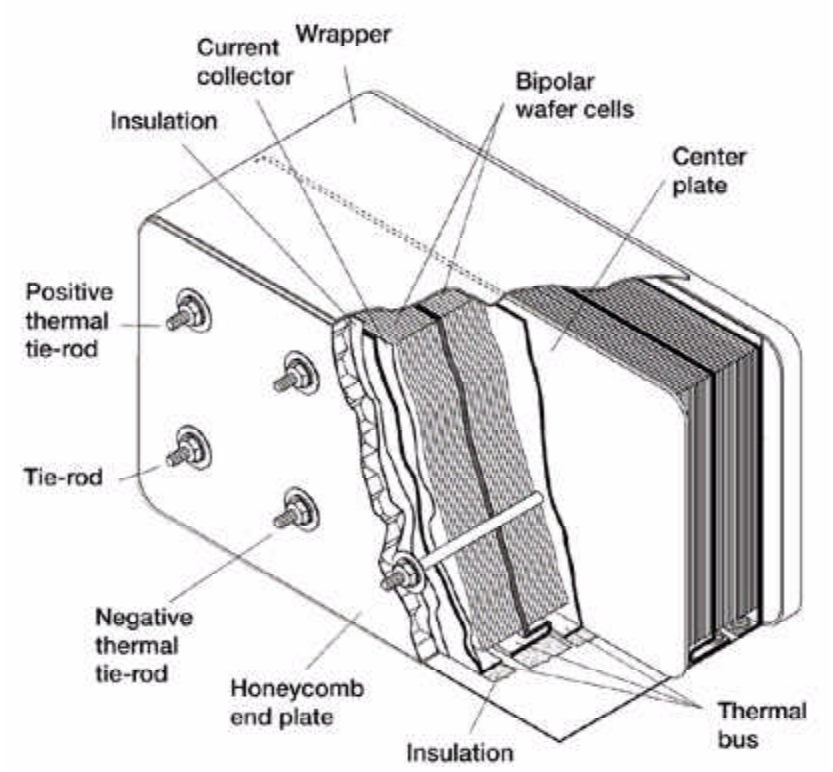
Bipolar Nickel-Metal Hydride Battery Being Developed



Electro Energy's bipolar nickel-metal hydride battery design layout-two parallel, 24-cell stacks. (Copyright Electro Energy; used with permission.)

The NASA Lewis Research Center has contracted with Electro Energy, Inc., to develop a bipolar nickel-metal hydride battery design for energy storage on low-Earth-orbit satellites (NASA contract NAS3-27787). The objective of the bipolar nickel-metal hydride battery development program is to approach advanced battery development from a systems level while incorporating technology advances from the lightweight nickel electrode field, hydride development, and design developments from nickel-hydrogen systems. This will result in a low-volume, simplified, less-expensive battery system that is ideal for small spacecraft applications. The goals of the program are to develop a 1-kilowatt, 28-volt (V), bipolar nickel-metal hydride battery with a specific energy of 100 watt-hours per kilogram (W-hr/kg), an energy density of 250 W-hr/liter and a 5-year life in low Earth orbit at 40-percent depth-of-discharge.

Electro Energy has teamed with Rhône-Poulenc, Eagle-Picher Industries, Inc., Rutgers University, and Design Automation Associates to provide a well-integrated battery design. Electro Energy is the prime contractor responsible for the overall management of the program, battery design and development, component development and testing, and cell and battery testing. Rhône-Poulenc is responsible for the metal hydride component development and improvement. Eagle-Picher is supporting component and hardware

development, battery design, fabrication procedures, trade studies, and documentation. Rutgers is providing treated material for the nickel electrodes in the batteries as well as analytical support for new and cycled cell components. Design Automation Associates is developing a rules-based technology program to aid in trade studies integrating battery design and thermal and structural analyses. This tool will be used to identify areas where development is required to meet the program goals. In addition, the rules-based technology program could be used in the design of bipolar nickel-metal hydride batteries for specific applications.

The program is beginning the third year of a 4-year effort. The baseline battery is a rectangular design that uses two substacks with a 26-ampere-hour (A-hr) capacity each, which are connected in parallel to yield a total capacity of 52 A-hr. Each substack contains 24 cells that measure 6 by 12 in., and the cells are connected in series to provide the required 28 V. The Electro Energy design uses wafer cells to encase the electrochemical cell components. These wafer cells are made of nickel foil and sealed with epoxy. The electrochemical cell components are composed of a lightweight nickel electrode, a Pellon separator, a plastic-bonded metal hydride electrode using AB_5 alloy material from Rhône-Poulenc, and an electrolyte solution of potassium hydroxide. The current version of the design is projected to have a specific energy of 69.5 W-hr/kg and an energy density of 128.3 W-hr/liter. The nickel and hydride electrodes and the battery packaging and housing have been targeted for further development to achieve the program goals of 100 W-hr/kg and 250 W-hr/liter. Preliminary cost estimates predict an 80-percent cost reduction compared with a similarly sized, state-of-the-art, individual pressure vessel nickel-hydrogen battery system.

.

Lewis contacts: Michelle A. Manzo, (216) 433-5261, Michelle.A.Manzo@grc.nasa.gov, and Thomas B. Miller, (216) 433-6300, Thomas.B.Miller@grc.nasa.gov
Author: Michelle A. Manzo
Headquarters program office: OSS
Programs/Projects: ATMS