

RESEARCH TOPIC ACCEPTANCE REQUEST

Title: Field Performance Assessment of Packaged Equipment to Quantify the Benefits of Proper Service and Assessing the Long Term Need for Monitoring, FDD, and Continuous Commissioning Technology

TC/TG: TC 4.11 Smart Building Systems (Todd Rossi: rossi@acr.com)

Research Category: Operation and Maintenance Tools

Research Classification: Basic and Applied

TC/TG Priority: 1 (TC 4.11)

Estimated Cost and Duration: \$150,000 (\$125,000 ASHRAE + \$25,000 DOE) and 24 months.

Other Interested TC/TGs: TC 9.9 (priority #2)

Expected Co-funding: \$25,000 co-funding for this project promised by the U.S. Dept. of Energy.

Handbook Chapters Affected by Project Results:

State of the Art (Background):

Packaged HVAC equipment is the most common source of heating, air conditioning, and ventilation in small- and medium-size commercial buildings, including popular suburban retail shopping malls, supermarkets, and restaurants. Compared to large built up systems, packaged equipment are generally smaller and more numerous. Therefore, technicians spend less time servicing individual packaged units and the resultant field performance of this equipment may be much worse than that of their counterpart in built up systems.

Field studies performed to date to assess the field performance of packaged equipment have been limited in scope and somewhat inconclusive. In 1992 and 1993, an HVAC/Refrigeration tune-up pilot program was implemented in Wisconsin to evaluate the effectiveness of HVAC and refrigeration tune-ups in saving energy and reducing peak demand in nine commercial buildings¹. The results varied widely, but energy savings of up to 15% were achieved in most buildings. Four major limitations to the study were cited including; (1) the number of sample points was small; (2) other factors affected building energy consumption; (3) HVAC performance enhancements improved comfort but did not always save energy; and (4) it was difficult to quantify the effect of particular maintenance activities without better controlled conditions or more sample points. A two-year study by the Electric Research Power Institute that was concluded in 1997 investigated the energy and demand impacts of maintenance on rooftop packaged heating and cooling equipment². Six long-term and 24 short-term sites were monitored. The short-term sites established the immediate impact of maintenance on savings and the long-term sites determined its persistence. The most prevalent problem was low refrigerant charge. No significant change in unit performance due to low charge, filter maintenance, or coil cleaning was observed. The study concluded that the cost of annual maintenance programs are unlikely to be offset by utility cost savings alone.

¹ Kasmar J., Valerie N., "Energy Impacts from Commercial Air Conditioning Maintenance – A WDSO Evaluation Report", Wisconsin Demand-side Demonstrations, 2901 W. Beltline Drive Suite 307, Madison WI 53713, (608) 275-7180, (608) 275-7199 (FAX), May 1995

² Krill W. (EPRI Project Manager, Customer Systems Group), "The Impact of Maintenance on Package Unitary Equipment", TR-107273 3831, Electric Power Research Institute, 3412 Hillview Ave, Palo Alto CA 94304, Feb. 1997

Other than these studies it is generally unknown how packaged equipment performs in the field. Laboratory studies of rooftop units show that performance is sensitive to typical faults observed in the field³, yet these studies provide mixed results. An open and unbiased ASHRAE sponsored research project provides opportunity for our engineering community to participate in a study to observe these effects in the field.

Advancement to the State of the Art (Justification):

This project would take additional steps toward quantifying the benefits of proper service in packaged equipment by assessing current performance of a statistically significant number of units in the field and documenting how the performance improves when a subset of these units are properly serviced. This approach will establish a more rigorous baseline than previous studies for the maximum possible benefits of proper servicing.

Packaged equipment performance has a direct impact on occupant comfort, indoor air quality and facility energy use in a large fraction of commercial buildings in the US. A recent DOE report indicates that rooftop and unitary A/C equipment consumes 1.03 out of a total of 1.66 quads (62%) of total energy consumed for cooling the current building stock of commercial buildings in the US. This research project will assess the level of improvement in energy efficiency that can be expected from proper servicing of packaged equipment, thereby establishing the need for diagnostic technology that can facilitate improved servicing of this type of equipment.

Justification and Value to ASHRAE:

Industry (i.e., building owners and facility managers) will benefit from this research by utilizing the results of the project to prioritize their maintenance and diagnostic efforts. The results will also help guide future efforts at ASHRAE, government and industry to develop technology and document its costs and benefits to help achieve widespread acceptance in the marketplace. Furthermore, the development of packaged equipment performance indices and experience with measuring, documenting, and reporting them will help researchers and product developers establish a unified approach to quantifying performance.

Objective:

The objectives of this research project are to study and document:

1. The actual field performances of 375 packaged HVAC units and compare them to industry norms or manufacturer's specifications for new equipment.
2. The implementation of diagnostic and proper service procedures and the resulting performance enhancement for at least 75 of the 375 units.
3. The need for monitoring, FDD, and continuous commissioning technology to address the long-term service needs of packaged equipment in the field.

To preserve generality and anonymity and to prevent competition between unit manufacturers, units are to be classified generically into categories including age, nominal capacity, refrigerant, type of expansion device, compressor technology, design EER, electrical specifications. No make or model names or any other similar characteristics will be used to identify the units used in this study.

Bidders will be expected to collaborate with maintenance organizations such that this project will fund only the incremental costs of collecting and analyzing the data, not the cost of servicing.

³ Breuker, M.S. and J.E. Braun. 1998b. Evaluating the Performance of a Fault Detection and Diagnostic System for Vapor Compression Equipment, *IJHVAC&R Research* 4(4).