January 20, 2014

TC 8.3 RESEARCH SUBCOMMITTEE MINUTES OF MEETING IN NEW YORK, NY

TC 8.3 Research Subcommittee met on January 20, 2014, in New York City, New York. A list of minute recipients and attendees is attached. (Attachment 1)

1. Review of Minutes from June 24, 2013 meeting in Denver, CO.

The minutes were reviewed and no changes were requested by the subcommittee members.

2. RTAR 1638 *"Absorption Refrigeration Cycle Training Simulator for Sustainable Resource Use".*

Paul Sarkisian reported on his activities as follows:

Paul developed and handed out revision 3 of the RTAR. (Attachment 2)

Paul contacted Steve Comstock for questions regarding software maintainability. (Attachment 3)

Software will be stand-alone software without need for permanent updates.

TC 8.3 Research Subcommittee recommended to officially asked Paul Sarkisian to proceed with the RTAR submission. Such motion was approved in the main committee meeting (6-0;3 absent)

3. 1462 RP *"Active Mechanisms for Enhancing Heat and Mass Transfer in Sorption Applications".*

The third project review related to the test equipment, instrumentation, data acquisition and final tests results.

An update report was supplied to the PMS a week before the review meeting.

Josephine Lau presented: She introduced the staff and roles of each project participant. The updated presentation is included as (Attachment 4).

Uwe Rockenfeller explained his concern with the results. The test conditions did not reach

steady state. The measurement error band is similar to the measured differentials. Air leaks are a problem for repeatability.

Tim Wagner also expressed concern with non-steady state conditions during measurements.

Tim also was concerned about discrepancy of bars on slide 6. He expressed concern that there may not be a "trend" statement justifiable.

Test conditions for measurements should be according to ASHRAE Guideline 2-2010, Engineering Analysis of Experimental Data.

4. Application Guide for Absorption Cooling/Refrigeration using Recovered Heat

Rajesh agreed to review Piyush's comments, he will try to get a digital copy of the guide and present his findings and results to the subcommittee. He will collaborate with Joe Brillhart.

Rajesh will email a document to Uwe and Ersin prior to the ASHRAE annual subcommittee meeting.

5. Other Business

None

Attachment 1

MINUTES RECIPIENTS AND ATTENDANCE LIST

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Unique Tracking Number Assigned by MORTS _____

RESEARCH TOPIC ACCEPTANCE REQUEST (RTAR) FORM

(Generally 2 to 6 pages, with 10 pt Times New Roman font)

Sponsoring TC/TG/SSPC: _____8.3_____

Title:
Absorption Refrigeration Cycle Training Simulator for Sustainable Resource Use

Applicability to ASHRAE Research Strategic Plan:
The absorption refrigeration cycle training simulator would meet Goal 7 (Support development of tools, procedures and methods suitable for designing low energy buildings) of the 2010-2015 ASHRAE Research Strategic Plan. The training tool would enable users with a better understanding of the absorption refrigeration cycle, which is deemed by industry experts to be a sustainable technology using zero-ODP, zero-GWP refrigerants and improving overall energy utilization rates. Further education and understanding of this technology would lead to further development and deployment of the absorption cycle, replacing systems using harmful ozone depleting substances and higher grades of energy. In addition, with further development, refrigeration / air-conditioning could be introduced to areas of the world where availability of this higher grade of energy (electric power) is limited.

Research Classification:
Technology Transfer

TC/TG/SSPC Vote:
6-0-0-6

Reasons for Negative Votes and Abstentions:
N/A

Estimated Cost:
$75,000

Estimated Duration:
15 months

RTAR Lead Author
Vikas Patnaik, vpatnaik@trane.com

Expected Work Statement Lead Author
Ebrahim Al-Hajri, ealhajri@pi.ac.ae

Co-sponsoring TC/TG/SSPCs and votes:
N/A

Possible Co-funding Organizations:
N/A

Application of Results:
Software program in DVD form available for purchase from ASHRAE, ASHRAE Green Guide, Handbook chapters 1 and 41.

State-of-the-Art (Background):
A few absorption cycle simulation programs have been developed and released in the past, the most notable of which is ABSIM (2002), from Oak Ridge National Laboratory. Others are not as publicly available and/or have not been actively maintained. Any active programs tend to be proprietary and serve as design tools for companies producing absorption equipment. ABSIM is a modular computer code for simulation of absorption systems, based on unit subroutines containing the governing equations for the system's components and on property subroutines containing the thermodynamic properties of the working fluids. However, ABSIM was developed in Windows 95, and is not currently funded or supported. As a result, it has not performed stably on a consistent basis in newer Windows environments.

Advancement to the State-of-the-Art:
For the purposes of training/educating the general HVAC&R practitioner, a tool is needed that uses state-of-the-art software technology and is not as complex as ABSIM or other previous similar tools. These have been more equipment-focused, rather than application- or solution-oriented. The proposed tool is more intended to show the functioning of the absorption cycle in its various configurations, and how these respond to changing operating conditions – heat source temperatures, ambient conditions, cooling load etc. The proposed simulator is thus intended to be a screening tool to allow the user to identify the potential for the use of absorption technology for a given application.

The underlying component models of the configurations will be based on the fundamental principles of thermodynamics, mixture equilibrium and heat & mass transfer. The simulator is independent, standalone code and does not require interface with ABSIM or other software packages. This approach is deemed sufficient to illustrate the benefits/applicability of absorption technology for a variety of application scenarios or envelope conditions. Validation of such models is typically not necessary, especially when they do not comprise a design tool. As a result, extensive model validation will not be part of the scope of this work.

Having said this, the proposed tool will be an advancement over the capabilities of ABSIM and other similar tools to be a more user-friendly program that could find widespread use in the HVAC&R industry beyond the advanced design engineer. It would give flexibility to the user to link components/fluids which are not available with the current version of ABSIM.

Justification and Value to ASHRAE:
Ultimately, the deployment of the tool will result in a better understanding and awareness of how absorption systems can reduce overall energy utilization via integrated energy systems that avail of renewable sources of energy such as waste heat and solar. The target market for the simulation software would be practitioners, energy engineers and students. Practitioners and energy engineers would benefit from being able to examine "what if" application scenarios while students would benefit by increasing their understanding of cycle thermodynamics. The commercial, industrial and retail HVAC&R consulting/contracting communities looking to reduce overall energy consumption rates will thus benefit from the proposed work. This directly supports the sustainability goals ASHRAE has set forth for itself. Last but not least, this work will result in increased revenues for ASHRAE through the sale of the simulator tool, in DVD format. Maintenance of the software would be limited to the possible expansion of its capabilities, which could occur every five years or so as new potential applications are identified.

Objectives:
1. Survey the open literature for simulation efforts on absorption technology to build upon.
2. Develop simulator that includes a library of energy sources and their characteristics, including renewables, a library of proven (in-practice) working fluids and their characteristics, and finally a library of proven (in-practice) sub-systems (components) and systems and their characteristics. Energy sources would include direct exhaust, indirect waste-heat (hot-water or steam), solar etc. Working fluids would include water-lithium bromide and ammonia-water. Components would include the generator, absorber, condenser, evaporator, solution heat exchangers, pumps, expansion valves, interconnecting piping, and so on.
3. Allow for plug-&-play simulation with components (dynamically linked libraries) from other sources.
4. Use state-of-the-art software platforms such as Windows 7 and the .NET framework while preserving backward compatibility with older systems.
5. Test tool for reasonableness (accuracy), robustness (crash-worthiness) and usability (speed, GUI). The GUI should closely reflect state-of-art for present ASHRAE products.
6. The resulting software should not require continuing maintenance.

Key References:
Grossman, Gershon, and Zaltash, Abdi, 2001, "ABSIM — modular simulation of advanced absorption systems," *International Journal of Refrigeration*, Volume 24, Issue 6, pp. 531-543.

McLinden, M. O., and Klein, S. A., 1985, "Steady State Modeling of Absorption Heat Pumps with a Comparison to Experiments," *ASHRAE Transactions*, Vol. 91, Part 2b, pp. 1793–1807.

Phillips, B. A., 1988, "Development of a Gas-Fired Heat Pump with an Improved Absorption Cycle," *Proceedings of the 1988 ASME Winter Annual Meeting, Chicago, Illinois, November 27–December 2*; Analysis and Applications of Heat Pumps, Vol. AES-8/SED-6, pp. 97–102.

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W. Stephen Comstock
Publisher and Director of Publications and Education

January 16, 2014

This letter is provided in support of a proposed research project to develop an Absorption Refrigeration Cycle Training Simulator.

This support is based on the understanding that the training tool would provide users with a better understanding of the absorption refrigeration cycle, one of the technologies which promotes zero-ODP, zero-GWP refrigerants and improves energy utilization rates. The availability of the tool will keep ASHRAE products at the forefront of technology application and will be an especially valuable addition to the tools that ASHRAE provides to educators. There will also be value in promoting the tool to members in China, India and other emerging manufacturing centers and to practitioners in developing countries where energy efficiency is especially critical.

Finally, it is envisioned that the tool could be the basis of an ASHRAE Learning Institute course to bring benefits of and new advances in absorption refrigeration to the membership and industry. There is a lack of equipment-based educational products, and this addition to the ASHRAE inventory of courses should be well received, especially globally as mentioned above.

I believe what while this product falls into the category of one which will not generate a substantial number of sales, all ASHRAE publishing costs of product manufacturing and delivery should be recovered within one year (the usual benchmark for ASHRAE publications support. I also believe this is a product which is needed to fulfill ASHRAE's mission of bringing technological advancement to the attention of the membership.

Lastly, it is assumed that if the tool is developed, ASHRAE publications will receive a finished product with user interfaces, menus and navigation complete. ASHRAE Publications staff will add digital rights management and other programming necessary to make the product viable and protected in the market place and will oversee editorial work and manufacturing.

I am letting the ASHRAE Publications Committee know of this judgment. Please let me know if further information is required.

Sincerely,

W. Stephen Comstock
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