NICKEL-HYDROGEN CPV BATTERY UPDATE

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The multicell common pressure vessel (CPV) nickel hydrogen battery manufactured by Johnson Controls Battery Group, Inc. has completed full flight qualification, including random vibration at 19.5 g for two minutes in each axis, electrical characterization in a thermal vacuum chamber, and mass-spectroscopy vessel leak detection. A first launch, is scheduled for late in 1992 or early 1993 by the Naval Research Laboratory (NRL). Specifics of the launch date are not available at this time due to the classified nature of the program. Release of orbital data for the battery is anticipated following the launch.

Three 5" diameter 22-cell, 12 Ah batteries (figure 10 have been fabricated and tested to various degrees as the qualification, flight and flight spare batteries for the NRL program. As part of the qualification, NRL has attached a strain gauge as a parallel means of pressure monitoring with the pressure transducer installed by Johnson Controls during fabrication of the battery.

Several additional units of similar design have been fabricated or a scheduled for fabrication in early 1993 as part of a variety of programs for several customers. Battery specific energy based on the delivered capacity and average discharge voltage delivered by the battery is 50.4 Wh/kg.

Fabrication of several 10" diameter CPV's, ranging in capacity from 25 Ah to 50 Ah, has also been initiated. These batteries incorporate an expandable stack design which is designed to accommodate the possible expansion of the nickel electrodes during long-term cycling (25,000 cycles or more) typical of LEO missions. A prototype 50 Ah test cell (48.2 Ah theoretical capacity), delivered 50 Ah to 1.0 volt/cell (104% utilization) and 51.6 Ah to 0.5 volt/cell (107% utilization) on a standard 10°C C/2 discharge characterization cycle (Figure 2) while maintaining an average discharge voltage of 1.25 V/cell. The 104% utilization is up considerably from the 95% utilization that had been more typical of previous cells and batteries. The improvement is attributed to minor process optimizations incorporated into the positive electrode fabrication processes. The higher utilization will translate directly into further improvement in specific energy.

Two 2-cell batteries dating back to the time of the original CPV battery prototype [1], were retrieved from a 1.5 year storage period and put back on test. The batteries had been discharged to 1.0 volt/cell average prior to storage. Storage conditions were open circuit at room temperature in an uncontrolled warehouse setting. Full capacity was achieved on the second cycle following reinitiation of testing. These two-cells have now been placed back on a 40% DOD LEO cycle and have accumulated 13,000 and 9,000 total cycles, respectively. A third 2-cell, which has been cycled continuously since 1989, remains on test at COMSAT Laboratories. Although we no longer receive formal reports on the test status, it is our understanding that the battery remains on test and has surpassed 22,000 cycles.

References:

Zagrodnik, J.P., Jones, K.R., "Advances in the Design of Common Pressure Vessel Nickel Hydrogen Batteries for Aerospace Applications," 26th Intersociety Energy Conversion Conference (IECEC), August, 1991.

Acknowledgement:

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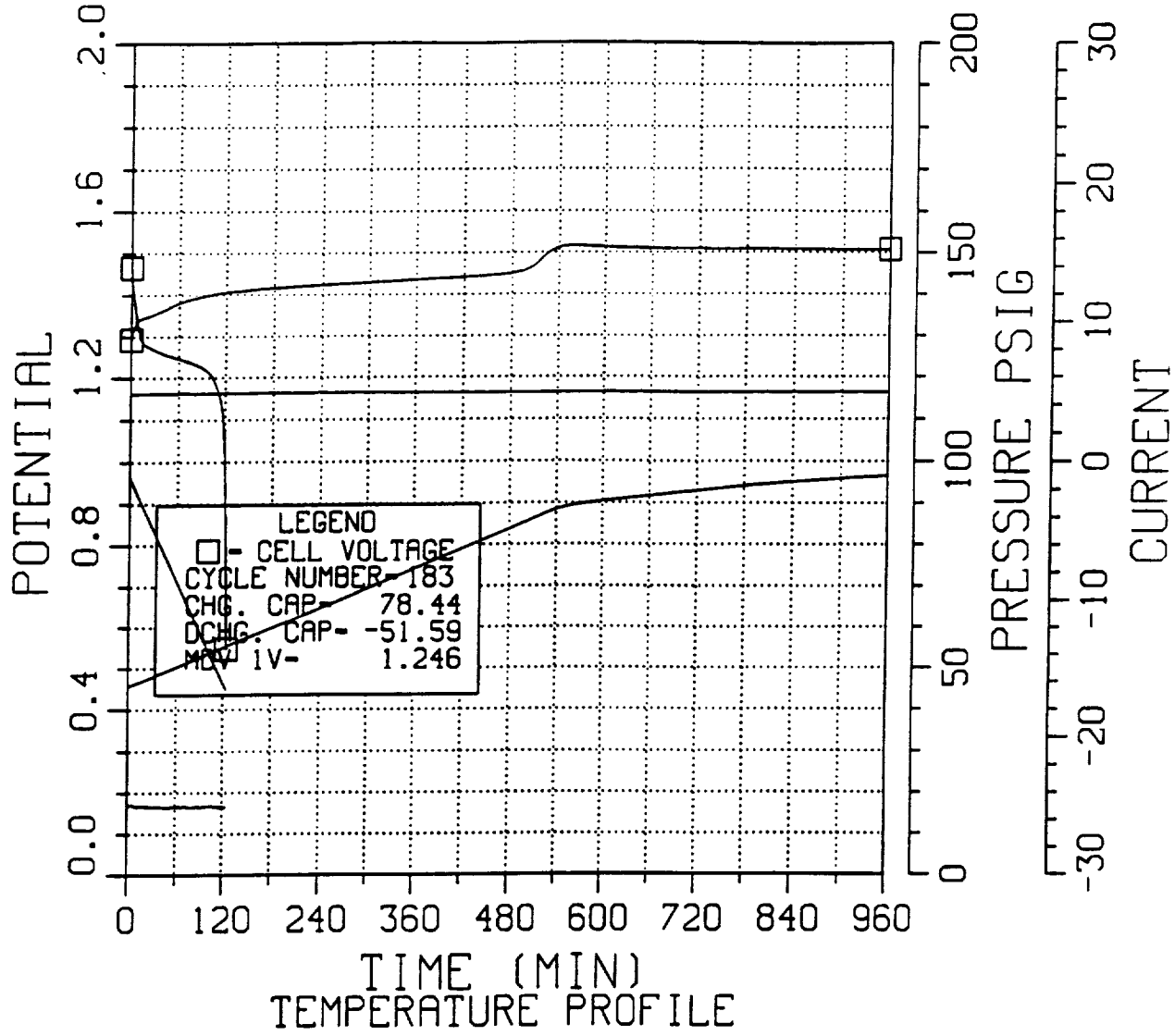
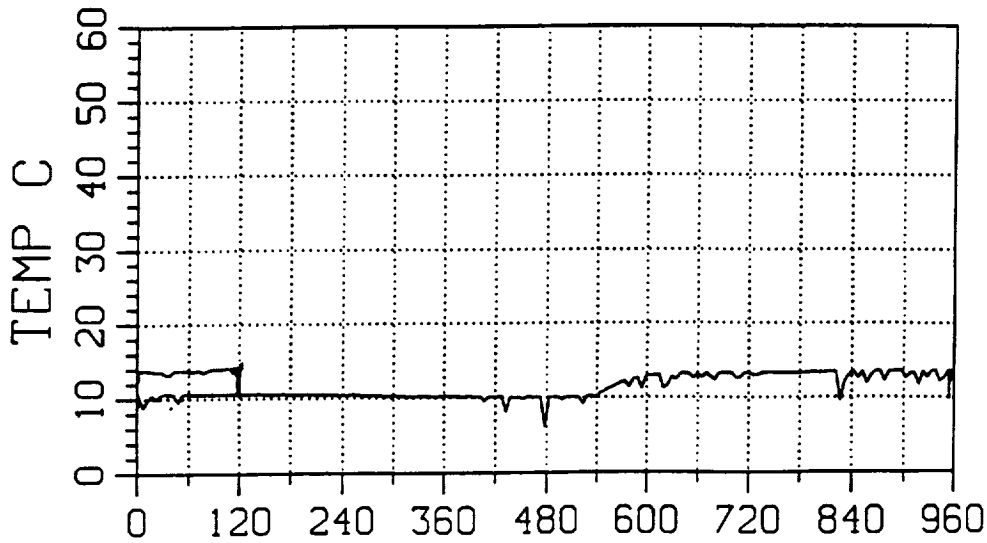
CELL S106

C/10, 16-hour charge
C/2 discharge to 0.5 volt/cell
10°C



TEMPERATURE PROFILE



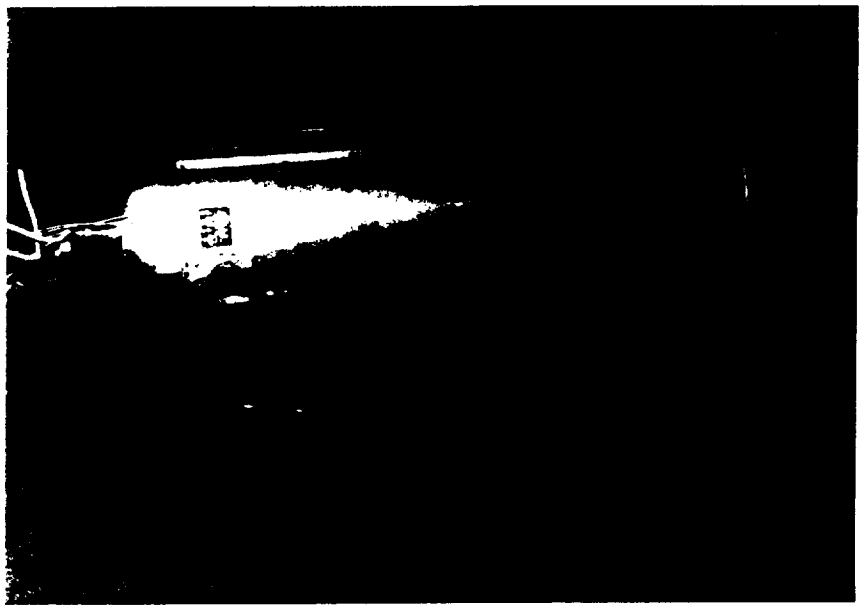


Figure 2:

5" Diameter, 22-Cell CPV Battery
With Pressure Transducer and Strain Gauge

Advanced Technologies Session

Organizers: Sal Di Stefano
Jet Propulsion Laboratory

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Marshall Space Flight Center