N87-11103

4.5" DIAMETER IPV $NI-H_2$ CELL DEVELOPMENT PROGRAM

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Introduction

Interest in larger capacity $Ni-H_2$ battery cells for space applications has resulted in the initiation of a development/qualification/production program. Cell component design has been completed and component hardware fabricated and/or delivered.

Finished cell design projections demonstrate favorable specific energies in the range of 70-75 Whr/Kg (32-34 Whr/Lb) for capacities of 100-250 AH.

It is further planned during this effort to evaluate the advanced cell design technology which has evolved from the work conducted at the NASA/Lewis Research Center

Background

Cell pressure vessels (PV) of 8.89 cm (3.50 in) diameter have successfully accommodated cell capacities ranging from 30-90 AH. However, further growth in PV length imposes certain design and fabrication technology problems. PV's of approximately 11.43 cm (4.50 in) diameter are therefore of interest because similar diameter-to-length relationships are maintained while accommodating larger cell capacities.

Cell Designs

The photograph presented in Figure 1 displays two (2) PV designs to be evaluated under this program. They are primarily distinguished by the method used to effect the vessel girth or joining weld.

The design on the left accommodates an electron beam (EB) welding process. The vessel is of thin walled, uniform construction and the weld ring (not machined in this view) design facilitates the necessary back supported, vessel "butt" joint. This concept is often referred to as the "Intelsat" PV design.

The design on the right accommodates an automatic, tungsten-inert-gas (TIG) welding process. The vessel is of thin walled, multiple thickness (chem-milled) construction and the weld ring design facilitates an unsupported, vessel "butt" joint. This concept is often referred to as the "Air Force" PV design.

Production designs will accommodate either "compression seal" (Intelsat) or "hydraulic seal" (Air Force) terminal assemblies. In addition, both external/internal terminal mounting either axial or 45^{o} off-set will be accommodated. An internal, 45^{o} off-set terminal arrangement (3.5 in cell) is shown in the center of the above view.

Projected Cell Characteristics

The characteristics or design features for four (4) cell capacities (100, 200, 220 and 300 AH) have been projected with very favorable results.

The design features for a 100 AH cell are presented in Figure 2. It was noted several listed parameters are independent of cell capacity. In Figure 3 only the parameters which change are summarized for all four (4) cell capacities.

A review of these data reveal an inverse relationship between cell specific energy and cell capacity (see graph in Figure 4). This unusual relationship is primarily attributed to accelerated current conductor, cross-section growth with increased cell length.

Advanced Cell Design Technology

Advanced $Ni-H_2$ cell design technology has been reported by researchers at the NASA/Lewis Research Center. Technical details were most recently presented at the 1984 GSFC Battery Workshop [1] and the 20th Intersociety Energy Conversion Engineering Conference [2].

Portions of this technology will be evaluated under this program to assess their potential benefit. The enhanced thermal/oxygen/electrolyte management characteristics offered by the catalyzed wall wick/reservoir concept may be well suited to the larger diameter cell configuration particularly in LEO applications. Each of these parameters becomes more difficult to management as cell cross-section increases.

Conclusion

A development/qualification/production program is proceeding on schedule to introduce 4.5" diameter $Ni-H_2$ cell technology. Production tooling has been completed and cell hardware fabricated or delivered. Cell assembly will soon be initiated for design qualification and user industry evaluation.

Large capacity $Ni-H_2$ cell (100-250 AH) exhibiting specific energies of 70-75 Whr/Kg (32-34 Whr/Lb) and offering improved operational characteristics will be available for the most demanding space missions on a near term basis.

References

1. Thaller, L. H. (LRC), "Nickel-Hydrogen Technology", 1984 Goddard Space Flight Center Battery Workshop, Publication 2382, Greenbelt, Maryland, November 1984.

2. Thaller, L. H. & Assoc. (LRC), "Design Principles For Nickel-Hydrogen Cells and Batteries", Proc. 20th Intersociety Energy Conversion Engineering Conference, SAE P-164, Miami Beach, Florida, August 1985.

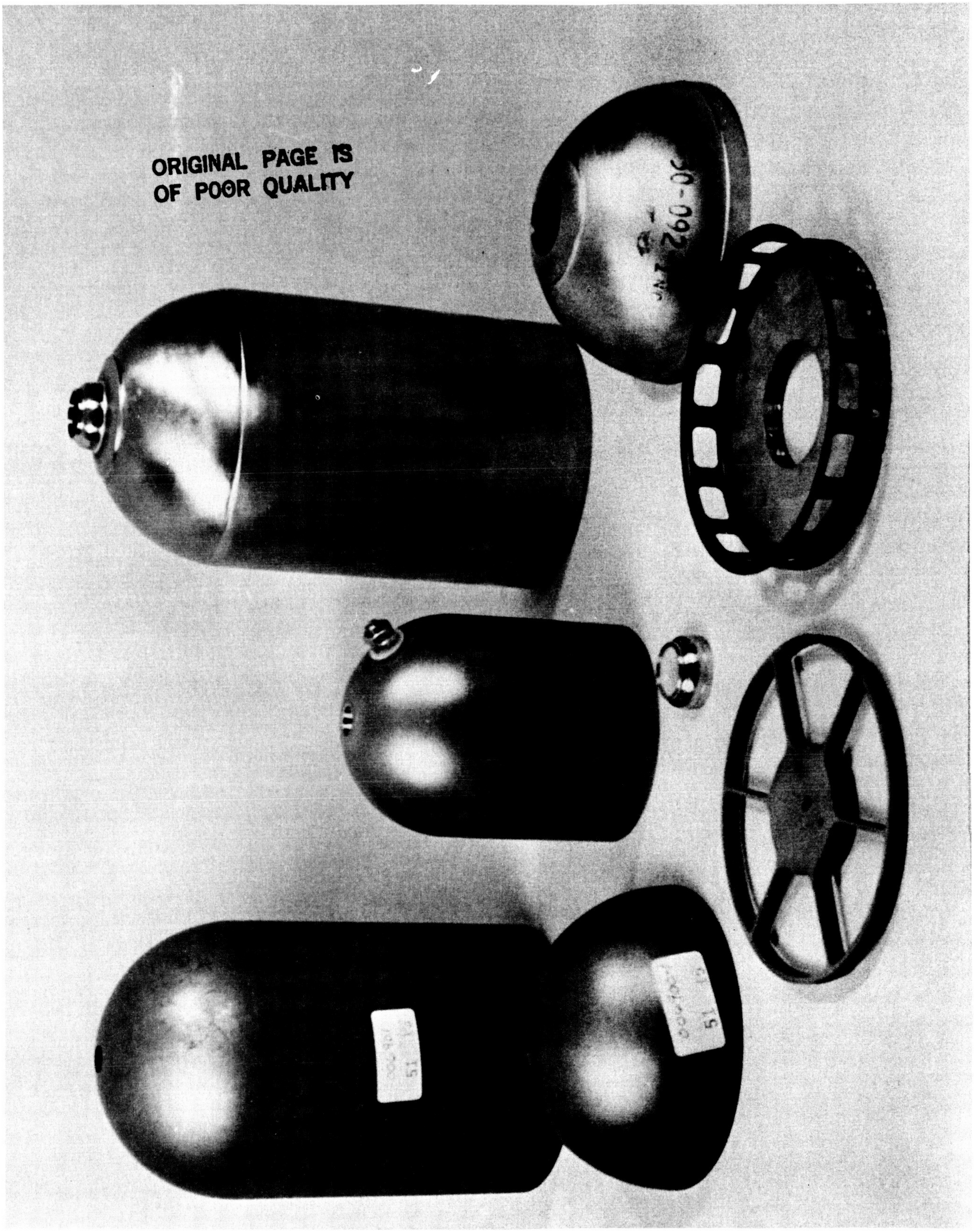

Figure 1.

100 AH 4.5" Dia NiH_2 CELL DESIGN FEATURES

NOMINAL CAPACITY (to 1.00 V)	109 AH
DIAMETER	11.76 CM (4.63 IN)
LENGTH	18.29 CM (7.20 IN)
OPERATING PRESSURE	61 ATM (900 PSI)
SAFETY FACTOR	2.5 : 1
TERMINALS	INTERNAL, 45° OFF-SET
MASS	1783 GM (3.92 LB)
SPECIFIC ENERGY	74.6 WH/KG (33.9 WH/LB)

Figure 2.

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FEATURES	100 AH	200 AH	220 AH	300 AH
NOMINAL CAP. (AH)	109	218	243	333
LENGTH (CM)	18.29	32.26	35.81	46.99
MASS (GM)	1783	3676	4164	6055
SPEC. EN. (WH/KG)	74.6	72.4	71.2	67.1

COMMON FEATURES

DIAMETER	11.76 CM (4.63 IN)
OPERATING PRESSURE	61 ATM (900 PSI)
SAFETY FACTOR	2.5 : 1
TERMINALS	INTERNAL, 45° OFF-SET

Figure 3. 4.5″ Dia. NiH_2 Cell Design Features

EAGLE PICHER

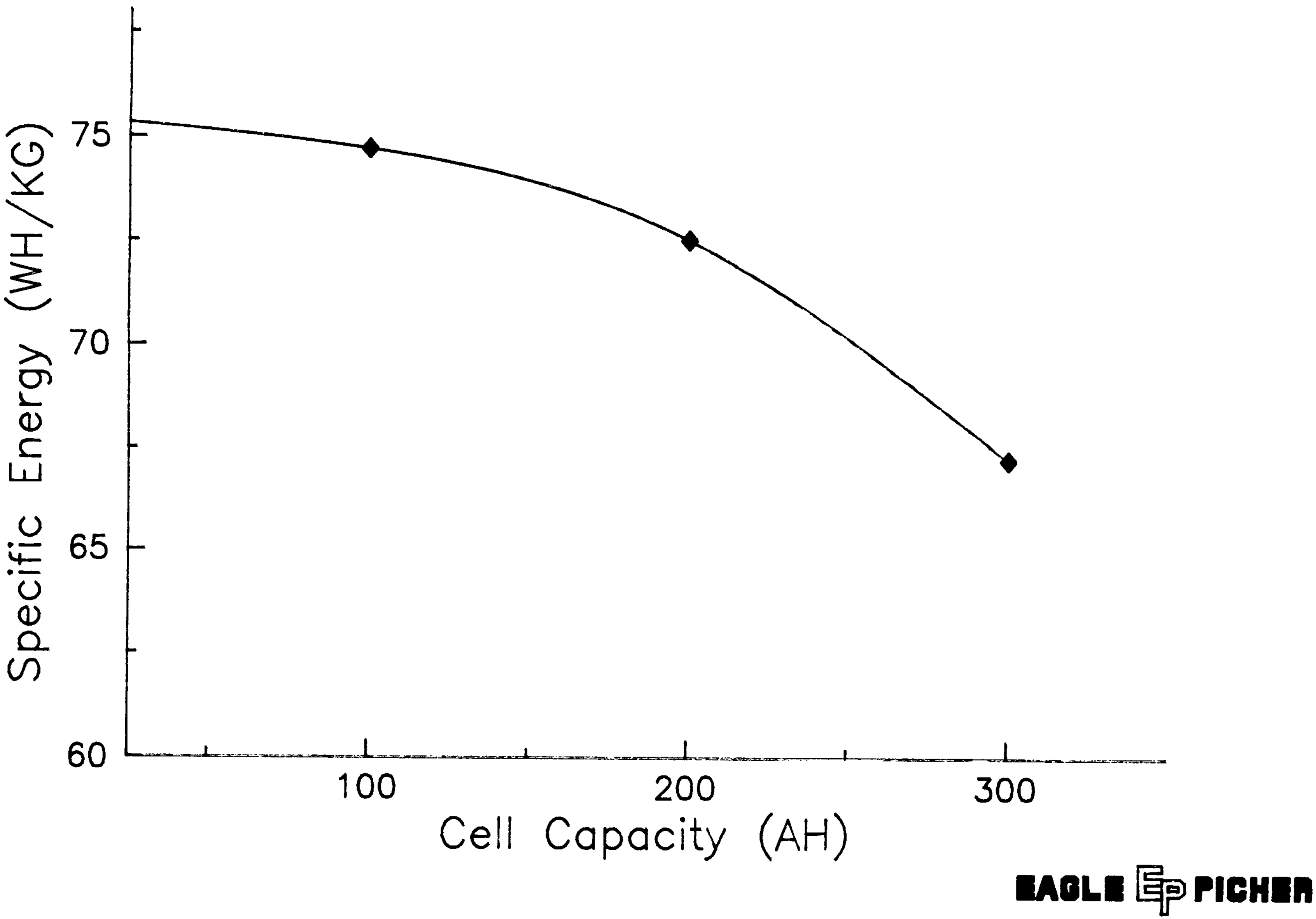

Figure 4. 4.5″ Dia. NiH_2 Cell Design Features