PROJECT PROFILE

By JS Rancourt

Sheraton Centre Toronto goes VRF

Sheraton Centre Toronto

- $90 million renovation
- 42 & 11 storeys (Queen Tower & Richmond Tower)
- 1,371 guest rooms and suites
- 1,373 guest rooms and suites after renovation
- Completion: Late 2015

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As part of a $90 million renovation project for all guest suites, the flagship Sheraton Centre Toronto hotel is replacing its existing two-pipe fan coil system with North America's largest Variable Refrigerant Flow (VRF) system, providing each guest suite full flexibility over heating and cooling needs year-round.

The hotel's decision to adopt VRF took operational costs, in-suite sound and total installation cost into consideration. The consulting engineers hired by the Sheraton Centre, M & E Engineering Ltd., used energy models to compare several HVAC retrofit options, identifying three that would allow for simultaneous heating or cooling in every guest suite. The use of slim 8" tall horizontal VRF fan coils, which employ small and precisely balanced direct drive fan assemblies, was ultimately selected.

The hotel's existing condenser water lines, which run from the basement mechanical room to the roof-mounted cooling towers, are used to feed the VRF condensing units on each floor.

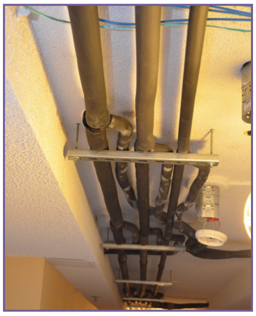
Project Team

- Property Owner: Starwood Hotels & Resorts Worldwide Inc.
- Construction Managers: Hospitality 3 LLC
- General Contractor: Gillam Group
- Mechanical and Electrical Consultant: M & E Engineering Ltd.
- Mechanical Contractor: Modern Niagara Toronto Inc.
- VRF Equipment Supplier: DXS Ontario [an HTS company]
- VRF Equipment Manufacturer: Daikin Industries Ltd.

M & E sized the systems such that one module can provide 85 per cent of the heating load or 70 per cent of the cooling load of the suites that it serves. The modules are stacked one on top of each other, and are located in small storage rooms in the middle of each floor.

The hotel will also make use of air-cooled VRF systems for 54 suites, where the roof-mounted outdoor condensing units will act as the sole source of heating and cooling for the suites. The air-cooled condensing units also have a minimum of two compressors for redundancy, and were also sized such that one module can provide 85 per cent of the heating load or 70 per cent of the cooling load of the suites that it serves.

With heating capacity and efficiency data now available for VRF systems (of certain manufacturers) down to -13°F, engineers have the ability to design air-cooled VRF systems without any back-up heating, as long as the condensing units are sized to meet the heating load at design temperature. The heating design temperature used on this project was -4°F.



The refrigerant piping layout is very similar for both the water and air-cooled systems. From

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each pair of condensing units forming one system, three refrigerant lines run down the hallway ceilings, and tee off into each suite where a small single port branch selector box resides in the bathroom ceiling, beside the respective fan coil.

For the air-cooled systems, there is a refrigerant riser from the roof mounted units down to the respective floor that each system serves. Larger centralized branch selector boxes were considered but not employed due to their space requirements and the refrigerant charge associated with homerun piping.

Branch selector boxes, which act as switchover devices between the hot and cold refrigerant supplies, allow each suite to heat and cool simultaneously.

The VRF heat recovery systems also offer energy recovery between suites, when some of the suites within a system are in heating mode while others are in cooling, which helps further decrease operational costs. With water-cooled VRF systems, there is a second level of heat recovery on the water-side.

Integrating into existing systems

The VRF system's control system is designed to work with the hotel's management system. Guest suites will be in energy saving mode during unrented periods, but will have the ability to reach the desired comfort level by the time guests reach their suite after check-in. The integrated control system will also allow hotel maintenance staff to monitor each suite, and to address any issues in the system prior to any noticeable disruption in the suite.

About Variable Refrigerant Flow technology

VRF technology uses refrigerant to circulate heating and cooling around buildings, instead of the traditional water-source systems typically used in large buildings in North America. The higher energy transfer capacity of refrigerant versus water, combined with the precise expansion devices in each space is what sets VRF systems apart on the energy efficiency front.

Even though the technology was invented over 30 years ago in Japan, the low cost of utilities has kept VRF manufacturers away from this market until the early 2000s. A reduction in up-front capital costs for VRF systems has allowed them to compete with traditional systems for market share. The zoning capabilities, the energy savings, the space savings and the total life cycle cost of VRF systems are still the driving factors in deciding whether or not VRF is the right solution for a project.

CSA B52 and VRF systems

In Ontario, where this project is taking place, the CSA B52 Mechanical Refrigeration Code governs the build. Arguably, the most important part of this code, as it applies to VRF systems, is the life safety refrigerant concentration limits. VRF systems distribute refrigerant throughout the building and throughout the occupied spaces, and do not contain the refrigerant to mechanical rooms.

Although R-410A refrigerant is considered non-toxic, it is heavier than air and can displace oxygen if enough leaks into a sealed space. The life safety clause of CSA B52, similar to the ASHRAE 15 life safety clause, assumes a worst-case scenario failure, where every ounce of refrigerant in a VRF system could leak into the smallest space served by the system.

While this is not likely to occur, to comply with the CSA B52 clause the full refrigerant charge of the system needs to be divided by the volume of the smallest space served by the system, and the R-410A concentration must remain under 26 pounds per thousand cubic feet.

The VRF systems on the Sheraton Centre Toronto Hotel were small enough to be within code, although the piping layout had to be optimized to ensure this limit was met.

Loads and redundancies

The average cooling load per floor is only around 160,000 BTUH, and the average heating load around 140,000 BTUH. However, due to the hotel's requirement for redundancy, close to 20 tons (240,000 BTUH) of VRF heating and cooling capacity was provided for each floor. This was accomplished by providing three VRF systems for every two floors, with each system composed of two condensing unit modules.

Each module, either six or seven tons in capacity, has its own compressor to ensure a certain level of redundancy. VRF systems automatically stage and alternate the modules, but the redundant module can continue to operate should one module fail.