

## SECTION 238126 - VARIABLE CAPACITY, HEAT PUMP HEAT RECOVERY AIR CONDITIONING SYSTEM

### PART 1 – GENERAL

#### 1.1 SYSTEM DESCRIPTION

- A. The variable capacity, heat pump heat recovery air conditioning system shall be a Mitsubishi Electric CITY MULTI VRF (Variable Refrigerant Flow) zoning system.
- B. The R2-Series system shall consist of a PURY outdoor unit, BC (Branch Circuit) Controller, multiple indoor units, and M-NET DDC (Direct Digital Controls). Each indoor unit or group of indoor units shall be capable of operating in any mode independently of other indoor units or groups. System shall be capable of changing mode (cooling to heating, heating to cooling) with no interruption to system operation. To ensure owner comfort, each indoor unit or group of indoor units shall be independently controlled and capable of changing mode automatically when zone temperature strays 1.8 degrees F from set point for ten minutes. The sum of connected capacity of all indoor air handlers shall range from 50% to 150% of outdoor rated capacity.

#### 1.2 QUALITY ASSURANCE

- A. The units shall be listed by Electrical 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 ASHRAE 90.1 efficiency requirements for VRF systems. Efficiency shall be published in accordance with the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 1230.
- E. A full charge of R-410A for the condensing unit only shall be provided in the condensing unit.

#### 1.3 DELIVERY, STORAGE AND HANDLING

- A. Unit shall be stored and handled according to the manufacturer's recommendation.

#### 1.4 CONTROLS

- B. The control system shall consist of a low voltage communication network of unitary built-in controllers with on-board communications and a web-based operator interface. A web controller with a network interface card shall gather data from this system and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface.

- C. System controls and control components shall be installed in accordance with the manufacturer's written installation instructions.
- D. Furnish energy conservation features such as optimal start, night setback, request-based logic, and demand level adjustment of overall system capacity as specified in the sequence.
- E. System shall provide direct and reverse-acting on and off algorithms based on an input condition or group conditions to cycle a binary output or multiple binary outputs.
- F. Provide capability for future system expansion to include monitoring and use of occupant card access, lighting control and general equipment control.
- G. System shall be capable of email generation for remote alarm annunciation.
- H. Control system start-up shall be a required service to be completed by the manufacturer or a duly authorized, competent representative that has been factory trained in Mitsubishi Electric controls system configuration and operation. The representative shall provide proof of certification for Mitsubishi Electric Controls Applications Training indicating successful completion of no more than two (2) years prior to system installation. This certification shall be included as part of the equipment and/or controls submittals. This service shall be equipment and system count dependent and shall be a minimum of one (1) eight (8) hour period to be completed during normal working hours.

#### 1.5 WARRANTY

- A. The CITY MULTI units shall be covered by the manufacturer's limited warranty for a period of one (1) year parts and seven (7) year compressor to the original owner from date of installation.
- B. The S-Series units shall be covered by the manufacturer's limited warranty for a period of one (1) year parts and six (6) year compressor to the original owner from date of installation. If the systems are:
  - 1. Designed by a certified CITY MULTI Diamond Designer using Diamond System Builder,
  - 2. Installed by a contractor that has successfully completed the Mitsubishi Electric three day service course, AND
  - 3. Verified with required materials submitted to and approved by the Mitsubishi Electric Service Department, which include:
    - As built Diamond System Builder file,
    - A one (1) hour Maintenance Tool record with system information, in Ordinary Control Mode (not initial),
    - Outdoor and Indoor unit dip switch settings
    - Outdoor unit(s) function settings,then the units shall be covered by an extended manufacturer's limited warranty for a period of ten (10) years to the original owner from date of installation.

In addition the compressor shall have a manufacturer's limited warranty for a period of ten (10) years to the original owner from date of installation.

If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer.

This warranty shall not include labor.

- C. The CITY MULTI VRFZ system shall be installed by a contractor with extensive CITY MULTI install and service training. The mandatory contractor service and install training should be performed by the manufacturer.

## PART 2 - PRODUCTS

### 2.1 R2-SERIES OUTDOOR UNIT

- A. General: The R2-Series PURY outdoor unit shall be used specifically with CITY MULTI VRFZ components. The PURY outdoor units shall be equipped with multiple circuit boards that interface to the M-NET controls system and shall perform all functions necessary for operation. Each outdoor unit module shall be completely factory assembled, piped and wired and run tested at the factory.
  - 1. All units requiring a factory supplied twinning kits shall be piped together in the field, without the need for equalizing line(s). If an alternate manufacturer is selected, any additional material, cost, and labor to install additional lines shall be incurred by the contractor.
  - 2. Outdoor unit shall have a sound rating no higher than 61 dB(A) individually or 64 dB(A) twinned. Units shall have a sound rating no higher than 51 dB(A) individually or 54 dB(A) twinned while in night mode operation. If an alternate manufacturer is selected, any additional material, cost, and labor to meet published sound levels shall be incurred by the contractor.
  - 3. Both refrigerant lines from the outdoor unit to the BC (Branch Circuit) Controller (Single or Main) shall be insulated.
  - 4. There shall be no more than 3 branch circuit controllers connected to any one outdoor unit.
  - 5. Outdoor unit shall be able to connect to up to 50 indoor units depending upon model.
  - 6. The outdoor unit shall have an accumulator with refrigerant level sensors and controls.
  - 7. The outdoor unit shall have a high pressure safety switch, over-current protection, crankcase heater and DC bus protection.
  - 8. The outdoor unit shall have the ability to operate with a maximum height difference of 164 feet and have total refrigerant tubing length of 1804-2625 feet. The greatest length is not to exceed 541 feet between outdoor unit and the indoor units without the need for line size changes or traps.
  - 9. The outdoor unit shall be capable of operating in heating mode down to -4°F ambient temperature or cooling mode down to 23°F ambient temperature, without additional low ambient controls. If an alternate manufacturer is selected, any additional material, cost, and labor to meet low ambient operating condition and performance shall be incurred by the contractor.

10. The outdoor unit shall be capable of operating in cooling mode down to -10°F with optional manufacturer supplied low ambient kit.
  11. Manufacturer supplied low ambient kit shall be provided with predesigned control box rated for outdoor installation and capable of controlling kit operation automatically in all outdoor unit operation modes.
  12. Manufacturer supplied low ambient kit shall be listed by Electrical Laboratories (ETL) and bear the ETL label.
  13. Manufacturer supplied low ambient kit shall be factory tested in low ambient temperature chamber to ensure operation. Factory performance testing data shall be available when requested.
  14. The outdoor unit shall not cease operation in any mode based solely on outdoor ambient temperature.
  15. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.
  16. Unit must defrost all circuits simultaneously in order to resume full heating more quickly. Partial defrost which may extend “no or reduced heating” periods shall not be allowed.
- B. Unit Cabinet: The casing(s) shall be fabricated of galvanized steel, bonderized and finished. Units cabinets shall be able to withstand 960 hours per ASTM B117 criteria for seacoast protected models (–BS models).
- C. Fan:
1. Each outdoor unit module shall be furnished with one direct drive, variable speed propeller type fan. The fan shall be factory set for operation under 0 in. WG external static pressure, but capable of normal operation under a maximum of 0.24 in. WG external static pressure via dipswitch.
  2. All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
  3. All fan motors shall be mounted for quiet operation.
  4. All fans shall be provided with a raised guard to prevent contact with moving parts.
  5. The outdoor unit shall have vertical discharge airflow.
- D. Refrigerant: R410A refrigerant shall be required for PURY-P-T/Y(S) JMU-A outdoor unit systems. Polyolester (POE) oil shall be required. Prior to bidding, manufacturers using alternate oil types shall submit material safety data sheets (MSDS) and comparison of hygroscopic properties for alternate oil with list of local suppliers stocking alternate oil for approval at least two weeks prior to bidding.
- E. Coil:
1. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
  2. The coil fins shall have a factory applied corrosion resistant blue-fin finish.
  3. A stainless steel pipe connects the aluminum coil to copper piping.
  4. The coil shall be protected with an integral metal guard.
  5. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.
  6. The outdoor coil shall include 4 circuits with two position valves for each circuit, except for the last stage.

## F. Compressor:

1. Each outdoor unit module shall be equipped with one inverter driven scroll hermetic compressor. Non inverter-driven compressors shall not be allowed.
2. A crankcase heater(s) shall be factory mounted on the compressor(s).
3. The outdoor unit compressor shall have an inverter to modulate capacity. The capacity shall be completely variable with a turndown of 19%-5% of rated capacity, depending upon unit size.
4. The compressor will be equipped with an internal thermal overload.
5. The compressor shall be mounted to avoid the transmission of vibration.
6. Field-installed oil equalization lines between modules are not allowed. Prior to bidding, manufacturers requiring equalization must submit oil line sizing calculations specific to each system and module placement for this project.

## G. Controls:

1. The outdoor unit shall have the capability of up to 8 levels of demand control for each refrigerant system

## H. Electrical:

1. The outdoor unit shall be controlled by integral microprocessors.
2. The control circuit between the indoor units, BC Controller and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

## 2.2 BRANCH CIRCUIT (BC) CONTROLLERS FOR R2-SERIES SYSTEMS

- A. General: The BC (Branch Circuit) Controllers shall be specifically used with R410A R2-Series systems. These units shall be equipped with a circuit board that interfaces to the M-NET controls system and shall perform all functions necessary for operation. The unit shall have a galvanized steel finish. The BC Controller shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory. This unit shall be mounted indoors, with access and service clearance provided for each controller. The sum of connected capacity of all indoor air handlers shall range from 50% to 150% of rated capacity.

## B. BC Unit Cabinet:

1. The casing shall be fabricated of galvanized steel.
2. Each cabinet shall house a liquid-gas separator and multiple refrigeration control valves.
3. The unit shall house two tube-in-tube heat exchangers.

## C. Refrigerant: R410A refrigerant shall be required.

## D. Refrigerant Valves:

1. The unit shall be furnished with multiple branch circuits which can individually accommodate up to 54,000 BTUH and up to three indoor units. Branches may be twinned to allow more than 54,000 BTUH.
2. Each branch shall have multiple two-position valves to control refrigerant flow.

3. Service shut-off valves shall be field-provided/installed for each branch to allow service to any indoor unit without field interruption to overall system operation.
  4. Linear electronic expansion valves shall be used to control the variable refrigerant flow.
- E. Integral Drain Pan: An integral condensate pan and drain shall be provided.
- F. Electrical:
1. The unit electrical power shall be 208/230 volts, 1 phase, 60 hertz.
  2. The unit shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253V (230V/60Hz).
  3. The BC Controller shall be controlled by integral microprocessors.
  4. The control circuit between the indoor units and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

### 2.3 PKFY (WALL MOUNTED) INDOOR UNIT

- A. General:
1. The PKFY shall be a wall-mounted indoor unit section and shall have a modulating linear expansion device and a flat front. The PKFY shall be used with the R2-Series outdoor unit and BC Controller, Y-Series outdoor unit, or S-Series outdoor unit. The PKFY shall support individual control using M-NET DDC controllers.
- B. Indoor Unit
1. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
- C. Unit Cabinet:
1. All casings, regardless of model size, shall have the same white finish
  2. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining shall be standard.
  3. There shall be a separate back plate which secures the unit firmly to the wall.
- D. Fan:
1. The indoor fan shall be an assembly with one or two line-flow fan(s) direct driven by a single motor.
  2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
  3. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).
  4. A motorized air sweep louver shall provide an automatic change in airflow by directing the air up and down to provide uniform air distribution.

## E. Filter:

1. Return air shall be filtered by means of an easily removable, washable filter.

## F. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain shall be provided under the coil.
6. Both refrigerant lines to the PKFY indoor units shall be insulated in accordance with the installation manual.

## G. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz)

## H. Controls:

1. This unit shall use controls provided by Mitsubishi Electric Cooling & Heating to perform functions necessary to operate the system.
2. The unit shall be able to control external backup heat.
3. The unit shall have a factory built in receiver for wireless remote control
4. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.
5. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.
6. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.
7. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

## 2.4 PEFY-NMAU (CEILING-CONCEALED DUCTED) INDOOR UNIT

## A. General:

1. The PEFY shall be a ceiling-concealed ducted indoor fan coil design that mounts above the ceiling with a 2-position, field adjustable return and a fixed horizontal discharge supply and shall have a modulating linear expansion device. The PEFY shall be used with the R2-Series outdoor unit and BC Controller, Y-Series outdoor unit, or S-Series outdoor unit. The PEFY shall support individual control using M-NET DDC controllers. The unit shall be suitable for use in plenums in accordance with UL1995 ed 4.

## B. Indoor Unit.

1. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
- C. Unit Cabinet:
1. The unit shall be, ceiling-concealed, ducted.
  2. The cabinet panel shall have provisions for a field installed filtered outside air intake.
- D. Fan:
1. PEFY-NMAU models shall feature external static pressure settings from 0.14 to 0.60 in. WG.
  2. The indoor unit fan shall be an assembly with one or two Sirocco fan(s) direct driven by a single motor.
  3. The indoor fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings.
  4. The indoor fan shall consist of three (3) speeds, High, Mid, and Low plus the Auto-Fan function
  5. The indoor unit shall have a ducted air outlet system and ducted return air system.
- E. Filter:
1. Return air shall be filtered by means of a return air filter grille(s).
- F. Coil:
1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
  2. The tubing shall have inner grooves for high efficiency heat exchange.
  3. All tube joints shall be brazed with phos-copper or silver alloy.
  4. The coils shall be pressure tested at the factory.
  5. A condensate pan and drain shall be provided under the coil.
  6. The condensate shall be gravity drained from the fan coil.
  7. Both refrigerant lines to the PEFY indoor units shall be insulated in accordance with the installation manual.
- G. Electrical:
1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
  2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).
- H. Controls:
1. This unit shall use controls provided by Mitsubishi Electric Cooling & Heating to perform functions necessary to operate the system.
  2. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of



compensation shall be possible for individual units to accommodate instances when compensation is not required.

3. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.
4. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.
5. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

## 2.5 CONTROLS OVERVIEW

### A. Wiring:

1. Control wiring shall be installed in a system daisy chain configuration from indoor unit to ME remote controller to indoor unit, to the BC controller (main and subs, if applicable) and to the outdoor unit. Control wiring to remote controllers shall be run from the indoor unit terminal block to the controller associated with that unit.
2. Control wiring for schedule timers, system controllers, and centralized controllers shall be installed in a daisy chain configuration from outdoor unit to outdoor unit, to system controllers, to the power supply.
3. Control wiring for the Deluxe MA, Simple MA, and Wireless MA remote controllers shall be from the remote controller to the first associated indoor unit (TB-15) then to the remaining associated indoor units (TB-15) in a daisy chain configuration.
4. The AE-200A system controller shall be capable of being networked with other AE-200A system controllers for web based control.

### B. Wiring Type:

1. Wiring shall be 2-conductor (16 AWG), twisted shielded pair, stranded wire, as defined by the Design Tool AutoCAD output.
2. Network wiring shall be CAT-5e with RJ-45 connection.

### C. Remote Controllers Backlit Simple MA Remote Controller (PAC-YT53CRAU) – **ALL AREAS**

1. The Backlit Simple MA Remote Controller (PAC-YT53CRAU) shall be capable of controlling up to 16 indoor units (defined as 1 group). The Backlit Simple MA Remote Controller shall be compact in size, approximately 3" x 5" and have limited user functionality. The Backlit Simple MA supports temperature display selection of Fahrenheit or Celsius. The Backlit Simple MA Remote Controller shall allow the user to change on/off, mode (cool, heat, auto (R2/WR2-Series only), dry, setback (R2/WR2-Series only) and fan), temperature setting, and fan speed setting and airflow direction. The Backlit Simple MA Remote Controller shall be able to limit the set temperature range from the Backlit Simple MA. The Backlit Simple MA Remote controller shall be capable of night setback control with upper and lower set temperature settings. The room temperature shall be sensed at either the Backlit Simple MA Remote Controller or the Indoor Unit dependent on the indoor unit dipswitch setting. The Backlit Simple MA Remote Controller shall display a four-digit error code in the event of system abnormality/error.
2. The Backlit Simple MA Remote Controller shall only be used in same group with Wireless MA Remote Controllers (PAR-FL32MA-E / PAR-FA32MA-E) or with other

Backlit Simple MA Remote Controllers (PAC-YT53CRAU), with up to two remote controllers per group.

3. The Backlit Simple MA Remote Controller shall require no addressing. The Backlit Simple MA Remote Controller shall connect using two-wire, stranded, non-polar control wire to TB15 connection terminal on the indoor unit. The Simple MA Remote Controller shall require cross-over wiring for grouping across indoor units.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install unit's level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

#### 3.2 CONNECTIONS

- A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.
- B. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.
- D. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

#### 3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
  1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
  1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

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

E. Prepare test and inspection reports.

#### 3.4 STARTUP SERVICE

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

1. Complete installation and startup checks according to manufacturer's written instructions.

#### 3.5 DEMONSTRATION

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

B. The VRF manufacturer shall provide the owner's representative a minimum 4-hour VRF Operation and Maintenance training class covering systems installed under this scope of work.

C. Training program is to be provided at the time of owner occupancy. Owner shall provide a suitable location, onsite, to conduct the VRF Operation and Maintenance class.

D. Training material shall be provided to participants in electronic format.

END OF SECTION 238126