Development of a Thermal and Water Management System for PEM Fuel Cells (New FY 2004 Project)

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Objectives

Develop an integrated thermal and water management (TWM) system that efficiently uses the fuel cell waste heat and water to minimize overall system weight and volume without compromising overall system efficiency

Technical Barriers

This project addresses the following technical barriers from the Fuel Cells section of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year R,D&D Plan:

- C. Thermal Management
- F. Heat Utilization
- R. Thermal and Water Management

Approach

For automotive applications, it is essential to develop a low-cost, high-performance thermal and water management (TWM) system for proton exchange membrane (PEM) fuel cells. The objective of this project is to develop an integrated TWM system that efficiently uses the fuel cell waste heat and water to minimize overall system weight and volume without compromising overall system efficiency. Water consumption and production will be balanced to eliminate the need for makeup water.

Waste heat generated by the PEM fuel cell cannot be easily removed from the system because it is supplied with a relatively low temperature. This requires heat exchangers with high effectiveness to achieve compact systems. Compact, lightweight heat exchangers of this type, having advanced heat transfer extended surfaces, have been developed for aerospace applications, where a premium is placed on size, weight, and performance. This heat transfer technology will be transitioned to Honeywell's automotive division, where high-volume manufacturing processes will be utilized to reduce costs of the equipment.

Some of the advanced technologies to be evaluated for accomplishing the objectives of the project include:

- An enthalpy wheel developed by Emprise Corporation, a member of the Honeywell team, utilizing latent heat transfer methods to greatly improve recovery of water and fuel cell waste heat.
- A membrane-based water management system developed by Isotronics, a member of the Honeywell team, that can be used to transfer water vapor from the hot and humid exhaust

stream from the fuel cell to the cooler and drier stream entering the fuel cell as reactant.

- A cathode recycle approach to avoid water condensation and revaporization.
- Microchannel thermal heat transfer equipment, an evolving technology that may lead to savings of 30 percent volume in the thermal management system over current technologies.

The analytical and test results of this study could have a dramatic impact on water and thermal management systems for PEM fuel cells for automotive applications. The project will be conducted over a three-year period in two phases.