

NEW VRF SYSTEM FOR AN OFFICE BUILDING PROJECT USING INTEGRATED PROJECT DELIVERY

This month's B2B will focus on a new 40,000-square-foot office building HVAC system using VRF and heat pump equipment. The project will include two VRF systems, each serving approximately 20,000 square feet of space. The building will also have a 100 percent DOAS gas-fired rooftop HVAC system for ventilation to the building's occupants.

The project delivery method shall be integrated project delivery (IPD) referenced in *2015 ASHRAE Handbook — HVAC Applications*, chapter 58 (Integrated Building Design), as well as chapter 3 (Commercial and Public Buildings). The IPD team shall include the building owner's office manager; building facility manager; third-party owner representative to facilitate the project and oversee the VRF manufacturer's startup and commissioning technician; HVAC consultant engineer as the design team leader; the architectural, structural, plumbing, and electrical consulting engineers; and the general contractor and HVAC subcontractor. The building's facility manager and her O&M staff will also participate in the IPD process beginning at the conceptual phase along with the preselected VRF equipment manufacturer's representative. The IPD team shall begin to come together at Phase 3 Concept Development with the IPD subcontractors joining the team.

The design engineer, as well as the IPD team, are directed to the *2016 ASHRAE Handbook*, chapter 18 (Variable Refrigerant Flow HVAC Systems), as well as *2015 ASHRAE Handbook — HVAC Applications*, chapters 36-43 (Building Operation and Management), and chapter 59 (HVAC Security). In addition, the team will review ASHRAE Standard 15-2016 and 34-2016-Safety Standard for Refrigeration Systems and Designation and Classification of Refrigerants (ANSI approved).

The facility manager shall have her O&M personnel review the documents throughout the design phase and receive introduction training of the new equipment. This staff shall observe equipment startup, IPD H&V contractor and subcontractors' punchlist, and the commissioning system demonstration of the HVAC system performance using the manufacturer's functional performance test (FPT) narratives. Once completed and accepted by the design engineer, the building owner will receive a 10-year VRF equipment warranty.

The VRF equipment shall consist of a three-pipe heat recovery refrigerant piping network with R-410A, direct digital control (DDC) communication wiring, and wireless technology. Both systems shall have multiple inverter compressors serving several indoor units consisting of a mixed combination of ducted and non-ducted indoor units through a common refrigerant piping network and integrated system controls and communication network. The outdoor VRF unit shall include oil management controls and defrost controls along with the standard HVAC controls and BACnet interface.

Indoor units shall be ducted and ductless based on the area served and shall be complete with factory-mounted controls, fans, coils, electronic expansion valves (EEVs), condensate drain pans, condensate drain lift pumps where specified, filter racks, return air temperature

sensors, refrigerant pipe temperature sensors, and wiring terminal blocks. The units shall have a multiple-speed, constant-flow fan. Units shall include seismic required hangers where units are hung from above. Each indoor unit shall be controlled individually with the heat recovery system capable of simultaneous heating and cooling of the individual zones as needed.

The outdoor air ventilation DOAS unit shall be heating-cooling providing makeup air to the spaces served by the various VRF units. The air handler will have 4-inch, MERV-13, pleated filters downstream of 2-inch pre-filters. The burner shall be a 91 percent efficient natural gas heater with four stages of control, factory-installed contactors, relays, sensors, switches to perform DDC with discharge air control and space temperature reset control, and BACnet interface.

Both the VRF systems and the DOAS unit shall be furnished with automatic controls that include a computerized system utilizing wireless technology integrated with the building's control system.

Electrical shall be 480/3/60 with 120/1/60 for motors less than 0.5 hp. The H&V subcontractor's ATC subcontractor and electrical subcontractor shall work together to interface the new H&V controls with the building's automation system.

After Phase 2 Project Initiative, the IPD team shall produce Concept Documents and Design Documents (drawings and specifications). The Phase 5 Construction Preparation shall include final approved submittal and field coordination drawings. Phase 6 Construction followed by Phase 7 Owner Acceptance and Phase 8 Use, Operate, and Maintain shall occur. The O&M personnel will review the documents beginning with the Concept Development Phase and observe equipment startup in the Construction Phase. There will be an air balancing and commissioning system demonstration at the initial dry run of the DOAS and two VRF systems, electrical, and fire protection system IPD project.

The IPD team's H&V contractor shall include the following during the shop drawing submittal phase:

- Equipment submittals - VRF performance curves - Startup sheets
- Troubleshooting sheets - O&M manuals, parts, and lubricants
- ATC and sequence of operation - Operating and maintenance instruction brochure

The owner representative shall oversee the VRF technician's startup and commissioning FPT demonstration as well as provide third-party air testing, adjusting, and balancing of the DOAS and indoor VRF units as follows:

- TAB system flow diagram of HVAC systems with makeup air, supply air, and return air airflow readings along with static pressure readings at specific points in the system and duct air velocity - TAB final air balance report
- Commissioning functional performance test of DOAS and VRF outdoor units and indoor units

Refer to The Facility File for additional information pertaining to completing the B2B test. **ES**



The design engineer shall check off the boxes from the list of company’s standardized field observation checklists below that he will need to upload to his tablet computer prior to heading out to the construction site to complete the final HVAC inspection and punchlist. These checklists will be touchscreen type. When the engineer returns to the office or he sends the completed checklists

via the internet to the office, the completed checklists shall be automatically downloaded to the company’s computer server and placed in the job folder’s “Project Closeout” section. The completed checklists, along with associated digital photographs taken at the time of the field visit, will automatically be electronically sent to the following individuals and departments.

TEAM CORRESPONDENCE DIRECTORY CHECKLIST

(Check the appropriate boxes)

- Owner Office Manager Owner Representative Facility Manager IPD Lead Engineer Construction Manager
- General Contractor Design-Build Contractor HVAC IPD Contractor ATC Subcontractor IPD Electrical Contractor
- Plumbing Subcontractor Fire Protection Subcontractor
- VRF Manufacturer Representative Architect State Energy Department Utility Energy Engineer Piping Subcontractor
- Sheet Metal Subcontractor Third-Party CxTAB Consultant
- Third-Party TAB Consultant Building Inspector
- Others: *(insert list)* _____

HVAC CONTRACT SPECIFICATION CHECKLIST

- Division 1 Project Closeout Owner Equipment Structural
- Electrical Plumbing Fire Protection HVAC VRF Equipment & System ATC Pumps Fans DOAS Air Handlers Terminal Units Piping System Sheet Metal System
- TAB Commissioning Others: _____

HVAC CONTRACT DRAWING INSTALLATION CHECKLIST

- Owner Equipment Structural Electrical Plumbing Fire Protection HVAC VRF Equipment and System ATC Pumps
- Fans DOAS Air Handler Terminal Units Piping System
- Sheet Metal System TAB Commissioning Others: _____

HVAC STARTUP CHECKLIST

- Owner Equipment Structural Electrical Plumbing
- Fire Protection HVAC VRF Equipment and System
- ATC Pumps Fans DOAS Air Handler Terminal Units
- Piping System Sheet Metal System TAB Commissioning
- Others: _____

COMMISSIONING FPT (Functional Performance Test)

- Structural Electrical Plumbing Fire Protection VRF System DOAS unit ATC System Heating System Chilled Water System Condenser Water System Pumps Chillers
- Fans Terminal Units Piping System Sheet Metal System
- Equipment Room Others: _____