles on outdoor units shall not be acceptable. All door handles shall be operable from both the unit exterior and interior.

6. Windows shall be provided in doors. Windows shall be mounted in a metal frame and shall be a minimum of 8” x 8”, with safety glass. For any instance where a window cannot fit in a door, a narrower window 8” tall may be provided. Windows in doors with a thermal break shall be thermal, double-pane type.

E. Roofs

1. Roof assemblies shall be double wall construction. Exterior roof panels and interior ceiling panels shall be of the same construction as the exterior and interior wall panels, respectively. All spaces and joints of roof assemblies shall be completely sealed. In addition to meeting the casing deflection limits contained herein, roof deflection shall not exceed L/200 under a point load of 200 pounds, where L is defined as the roof panel span.

2. A Class “A” thermal break shall be provided throughout the entire roof assembly.

3. Insulation that meets a minimum R-value of 24 shall be provided throughout all roof assemblies. Insulation shall completely fill the panel cavity in all directions so that no voids exist. Roof assemblies shall comply with NFPA 90 A.

4. Outdoor unit roofs shall incorporate a standing seam on the exterior to ensure a rigid roof construction. Outdoor roofs shall be sloped, not less than 1/8” per foot for water drainage. Where outdoor units are shipped in multiple sections, provide standing-seam joiners at each split with adhesive, hardware, and cover strips for field joining by the installing contactor. Rain gutters shall be provided over all doors to direct rain away from the door assembly.

F. Unit Paint: External surfaces of all outdoor unit casings shall be prepared and painted resulting in a minimum 1.5 mil thick coating when dry. Paint shall be able to withstand a salt spray test in accordance with ASTM B117 for a minimum of 500 consecutive hours. Paint air handling units to match the existing rooftop air handling units.

2.5 UNIT COMPONENTS

A. Louvers

1. Approved manufacturers: Ruskin or equal.

2. Louver frames and blade material shall be constructed of aluminum. Louvers shall have a minimum of 45% free area. Louvers shall be painted with the same paint requirements identified for the external casing herein.

3. Intake louver frames shall be 6” deep. Intake louvers shall be drainable with stationary blades, front flanges, and bird screens. The intake louver shall be sized for no more than 0.1" w.g. pressure drop.

4. Relief louver frames shall be 4” deep. Relief louvers shall be sized for no more than 0.1” w.g. pressure drop.

5. The louvers for intake and relief shall be equal to Ruskin Model EME-4625, wind driven rain louver.

C. Dampers

1. Approved manufacturers: Ruskin or equal.

2. Ultra low-leak modulating dampers shall be provided, sized, and located as indicated on the schedule and drawings. Blade arrangement (parallel or opposed) and orientation (horizontal blades or vertical blades) shall also be provided as indicated on the schedule and drawings. Dampers shall be galvanized double-skin airfoil design for minimal pressure drop. Leakage rate shall not exceed 3 cfm/square foot at 1” w.g. All leakage testing and pressure ratings shall be based on AMCA Standard 500-D. All dampers, except external bypass and multizone dampers, shall be mounted on the AHU interior.

3. Smoke dampers shall be provided, sized, and located to match the existing duct risers. Dampers shall be galvanized double-skin airfoil design for minimal pressure drop. Dampers shall meet UL 555S Leakage Class I of no more than 4 cfm/square foot at 1” w.g. Smoke damper actuators shall be factory mounted as required by UL 555S.

D. Air Filters

1. Approved manufacturers: AAF, Airguard, and Camil Farr.

2. All filters shall be 12” x 24”, 24” x 24”, or 24” x 12” nominal sizes to minimize the number of sizes required to be stocked by the Owner. Filters of other nominal sizes will not be acceptable.

3. All filters shall be equipped with magnehelic gages.

4. Medium Efficiency Pleated Media and Cartridge Filters

a. Pleated media filters 2” deep shall be provided as indicated on the schedule and drawings. The MERV rating shall be 7 when tested in accordance with ANSI/ASHRAE 52.1. Filter media shall be of non-woven fibers with metal grid support. Set(s) of extra filters shall be provided with each unit.

b. Rigid cartridge filters 6” deep shall be provided as indicated on the schedule and drawings. The MERV rating shall be 11 (60% to 65%) when tested in accordance with ANSI/ASHRAE 52.1. Filters shall consist of high density glass fiber media enclosed in galvanized steel frames with diagonal supports on both the entering and leaving sides.

c. Filters shall be UL Class 2 when tested in accordance with UL Standard 900.

d. Filters shall be provided with front-loading frames. Filter holding frames shall be constructed of galvanized steel and equipped with foam gaskets to seal filters against filter frames. Frame seams shall be sealed to eliminate air bypass. Front-loading frames shall be equipped with filter fasteners of the same material as the filter frame. Filter fasteners shall be capable of being installed without the use of special tools, bolts or nuts. Filter holding frames shall be of a universal type to accommodate standard filters of the same nominal size as well as appropriate fasteners. Filter access shall be as indicated on the schedule and drawings

5. High Efficiency Cartridge Filters

a. Rigid cartridge filters 12” deep shall be provided as indicated on the schedule and drawings. The MERV rating shall be 14 (90% to 95%) when tested in accordance with ANSI/ASHRAE 52.1. Filters shall consist of high density glass fiber media enclosed in galvanized steel frames with diagonal supports on both the entering and leaving sides.

b. Filters shall be UL Class 1 when tested in accordance with UL Standard 900.

c. Filters shall be provided with front-loading frames. Filter holding frames shall be constructed of galvanized steel and equipped with foam gaskets to seal filters against filter frames. Frame seams shall be sealed to eliminate air bypass. Front-loading frames shall be equipped with filter fasteners of the same material as the filter frame. Filter fasteners shall be capable of being installed without the use of special tools, bolts or nuts. Filter holding frames shall be of a universal type to accommodate standard filters of the same nominal size as well as appropriate fasteners. Filter access shall be as indicated on the schedule and drawings

E. Cooling Coils

1. Coil performance shall be provided as indicated on the schedule and drawings. Coil capacities, pressure drops and selection procedures shall be certified to ARI Standard 410.

2. Water coils shall have non-ferrous headers. Water coils shall have vent and drain taps and MPT connections. Connection locations (handing) shall be as indicated on the drawings. Grommets shall be provided at coil casing penetrations around the coil piping. Grommets shall be designed to seal the opening under positive and negative pressure.

3. Chilled Water Coils

   a. Chilled water coils shall be provided as indicated on the schedule and drawings.

   b. Chilled water coils shall have 0.008" thick aluminum fins. Fins shall be mechanically bonded to 5/8" OD seamless copper tubes with 0.020" thick walls. Fins shall have collars drawn, belled and firmly bonded to the tubes by means of mechanical expansion. Coils shall be circuited for counter-flow heat transfer. Coil casings shall be constructed of galvanized steel.

   c. Chilled water coils shall be proof and leak tested under water. Proof test shall be at 300 psig and leak test shall be at 200 psig.

4. Primary Drain Pans: Primary condensate drain pans shall be provided in coil sections as detailed in the drawings. Cooling coil sections shall be provided with stainless steel primary drain pans. Primary drain pans shall extend under the entire coil, including headers and return bends. Primary drain pans shall extend downstream of the coil bank for a minimum distance as indicated in the drawings. Primary drain pans shall be sloped a minimum of 1/8” per foot, shall be a minimum of 2” deep, and shall be double-sloped (sloped in 2 planes) to positively drain. Drain connections shall be of the same material as the primary drain pan and shall extend a minimum of 1-1/2” beyond the base to ensure adequate room for field piping of condensate drain traps. Drain connection locations (handing) shall be as indicated on the schedule and drawings. Any coil support member located inside a primary drain pan shall be of the same material as the drain pan.

5. Intermediate Drain Pans: For cooling coil sections requiring stacked coils, sloped intermediate drain pans constructed of stainless steel shall be provided under each upper-level coil in the coil bank and shall extend under the entire coil, including headers and return bends. Intermediate drain pans shall extend downstream of the

leaving face of the coil bank for a minimum of 4". Non-corrosive pipe with a minimum diameter of 1" shall be connected to each end of all intermediate drain pans, and shall be piped to the primary drain pan of the coil section. Any coil support member located inside an intermediate drain pan shall be of the same material as the drain pan.

F. Integral Face and Bypass Heating Coils

1. IFB coils shall have vertical or horizontal tubes as indicated in the schedule and drawings and shall consist of built-in series of finned heating elements and bypasses with interlocked dampers. Coil performance shall be provided as indicated on the schedule and drawings.

2. Connection locations (handing) shall be as indicated on the schedule and drawings.

3. Finned heating elements shall be fabricated of seamless copper tubes with aluminum fins. Finned elements shall be suitable for 100 psig saturated steam at 330 F and shall be factory tested with steam at 200 psig and under water with air at 400 psig.

4. Dampers shall be arranged so as to completely enclose and isolate the heating coil fins when no temperature rise is required. Proportioning of the air shall be such that the temperature at any point in a plane parallel to the face of the coil three feet downstream from the leaving side will not vary more than 5°F from the average discharge air temperature. Each coil shall be capable of maintaining a constant discharge air temperature regardless of variations in entering air temperature with full hot water flow. Pressure drop of air passing through the coil shall not vary more than plus or minus 5%, regardless of the position of the dampers.

G. Steam Dispersion Humidifiers

1. Approved manufacturers: Armstrong, Dri-Steem, and Carel.

2. Humidifiers shall be provided as indicated on the schedule and drawings. Humidifier type and performance shall be provided as indicated on the schedule and drawings.

3. No component shall be located downstream of the humidifier within the absorption distance cataloged by the humidifier manufacturer. A double-sloped (sloped in 2 planes) stainless steel drain pan shall be provided under the humidifier and shall extend downstream of the humidifier for a minimum distance as indicated in the drawings.

4. The AHU Manufacturer shall furnish and install humidifiers inside the AHUs. The AHU Manufacturer shall extend the steam supply piping

through the side of the units. Connection locations (handing) shall be as indicated on the schedule and drawings.

5. Steam separators, control valves, traps, and strainers shall be provided by the AHU Manufacturer and shipped loose for field installation.

6. Humidifiers shall consist of a dispersion panel with a steam supply header/separator and a bank of steam dispersion tubes. Each active tube shall be fitted with a series of nozzles which extend from the center of the tube. The nozzles shall be sized and spaced to accept steam from the separator/header and provide a dry and uniform discharge of steam. All wetted tubes and headers shall be stainless steel.

H. Fans

1. Fans shall be tested, rated and certified in accordance with ANSI/AMCA Standard 210 for air delivery and in accordance with AMCA Standard 300 for sound power levels and shall bear the AMCA seal. The fan balancing process, including vibration limits and documentation, shall be performed in accordance with ANSI/AMCA Standard 204. Fan and motor performance requirements shall be as shown on the schedule and drawings. Maximum rated speed of the fans shall not exceed 75% of the first critical speed.

2. Unhoused Plenum Fans - Direct Drive: Fans shall be unhoused, SWSI plenum type with high efficient AF blades as indicated on the schedule and drawings. Fans shall be direct driven. Fan wheels shall be aluminum. The Hp characteristic of the fans shall be non-overloading. Fans shall be furnished with protective enclosures around the fan wheels. Fans shall be furnished with inlet collars. Fans shall be furnished with inlet screens.

3. Multiple Fans in Parallel: Multiple fans in parallel of type indicated on the schedule shall be provided. Fans shall meet the specifications for the fan type contained herein. Each fan shall have its own VFD. Individual VFDs running multiple fans shall not be acceptable. Motorized isolation dampers shall be factory mounted to prevent reverse airflow through any fan that fails. Dampers shall be sized and positioned to minimize impact on fan performance. All losses associated with the dampers shall be considered when making fan selections. Fan shall be installed on structural frame and shall be located on 2 rows in front of the coil with 2 high and 2 low to provide greater velocity profile across the coil.

4. Fan Motors

   a. Approved manufacturers: A. O. Smith, Baldor, and Toshiba.

b. Locations of motors shall be as indicated on the schedule and drawings.

c. All motors shall conform to ANSI/NEMA MG 1 as well as all applicable requirements of NEC and shall be UL Listed. Motors shall be inverter ready, ODP, and of the voltage, phase, frequency, and Hp indicated on the schedule and drawings. Motors shall be premium efficient, exceeding the EPAct efficiency requirements. Motors shall be 1800 rpm, except where noted. The motor shall be provided with a heavy duty, adjustable, steel base.

d. Motors shall be NEMA Design B, with Class B insulation.

e. Provide greasible motor bearings.

f. Provide Aegis shaft grounding rings.

g. Provide fan motor removal rail system.

5. Fan Airflow Measurement Systems: Fan airflow measurement systems shall be provided to measure fan airflow directly or to measure differential pressure that can be used to calculate fan airflow. The accuracy of the devices shall be no worse than +/-5% when operating within stable fan operating conditions. Devices shall not affect the submitted fan performance and acoustical levels. Devices that obstruct the fan inlet or outlet shall not be acceptable. Devices shall be connected to transducers with selectable 4-20 mA or 2-10 VDC output. Signal shall be proportional to air velocity.

I. Silencers (Sound Attenuators)

1. Approved manufacturers: IAC, Rink, and Vibro-Acoustics.

2. Silencers shall be of the size, configuration, length and acoustical performance as shown on the schedule and drawings and shall be located in the AHU as indicated on the schedule and drawings. Silencer media shall be of acoustic quality, shot-free glass fiber insulation and shall comply with NFPA 90 A. A long-strand fiberglass cloth shall be provided around the insulation to isolate it from the air stream. Silencer casing, including internal partitions, shall be galvanized steel and shall be sealed to reduce air bypass. Silencer casing shall not fail structurally when subjected to a differential air pressure of 8.0” w.g.

3. Silencers shall be constructed in accordance with ASHRAE and SMACNA standards for the pressure and velocity classification specified for the air distribution system in which it is installed.

4. Acoustical performance shall include dynamic insertion loss and generated noise for forward flow (air and noise in the same direction) or reverse flow (air and noise in the opposite direction) per the project's requirements. Silencer dynamic insertion loss shall not be less than that listed in the silencer schedule. Silencer generated noise shall not be greater than that listed in the silencer schedule. Silencer ratings shall be determined in a duct-to-reverberant room test facility which provides for airflow in both directions through the test silencer in accordance with ASTM E477. The test set-up, procedure and facility shall eliminate all effects due to flanking, directivity, end reflection, standing waves and reverberation room absorption.

5. Silencer pressure drop measurements shall be made in accordance with ASTM E477. Tests shall be conducted and reported on the identical units for which acoustical data is presented.

## 2.6 VIBRATION ISOLATION

A. The entire fan and motor assembly shall be mounted on vibration isolators which have a 2” deflection to isolate the assembly from the unit housing. Vane axial fan assemblies, the discharge of housed fan assemblies, and the inlet of plenum fan assemblies shall be connected to the pressure-bulkhead panel (wall, floor, or roof) with flexible duct to prevent transmission of vibration to the unit casing. No metal-to-metal contact will be permitted between fixed and floating parts. Thrust restraints shall be provided as required to limit horizontal movement of fan assembly at design conditions. Fan base assemblies shall be rigidly tied to the unit base during shipment to prevent damage from shipping vibrations. Rigid tie shall be field removable with a common tool.

B. Each fan assembly shall be vibration tested prior to shipment. Measurements shall include both radial and axial displacement at each fan bearing using magnetic accelerometers connected to a vibration analyzer. Vibration shall not exceed limits specified herein. Provide written documentation of testing procedures and results.

## 2.7 ELECTRICAL

A. Marine Lights: Marine lights shall be provided throughout AHUs as indicate on the schedule and drawings. Lights shall be fluorescent type to minimize amperage draw and shall produce lumens equivalent to a minimum 64 W, instant-start bulb. Lights shall be constructed of safety glass. Lights shall be suitable for wet locations.

B. Marine Light Switches: Each shipping section shall be provided with an on-off switch for all marine lights in that section. On outdoor units, light switches shall be mounted inside the unit behind access doors. Lighting circuit(s) shall be wired by the AHU Manufacturer to a common junction box separate from the VFD or starter so the lights can remain on when the main disconnect to the unit is on or off.

C. Convenience Outlets: A 15 amp, 115V GFCI convenience outlet shall be provided by the AHU Manufacturer. On outdoor units, the outlet shall be mounted inside the unit at the fan access door. The outlet shall be wired by the AHU Manufacturer to the same circuit as the lights.

D. Factory-Installed Motor Wire Termination, VFD, and Fan Disconnect Switch Enclosures

1. Shall be factory mounted on the drive side of the fan section on the interior of the unit, accessible from the unit exterior through an access door.

2. Any welds shall be properly finished with no rough edges. Enclosures shall house circuit breaker disconnects. VFDs, starter/disconnects, and fan disconnect switches shall have a manual shut down switch located on the outside of the access door.

E. Factory Wiring of Lights, and Other Electrical Devices

1. Shall be wired per NEC, UL, and NFPA 90 A requirements.

2. All power wiring for voltages greater than 24V shall be contained in an enclosed, metal, power-wiring raceway or EMT. Sections less than 6' in length may be contained in FMC.

3. The AHU Manufacturer shall provide one single-point power connection for all lights and receptacles, on each AHU.

F. The location of all control panels, VFDs, lights, outlets, and other accessories shall match the layout of AHU-6A unless otherwise directed by the Owner.

2.8 ROOF CURB: The entire unit shall be mounted on the existing concrete roof curb.

2.9 PHOTO CATALYTIC AIR CLEANING SYSTEM

A. The Photo Catalytic Air Cleaner System shall be factory-engineered and factory-installed in the air handler by the air handler manufacturer and shall be covered under warranty by the air handler manufacturer.

B. Submittal information shall include a list of reference projects, third party

testing that lists reduction in colony forming units (CFU) versus time for vegetative bacteria including MRSA, viruses, and other common bioaerosols and VOCs. Data shall also include rated pressure drop at the design airflow.

C. The Catalytic Air Cleaner System shall be a three part integral assembly for treatment of air by: (1) High Efficiency Particle Filtration (2) Ultraviolet Germicidal Irradiation (UVGI) using UV-C lamps and fixtures; and (3) Photocatalytic Oxidation (PCO) catalyst media using titanium dioxide (TiO2).

D. High Efficiency Particle Filters shall be rated MERV 13 or higher. Filters are positioned upstream of the PCO media.

E. UV-C lamps and ballasts designed specifically to provide type-C ultraviolet light with a wavelength at or near 253.7 Angstroms and shall not produce any ozone. Lamps shall be imbedded in the center of the catalyst media bank, spaced no further than 6" apart, and shall achieve a minimum coverage of 5 milliwatts per square inch of UVC light across all exposed surfaces of the PCO media.

F. The catalyst media shall consist of six-inch deep (direction of airflow) grid with face area to match casing opening, one pleat per inch (nominal), and coated with 40-200 nanometer TiO2. The complete PCO media bank assembly shall be housed in a galvanized or stainless steel casing and placed in the air handler perpendicular to the airflow.

G. All UV lamps and PCO media shall be removable from outside the AHU casing through a side access door for maintenance purposes.

H. An air flow switch shall be wired into the control circuit to disable the UV lights when the AHU fan is not running.

I. The Catalytic Air Cleaner System shall be configured to operate electrical power that matches the power requirement in the air handler schedule. Three phase systems shall be either independent single point power or integral with the AHU main power. All necessary main fusing shall be included.

J. Electrical fixtures shall meet the UL drip proof design criteria. Component enclosures shall be constructed of galvanized steel or stainless steel to resist corrosion. Fixtures shall have been tested and recognized by UL/C-UL under Category Code ABQK (Accessories, Air Duct Mounted), UL Standards 1995.

K. For Line Voltage options, the CACS shall be provided with a UL 508 listed panel for power distribution and over-current protection.

L. CACS assemble shall be capable of withstanding 750 fpm face velocity with no structural damage

M. All polymeric materials that come into direct or indirect (reflected) contact with UV-C light shall be tested and certified as UV-C tolerant. Any non-conforming construction materials or components within the exposure zone shall be completely shielded from the UV-C light using a certified UV-C tolerant material. UV-C tolerance is defined as being capable of performing its intended duty for a minimum of 20 years.

N. Safety

1. Access doors or panels shall be provided at the location of each Catalytic Air Cleaner System as indicated on the schedule. All access doors/panels shall have a mechanical safety interlock switch that disconnects the CACS power upon opening.

2. Each CACS shall be equipped with an externally mounted electrical disconnect switch, with lock-out capability to prevent unwanted operation for maintenance purposes.

3. A window shall be provided on each air handler to allow visual inspection of the Catalytic Air Cleaner System during operation. The viewing window shall be guaranteed to block UV-C light emissions below the threshold limits specified by NIOSH and/or ACGIH.

4. Units shall have a safety warning label applied to the exterior of each section containing UV-C lights.

5. Complete safety, maintenance and servicing instructions for the Catalytic Air Cleaner System shall be incorporated into the air handler manufacturer’s standard installation, operating and maintenance manuals.

## PART 3 EXECUTION

3.1 FACTORY INSPECTIONS: All work shall be subject to the Owner's inspection and approval at all times, but such approval does not relieve the AHU Manufacturer of responsibility for proper functioning of material and work. Notification shall be given to the AHU Manufacturer by the Owner, in writing, a minimum of 10 business days in advance of the visit.

## 3.2 FACTORY TESTING

A. Factory testing shall be conducted at the AHU Manufacturer's facility prior to shipment of the units being tested. The Owner or his designated representative shall witness the tests. The AHU Manufacturer shall notify the Owner, in writing, a minimum of 10 business days in advance of the testing to provide time to coordinate travel arrangements. The AHU Manufacturer shall provide all equipment and trained personnel to conduct each test. Results shall be recorded and provided to the Owner and Engineer.

B. Costs for travel and lodging for total of 4 people shall be covered by the AHU Manufacturer.

C. Air Leakage Tests: The AHU Manufacturer shall conduct factory air leakage tests. Positive-pressure sections of units shall be tested under positive pressure and negative-pressure sections of units shall be tested under negative pressure. Unit air leakage shall not exceed 1.0% of design cfm at maximum operating pressure to a maximum of +12" w.g. in all positive-pressure sections and -12" w.g. in all negative-pressure sections. Leakage shall be calculated by totaling all leakage either in to or out of the unit.

D. Panel Deflection Test: The AHU Manufacturer shall conduct factory panel deflection tests on units as indicated in the schedule and drawings. Positive-pressure sections of units shall be tested under positive pressure and negative-pressure sections of units shall be tested under negative pressure. Casing deflection shall not exceed L/200 at maximum operating pressure to a maximum of +12" w.g. in all positive-pressure sections and -12" w.g. in all negative-pressure sections, where L is defined as the panel span.

E. The AHU Manufacturer shall repair/replace at his own expense any items that fail or are damaged during testing. For any unit that fails testing, the AHU Manufacturer shall retest the unit until all items are in compliance with limits specified herein.

F. After factory assembly, inspection and testing of units, the AHU Manufacturer shall disassemble each unit (where required) only to the extent necessary for shipment, unless otherwise detailed herein.

G. The AHU Manufacturer shall legibly mark the parts of work to be erected or field assembled to enable the Mechanical Contractor to identify the various parts and erect the work without delay.

H. After the air handling unit is assembled on the roof, the air unit representative shall conduct leak test by blanketing off the unit return, exhaust, and supply openings to verify air handling unit air leakage is in accordance to factory testing prior to shipment. The on site inspection by the Engineer of record shall be done if the unit does not meet the factory testing result for leakage. The manufacturer shall be responsible to repair the leakage. Caulking will not be acceptable means of repairing leakage. Unit will not be accepted until the unit leakage meets the factory testing results.

3.3 SHIPPING

A. Paper copies of the IOM shall also be shipped with each AHU.

B. The AHU Manufacturer shall identify all shipments with the order number. Enough information shall be provided with each shipment to enable the Mechanical Contractor to confirm the receipt of units when they are received. For parts too small to mark individually, the AHU Manufacturer shall place them in containers.

C. To protect equipment during shipment and delivery, exposed casing openings shall be covered. Pipe ends and pipe connection holes in the casing shall be capped or plugged prior to shipment.

D. After loading the equipment for shipment, the AHU Manufacturer shall contact the shipping contact on the order and provide the name of the carrier, description of equipment, order number, shipping point, and date of shipment.

3.4 ON-SITE STORAGE: If equipment is to be stored for a period of time prior to installation, the Mechanical Contractor shall either place the units in a controlled indoor environment or shall cover the units with canvas tarps and place them in a well-drained area. Covering units with plastic tarps shall not be acceptable.

3.5 FIELD EXAMINATION

A. The Mechanical Contractor shall verify that the roof is ready to receive work and the opening dimensions are as indicated on the shop drawings and contract documents. The existing curb shall be leveled, if necessary, before installation.

B. The Mechanical Contractor shall verify that the proper power supply is available prior to starting of the fans.

## 3.6 INSTALLATION

A. The Mechanical Contractor shall be responsible to coordinate ALL of his installation requirements with the Owner and the Owner's selected Mechanical Contractor to insure that a complete installation for each unit is being provided. Coordination efforts shall include such items as unloading and hoisting requirements, field wiring requirements, field piping requirements, field ductwork requirements, requirements for assembly of field-bolted or -welded joints, and all other installation and assembly requirements.

B. The AHU Manufacturer shall provide all screws and gaskets for joining of sections in the field.

C. The AHU Manufacturer shall provide assistance to Mechanical Contractor during the installation.

D. The Mechanical Contractor shall verify that the following items have been completed prior to scheduling the AHU Manufacturer's final inspection and start up:

1. All spring-isolated components have had their shipping restraints removed and the components have been leveled.

2. On all field-joined units, that all interconnections have been completed, i.e., electrical and control wiring, piping, casing joints, bolting, welding, etc.

3. All water and steam piping connections have been completed and hydrostatically tested and all waterflow rates have been set in accordance with the capacities scheduled on the Drawings.

4. All ductwork connections have been completed and all ductwork has been pressure tested for its intended service.

5. All power wiring, including motor starters and disconnects, serving the unit has been completed.

6. All automatic temperature and safety controls have been completed.

7. All dampers are fully operational.

8. All shipping materials have been removed.

9. All (clean) filter media has been installed in the units.

3.7 LEVELING: The Mechanical Contractor shall level all unit sections in accordance with the unit manufacturer's instructions. The Mechanical Contractor shall provide and install all necessary permanent shim material to ensure individual sections and entire assembled units are level.

3.8 FINAL INSPECTION AND START UP SERVICE

A. After the Mechanical Contractor has provided all water and steam piping connections, ductwork connections, and field control wiring, and Electrical Contractor has provided all the field power wiring, the Mechanical Contractor shall inspect the installation. The Mechanical Contractor shall then perform startup of the equipment.

B. The Automatic Temperature Control (Building Direct Digital Control) Contractor shall be scheduled to be at the job site at the time of the equipment start up.

C. The Mechanical Contractor, shall perform the following tests and services and submit a report outlining the results:

1. Record date, time, and person(s) performing service.

2. Lubricate all moving parts.

3. Check all motor and starter power lugs and tighten as required.

4. Verify all electrical power connections.

5. Conduct a start up inspection per the AHU Manufacturer's recommendations.

6. Record fan motor voltage and amperage readings.

7. Check fans rotation and spin wheel to verify that rotation is free and does not rub or bind.

8. Check fan for excessive vibration.

9. Remove all foreign loose material in ductwork leading to and from the fan and in the fan itself.

10. Disengage all shipping fasteners on vibration isolation equipment.

11. Check safety guards to insure they are properly secured.

12. Secure all access doors to the fan, the unit and the ductwork.

13. Switch electrical supply "on" and allow fan to reach full speed.

14. Physically check each fan at start up and shut down to insure no abnormal or problem conditions exist.

15. Check entering and leaving air temperatures (dry bulb and wet bulb) and simultaneously record entering and leaving chilled water temperatures and flow, steam pressures and flow, and outside air temperature.

16. Check all control sequences.

# EXTENDED WARRANTY SPECIFICATIONS

1.01 Supplier shall provide an extended warranty for up to four (4) additional years to result in a five (5) year period of complete air handling unit warranty protection from initial Project Acceptance.

1.02 SCOPE OF SERVICES: Extended Warranty shall cover the entire unit including labor with the exception of filters.

1.03 AGREEMENT: Extended Warranty Agreement shall be between the Owner and the equipment manufacturer.

1.04 RESPONSE TIME: The Supplier shall provide on-site warranty service within 4 hours of the initial call for warranty.

# DRAWINGS

Existing Air Handling Units - POD 1

Quadrant B: AHU-4
Quadrant C: AHU-5
Quadrant D: AHU-6
Quadrant E: AHU-7

Existing Air Handling Units - POD 2

Quadrant H: AHU-4A
Quadrant K: AHU-5A
Quadrant L: AHU-7A

Basis Of Design Air Handling Unit Selections

Sheet M1.1: Chilled Water Coil Piping Detail
Sheet M1.2: Steam Preheat Coil Piping Detail
Sheet M1.3: Heating and Cooling Fan Coil Unit Piping Detail