GEN V – VRF-VAV Control System

Using

Programmable Wired Thermostats
and/or
Wireless Zone Sensors (TAP)

Automatic Temperature Control Specification

Section 15950 - Controls and Automation

PART 1: General

1.1 The automatic temperature controls (ATC) under this section will be supplied and installed in accordance with the General Conditions, Supplementary Conditions, and all Division I General Requirements and Referenced Documents.

1.2 The installation of the ATC shall be in accordance with all National, State and Local codes pertaining to this type of work.

1.3 All work must comply with Section 15050 − Basic Materials and Methods − and all other Division 15 Sections, as applicable.

1.4 The scope shall include furnishing and installing a temperature control system to include remote control panels, temperature control devices, appurtenances, etc. to accomplish specific control sequences specified herein, to provide overheating and freeze protection for HVAC units, sensing and indicating devices, temperature indicating instruments, supporting structures and other required components.

1.5 The scope shall include all thermostats, sensors, VAV-SMART AIR VALVES (SAV), actuators, microprocessor central controllers, VAV diffusers, static pressure sensors, fan powered boxes, and reheat products and all other new components of the system requiring connections.

PART 2: General Instructions

2.1 The Building Automation System/Automatic Temperature Control (BAS/ATC) Systems as specified herein shall be provided in their entirety by the BAS/ATC Contractor. The BAS/ATC Contractor shall base his Bid on the system as specified and on the sequence of operations.

2.2 As part of his Bid, the BAS/ATC Contractor shall submit for review by the owner's authorized representatives a written description of his BAS/ATC systems, including block diagrams, showing all major components and control panels and required cabling between each.

2.3 The BAS/ATC contractor shall include manufacturer's literature for each type of panel, controller, or device that may be shown on the Riser Diagram.

2.4 The Riser Diagram shall show schematically the entire building system with all major components identified.

PART 3: Scope of Work

3.1 The BAS/ATC systems shall be supplied and installed completely under the BAS/ATC Contract. Control components shall be mounted and wired by the BAS/ATC Contractor.

3.2 The BAS/ATC Contractor shall provide the engineering, installation, calibration, software programming and checkout necessary for complete and fully operational BAS/ATC systems, as specified hereafter.

3.3 Wiring in exposed areas and in mechanical rooms shall be in EMT. Wiring in accessible, concealed areas shall be plenum rated cable.

PART 4: Submittals

4.1 The following data/information shall be submitted for approval:
4.2 Complete sequence of operation.
4.3 Control system drawings, including all pertinent data, to provide a functional operating system.
4.4 SAV schedules showing size, configuration, capacity and location of all equipment.
4.5 Data sheets for all hardware control components.
4.6 A description of the installation materials including conduit, wire, flex, etc.
4.7 Thermostat/Sensor locations.
4.8 Control panel locations.
4.9 Provide as part of the submittal five copies of all data and control drawings.

PART 5: Qualifications

5.1 The BAS/ATC Contractor shall participate in an on-line training with Zonex Systems prior to installation of the *GEN V - VRF-VAV* control system.
5.2 The BAS/ATC Contractor shall complete Zonex Job Completion and Start Up Check List and review with building owner or representative at the conclusion of the controls system installation.
5.3 The BAS/ATC Contractor shall have an office within a 100-mile radius of the job site, staffed with factory trained personnel capable of providing instruction, routine maintenance and 24-hour emergency maintenance service for all system components.
5.4 The BAS/ATC Contractor shall have a minimum of three years' experience installing and servicing similar microprocessor-based control systems.
5.5 The Contractor shall be prepared to provide evidence of this history as a condition of acceptance and approval prior to bidding.

PART 6: System Description

6.1 The SYSTEM shall be a pressure independent Auto Changeover VRF-VAV zoning system that controls one VRF Condensing Unit, one VRF fan coil or VRF rooftop unit with each supporting 2 - 20 Pressure Independent Smart Air Valves (SAV) - zones per ducted VRF Fan Coil. Each SAV shall emulate the operation of an indoor VRF fan coil / rooftop unit. VRF-VAV system shall allow for the addition of VAV or Variable Air Volume control with VRF systems controlling up to 20 SAV zones per fan coil. Zones shall be controlled via programmable thermostats, Pressure Independent SAV self-balancing air valves and a HUB to configure and monitor system operation on-site. The *GEN V – VRF-VAV* control panel shall be Universal and support Cooling Only/Heat Pump/Gas – Electric applications.
6.2 The "HUB" shall be the central control point for the system to configure, manage, and monitor system operation.
6.3 The HUB shall display Leaving and Return Air Temperatures at all times from the unit and System Diagnostics menu. Occupied and unoccupied set up and set back capability shall also be available with 2 – 8-hour override capability. An individual or global thermostat locking function shall be available from the HUB providing minimum local control at each thermostat in the system.
6.4 Each pressure independent SAV shall include a built-in Pitot tube measuring section to monitor air velocities, which are measured by differential pressure sensors. The SAV velocity setting

potentiometers shall assign a target air velocity at each SAV; these settings shall be set at the factory. The SAV shall adjust itself to match the target velocity. SAV will hold assigned air delivery regardless of static pressure changes in the system. Each EzTouchX zone thermostat can request air volume targets based on demand for cooling, heating or ventilation. Round SAVs shall have elliptical blades and Rectangular SAVs shall have louvered blades.

6.5 The System shall provide full control of HVAC heating and cooling equipment in multiple zone applications. System shall also support non zoned RTU, fan coil or split systems networked into the system and all systems and zones shall be accessible to view, monitor and control from the HUB.

6.6 The system shall poll each thermostat every 60 seconds to evaluate the number of heating and cooling calls in the System. Control decisions shall be Vote based.

6.7 The system shall allow for zone thermostats to be configured with weighted voting, priority, for each thermostat. Via the HUB, a thermostat shall be configurable to establish priority votes. Priority selections shall be 0 or Null Vote, 1, 2, or 3 votes selectable for each thermostat independently. System shall also provide an Opposed Call feature to address maverick zones in the system.

6.8 Occupied and unoccupied set up and set back capability shall also be available with 2–8-hour override capability.

6.9 Zone thermostat locking function shall be available from the HUB with minimum local control at each thermostat in the system.

6.10 The System shall integrate with the VRF Manufacturer's 24 VAC legacy thermostat interface to provide calls for cooling and heating.

6.11 The System shall use SAV - self balancing process to measure air velocity to adjust automatically to meet zone designed airflow requirements.

6.12 The System shall automatically reset the SAV's position based on zone thermostat call for cooling, heating or ventilation targets based upon SAV design.

6.13 The System shall provide system diagnostics via the HUB.

6.14 The System shall not alter the operation of the VRF System, Outdoor Unit or Air Handler, in any way.

PART 7: Control Manufacturer

7.1 The control system will be the *GEN V – VRF-VAV – Control* System, as manufactured by Zonex Systems, Huntington Beach, CA. Any substitution of the above specified control system will require a 10-day prior approval by the engineer.

7.2 For pricing, contact the factory at 800-228-2966 or visit www.zonexproducts.com

7.3 For substitution, submit a complete description, engineering data, and names of existing installations of substitute products.

7.4 Be prepared to provide a field inspection by the engineer, if they choose to observe the actual installation of proposed substitution.

PART 8: Stand Alone System Controller

8.1 Each zoned VRF Ducted Fan Coil unit shall be controlled by a stand-alone microprocessor controller capable of supporting up to 20 pressure independent SAV zone valves, to be controlled with wired thermostats or wireless zone sensors on site directly from the HUB. A computer, mobile device, or internet connection is NOT required for system operation.

8.2 The system controller shall be universal and equipped to handle Cooling Only or Heat Pump VRF units which will communicate and power all zones with one plenum rated twisted data link and one transformer – 24 VAC power daisy chained from SAV to SAV and thermostat to thermostat with no home run wiring. System controller shall power all SAVs and thermostats in the system with only 1– 24V 100 VA transformer.

8.3 The system controller shall provide and operate with automatic changeover logic. The system algorithm is based on a first call first serve majority wins on changeover strategy. System shall address or have the ability to address opposing calls. When a call is made to the system, the VRF system shall be energized to the proper mode. During the operation of the VRF unit the VRF-VAV system controller shall poll all zones every 60 seconds to determine the majority and minority of votes to set system to proper mode of operation.

8.4 If the majority of the zones demand the opposite mode during the polling, the changeover to the opposite mode will start after a maximum of five minutes in the existing mode to attempt to satisfy all calls in that mode. After five minutes, the existing mode of operation is terminated with the blower continuing to purge the system for 240 seconds. After the purge cycle is completed, the SAVs will take 90 seconds to reposition themselves for the opposite mode. After the SAVs reposition themselves, the opposite mode is energized. If the system has satisfied all calls, all SAVs shall open to the vent position.

8.5 The system controller shall communicate to the zone thermostats the mode of system operation and the zone thermostats will notify the SAV of which position is required to meet zone needs.

8.6 *GEN V – VRF-VAV* controller shall support ADR functions and provide FDD alerts to meet California Title 24 and other states energy requirements.

PART 9: Communications Hub

9.1 Any thermostat in the system shall be capable of communicating with the *GEN V – VRF-VAV* Controller to initiate control sequences.

9.2 System schedules i.e. set up and set back times along with days of operation shall be established at the HUB.

9.3 Set points shall be lockable, either individually or globally, from the HUB, allowing for minimum temperature adjustment at each local thermostat.

9.4 The HUB shall monitor temperatures, both occupied and unoccupied set points, and can be configured either individually or globally from the HUB.

9.5 Second Stage delay operation shall be initiated by time or temperature selection from the HUB.

9.6 The HUB shall provide adjustable override hours for system thermostats for 2 – 8 hours.

9.7 The HUB shall provide a selectable fan option for continuous or intermittent operation.

9.8 System shall be vote based and the HUB shall provide the ability to establish system priority with 1, 2 or 3 additional votes on one or all thermostats in the system, establishing priority votes to accelerate changeover operation. A “0” or null option shall also be available.

9.9 Unit type VRF shall be configured from the HUB.

9.10 The system controller shall be equipped with an onboard diagnostic accessed via the HUB to ensure the installing contractor’s control wiring and communication wiring are operational.

9.11 The system controller shall allow the contractor to provide default occupied and unoccupied set points for every thermostat or sensor in the system directly from the HUB.

9.12 Maverick or rogue system calls shall be recognized and, if not addressed with a field selectable 3 – 30-minute period, system shall purge and satisfy the maverick call. This feature may be enabled or disabled from the HUB.

9.13 Temperature format F (Fahrenheit) or C (Celsius) shall be selectable at the HUB and, when selected, any and all temperature or sensing devices shall be displayed in that temperature format.

9.14 HUB shall provide all time clock functions for the system.
9.15 HUB shall enable / disable vacation scheduling.
9.16 Morning warm-up shall be enabled from the HUB.
9.17 *GEN V* controller shall retain all set points in non-volatile memory.
9.18 All Thermostat functions shall be available for review from each system thermostat to streamline service and system trouble shooting.

Part 10: Compressor Staging

10.1 The *GEN V* controller shall be equipped with a Leaving Air Temperature sensor to constantly monitor and display the discharge air temperature along with Return Air Temperature shall be displayed at the HUB's system diagnostics screen.
10.2 Capacity control shall also provide second stage heating or cooling operation based on a fully adjustable timer with a range of 3 – 30 minutes in increments of 1 minute. Second stage operation shall be initiated based on time and leaving air temperature selectable options on the HUB.

PART 11: Zone Temperature Sensors (Zone Thermostats)

11.1 The typical Zone Temperature Sensor is a wired thermostat (EzTouchX) or wireless zone sensor (TAP) and will contain all of the electronics to:
11.2 Thermostats shall control SAV pressure independent self-balancing zone valves and provide for proper temperature requirement.
11.3 Thermostats shall include color LCD touch screen control to set independent heating and cooling set points and to contain a minimum two-degree dead band.
11.4 Thermostats shall include touch screen that allows the operator to change or review the thermostat set points along with multiple and selectable thermostat control functions, display options and diagnostic capabilities.
11.5 The thermostat, if remotely locked from the HUB shall provide local control of +/- 2 degrees from the locked heating or cooling set point or "0" degrees if required. The adjustable temperature range is from 55 to 95 degrees F. Celsius display shall also be available.
11.6 Each zone thermostat shall contain one microprocessor that receives the current temperature from the space, which communicates to the central *GEN V – VRF-VAV* control microprocessor via a 2-wire RS 485 data communications link.
11.7 The zone thermostat shall have a large digital display showing current space temperature, time, day, current mode of operation, and the heating & cooling set points established for that zone.
11.8 Each zone thermostat shall have the ability to be switched to the OFF mode; when initiated, its SAV will drive to the fully closed position.
11.9 Each zone thermostat can control only one SAV. Slaving SAVs is NOT permissible.
11.10 Thermostat shall be configurable for Baseboard, AUX, and Reheat operations.
11.11 Thermostat shall be available with Remote sensor capability.
11.12 Temperature Access Point or a TAP is available and shall communicate wirelessly to its specific SAV equipped with a BLE Damper Control Board. Each TAP operates like a zone thermostat and shall be managed and controlled from the HUB.
11.13 When utilizing perimeter electric or hot water baseboard heating for supplemental heating, the thermostat or TAP with BLE Damper Control Board operates an SAV only for airflow and energizes the supplemental heat when the temperature drops two degrees below set point. At one degree below set point, it signals the system of a heating call. Heat range shall be adjustable at the HUB from 2-4 degrees.

11.14 When utilizing reheat feature, the thermostat shall energize reheat and position the SAV to provide space temperature heating.

11.15 System shall support control and network one or multiple standalone units using the SATouchX LCD color touch screen thermostat integrated into same system, all accessible locally from the HUB.

PART 12: Smart Air Valves (SAV)

12.1 Smart Air Valves or SAV shall be available in either round or rectangular sizes and configuration.

12.2 Each round SAV (Model SAV) shall consist of 20-22 gauge galvanized metal duct fitted with an elliptical blade to provide linear airflow. The SAV shall contain a seal to prevent leakage when fully closed. Each SAV shall contain a full stall 24-volt actuator, which shall not draw more than 5 VA on one drive assembly. The SAV shell will be crimped on one end and beaded on both ends for rigidity. SAVs shall be equipped with min/max position stops and indicators. Each SAV shall be equipped with a self-balancing damper control board to accommodate 24 VAC power and communications link and outputs to adjust SAV position.

12.3 Each rectangular SAV (MODEL SAV WxH) shall be constructed of 20-gauge "snap-lock" steel frame with S & Drive connections. The total length of the SAV will be 16". SAVs 10" and smaller in height will utilize a single blade construction: those SAVs larger than 10" height will utilize opposed blade construction. Each SAV shall contain a full stall 24-volt actuator, which shall not draw more than 5 VA on one drive assembly. SAVs shall be equipped with min/max position stops and indicators. Each SAV shall be equipped with a self-balancing damper control board to accommodate 24 VAC power and communications link and outputs to adjust SAV position.

12.4 SAV will be installed with a minimum of 3 feet of branch duct between the SAV and main trunk ducting.

12.5 SAV board shall also be equipped with three potentiometers to set air velocity requirements to meet zone design.

12.6 Self-balancing SAVs shall adjust for Cooling, Heating (including Reheat) and ventilation modes of operation.

12.7 SAV board shall monitor air velocity and self-balance SAVs to meet configured air flow requirements for cooling, heating, and ventilation modes.

12.8 SAV shall sense varying air flows, the fan coils expansion valve shall direct information to the VRF systems inverter to slow or reduce compressor RPM to enhance energy savings operation.

PART 13: SAV Damper Controller

13.1 The SAV Damper Controller shall include the ability to configure three target air velocities, Heat/ Cool/ Ventilation, for each independent zone.

13.2 Each fan coil or indoor unit shall have the ability to support up to 20 SAVs.

13.3 SAV Controller shall have the ability to set up target CFM-Velocities for Heat, Cool, and Ventilation air flows.

13.4 SAV Controllers shall receive mode of operation information from VRF-VAV controller as to current mode of operation and self-balance SAVs to meet current zone demand and system mode of operation.

13.5 SAV shall monitor air velocity and adjust SAV's position to maintain configured air velocities to deliver specific CFM to each zone.

13.6 SAV controller shall communicate with assigned zone thermostat.

PART 14: Transformers and Wiring

14.1 An independent 24-volt transformer sized at 5 VA per zone SAV shall power the GEN V - *VRF-VAV* System Controller and all SAVs in the system.

14.2 All power wiring shall be 24-volt AC.

14.3 Zonex' twisted two wire plenum rated communication bus shall be used to daisy chain *GEN V – VRF-VAV* controller, EzTouchX thermostats, and SAV boards, two wire communication bus shall be Zonex Part # STPR.

END OF SECTION 15950

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