CENTRAL FLORIDA EXPRESSWAY AUTHORITY

MEMORANDUM

TO: Authority Board Members

FROM: Claude Miller
Director of Procurement

DATE: January 27, 2015

RE: Award of Contract to Kenyon & Partners, Inc., for
S.R. 417 Mainline Toll Plazas Air Conditioner Replacements
Project No. 599-732; Contract No. 001075

In accordance with the approved Procurement Policy and Procedures for an invitation to bid, the Procurement Department opened sealed bids on January 21, 2015, for the referenced project. Bid results were as follows:

	Bidder	**Bid Amount**
1.	Kenyon & Partners, Inc.	$692,502.00
2.	Air Mechanical & Service Corp.	$823,910.00

The Engineer's Estimate for this project is $748,449.35

The Procurement Department has evaluated both bids and has determined that both bids are responsible and responsive to the bidding requirements. Since less than three bids were received, the Procurement Procedures Manual requires that the Deputy Executive Director and the Director of Procurement meet to discuss the Authority's options to either reject the bids and re-bid the project or recommend award of the contract. That meeting took place on January 23, 2015, with the Director of Construction and Maintenance (representing the Deputy Executive Director) and the Director of Procurement. The results of the meeting were included in a memo to the Interim Executive Director recommending that the contract be awarded to Kenyon & Partners, Inc. The Interim Executive Director accepted the recommendation.

Award of the contract to Kenyon & Partners, Inc., in the amount of $692,502.00 is recommended contingent upon final execution of the contract by both parties.

cc: Joe Berenis, Deputy Executive Director, Engineering, Operations, Construction and Maintenance
Laura Kelley, Deputy Executive Director, Finance and Administration
Ben Dreiling, Director of Construction and Maintenance
Contract File

MEMORANDUM

TO: Joseph A. Berenis, P.E.
Deputy Executive Director, Engineering, Operations, Construction & Maintenance

FROM: Ben Dreiling, P.E.
Director of Construction & Maintenance

Claude Miller
Director of Procurement

SUBJECT: S.R. 417 Mainline Toll Plazas Air Conditioner Replacements
Project No. 599-732; Contract No. 001075
Recommendation for Award of Contract

DATE: January 23, 2015

On January 21, 2015, two (2) sealed bids were opened for the subject project:

	Bidder	**Bid Amount**
1.	Kenyon & Partners, Inc.	$692,502.00
2.	Air Mechanical & Service Corp.	$823,910.00

The Engineer's Estimate for the project is $748,450.00.

Since less than three bids were received, the Procurement Procedures Manual requires that the Deputy Executive Director and the Director of Procurement meet to discuss the Authority's options to either reject the bids and re-bid the project or recommend award of the contract to the Executive Director. Since there is currently no Executive Director, responsibility for approvals related to engineering and construction has been delegated by the Board to the Deputy Executive Director acting as the Interim Executive Director. As a result, it was decided that the Director of Construction and Maintenance and the Director of Procurement would meet with the recommendation going to the Interim Executive Director. That meeting took place on January 23, 2015.

During the meeting we noted that 11 contractors had registered as "primary", or prime contractors, to download the bid documents from the Procurement web site and only 2 submitted bids. We considered that fact, the fact that the low bid was 8% below the Engineer's Estimate, the cost to re-bid the project, whether or not a re-bid would result in more bids and a lower price. Based on these considerations, it is our opinion that rebidding the project would not be in the best interest of the Authority since it probably would not result in more bids or a lower price. Therefore, in accordance with Article V, Procurement Processes, of the Procurement Procedures Manual, we jointly recommend award of Contract No. 001075 to Kenyon & Partners, Inc.

Accept Recommendation X Reject Recommendation _____

Joseph A Berenis

Interim Executive Director

If rejected, reason(s) for rejection:

_____

_____

CONTRACT

This Contract No. 001075 (the "Contract"), made this _____ day of _____, 2015, between the CENTRAL FLORIDA EXPRESSWAY AUTHORITY, hereinafter called the AUTHORITY and KENYON & PARTNERS, INC., 3203 Queen Palm Drive, Tampa, Florida 33619, hereinafter the CONTRACTOR:

WITNESSETH: The CONTRACTOR shall, for the consideration herein mentioned and at its cost and expense, do all the work and furnish all the materials, equipment, supplies and labor necessary to perform this Contract in the manner and to the full extent as set forth in the Contract Documents (and under security as set forth in the attached Public Construction Bond) all of which are hereby adopted and made part of this Contract as completely as if incorporated herein. The Contract shall be performed to the satisfaction of the duly authorized representatives of the AUTHORITY, who shall have at all times full opportunity to inspect the materials furnished and the work done under this Contract.

The work to be done under this Contract includes installation of all items associated with Contract No. 001075, S.R. 417 Air Conditioner Replacements, as detailed in the Contract Documents and any addenda or modifications thereto. Contract time for this project shall be 270 calendar days. The Contract Amount is $692,502.00. This Contract was awarded by the Authority's Board of Directors at its meeting on February 12, 2015.

The Contract Documents consist of:

1. The Contract,
2. The Memorandum of Agreement,
3. The Addenda, modifying the General Specifications, Technical Specifications, Special Provisions, Plans or other Contract Documents,
4. The Plans,
5. The Special Provisions,
6. The Technical Specifications,
7. The General Specifications, and
8. The Proposal.

In consideration of the foregoing premises, the AUTHORITY agrees to pay the CONTRACTOR for work performed and materials furnished at the unit and lump sum prices, and under the conditions set forth, in the Proposal.

IN WITNESS WHEREOF, the authorized signatures named below have executed this Contract on behalf of the parties on the date first set forth above.

CENTRAL FLORIDA EXPRESSWAY AUTHORITY

By:_____
Director of Procurement

KENYON & PARTNERS, INC.

By:_____
Signature

_____
Print Name

_____
Title

ATTEST: _____(Seal)

Approved as to form and execution, only.

General Counsel for the AUTHORITY

_____

SECTION 01010

SUMMARY OF WORK

PART 1 - GENERAL

1.1 PROJECT DESCRIPTION

The work consists of providing all labor, materials, equipment and incidentals necessary to replace the air conditioning systems for the administration building, tunnel, toll booths and exit and entrance ramps associated with John Young, Boggy Creek, Curry Ford and University Mainline Plazas located on S.R. 417. The work includes, but is not necessarily limited to:

a. Administration Building (John Young Parkway):
   i. Replace the existing air handling unit and condenser which serve the main building with a new 7.5 ton direct expansion (DX) heat pump split system Trane Odyssey model TWE090/TWA090 or Authority approved equal.
   ii. Replace the existing ductless split systems which serve the recording rooms with new 2 ton ductless split systems, Liebert Mini-Mate 2 model MMD24E/PFH027A or Authority approved equal. The indoor evaporator shall be the ceiling mounted plenum type which fit in a 2'x4' ceiling grid. The outdoor unit shall be an air-cooled propeller fan condensing unit. Supply and return ducts from main building unit, AHU-1, and manual dampers which serve as backup cooling shall remain.
   iii. Replace the existing indoor air handling unit and outdoor condensers which serve the tunnel with a new 8 ton modular Air Handling Unit, Trane M-series Climate Changer model CSAA006UB and two condensing units, Trane model 4TTA3048 or Authority approved equal. The existing indoor air handling unit will be relocated outside, behind the building and the condensers will be in the existing location behind the building. The units return air duct will be demolished and the supply duct will be connected to the outdoor air duct. The outdoor air intake louver will be removed and the outdoor air duct will be extended to the discharge side of the new air handler. Relocate smoke detectors and balancing damper. Relocate electrical connection to outdoor AHU. Install new refrigerant piping between AHU and condensing units. Provide new p-trap and condensate line. Provide new 6" concrete pad and equipment supports for AHU.

b. Administration Building (Boggy Creek):
   i. Replace the existing air handling unit and condenser which serve the main building with a new 7.5 ton direct expansion (DX) heat pump split system, Trane Odyssey model TWE090/TWA090 or Authority approved equal.
   ii. Replace the existing ductless split systems which serve the recording rooms with new 2 ton ductless split systems, Liebert Mini-Mate 2 model MMD24E/PFH027A or Authority approved equal. The indoor evaporator shall be the ceiling mounted plenum type which fit in a 2'x4' ceiling grid. The outdoor unit shall be an air-cooled propeller fan condensing unit. Supply and return ducts from main building unit, AHU-1, and manual dampers which serve as backup cooling shall remain.
   iii. Replace the existing packaged outdoor air unit which serves the tunnel with a new 8 ton modular Air Handling Unit, Trane M-series Climate Changer model CSAA006UB and two condensing units, Trane model 4TTA3048 or Authority approved equal. The air handling unit and condensers will be located outside, behind the building. Locate condensers on new 4" concrete pad.

c. Administration Building (Curry Ford):
   i. Replace the existing air handling unit and condensers which serve the main building with a new 7.5 ton direct expansion (DX) heat pump split system, Trane Odyssey model TWE090/TWA090 or Authority approved equal.
   ii. Replace the existing ducted split system which serves the recording room with new 2 ton ductless split systems, Liebert Mini-Mate 2 model MMD24E/PFH027A or Authority approved equal. The indoor evaporator shall be the ceiling mounted plenum type which fit in a 2'x4' ceiling grid. The outdoor unit shall be an air-cooled propeller fan condensing unit. Remove existing ducted indoor unit above ceiling and associated supply and return ducts. Supply and return ducts from main building unit, AHU-1, and manual dampers which serve as backup cooling shall remain.
   iii. Replace the existing air handling unit and condensers which serve the tunnel with a new 8 ton modular Air Handling Unit, Trane M-series Climate Changer model CSAA006UB and two condensing units, Trane model 4TTA3048 or Authority approved equal. The air handling unit and condensers will be located outside, behind the building.
   iv. A new 1 ton ductless split system will be added to the Technicians Room, Liebert Mini-Mate 2 model MMD12E/PFH014A or Authority approved equal. The indoor evaporator shall be the ceiling mounted grille type which fit in a 2'x4' ceiling grid. The outdoor unit shall be an air-cooled propeller fan condensing unit. Locate condenser on new 4" concrete pad.

d. Administration Building (University):

i. Replace the existing air handling unit and condensers which serve the main building with a new 7.5 ton direct expansion (DX) heat pump split system, Trane Odyssey model TWE090/TWA090 or Authority approved equal.

ii. Replace the existing ductless split systems which serve the recording rooms with new 2 ton ductless split systems, Liebert Mini-Mate 2 model MMD24E/PFH027A or Authority approved equal. The indoor evaporator shall be the ceiling mounted plenum type which fit in a 2'x4' ceiling grid. The outdoor unit shall be an air-cooled propeller fan condensing unit. Supply and return ducts from main building unit, AHU-1, and manual dampers which serve as backup cooling shall remain.

iii. Replace the existing air handling unit and condensers which serve the tunnel with a new 8 ton modular Air Handling Unit, Trane M-series Climate Changer model CSAA006UB and two condensing units Trane model 4TTA3048 or Authority approved equal. The air handling unit and condensers will be located outside, behind the building.

iv. A new 1 ton ductless split system will be added to the Technicians Room, Liebert Mini-Mate 2 model MMD12E/PFH014A or Authority approved. The indoor evaporator shall be the ceiling mounted grille type which fit in a 2'x4' ceiling grid. The outdoor unit shall be an air-cooled propeller fan condensing unit. Locate condenser on new 4" concrete pad.

e. Toll Booths:

i. For toll booths at mainline plazas John Young, Curry Ford and University, replace the roof mounted AC units on the 2 outside cash lanes in each direction, 12 total.

ii. For toll booths at mainline plaza Boggy Creek, replace the roof mounted AC units on the 3 outside cash lanes in each direction, 6 total.

iii. Replace the existing packaged rooftop heat pump units which serve each toll booth at the plazas with new 1.5 ton package rooftop heat pump units, Trane model 4WCC018 or Authority approved equal. New supply air duct shall supply air to the attendant end of the booth. Install new return air grille in the center of the booth where existing opening is. New packaged rooftop unit shall have a bottom return opening and return plenum.

iv. Replace existing ducted window units with which serve each toll booth at the plazas with new 1.5 ton package rooftop heat pump units, Trane model 4WCC018 or Authority approved equal. New supply air duct shall supply air to the attendant end of the booth and demolish the other existing supply duct and existing return duct. Return air grille in center of booth shall remain. New packaged rooftop unit shall have a bottom return opening and new return plenum.

v. Replace existing packaged heat pump rooftop units with which serve each toll booth at the plazas with new 1.5 ton package rooftop heat pump units, Trane model 4WCC018 or Authority approved equal. New supply air duct shall supply air to the attendant end of the booth and demolish the other existing supply duct and existing return duct. Return air grille in center of booth shall remain. New packaged rooftop unit shall have a bottom return opening and new return plenum.

f. Ramps:

i. Type A: For ramps with an existing 1 ton DX mini-split system serving the recording room with backup cooling from a packaged rooftop unit which serves attendant room, replace the 1 ton mini-split system and existing 1.5 ton packaged rooftop units which serve Lane 1 attendant room with one new 3 ton packaged rooftop unit, Trane model 4TCC3036, or Authority approved equal, to serve both rooms.

ii. Type B: For ramps with two 1.5 ton packaged rooftop units which serve the recording room and attendant room separately, replace the packaged rooftop units with one new 3 ton packaged rooftop unit, Trane model 4TCC3036 or Authority approved equal. Demolish attendant room ductwork and rooftop unit. Extend recording room supply and return ductwork to serve tenant room.

iii. Type C: For ramps with two 1.5 ton split systems with ducted indoor units which serve the recording room and attendant room separately, replace the split systems with one new 3 ton split system, Trane model 4TTB3036/TAM4A0A36 or Authority approved equal. Demolish attendant room ductwork and split system. Extend recording room supply and return ductwork to serve attendant room.

iv. Type D: For ramps with an existing 1 ton DX mini-split system serving the Recording room and a DX split system serving the attendant room, replace the 1 ton mini-split system and existing 1.5 ton split system which serves Lane 1 Attendant Room with one new 3 ton ducted indoor fan coil unit and condenser, Trane model 4TTB3036/TAM4A0A36, or Authority approved equal, to serve both rooms. Extend supply and return ductwork to recording room.

v. Type E: For ramps with one vertical floor mounted indoor fan coil unit (FCU) serving both rooms, replace the indoor FCU with a horizontal ceiling mounted 3 ton FCU and the outdoor unit with a new 3 ton condensing unit, Trane model 4TTB3036/TAM4A0A36 or Authority approved equal. Reconnect supply duct to new FCU.

vi. General:
    1. Demolish suspended ceiling where work is required above the ceiling. Remove ceiling tiles and grid and do not replace. Re-hang lighting fixtures from structure.
    2. Where rooftop units are being removed and not replaced, patch roof opening and seal.
    3. Locate new condensing units on roof, install new disconnects and install new refrigerant piping, seal roof penetrations.
    4. Locate thermostat in Recording Room.
    5. Balance supply airflows to each room per CFM indicated on drawings. Provide manual balancing dampers for new diffusers.

g. Excluded areas:
    i. There will be no replacement or removal of AC units serving the unmanned toll booths at the inside lanes of mainline plazas. AC units serving unmanned toll booth lanes will remain.
    ii. There will be no replacement or removal of AC units serving ramp plazas Lane 2 building. Packaged Rooftop units serving Lane 2 Tenant rooms will remain.
    iii. Moss Park and Innovation Way Exit and Entrance Ramp plazas will require no work.

h. General:
    i. Disconnect existing ducts, refrigerant piping, electrical wiring and condensate lines from HVAC equipment. Retain ductwork for connection to new HVAC equipment.
    ii. Contractor shall properly recover and recycle R-22 refrigerant according to EPA guidelines. Recovered R-22 can either be returned to the Authority for use in other systems or sent to an EPA certified refrigerant reclaimer for reclamation and resale.
    iii. Remove AHUs, FCUs, and CUs and replace with new equipment. Reconnected ductwork and provide new flexible connections. Provide water-/air-tight connections to new equipment. Refer to Division 23 of the Technical Specifications for new pipe/duct insulation and jacketing.
    iv. Install new refrigerant piping per manufacturer's recommendations.
    v. Provide new condensate drain p-traps and connect to existing condensate line. Re-use drain lines as much as possible.
    vi. Install new disconnect and electrical wiring.
    vii. Remove existing thermostat and replace with new thermostat and rewire.
    viii. Existing duct mounted accessories shall remain and be re-used i.e. duct smoke detectors.

i. Prior to the start of construction, a pre-construction meeting is required. The Contractors on-site supervisor and any other key personnel shall be present at the pre-construction meeting.

1.2 WORK SEQUENCE

The Work will be conducted while the facilities remain functional. The Contractor shall sequence work so as to provide the least possible interference to the activities of the public and the Authority's personnel.

1.3 CONTRACTOR USE OF PREMISES

1.3.1 General: Limit use of the premises to construction activities associated with administration building, tunnel, toll booths and ramps work; allow for employee occupancy and use by the public.

1.3.2 Keep driveways and entrances serving the premises clear and available to the Authority and the Authority's employees at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on site.

1.3.3 The Contractor will have the use of three standard size parking spaces at the main plazas which the Authority will assign. The Contractor shall have no more than three vehicles on the site, other than during material deliveries.

1.3.4 All waste material shall be removed and properly disposed of off-site. Store salvaged materials which are designated as property of the Authority in designated areas and promptly remove all other materials from site. Refer to Special Provisions section SP-8 for list of equipment to be salvaged.

1.3.5 Use of the Existing Building: Maintain the existing buildings in operational condition throughout the construction period. Space temperature and relative humidity shall be maintained at 68° F to 78° F and 40% to 60% respectively, throughout construction through the use of temporary heating and cooling equipment as necessary. Repair any damage caused by construction operations. Take all precautions necessary to protect the buildings and their occupants during the construction period.

1.3.6 Work shall be conducted between the hours of 7:00 am and 6:00 pm, Monday through Friday. No work on Saturday or Sunday unless prearranged and approved by the Authority.

1.4 EMPLOYEE OCCUPANCY

Full Employee Occupancy: The Authority's employees will occupy the site and existing building during the entire construction period. The Contractor shall cooperate with the Authority during construction operations to minimize conflicts and facilitate employee usage. Perform the Work so as not to interfere with the Authority's operations. Provide temporary cooling and heating as necessary to maintain normal temperature and humidity setpoints during construction.

1.5 WORK OF OTHER CONTRACTORS

1.5.1 The Contractor shall coordinate and cooperate with the Authority's toll collection equipment contractor (TransCore) and toll operations contractor (Florida Toll Services) during the term of the Contract.

1.5.2 Contractor shall comply with the safety rules and requirements of the National Electrical Code and all applicable building code requirements. The Expressway Authority is self permitting. An Orange County building permit is not required.

1.6 SECURITY

Contractor shall coordinate and cooperate with the Authority in maintaining the required level of security at this facility. Contractor shall provide all workers with photo identification badges. All workers shall be required to sign in and out of the job site each day. Contractor shall coordinate the hours of work with the plaza manager/supervisor and obtain proper admittance and exit to the building and recording room.

END OF SECTION 01010

SECTION 236200 - PACKAGED COMPRESSOR AND CONDENSER UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

A. Section includes packaged, refrigerant compressor and condenser units.

1.3 ACTION SUBMITTALS

A. Product Data: For each compressor and condenser unit. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include equipment dimensions, weights and structural loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For compressor and condenser 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. Fabricate and label refrigeration system according to ASHRAE 15, "Safety Standard for Refrigeration Systems."

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases. Cast anchor-bolt inserts into bases.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

C. Coordinate location of piping and electrical rough-ins.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of compressor and condenser units that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Compressor failure.
      b. Condenser coil leak.
   2. Warranty Period: Five years from date of Substantial Completion.
   3. Warranty Period (Compressor Only):10 years from date of Substantial Completion.
   4. Warranty Period (Components Other Than Compressor): Five years from date of Substantial Completion.
   5. Warranty Period (Condenser Coil Only): Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 COMPRESSOR AND CONDENSER UNITS, AIR COOLED, 1 TO 5 TONS (3.5 TO 17.6 kW)

A. Manufacturers: Subject to compliance with requirements, provide products by TRANE or Authority approved equal.

B. Description: Factory assembled and tested; consisting of compressor, condenser coil, fan, motors, refrigerant reservoir, and operating controls.

C. Compressor: Scroll, hermetically sealed, with rubber vibration isolators.
   1. Motor: Single speed, and includes thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
   2. Two-Speed Compressor: Include manual-reset, high-pressure switch and automatic-reset, low-pressure switch.
   3. Accumulator: Suction tube.

D. Refrigerant: R-410A.

E. Condenser Coil: Seamless copper-tube, aluminum-fin coil; circuited for integral liquid subcooler, with removable drain pan and brass service valves with service ports.

F. Condenser Fan: Direct-drive, aluminum propeller fan; with permanently lubricated, totally enclosed fan motor with thermal-overload protection.

G. Accessories:
   1. Cycle Protector: Automatic-reset timer to prevent rapid compressor cycling.
   2. Electronic programmable thermostat to control compressor and condenser unit and evaporator fan.

3. Evaporator Freeze Thermostat: Temperature-actuated switch that stops unit when evaporator reaches freezing temperature.
4. Filter-dryer.
5. High-Pressure Switch: Automatic-reset switch cycles compressor off on high refrigerant pressure.
6. Liquid-line solenoid.
7. Low-Ambient Controller: Cycles condenser fan to permit operation down to 30 deg F (minus 1 deg C) with time-delay relay to bypass low-pressure switch.
8. Low-Pressure Switch: Automatic-reset switch cycles compressor off on low refrigerant pressure.
9. Thermostatic expansion valve.
10. Time-Delay Relay: Continues operation of evaporator fan after compressor shuts off.
11. Reversing valve.

H. Unit Casing: Galvanized steel, finished with baked enamel; with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Mount service valves, fittings, and gage ports on exterior of casing.

2.2 COMPRESSOR AND CONDENSER UNITS, AIR COOLED, 6 TO 120 TONS (21 TO 422 kW)

A. Manufacturers: Subject to compliance with requirements, provide products by TRANE or Authority approved equal.

B. Description: Factory assembled and tested, air cooled; consisting of casing, compressors, condenser coils, condenser fans and motors, and unit controls.

C. Compressor: Hermetic scroll compressor designed for service with crankcase sight glass, crankcase heater, and backseating service access valves on suction and discharge ports.
1. Capacity Control: On-off compressor cycling.

D. Refrigerant: R-410A.

E. Condenser Coil: Seamless copper-tube, aluminum-fin coil, including subcooling circuit and backseating liquid-line service access valve. Factory pressure test coils, then dehydrate by drawing a vacuum and fill with a holding charge of nitrogen or refrigerant.

F. Condenser Fans: Propeller-type vertical discharge; either directly or belt driven. Include the following:
1. Permanently lubricated, ball-bearing totally enclosed motors.
2. Separate motor for each fan.
3. Dynamically and statically balanced fan assemblies.

G. Operating and safety controls include the following:
1. Manual-reset, high-pressure cutout switches.
2. Automatic-reset, low-pressure cutout switches.
3. Low-oil-pressure cutout switch.
4. Compressor-winding thermostat cutout switch.
5. Control transformer.
6. Timer to prevent excessive compressor cycling.

H. Accessories:
   1. Electronic programmable thermostat to control compressor and condenser unit and evaporator fan.
   2. Low-Ambient Controller: Cycles condenser fan to permit operation down to 0 deg F (minus 18 deg C) with time-delay relay to bypass low-pressure switch.
   3. Reversing valve.

I. Unit Casings: Designed for outdoor installation with weather protection for components and controls and with removable panels for required access to compressors, controls, condenser fans, motors, and drives. Additional features include the following:
   1. Steel, galvanized or zinc coated, for exposed casing surfaces; treated and finished with manufacturer's standard paint coating.
   2. Perimeter base rail with forklift slots and lifting holes to facilitate rigging.
   3. Gasketed control panel door.
   4. Nonfused disconnect switch, factory mounted and wired, for single external electrical power connection.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
   1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.4 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate compressor and condenser units according to ARI 210/240.

B. Energy Efficiency: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings," Section 6, "Heating, Ventilating, and Air-Conditioning."

C. Test and inspect shell and tube condensers according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. Testing Requirements: Factory test sound-power-level ratings according to ARI 270.

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 compressor and condenser units.

B. Examine roughing-in for refrigerant piping systems to verify actual locations of piping connections before equipment installation.

C. Examine walls, floors, and roofs for suitable conditions where compressor and condenser units will be installed.

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

3.2 INSTALLATION

A. Install units level and plumb, firmly anchored in locations indicated.

B. Equipment Mounting:
   1. Install compressor and condenser units on cast-in-place concrete equipment bases.

C. Maintain manufacturer's recommended clearances for service and maintenance.

D. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

3.3 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

C. Connect precharged refrigerant tubing to unit's quick-connect fittings. Install tubing so it does not interfere with access to unit. Install furnished accessories.

D. Connect refrigerant piping to air-cooled compressor and condenser units; maintain required access to unit. Install furnished field-mounted accessories. Refrigerant piping and specialties are specified in Section 232300 "Refrigerant Piping."

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 and perform the following:
      a. Inspect for physical damage to unit casing.
      b. Verify that access doors move freely and are weathertight.
      c. Clean units and inspect for construction debris.
      d. Verify that all bolts and screws are tight.
      e. Adjust vibration isolation and flexible connections.
      f. Verify that controls are connected and operational.

B. Lubricate bearings on fan motors.

C. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.

D. Adjust fan belts to proper alignment and tension.

E. Start unit according to manufacturer's written instructions and complete manufacturer's startup checklist.

F. Measure and record airflow and air temperature rise over coils.

G. Verify proper operation of condenser capacity control device.

H. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

I. After startup and performance test, lubricate bearings.

END OF SECTION 236200

SECTION 237413 - PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:
   1. Direct-expansion cooling.
   2. Heat-pump refrigeration components.
   3. Electric-heating coils.
   4. Roof curbs.

B. Related Sections include the following:
   1. Section 237433 "Dedicated Outdoor-Air Units" for outdoor equipment air conditioning 100 percent outdoor air to replace air exhausted from a building.

1.3 DEFINITIONS

A. ECM: Electrically commutated motor.

B. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

C. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

D. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

E. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

1.4 ACTION SUBMITTALS

A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer Wind Loading Qualification Certification: Submit certification that specified equipment will withstand wind forces identified in "Performance Requirements" Article.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Warranty: Special warranty specified in this Section.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

1.7 MATERIALS MAINTENANCE SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Filters: One set of filters for each unit.

1.8 QUALITY ASSURANCE

A. ARI Compliance:
   1. Comply with ARI 203/110 and ARI 303/110 for testing and rating energy efficiencies for RTUs.
   2. Comply with ARI 270 for testing and rating sound performance for RTUs.

B. ASHRAE Compliance:
   1. Comply with ASHRAE 15 for refrigeration system safety.
   2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
   3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. NFPA Compliance: Comply withNFPA 90A and NFPA 90B.

E. UL Compliance: Comply withUL 1995.

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

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
   2. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by TRANE or Authority approved equal.

2.2 CASING

A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

B. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
   1. Exterior Casing Thickness: 0.0626 inch (1.6 mm) thick.

C. Inner Casing Fabrication Requirements:
   1. Inside Casing: Galvanized steel, 0.034 inch (0.86 mm) thick.

D. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
   1. Materials: ASTM C 1071, Type I.
   2. Thickness: 1/2 inch (13 mm).
   3. Liner materials shall have air-stream surface coated with an erosion- and temperature-resistant coating or faced with a plain or coated fibrous mat or fabric.
   4. Liner Adhesive: Comply with ASTM C 916, Type I.

E. Condensate Drain Pans: Formed sections of stainless-steel sheet, a minimum of 2 inches (50 mm) deep, and complying with ASHRAE 62.1.
   1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
   2. Drain Connections: Threaded nipple.
   3. Pan-Top Surface Coating: Corrosion-resistant compound.

2.3 FANS

A. Direct-Driven Supply-Air Fans: Double width, forward curved, centrifugal; with permanently lubricated, ECM motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.

B. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.

C. Relief-Air Fan: Propeller, shaft mounted on permanently lubricated motor.

D. Fan Motor: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.4 COILS

A. Supply-Air Refrigerant Coil:
   1. Aluminum-plate fin and seamless internally grooved copper tube in steel casing with equalizing-type vertical distributor.
   2. Coil Split:.
   3. Baked phenolic coating.

B. Outdoor-Air Refrigerant Coil:
   1. Aluminum-plate fin and seamless internally grooved copper tube in steel casing with equalizing-type vertical distributor.
   2. Baked phenolic coating.

C. Electric-Resistance Heating:
   1. Open Heating Elements: Resistance wire of 80 percent nickel and 20 percent chromium, supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized-steel frame. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.
   2. Overtemperature Protection: Disk-type, automatically reset, thermal-cutout, safety device; serviceable through terminal box.
   3. Overcurrent Protection: Manual-reset thermal cutouts, factory wired in each heater stage.
   4. Control Panel: Unit mounted with disconnecting means and overcurrent protection. Include the following controls:
      a. Magnetic contactors.
      b. Step Controller: Pilot lights and override toggle switch for each step.
      c. SCR Controller: Pilot lights operate on load ratio, a minimum of five steps.
      d. Time-delay relay.
      e. Airflow proving switch.

2.5 REFRIGERANT CIRCUIT COMPONENTS

A. Compressor: Hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief.

B. Refrigeration Specialties:
   1. Refrigerant: R-410A.
   2. Refrigerant: R-407C or R-410A.
   3. Expansion valve with replaceable thermostatic element.
   4. Refrigerant filter/dryer.
   5. Manual-reset high-pressure safety switch.
   6. Automatic-reset low-pressure safety switch.
   7. Minimum off-time relay.
   8. Automatic-reset compressor motor thermal overload.
   9. Brass service valves installed in compressor suction and liquid lines.
   10. Low-ambient kit high-pressure sensor.
   11. Hot-gas bypass solenoid valve with a replaceable magnetic coil.
   12. Four-way reversing valve with a replaceable magnetic coil, thermostatic expansion valves with bypass check valves, and a suction line accumulator.

2.6 AIR FILTRATION

A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
   1. Pleated: Minimum 90 percent arrestance, and MERV 7.

2.7 DAMPERS

A. Outdoor-Air Damper: Linked damper blades, for 0 to 25 percent outdoor air, with manual damper filter.

2.8 ELECTRICAL POWER CONNECTION

A. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

2.9 CONTROLS

A. Basic Unit Controls:
   1. Control-voltage transformer.
   2. Wall-mounted thermostat or sensor with the following features:
      a. Heat-cool-off switch.
      b. Fan on-auto switch.
      c. Automatic changeover.
      d. Unoccupied-period-override push button.
      e. Data entry and access port to input temperature set points, occupied and unoccupied periods, and output room temperature, supply-air temperature, operating mode, and status.
   3. Remote Wall-Mounted Annunciator Panel for Each Unit:

a. Lights to indicate power on, cooling, heating, fan running, filter dirty, and unit alarm or failure.
b. DDC controller or programmable timer and interface with HVAC instrumentation and control system.
c. Digital display of outdoor-air temperature, supply-air temperature, return-air temperature, economizer damper position, indoor-air quality, and control parameters.

B. Electronic Controller:
1. Controller shall have volatile-memory backup.
2. Safety Control Operation:
a. Smoke Detectors: Stop fan and close outdoor-air damper if smoke is detected. Provide additional contacts for alarm interface to fire alarm control panel.
b. Firestats: Stop fan and close outdoor-air damper if air greater than 130 deg F (54 deg C) enters unit. Provide additional contacts for alarm interface to fire alarm control panel.
c. Fire Alarm Control Panel Interface: Provide control interface to coordinate with existing operating sequence.
d. Low-Discharge Temperature: Stop fan and close outdoor-air damper if supply air temperature is less than 40 deg F (4 deg C).
e. Defrost Control for Condenser Coil: Pressure differential switch to initiate defrost sequence.
3. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of two programmable periods per day.
4. Unoccupied Period:
a. Heating Setback: 10 deg F (5.6 deg C).
b. Cooling Setback: System off.
c. Override Operation: Two hours.
5. Supply Fan Operation:
a. Occupied Periods: Run fan continuously.
b. Unoccupied Periods: Cycle fan to maintain setback temperature.
6. Refrigerant Circuit Operation:
a. Occupied Periods: Cycle or stage compressors to match compressor output to cooling load to maintain room temperature. Cycle condenser fans to maintain maximum hot-gas pressure. Operate low-ambient control kit to maintain minimum hot-gas pressure.
b. Unoccupied Periods: Cycle compressors and condenser fans for heating to maintain setback temperature.
c. Switch reversing valve for heating or cooling mode on air-to-air heat pump.
7. Electric-Heating-Coil Operation:
a. Occupied Periods: Cycle coil to maintain room temperature.
b. Unoccupied Periods: Energize coil to maintain setback temperature.
c. Operate supplemental electric heating coil with compressor for heating with outdoor temperature below 25 deg F (minus 4 deg C).
8. Fixed Minimum Outdoor-Air Damper Operation:
a. Occupied Periods: Open to 25 percent.
b. Unoccupied Periods: Close the outdoor-air damper.

2.10 ACCESSORIES

A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required.

B. Low-ambient kit using staged condenser fans for operation down to 35 deg F (1.7 deg C).

2.11 ROOF CURBS

A. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
   1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
      a. Materials: ASTM C 1071, Type I or II.
      b. Thickness: 1-1/2 inches (38 mm).
   2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
      a. Liner Adhesive: Comply with ASTM C 916, Type I.
      b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
      c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
      d. Liner Adhesive: Comply with ASTM C 916, Type I.

B. Curb Height: 14 inches (355 mm).

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 RTUs.

B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.

C. Examine roofs for suitable conditions where RTUs will be installed.

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

3.2 INSTALLATION

A. Roof Curb: Install on roof structure or concrete base, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install RTUs on curbs and coordinate roof

penetrations and flashing with roof construction. Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.

3.3 CONNECTIONS

A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.

B. Install piping adjacent to RTUs to allow service and maintenance.

C. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
   1. Install ducts to termination at top of roof curb.
   2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
   3. Connect supply ducts to RTUs with flexible duct connectors.
   4. Install return-air duct continuously through roof structure.
   5. Install normal-weight, 3000-psi (20.7-MPa), compressive strength (28-day) concrete mix inside roof curb, 4 inches (100 mm) thick. Concrete, formwork, and reinforcement are specified with concrete.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
   1. Inspect for visible damage to unit casing.
   2. Inspect for visible damage to compressor, coils, and fans.
   3. Inspect internal insulation.
   4. Verify that labels are clearly visible.
   5. Verify that clearances have been provided for servicing.
   6. Verify that controls are connected and operable.
   7. Verify that filters are installed.
   8. Clean condenser coil and inspect for construction debris.
   9. Remove packing from vibration isolators.
   10. Inspect operation of barometric relief dampers.
   11. Verify lubrication on fan and motor bearings.
   12. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
   13. 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.
   14. Inspect and record performance of interlocks and protective devices; verify sequences.
   15. Operate unit for an initial period as recommended or required by manufacturer.
   16. Adjust and inspect high-temperature limits.
   17. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.

18. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F (8 deg C) 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.
19. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
20. 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.
21. 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.
22. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.5 CLEANING AND ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.

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

END OF SECTION 237413

SECTION 237433 - DEDICATED OUTDOOR-AIR UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

A. Section includes factory-packaged units capable of supplying up to 100 percent outdoor air and providing cooling only.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rated capacities, operating characteristics, and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For units to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fan Belts: One set for each belt-driven fan.
   2. Filters: One set for each unit.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Compressors: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by TRANE or Authority approved equal.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer to design wind restraints.

B. Wind-Restraint Performance:
   1. Basic Wind Speed: 140 mph.
   2. Building Classification Category: II.
   3. Minimum 10 lb/sq. ft (48.8 kg/sq. m) multiplied by the maximum area of unit projected on a vertical plane that is normal to the wind direction and 45 degrees either side of normal.

C. Cabinet Thermal Performance:
   1. Maximum Overall U-Value: Comply with requirements in ASHRAE/IESNA 90.1.
   2. Include effects of metal-to-metal contact and thermal bridges in the calculations.

D. Cabinet Surface Condensation:
   1. Cabinet shall have additional insulation and vapor seals if required to prevent condensation on the interior and exterior of the cabinet.
   2. Portions of cabinet located downstream from the cooling coil shall have a thermal break at each thermal bridge between the exterior and interior casing to prevent condensation from occurring on the interior and exterior surfaces. The thermal break shall not compromise the structural integrity of the cabinet.

E. Maximum Cabinet Leakage: 0.5 percent of the total supply-air flow at a pressure rating equal to the fan shut-off pressure.

F. Cabinet Deflection Performance:
   1. Walls and roof deflection shall be within 1/200 of the span at the design working pressure equal to the fan shut-off pressure. Deflection limits shall be measured at any point on the surface.
   2. Floor deflections shall be within 1/240 of the span considering the worst-case condition caused by the following:
      a. Service personnel.
      b. Internal components.
      c. Design working pressure defined for the walls and roof.

G. 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.

H. Construction: double wall.

I. Exterior Casing Material: Galvanized steel with paint finish.

J. Interior Casing Material: Galvanized steel.

K. Lifting and Handling Provisions: Factory-installed shipping skids and lifting lugs.

L. Base Rails: Galvanized-steel rails for mounting on roof curb or pad as indicated.

M. Roof: Standing seam or membrane; sloped to drain water.

N. Floor: Reinforced, metal surface; reinforced to limit deflection when walked on by service personnel. Insulation shall be below metal walking surface.

O. Cabinet Insulation:
1. Type: flexible elastomeric insulation complying with ASTM C 534, Type II, sheet materials.
2. Thickness: 2 inches (50 mm).
3. Insulation Adhesive: Comply with ASTM C 916, Type I.
4. Mechanical Fasteners: Suitable for adhesive, mechanical, or welding attachment to casing without damaging liner and without causing air leakage when applied as recommended by manufacturer.

P. Condensate Drain Pans:
1. Shape: Rectangular, with 1 percent slope in at least two planes to direct water toward drain connection.
2. Size: Large enough to collect condensate from cooling coils including coil piping connections, coil headers, and return bends.
   a. Length: Extend drain pan downstream from leaving face Insert distance.
   b. Depth: A minimum of 2 inches (50 mm) deep.
3. Configuration: Double wall, with space between walls filled with foam insulation and moisture-tight seal.
4. Material: Stainless-steel sheet.
5. Drain Connection:
   a. Located on one end of pan, at lowest point of pan.
   b. Terminated with threaded nipple.
   c. Minimum Connection Size: NPS 1 (DN 25).
6. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

2.3 SUPPLY FAN

A. Forward-Curved Fan Type: Centrifugal; statically and dynamically balanced.
1. Fan Wheel Material: Galvanized steel, mounted on solid-steel shaft.
2. Bearings: Self-aligning, permanently lubricated ball bearings.

B. Service Factor for Belt Drive Applications: V-belt drive with matching fan pulley and adjustable motor sheaves and belt assembly with minimum 1.4 service factor.

C. Motors:
1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

2. Enclosure: Totally enclosed.
3.

D. Mounting: Fan wheel, motor, and drives shall be mounted to fan casing with restrained isolators.

2.4 COOLING COILS

A. Capacity Ratings: Comply with ASHRAE 33 and ARI 410.

B. Coil Casing Material: Manufacturer's standard material.

C. Tube Material: Copper.

D. Tube Header Material: Manufacturer's standard material.

E. Fin Material: Aluminum.

F. Fin and Tube Joints: Mechanical bond.

G. Leak Test: Coils shall be leak tested with air underwater.

H. Refrigerant Coil Capacity Reduction: Circuit coils for face control.

I. Refrigerant Coil Suction and Distributor Header Materials: Seamless copper tube with brazed joints.

2.5 REFRIGERATION SYSTEM

A. Comply with requirements in ASHRAE 15, "Safety Standard for Refrigeration Systems."

B. Refrigerant Charge: Factory charged with refrigerant and filled with oil.

C. Compressors: Scroll compressors with integral vibration isolators, internal overcurrent and overtemperature protection, internal pressure relief.

D. Refrigerant: R-410A.
1. Classified as Safety Group A1 according to ASHRAE 34.
2. Provide unit with operating charge of refrigerant.

E. Refrigeration System Specialties:
1. Expansion valve with replaceable thermostatic element.
2. Refrigerant dryer.
3. High-pressure switch.
4. Low-pressure switch.
5. Thermostat for coil freeze-up protection during low ambient temperature operation or loss of air.
6. Brass service valves installed in discharge and liquid lines.

F. Refrigerant condenser coils:

1. Capacity Ratings: Complying with ASHRAE 33 and ARI 410.
2. Tube Material: Copper.
3. Fin Material: Aluminum.
4. Fin and Tube Joint: Mechanical bond.
5. Leak Test: Coils shall be leak tested with air underwater.

G. Condenser Fan Assembly:
1. Fans: Direct-drive propeller type with statically and dynamically balanced fan blades.
2. Fan Motors:
   a. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
   b. Motor Enclosure: Totally enclosed non-ventilating (TENV) or totally enclosed air over (TEAO) enclosure.

H. Safety Controls:
1. Compressor motor and condenser coil fan motor low ambient lockout.
2. Overcurrent protection for compressor motor.

2.6 OUTDOOR-AIR INTAKE HOOD

A. Type: Manufacturer's standard hood or louver.

B. Materials: Match cabinet.

C. Bird Screen: Comply with requirements in ASHRAE 62.1.

D. Configuration: Designed to inhibit wind-driven rain and snow from entering unit.

2.7 FILTERS

A. Extended-Surface, Disposable Panel Filters:
1. Comply with NFPA 90A.
2. Factory-fabricated, dry, extended-surface type.
3. Thickness: 2 inches (50 mm).
4. Minimum Arrestance: 90, according to ASHRAE 52.1.
5. Minimum Merv: 7, according to ASHRAE 52.2.
6. Media: Fibrous material formed into deep-V-shaped pleats and held by self-supporting wire grid.

B. Mounting Frames:
1. Panel filters arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or from access plenum.
2. Extended surface filters arranged for flat orientation, removable from access plenum.
3. Galvanized or stainless steel with gaskets and fasteners, suitable for bolting together into built-up filter banks.

2.8 ELECTRICAL POWER CONNECTIONS

A. General Electrical Power Connection Requirements: Factory-installed and -wired switches, motor controllers, transformers, and other necessary electrical devices shall provide a single-point field power connection to unit.

B. Enclosure: NEMA 250, Type 3R, mounted in unit with hinged access door in unit cabinet having a lock and key or padlock and key,

C. Wiring: Numbered and color-coded to match wiring diagram.

D. Wiring Location: Install factory wiring outside an enclosure in a raceway.

E. Power Interface: Field power interface shall be to NEMA KS 1, heavy-duty, nonfused disconnect switch.

F. Factory Wiring: Branch power circuit to each motor and to controls with one of the following disconnecting means:
   1. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
   2. NEMA KS 1, heavy-duty, nonfusible switch.
   3. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

G. Factory-Mounted, Overcurrent-Protection Service: For each motor.

H. Transformer: Factory mounted with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.

I. Controls: Factory wire unit-mounted controls where indicated.

J. Lights: Factory wire unit-mounted lights.

K. Receptacle: Factory wire unit-mounted, ground fault interrupt (GFI) duplex receptacle.

L. Control Relays: Auxiliary and adjustable time-delay relays.

2.9 CONTROLS

A. Control Valves: Comply with manufacturer's requirements.

B. Control Wiring: Factory wire connection for controls' power supply.

C. Control Devices: Sensors, transmitters, relays, switches, detectors, operators, actuators, and valves shall be manufacturer's standard items to accomplish indicated control functions.

D. Remote-Mounted Status Panel:
   1. Cooling/Off/Heating Controls: Control operational mode.
   2. Damper Position: Indicate position of outdoor-air dampers in terms of percentage of outdoor air.
   3. Status Lights:

a. Filter dirty.
b. Fan operating.
c. Cooling operating.
d. Heating operating.
e. Smoke alarm.
f. General alarm.

4. Digital Numeric Display:
   a. Outdoor airflow.
   b. Supply airflow.
   c. Outdoor dry-bulb temperature.
   d. Outdoor dew point temperature.
   e. Space temperature.
   f. Supply temperature.
   g. Space relative humidity.
   h. Space carbon dioxide level.
   i.

E. Control Dampers:
1. Damper Location: Factory installed inside unit for ease of blade axle and bushing service. Arrange dampers located in a mixing box to achieve convergent airflow to minimize stratification.
2. Damper Leakage: Comply with requirements in AMCA 500-D. Leakage shall not exceed 6.5 cfm per sq. ft. (33 L/s per sq. m) at a static-pressure differential of 4.0 inches water column (1000 Pa) when a torque of 5 inch pounds per sq. ft. (30.1 Newton meters per sq. m) is applied to the damper jackshaft.
3. Damper Rating: Rated for close-off pressure equal to the fan shutoff pressure.
4. Damper Label: Bear the AMCA seal for both air leakage and performance.
5. Blade Configuration: Unless otherwise indicated, use parallel blade configuration for two-position control and equipment isolation service and use modulating control when mixing two airstreams. For other applications, use an opposed-blade configuration.
6. Damper Frame Material: Extruded aluminum,,.
7. Blade Type: Single-thickness metal reinforced with multiple V-grooves.
8. Blade Material: Extruded aluminum,,.
9. Maximum Blade Width: 6 inches (150 mm).
10. Maximum Blade Length: 48 inches (1200 mm).
11. Blade Seals: Replaceable, continuous perimeter vinyl seals and jambs with stainless-steel compression-type seals.
12. Bearings: Thrust bearings for vertical blade axles.

F. Damper Operators:
1. Factory-installed electric operator for each damper assembly with one operator for each damper assembly mounted to the damper frame.
2. Operator capable of shutoff against fan pressure and able to operate the damper with sufficient reserve power to achieve smooth modulating action and proper speed of response at the velocity and pressure conditions to which the damper is subjected.
3. Maximum Operating Time: Open or close damper 90 degrees in 60 seconds.
4. Adjustable Stops: For both maximum and minimum positions.
5. Position Indicator and Graduated Scale: Factory installed on each actuator with words "OPEN" and "CLOSED," or similar identification, at travel limits.
6. Spring-return operator to fail-safe; either closed or open as required by application.

7. Operator Type: Direct coupled, designed for minimum 60,000 full-stroke cycles at rated torque.
8. Position feedback Signal: For remote monitoring of damper position.
9. Coupling: V-bolt and V-shaped, toothed cradle.
10. Circuitry: Electronic overload or digital rotation-sensing circuitry.

G. Refrigeration System Controls:
1. Unit-mounted enthalpy controller shall lock out refrigerant system when outdoor-air enthalpy is less than 28 Btu/lb (65 kJ/kg) (adj.) of dry air or outdoor-air temperature is less than 60 deg F (15 deg C) (adj.).

2.10 ACCESSORIES

A. Duplex Receptacle: Factory mounted in unit supply-fan section, with 20 amp 120 V GFI duplex receptacle and weatherproof cover.

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 the Work.

B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.

C. Examine roof curbs and equipment supports for suitable conditions where units will be installed.

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

3.2 INSTALLATION

A. Comply with manufacturer's rigging and installation instructions for unloading units and moving to final locations.

B. Equipment Mounting:
1. Install air units on cast-in-place concrete equipment bases. Retain "Suspended Units" Paragraph below for suspended units. Retain option for projects in seismic areas.

C. Install wall- and duct-mounted sensors furnished by manufacturer for field installation. Install control wiring and make final connections to control devices and unit control panel.

D. Install separate devices furnished by manufacturer and not factory installed.

E. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

F. Install drain pipes from unit drain pans to sanitary drain.
   1. Drain Piping: Schedule 40 PVC pipe complying with ASTM D 1785, with solvent-welded fittings.
   2. Pipe Size: Same size as condensate drain pan connection.

3.3 CONNECTIONS

A. Where installing piping adjacent to units, allow space for service and maintenance.

B. Duct Connections:
   1. Comply with requirements in Section 233113 "Metal Ducts."
   2. Drawings indicate the general arrangement of ducts.
   3. Connect ducts to units with flexible duct connectors.

C. Electrical Connections: Comply with requirements for power wiring, switches, and motor controls in electrical Sections.
   1. Install electrical devices furnished by unit manufacturer but not factory mounted.

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.
   2. Inspect units for visible damage to refrigerant compressor, condenser and evaporator coils, and fans.
   3. Start refrigeration system when outdoor-air temperature is within normal operating limits and measure and record the following:
      a. Cooling coil leaving-air, dry- and wet-bulb temperatures.
      b. Cooling coil entering-air, dry- and wet-bulb temperatures.
      c. Condenser coil entering-air dry-bulb temperature.
      d. Condenser coil leaving-air dry-bulb temperature.
   4. Simulate maximum cooling demand and inspect the following:
      a. Compressor refrigerant suction and hot-gas pressures.
      b. Short-circuiting of air through outside coil or from outside coil to outdoor-air intake.
   5. Inspect casing insulation for integrity, moisture content, and adhesion.
   6. Verify that clearances have been provided for servicing.
   7. Verify that controls are connected and operable.
   8. Verify that filters are installed.
   9. Clean coils and inspect for construction debris.
   10. Verify bearing lubrication.
   11. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
   12. Adjust fan belts to proper alignment and tension.
   13. Start unit.
   14. Inspect and record performance of interlocks and protective devices including response to smoke detectors by fan controls and fire alarm.
   15. Operate unit for run-in period.
   16. Calibrate controls.
   17. Adjust and inspect high-temperature limits.

18. Verify operational sequence of controls.
19. Measure and record the following airflows. Plot fan volumes on fan curve.
    a. Supply-air volume.
    b. Outdoor-air flow.

B. After startup, change filters, verify bearing lubrication, and adjust belt tension.

C. Remove and replace components that do not properly operate and repeat startup procedures as specified above.

D. Prepare written report of the results of startup services.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION 237433

SECTION 238123 – COMPUTER ROOM AIR CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Ceiling-mounted computer-room air conditioners.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For computer-room air conditioners to include in emergency, operation, and maintenance manuals.

1.6 MATERIALS MAINTENANCE SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fan Belts: One set(s) for each belt-driven fan.
   2. Filters: One set(s) of filters for each unit.

1.7 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. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1

D. ASME Compliance: Fabricate and label water-cooled condenser shell to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

1.8 COORDINATION

A. Coordinate layout and installation of computer-room air conditioners and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

B. Coordinate installation of computer-room air conditioners with computer-room access flooring Installer.

C. Coordinate sizes and locations of concrete bases with actual equipment provided.

D. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of computer-room air conditioners that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
   2. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CEILING-MOUNTED UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by LIEBERT or Authority approved equal.

B. Description: Self-contained, factory assembled, prewired, and prepiped; consisting of cabinet, fan, filters, and controls; for horizontal ceiling mounting to fit T-bar ceiling opening of 24 by 48 inches (610 by 1220 mm).

C. Cabinet: Galvanized steel with baked-enamel finish, insulated with 1/2-inch-(13-mm-) thick duct liner.
   1. Integral factory-supplied supply and return grille to fit ceiling grid kit of 24 by 48 inches (610 by 1220 mm), with filter.
   2. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Supply-Air Fan: Forward curved, centrifugal, and directly driven by two-speed motor.

E. Refrigeration System:
   1. Compressor: Hermetic, with oil strainer, internal motor overload protection, resilient suspension system, and crankcase heater.
   2. Refrigeration Circuit: Low-pressure switch, manual-reset high-pressure switch, thermal-expansion valve with external equalizer, sight glass with moisture indicator, service shutoff valves, charging valves, and charge of refrigerant.
   3. Refrigerant: R-407C or R-410A.
   4. Refrigerant Evaporator Coil: Direct-expansion coil of seamless copper tubes expanded into aluminum fins.
      a. Mount coil assembly over stainless-steel drain pan complying with ASHRAE 62.1 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir.
   5. Remote Air-Cooled Refrigerant Condenser: Integral, copper-tube aluminum-fin coil with propeller fan, direct driven.
   6. Split system shall have suction- and liquid-line compatible fittings and refrigerant piping for field interconnection.

F. Electric-Resistance Heating Coil: Finned-tube electric elements with contactor, dehumidification relay, and high-temperature-limit switches.

G. Filter: 1-inch-(25-mm-) thick, disposable, glass-fiber media.
   1. Merv (ASHRAE 52.2): 7.

H. Disconnect Switch: Nonautomatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.

I. Control System: Unit-mounted panel with main fan contactor, compressor contactor, compressor start capacitor, control transformer with circuit breaker, solid-state temperature-control modules, time-delay relay, heating contactor, and high-temperature thermostat. Provide solid-state, wall-mounted control panel with start-stop switch and adjustable temperature set point.

2.2 FAN MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
   1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
   2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

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 the Work.

B. Examine roughing-in for hydronic piping systems to verify actual locations of piping connections before equipment installation.

C. Examine walls, floors, and roofs for suitable conditions where computer-room air conditioners will be installed.

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

3.2 INSTALLATION

A. Install computer-room air conditioners level and plumb, maintaining manufacturer's recommended clearances.

B. Suspended Computer-Room Air Conditioners: Install using continuous-thread hanger rods and elastomeric hangers of size required to support weight of computer-room air conditioner.
   1. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

C. Air-Cooled Refrigerant Condenser Mounting: Install using elastomeric pads.
   1. Minimum Deflection: 1/4 inch (6 mm).

3.3 CONNECTIONS

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

B. Install piping adjacent to machine to allow service and maintenance.

C. Water and Drainage Connections: Provide adequate connections for condensate drain.

D. Refrigerant Piping: Comply with applicable requirements in Section 232300 "Refrigerant Piping." Provide shutoff valves and piping.

3.4 ADJUSTING

A. Adjust initial temperature set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION 238123