aimed at improving the electrolyte and gas management system to increase reliability and safety.

Recent publications

1 J. F. Jackovitz and J. Seidel, Structural studies of alkaline nickel electrode powders, *Electrochemical Society Meeting, Denver, CO, October 11 - 16, 1981, Extended Abstracts, 81-2* (1981) 66 - 67.
2 N. J. Maskalick, Alkaline nickel electrode voltage *vs.* current performance, *Electrochemical Society Meeting, Denver, CO, October 11 - 16, 1981, Extended Abstracts, 81-2* (1981) 90 - 91.
3 N. J. Maskalick and E. S. Buzzelli, Performance of nickel/iron cells related to electrolyte composition, *Electrochemical Society Meeting, Detroit, MI, October 17 - 22, 1982.*
4 R. Rosey, Manufacturing techniques and cost analysis for nickel/iron batteries, *Fall ECS Meeting, Detroit, MI, October 17 - 22, 1982.*
5 R. Rosey, Westinghouse nickel/iron battery performance characteristics, *8th Energy Technology Conference, March 9 - 11, 1981.*
6 R. Rosey, Westinghouse nickel/iron battery performance — 1981, *EVC Symposium VI, sponsored by the Electric Vehicle Council, Baltimore, MD, October 21 - 23, 1981.*
7 R. Rosey, Westinghouse nickel/iron technology features, *4th DOE Battery and Electrochemical Contractors' Conference, Washington, DC, June 2 - 4, 1981.*
8 Westinghouse Electric Corporation, Annual report for 1981 on research, development and demonstration of nickel/iron batteries for electric vehicle propulsion, Argonne National Laboratory, *Report ANL/OEPM-81-14,* March 1982.

RESEARCH, DEVELOPMENT, AND DEMONSTRATION OF A NICKEL/IRON BATTERY FOR ELECTRIC VEHICLE PROPULSION

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The purpose of this contract is to design, develop, and demonstrate full-sized (25- to 30-kW h), nickel/iron batteries suitable for use in electric vehicle propulsion, while meeting performance goals of specific energy of 54 W h/kg, peak specific power of 104 W/kg, and a cycle life of 800 cycles for 1982.

The Eagle–Picher Industries (EPI) program has concentrated on the characterization, fabrication, and testing of the required electrodes, cells, and 6-V, 270-A h modules. Electrodes of the final configuration have now exceeded 2000 cycles in tests at EPI and have shown very little capacity decline. Full-scale cells and modules at EPI have completed over 800 cycles

at 100 percent depth of discharge (DOD) at the C/3 rate. Identical modules at the National Battery Test Laboratory (NBTL) failed to reach 75 percent of rated capacity at around 800 cycles. A specific peak power (30 s sustained) of 112 W/kg and a specific energy of 47 W h/kg at the C/3 rate have been demonstrated at NBTL.

Eagle–Picher has tested the nickel/iron battery in vehicles. In a Volkswagen Transporter Van, the EPI battery provided a range of 100 mi on a modified urban run and a range of nearly 120 mi in highway driving. In tests at the Jet Propulsion Laboratory, this 90-cell battery provided a range of nearly 100 mi at 55 mph in a South Coast Technology Rabbit test vehicle. In two other vehicles, an Electric Vehicle Associates F-100 pickup and an SCT Rabbit pickup, the ranges on a modified urban cycle were 71 and 91 mi, respectively. In a modified Society of Automotive Engineers J227/ a/C cycle with these vehicles, the corresponding ranges were 61 and 74 mi. In temperature testing at −20 °C, EPI has noted a decline of 16 percent of the capacity at 20 °C. In other experiments, EPI has identified the beneficial effects of sulfide additive on the performance of the negative electrode, and examined various replacements for cobalt in the positive electrode.

EPI's primary effort during 1983 is aimed at improving the nickel electrode manufacturing process to reduce production and material costs. Various electrode substrates are being evaluated. Eagle–Picher is investigating steps to reduce the costs of manufacturing the different components and is currently attempting to define the costs of their cells and modules at production levels of 10 000 to 25 000 batteries per year. EPI is evaluating a single-point watering system designed to reduce maintenance requirements. EPI plans to deliver a full-sized battery to NBTL with molded cases and a single-point watering system in 1983.

Recent publications

1 Eagle–Picher Industries, Inc., Annual report for 1981 on research, development, and demonstration of nickel–iron batteries for electric vehicle propulsion, Argonne National Laboratory, *Report ANL/OEPM-81-13*, March 1982.

2 K. Gentry and R. Hudson, Ni/Fe batteries — an alternate to lead–acid electric vehicle propulsion, *Proc. 16th Intsoc. Energy Conversion Eng. Conf., August 9 - 14, 1981, Paper No. 819322, Vol. I*, 1981, pp. 648 - 652.

3 R. Hudson, Eagle–Picher nickel–iron technology features, *4th DOE Battery and Electrochemical Contractors' Conference, Washington, DC, June 2 - 4, 1981.*

4 R. Hudson, The nickel–iron battery for electric vehicle propulsion, *EVC Symposium VI, sponsored by the Electric Vehicle Council, Baltimore, MD, October 21 - 23, 1981.*

5 R. Hudson, The nickel–iron battery for electric vehicle propulsion, *Electric Vehicle News, 10* (4) (November 1981) 12 - 17.