RESEARCH TOPIC ACCEPTANCE REQUEST
TC 6.7 – Solar Energy Utilization

TITLE: Optimization and Testing of a Solar Cooling System

RESEARCH CATEGORY: Applied Research

RESEARCH CLASSIFICATION: High Risk, Innovative and Emerging Technologies

TC/TG PRIORITY: 2

ESTIMATED COST: The installed cost of a solar cooling system, assuming a 25-ton capacity, using advance components that are still "pre-commercial" will be approximately $140,000. Two years of monitoring and the analysis that supports the monitoring will cost approximately $50,000. Finally, the analytical modeling to compare the competition between a conventional air conditioner and the solar system will be approximately $30,000. The total cost for the project is $220,000. ASHRAE contribution to this project is expected to be 50% ($110,000).

OTHER INTERESTED TC/TGS: TC 8.12 – Desiccant and Sorption Technology

POSSIBLE CO-FUNDING ORGANIZATIONS: State Energy Offices, U.S. Department of Energy – Solar Energy Technologies Program

HANDBOOK CHAPTERS TO BE AFFECTED BY RESULTS OF THIS PROJECT: 33 – "Solar Energy Equipment," HVAC Systems and Equipment

BACKGROUND / STATE-OF-THE-ART: Non-renewable energy is the source for almost all comfort cooling and dehumidification now provided throughout the world. This reliance on non-renewables both depletes our finite fossil resources and accelerates global climate changes. A more immediate impact of our need for summer space conditioning is the overloaded generation, transmission and distribution network for electricity that results in brownouts, blackouts and, with deregulation, dramatic price spikes.

The coincidence between the availability of solar energy and the need for cooling / dehumidification has motivated many past attempts at solar cooling systems. Although this past work has not led to a commercial product, recent developments in technology and changes in the markets for fossil energy have created important new opportunities for this technology.

ADVANCEMENT TO THE STATE-OF-THE-ART: Although it is now difficult to estimate their market share, solar cooling systems will be commercialized within the next three years. This assessment is based on the following technology developments:

- As reported by Solargenix (formerly Duke Solar), high-temperature solar collectors will be available within three years at a cost that is less than 20% of their cost a few years ago (i.e., $1,000 per square meter versus over $5,000 per square meter); they will also operate with a collection efficiency of approximately 50%.

- Small-scale (less than 50 tons) double-effect absorption chillers are now commercially available with COPs between 1.2 and 1.4
- Pre-commercial prototypes of higher efficiency, more compact and lower cost desiccant systems are now being demonstrated that can be used to improve indoor air quality and solve moisture problems

These technology advances come at a time when natural gas prices have been extremely volatile and the adequacy of future supplies has been called into question.

JUSTIFICATION / VALUE TO ASHRAE: As with other energy-intensive technologies that replace non-renewable resources with renewables, the successful introduction of a solar cooling system will provide many strategic benefits including (1) reduction in pollution and the potential for climate change, (2) conservation of non-renewable resources, (3) reduction in imported energy (particularly important now that future demand for natural gas will most likely be met with imports) and the concomitant increase in national security, and (4) protection from energy price fluctuations and the disruptions they cause. In addition to these rather "lofty" benefits, the proposed project will provide very concrete information on the characteristics of solar cooling systems. Since a large majority of engineers are unfamiliar with both thermally activated cooling systems and solar thermal systems, this information on system performance, O&M requirements and economics will be an important first step at introducing the technology to the ASHRAE community.

OBJECTIVE: The objective of the proposed project is to provide the ASHRAE community with the engineering data needed to evaluate, design, install, operate and maintain solar cooling systems. The first task will be to identify the most promising early applications for a solar cooling system. This work will study utility rates, geography, building types and building usage patterns as they effect the competition between a conventional air conditioner and a solar cooling system. The second task will identify a test site, design the solar cooling system and specify the instrumentation and monitoring equipment that will be needed for a field test. This task will also develop a test plan for a two-year field test of the solar cooling system. The third task will execute the test plan, focusing on the regular reporting of performance, the maintenance of the system and possible upgrades to the system to improve performance. The last task will summarize the results of the field test in a final report. This report will also revisit the conclusions of the first task, possibly modifying them based on the field-test experience. The report will be a start at identifying (1) the information that engineers will need to design and specify a solar cooling system, (2) the economics of ownership, (3) O&M procedures needed to maintain performance, and (4) if the technology is judged to have a favorable economic impact, key future activities that can accelerate the adoption of this technology.