TIP 216: Performance Mapping of Advanced Variable Refrigerant Flow Heat Recovery Systems (VRF-HR)

Context

Variable refrigerant flow systems with heat recovery capability allow indoor units to operate in either heating or cooling mode, enabling heat to be used, rather than rejected as it would be in traditional heat pump systems. VRF-HR systems also build on traditional heat pump technology by integrating inverters to drive compressors and fans and sophisticated expansion valve, refrigerant and distributed control. VRF-HR systems are an enhanced version of the VRF Heat Pump and operate in net heating or net cooling mode depending on which is in greater demand by the conditioned space.

Asian manufactured VRF-HR heating and cooling systems are relatively new to the United States and promise high performance. But proof of efficiency gains is lacking. Utility companies and the heating, ventilating and air conditioning (HVAC) industry will benefit from understanding VRF-HR system performance for future energy efficiency acquisitions, as well as potential demand response applications and system designs that improved comfort.

Description

This project develops detailed performance maps of the two primary types of VRF-HR systems: two-pipe and three-pipe. This project will construct a laboratory test facility to test four-zone variable speed VRF Heat Recovery systems over a range of conditions, with a focus on heating performance at lower ambient temperature conditions, where frosting and de-frosting traditionally occurs. Each indoor unit with a thermostat is defined as a zone that allows individual control over temperature and humidity. This performance data will be compared to manufacturers' data and incorporated into one or more building energy simulation modeling tools. With these energy simulation modeling tools, the energy use of VRF-HR systems can be compared with the energy use of traditional HVAC systems, such as resistance heat, roof top units with gas heat and air conditioning, air to air heat pumps, variable air volume systems, ground source heat pumps. The comparison will allow evaluation of the cost-effectiveness of VRF-HR systems.

Why It Matters

BPA needs an accurate, nonproprietary and reliable way of estimating VRF-HR system energy use to determine savings for energy efficiency acquisitions, which offset regional load growth. This is accomplished by quantifying and verifying the energy use of traditional HVAC systems and a similar effort regarding variable refrigerant flow systems. The resulting difference between the two is deemed savings. Currently building energy simulation modeling tools do not accurately model VRF-HR system energy use. This performance data will enable modeling of VRF-HR system energy use for BPA Programs. Ultimately, this lab test will create performance curves for variable refrigerant flow systems in the various modes of heat recovery to quantify the kW draw and determine actual kW savings from system to system for most efficient application.

Goals and Objectives

Performance maps will be developed for two commercially available VRF-HR systems. Starting with approval of the experiment design, EPRI will perform laboratory testing that results in detailed performance maps. This data will be compared to manufacturers' data, building energy simulation modeling outputs and EPRI's Energy Efficiency Demo database of VRF-HR system performance.

A repositioning of the original contract has ensued, which has extended the project end date to September 30, 2012, allowing for the inclusion of a new VRF-HR system along with another VRF unit to facilitate better comparison with actual field data. Many exciting future possibilities may be obtained from this effort. Under a separate contract funded by Southern California Edison, this data will be incorporated into one or more, non-proprietary building energy simulation modeling tools by 2013. These building energy simulation modeling tools can then be used for designing and estimating the energy use of VRF-HR systems.

Deliverables

1. Performance Modules for 4 VRF systems
2. Final Report discussing the status as of Sept 30, 2012 as to whether they have been incorporated into building energy simulation modeling tools, whether any buildings have been simulated using those tools and whether any field data under the energy efficiency demo is appropriate for vetting output from those tools.

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Project Start Date: December 2010

Project End Date: September 30, 2012

Funding

Total Project Cost:	$997,093
BPA Share:	$499,796
External Share:	$497,296
BPA FY2012 Budget:	$115,685

Participating Organizations

EPRI
Southern California Edison

For More Information Contact

BPA Project Manager:

Mira Vowels
mkvowels@bpa.gov