SECTION 237300

VARIABLE REFRIGERANT FLOW SYSTEMS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Indoor units, outdoor units and accessories associated with variable refrigerant flow systems.

B. Unit operating controls.

C. Electrical power connections.

D. Operation and maintenance service.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary General Conditions and other Division 01 specification sections, apply to work of this Section.

B. All related Specification sections shall be used in conjunction with this Section.

1.3 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 230100.

B. Submit drawings indicating components, dimensions, weights and loadings, required clearances, and location and size of field connections.

C. Submit product data indicating rated capacities, weights, accessories, service clearances and electrical requirements.

D. Submit manufacturer's installation instructions.

E. Submittals shall include the following: performance and capacity details of all units at specified indoor and outdoor conditions, piping schematics outputted from manufacturer specific software including pipe sizes and estimated piping lengths, refrigerant charge per system including ASHRAE 15 analysis, wiring diagrams, and 10 year parts only warranty information.

F. Submittal shall include a copy of the installing contractor’s certification of VRF manufacturer approved training.

G. OPERATION AND MAINTENANCE

H. Certifications: Provide manufacturer’s certification that all applicable products were manufactured in United States and meet the requirements of the Build America, Buy America Act (BABA) (part of Infrastructure Investment and Jobs Act).

1.4 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 230100.

B. Include manufacturer's descriptive literature, start-up and operating instructions, installation instructions and maintenance procedures.

1.5 EXTRA MATERIALS

A. Provide one set of spare filters for each system.

1.6 QUALITY ASSURANCE

A. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label.

B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).

C. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).

D. All units must meet or exceed the 2010 Federal minimum efficiency requirements and the proposed ASHRAE 90.1 efficiency requirements for VRF systems. Efficiency shall be published in accordance with the DOE alternative test procedure, which is based on the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standards 340/360, 1230 and ISO Standard 13256-1.

E. A full charge of R-410A for the condensing unit only shall be provided in the condensing unit.

F. Build America, Buy America Act (BABA) Requirements: All applicable products shall be manufactured in United States and shall meet the requirements of the Build America, Buy America Act (BABA) (part of Infrastructure Investment and Jobs Act).

1.7 DELIVERY, STORAGE AND HANDLING

A. Unit shall be stored and handled according to the manufacturer’s recommendations.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers

1. Daikin
2. Mitsubishi
3. LG – ASK OWNER
4. Owner approved equal

2.2 GENERAL

A. This section includes the design, performance, refrigerant details, controls and installation requirements for Daikin VRV systems (Variable Refrigerant Volume) distributed by DXS New England (978-977-9911).

B. All units shall be listed and rated by ANSI/AHRI Standard 1230-2010 and meet all minimum IEER performance requirements as scheduled.

C. The units shall be ANSI/UL STD 1995 listed and listed by Electrical Testing Labs (ETL) and bear the cETL label.

D. All wiring shall be in accordance with the National Electric Code (NEC).

E. The system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.

F. The system and the design shall be in compliance with ASHRAE 15 Mechanical Refrigerant Code.

G. Acceptable manufacturer: Daikin, distributed by DXS New England.

H. Submittals for Daikin products not provided by DXS New England will not be considered.

I. Alternate manufacturers shall send approval requests to consultant 14 days prior to bid day, and include all information relevant to the alternate VRF system, including but not limited to: unit selections, refrigerant piping layout, refrigerant charge with ASHRAE 15 analysis, branch selector box layout and locations, heating and cooling capacities at design temperatures and including capacity losses from piping lengths, defrost cycles, and combination ratios, dimensional and weight differences, and any other aspect of the system that differs from the system specified.

2.3 SYSTEM DESCRIPTION

A. VRF system shall automatically vary the target evaporating and condensing temperatures based on building load and weather conditions to increase part load efficiency (Variable Refrigerant Temperature). The condensing unit shall also feature customizable operating modes which allows for the manual setting of target evaporating and condensing temperatures.

B. Heat Recovery

1. System shall permit simultaneous heating and cooling of each indoor unit. Multiple indoor units connected to a single branch selector port shall operate in the same mode (heating or cooling), similar to a two pipe heat pump system. Refer to the controls section of this specification for any central controller and/or mode switchover sequence that may be required.

2.4 START-UP AND WARRANTY

A. Installing contractor must be certified by VRF manufacturer. The bidders shall be required to submit training certification proof with bid documents and submittal documents. Untrained contractors who wish to bid this project may contact DXS New England (978-977-9911) to arrange training prior to bid day.

B. The manufacturer shall provide a factory trained service technician to start-up each unit. Manufacturer shall provide instruction to the owners' personnel on proper unit operation and maintenance.

C. The warranty period on all parts and compressors shall commence on the date of initial start-up and shall continue for a period of Ten (10) years not to exceed one hundred and twenty-six (126) months from date of shipment. Proper maintenance of the equipment shall be conducted by certified technicians as per the manufacturer or manufacturer’s representative requirements. Maintenance logs shall be supplied by the owner upon request.

D. All manufacturer warranty shall be for parts only. All diagnosis and labour warranty shall be carried out by installing contractor as per the warranty requirements of this project.

2.5 REFRIGERANT PIPING

A. Refer and comply to the refrigerant piping specifications, including the special considerations for VRF refrigerant piping section.

B. Standard T style joints are not acceptable for a variable refrigerant volume system. Manufacturer specific Y joints shall be supplied by the VRF manufacturer.

2.6 FAN COILS

A. Fan coils shall monitor and maintain the unit superheat (cooling mode) or subcooling (heating mode) using a computerized PID control. Internal unit components shall be factory wired and piped, and complete with electronic proportional expansion valve, flare connections, condensate drain pan, self-diagnostics, and auto-restart function.

2.7 FXZQ-TBVJU – 4 Way Vista Flat Ceiling Cassette Unit

A. Daikin indoor unit model FXZQ shall be a ceiling cassette fan coil unit with a variable speed direct drive DC type fan for installation into the ceiling cavity, equipped with an air panel grill. It shall be a four-way air distribution type with fresh white or Daikin silver, impact resistant washable decoration panel. The supply air is distributed via motorized louvers which can be horizontally and vertically adjusted from 0° to 90°.

B. The indoor unit’s sound pressure shall range from 25.5 dB(A) to 33 dB(A) at low speed measured at 5 feet below the unit.

C. The 4-way supply air flow shall be capable of field modification to 2-way or 3-way airflow to accommodate various installation configurations including corner installations.

D. The decoration panel shall be a low-profile design, extending only 5/16” below the ceiling without any overlap with neighboring ceiling tiles, allowing for installation directly adjacent to other ceiling components such as lights, diffusers, and sprinklers, etc.

E. Return air shall be through the concentric panel, which includes a resin net mold resistant filter. The indoor units shall be equipped with a condensate pan and a factory-mounted condensate pump with up to 21” of lift and have a built-in safety shutoff and alarm.

F. Three auto-swing positions shall be available to choose from, which include standard, draft prevention and ceiling stain prevention.

G. The fan shall have a variable speed direct drive DC motor with a statically and dynamically balanced impeller with 3 user-selectable fan speeds. The automatic fan speed mode shall allow the fan to vary between 5 speeds based on space load.

2.8 FXMQ_M – CONCEALED CEILING DUCTED UNIT (Med. Static)

H. General: Daikin indoor unit FXMQ_M shall be a built-in ceiling concealed fan coil unit, operable with refrigerant R-410A, equipped with an electronic expansion valve, for installation into the ceiling cavity. It is constructed of a galvanized steel casing. It shall be available in capacities from 72,000 Btu/h to 96,000 Btu/h. Model numbers are FXMQ72MVJU and FXMQ96MVJU to

be connected to outdoor unit model RXYQ / RWEYQ heat pump and REYQ / RWEYQ heat recovery model. It shall be a horizontal discharge air with horizontal return air configuration. All models feature a low height cabinet making them applicable to ceiling pockets that tend to be shallow. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature when used with Daikin remote control BRC1E72, BRC1E73 and BRC2A71. The indoor unit's sound pressure shall be 48 dB(A) at low speed measured 5 feet below the ducted unit.

I. Performance: As scheduled.

J. Indoor Unit:

1. The Daikin indoor unit FXMQ_M shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall have an adjustable external static pressure switch.
2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
3. Both refrigerant lines shall be insulated from the outdoor unit.
4. The indoor units shall be equipped with a return air thermistor.
5. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.
6. The voltage range will be 253 volts maximum and 187 volts minimum.

K. Unit Cabinet:

1. The cabinet shall be located into the ceiling and ducted to the supply and return openings.
2. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

L. Fan:

1. The fan shall be direct-drive Sirocco type fan, statically and dynamically balanced impeller with high and low fan speeds available.
2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz, with a motor output of 0.51 HP.
3. The airflow rate shall be available in high and low settings.
4. The fan motor shall be thermally protected.
5. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings.
6. Fan motor external static pressure for nominal airflow: as scheduled.

M. Coil:

1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
3. The coil shall be a 3 row cross fin copper evaporator coil with 13 fpi design completely factory tested.

4. The refrigerant connections shall be flare connections and the condensate will be 1-5/16 inch outside diameter PVC.
5. A thermistor will be located on the liquid and gas line.

N. Electrical:

1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

O. Control:

1. The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.
2. The unit shall be compatible with interfacing with a BMS system via optional LonWorks or BACnet gateways.
3. The unit shall be compatible with a Daikin Intelligent Touch Manager advanced multi-zone controller.

2.9 CONDENSING UNIT

A. The condensing unit shall be factory assembled in North America and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of Daikin inverter scroll compressors, motors, fans, heat exchanger, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports, liquid receiver (heat recovery only) and suction accumulator.

B. The system will automatically restart operation after a power failure and will not cause any settings to be lost.

C. The unit shall incorporate an auto-charging feature to ensure proper refrigerant charge.

D. The following safety devices shall be included on the condensing unit: high pressure sensor and switch, low pressure sensor, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter, and anti-recycling timers.

E. The Daikin inverter scroll compressors shall be high efficiency reluctance DC (digitally commutating), hermetically sealed, variable speed type. Temperatures and pressures shall be read every 20 seconds and calculated. With each reading, the compressor capacity (INV frequency) shall be controlled to eliminate deviation from target value. Noninverter-driven compressors shall not be accepted.

F. Neodymium magnets shall be adopted in the rotor construction to yield a higher torque and efficiency in the compressor instead of the normal ferrite magnet type. Upon complete stop of the compressor, the neodymium magnets will position the rotor into the optimum position for a low torque start.

G. The compressors' motors shall have a cooling system using discharge gas, to avoid sudden changes in temperature resulting in significant stresses on winding and bearings.

H. Inverter board shall be refrigerant-cooled to prevent inefficient and unstable operation that can result from air-cooled inverter boards due to varying ambient conditions.

I. The compressor shall be internally isolated to avoid the transmission of vibration.

J. In the case of multiple condenser modules, operation hours of the compressors shall be balanced by means of the Duty Cycling Function.

K. Air Cooled

1. The fan motor shall have inherent protection and permanently lubricated bearings. The motor shall be provided with a fan guard to prevent contact with moving parts. The condensing unit shall consist of one or more propeller type, direct-drive 350 or 750 W fan motors that have multiple speed operation via a DC (digitally commutating) inverter. Motors shall be capable of delivering design air at high external static pressures up to 0.32 in WG (factory set as standard at 0.12 in. WG) to accommodate field applied condensing unit discharge ductwork.
2. Night setback control for low noise operation shall automatically limit the maximum speed of the fan motor.
3. The heat exchanger on the condensing units shall be manufactured from Hi-X seamless copper tubes with N-shape internal grooves mechanically bonded on to aluminum fins to an e-Pass Design. The heat exchanger coil shall be of a waffle louver fin and rifled bore tube design to ensure high efficiency performance.
4. The fins are to be covered with an anti-corrosion hydrophilic blue coating as standard with a salt spray test rating of 1000hr (ASTM B117 & Blister Rating:10), Acetic acid salt spray test of 500hr (ASTM G85 & Blister Rating:10).

2.10 REYQ – HEAT RECOVERY VRV-IV

A. The outdoor unit shall be capable of heating operation down to -13°F ambient temperature. Tested factory data on heating capacity and efficiency shall be available. Continuous heating shall be provided during defrost mode for multi-module systems.

B. The outdoor unit shall be capable of cooling operation down to +23°F without any additional low ambient controls.

C. The outdoor coil shall have a three-circuit heat exchanger design. The lower part of the coil shall be used for inverter cooling, enhancing defrost during heating operation.

D. The system shall have a factory standard technical cooling option to allow simultaneous heating and cooling down to -4°F. Manufacturers that cannot guarantee simultaneous heating and cooling down to -4°F, even when the system is cooling-dominant, shall provide separate systems for zones requiring year-round cooling.

2.11 BRANCH SELECTOR BOX

A. Selector box cabinets shall have a galvanized steel plate casing and shall house multiple electronic expansion valves and a sub-cooling loop. The unit shall contain sound absorption thermal insulating material made of flame and heat resistant foamed polyethylene.

B. Branch selector boxes shall not require drain pan and drain connections. Manufacturers with branch selector boxes requiring secondary drain pans and drain connections shall coordinate with the installing contractor at no extra cost to the owner.

C. Manufacturers with branch selector box sizes, arrangements, or locations that differ from what is specified shall make the necessary arrangements to ensure their alternative branch selector boxes both fit in the space and that ASHRAE 15 compliance is still met.

D. Manufacturers shall provide sound data for all branch selector boxes. If sound data is unavailable or exceeds the values below, or if branch boxes make use of solenoid valves instead of electronic expansion valves, necessary precautions shall be taken. Precautions shall include the supply and install of sound blankets, or the relocation of branch boxes away from the occupied spaces, or extra insulation to the ceilings and walls around the branch selector boxes, all at no extra cost to the owner.

Model	Voltage	MCA A	Operating Sound dB(A)	Max Sound dB(A)	WxHxD inch	Weight lbs
BSQ36TVJ	230V 1ph	0.1	35	40	15.3x8.1x12.8	27
BSQ60TVJ	230V 1ph	0.1	41	45	15.3x8.1x12.8	27
BSQ96TVJ	230V 1ph	0.1	41	45	15.3x8.1x12.8	33
BS4Q54TVJ	230V 1ph	0.4	38	45	14.6x11.7x18.9	49
BS6Q54TVJ	230V 1ph	0.6	39	47	22.8x11.7x18.9	68
BS8Q54TVJ	230V 1ph	0.8	39	47	22.8x11.7x18.9	73
BS10Q54TVJ	230V 1ph	1.0	40	48	32.3x11.7x18.9	101
BS12Q54TVJ	230V 1ph	1.2	40	48	32.3x11.7x18.9	106

2.12 LOCAL CONTROLS

A. Fan coil units shall be supplied with individual zone controllers, similar to Daikin model BRC1E73.

B. Zone controllers shall be hard wired by installing contractor.

C. Controllers shall be able to function as follows:

1. The controller shall have single and dual setpoints for occupied periods, and independent setback setpoints for unoccupied periods.
2. The controller shall have the ability to digitally prohibit individual buttons and functions, including custom mode selection.
3. The controller shall have a self-diagnosis function that constantly monitors the system for malfunctions.
4. The controller shall be equipped with a thermostat sensor.
5. Controller shall have built-in 7 day, weekday plus Saturday Sunday (5+1+1), weekday plus weekend (5+2) and everyday (1) scheduler.

D. Units shall be provided with a remote “in-room” sensor kit for field installation. Sensor shall detect the room temperature at a remote location away from the indoor unit.

2.13 CENTRAL CONTROLS

A. Provide an advanced multi-zone controller for installation in a common area as shown on the plans, equal to Daikin iTouch Manager. The controller shall have a 10” LCD touch screen display with the following screen views and functionalities:

B. Central control of set points, schedules, fan speeds, heat/cool mode, and of setback (override) temperature settings during unoccupied periods.

C. Adjustable temperature limits to restrict local wall mounted thermostat setpoint ranges.

D. Visible and audible alarm indication of any system malfunctions with error code.

E. Tiered hierarchy allowing for control of fan coil units independently or as a group.

F. Remotely disable individual functions of the wall mounted zone controllers.

G. Web enabled for remote access from PC, tablet or portable device and automatic alert and error emails.

H. The following two automatic changeover methods shall be available. One shall be selected upon commissioning.

1. Averaging Method – the central controller shall sum up the difference between room temperatures and set points for all indoor units in the system. Once this delta reaches the primary changeover deadband of ± 2°F (adjustable), the central controller shall change over the system automatically.
2. Voting Method – The central controller shall evaluate the difference between individual room temperatures and set points, and only include a fan coil in the algorithm if the difference has passed the primary dead band for more than the guard timer, or past the secondary dead band. Heating priority option shall be available.

I. For both automatic changeover options, a weight (0-3) can be added to each indoor unit. The automatic changeover algorithm shall use this weighting to prioritize changeover for the more heavily weighted fan coils.

J. Upon any changeover, a guard timer shall prevent another changeover for a period of 15, 30, or 60 (default) minutes.

K. The guard timer shall be ignored by a change of setpoint manually from either the central controller or the remote controller, by schedule, or if the secondary deadband is reached with either of the automatic changeover algorithms. The secondary changeover deadband shall be the sum of the primary changeover deadband (adjustable) ± 1°F (adjustable)

L. “3D” Floor plan graphic layout

1. The central controller shall have the capability for site floor plans to be uploaded as a background to create a graphics interface. Background shall be project specific floor plans rendered in “2D” or “3D”.
2. Floor plan layout shall be displayed both on the local central controller, as well as accessible from the web.
3. Floor plan will include capability to control indoor unit, and auxiliary inputs / outputs, such as designated lighting control, as follows:

4. Up to 4 status points to be assigned to the control point icon (room name, room temperature, set point, and mode).
5. Status and control points to display on corresponding location of zone served on floor plan.
6. Digital input and output icons will display On/Off status.
7. Analog input icons will display analog value.
8. Up to 60 floor layout sections shall be possible depending on project scope.

M. BACnet Server

1. The iTM BACnet Server Gateway Option shall be capable of making the iTouch Manager work as a BACnet gateway using the BACnet/IP protocol. The iTM BACnet Server Gateway Option shall be capable of exposing indoor unit management points as BACnet objects to the BMS.
2. The iTM BACnet Server Gateway Option shall allow the following functions:

    a. Support Change of Value (COV) notifications.
    b. Provide unique virtual BACnet device identification number (ID) for every indoor unit group address.
    c. The iTM BACnet Server Gateway Option shall be capable of being configured as a foreign device. It shall be capable of communicating across BACnet Broadcast Management Devices (BBMD) in different subnet networks.

3. In addition to the standard BACnet VRF points, the Building Management System shall monitor and/or control the following BACnet objects for indoor units:

    a. Occupancy Mode: Unoccupied, Occupied, Standby
    b. Cooling and heating setpoints during occupied and unoccupied modes.

4. The Building Management System may choose to monitor and control the following BACnet objects linked to iTM control logic:

    a. Enable/Disable iTM Schedule operation.
    b. Enable/Disable iTM Auto Changeover Operation.
    c. Set Timed Override Minutes - Monitor and configure timer extension for the indoor unit on iTM (30, 60, 90, 120, 150, 180 minutes)
    d. System forced off - Enable/Disable all emergency stop programs that are registered on the iTM.

5. The BMS shall have the ability to utilize scheduling functions on the iTouch Manager.
6. The BMS shall have the ability to utilize automatic changeover function on the iTouch Manager, removing the need to program automatic changeover sequences on the BMS.
7. VRF manufacturer shall commission the BACnet server. BMS contractor shall provide VRF manufacturer with static IP address and instance number for commissioning. IP connection shall be by BMS contractor.
8. All programming for monitoring and control of VRF system via the BACnet server shall be by BMS contractor, as per the Sequence of Operation.

2.14 ELECTRICAL

A. Independent electrical power for fan coils and branch selector boxes shall be 208/230 volts, 1 phase, 60 hertz. The unit shall be capable of operating within the limits of 187 volts to 253 volts.

B. Unless limited by local electrical codes and standards, multiple fan coils and branch selector boxes can be connected to the same breaker. Field provided individual disconnect switches for each fan coil are required.

C. Selection: Electrical power for condensing units shall be 460 volts, 3 phase, 60 hertz.

D. Selection: Electrical power for condensing units shall be 208/230 volts, 3 phase, 60 hertz. The unit shall be capable of operating within the limits of 187 volts to 253 volts.

E. The control voltage between the indoor and outdoor unit shall be 16VDC. The control wiring shall be communication type stranded non-shielded 18-2 AWG.

F. Control wiring shall be installed in a daisy chain configuration between all VRF components as per Manufacturer.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install condensing units on a flat surface level within 1/8 inch and elevated a minimum of 18” from ground or roof surface. Provide intermediate supports as recommended by the equipment manufacturer.

B. Provide all necessary control wiring as recommended by the manufacturer.

C. High/low pressure gas line, liquid, and suction lines must be individually insulated between the outdoor and indoor units.

D. Contact DXS (978-977-9911) prior to installation to review and confirm piping layout and lengths.

E. Use refrigeration best practice to allow pipes to expand and contract freely. Review manufacturer installation instructions to ensure expansion joints are properly designed.

F. Pressure test ALL systems to 550 PSI after system was vacuumed and held to below 500 microns for at least one hour. Review manufacturer installation instructions for proper pressure test procedures.

END OF SECTION