APPLIED BATTERY AND ELECTROCHEMICAL RESEARCH PROJECT

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Lawrence Berkeley Laboratory, together with the San Francisco Operations Office (SAN), is assuming field management responsibility for the contracts comprising the Applied Battery and Electrochemical Research Project supported by the Energy Storage Systems Division (STOR) of the Department of Energy (DOE). This project provides the applied research base which supports all of the Electrochemical Systems missions in STOR, and the general objective of the project is to help provide electrochemical systems that satisfy economic, performance and schedule requirements of these missions. The specific goal of the project is to identify the most promising technologies and transfer them to industry and/or another DOE program for further development and scale-up.

This project started during July 1979, and an implementation plan has been prepared, describing how LBL, in cooperation with SAN, will conduct the management responsibilities, delineating appropriate managerial controls to meet the project objectives. LBL will contract with (through SAN, as appropriate) and direct the activities of project participants. LBL will oversee the technical status, costs, and schedules of the technical programs, provide reports of these to STOR, and establish corrective actions as required. LBL will maintain overall accountability for successful field management of the project.

The technical direction of the Applied Battery and Electrochemical Research Project for the last quarter of 1979 and for 1980 is described in the implementation plan and is designed to support the DOE Electrochemical Systems missions: electric vehicles, solar electricity, dispersed electric load-leveling, and energy and resource conservation. General problem areas addressed by the project include the identification of new electrochemical couples for advanced batteries, the determination of technical feasibility of the new couples, improvements in components of batteries under development by other Electrochemical Systems projects funded by STOR, and the establishment of engineering principles applicable to batteries and electrochemical processes. Major emphasis will be on applied research which will lead to superior technical performance and lower life-cycle costs. The project is divided into three major research areas: Exploratory Battery R & D, Engineering Science Research, and Materials Research.

The Exploratory Battery R & D area provides for the study of new electrochemical couples, or of new approaches to known battery systems, and offers the prospect of developing better-performing, simpler, longer-life,

safer, and/or lower-cost batteries. Research on zinc/bromine, calcium/metal sulfide, and iron/chromium (redox) cells will progress toward the technology transfer stage, and exploratory work on such systems as solid electrolyte, organic electrolyte, and molten-salt cells will be pursued.

Engineering Science Research will include morphological studies that address problems hindering the timely development of near-term batteries (lead/lead dioxide, iron/nickel oxide, and/or zinc/nickel oxide); phenomenological studies to provide basic information needed for the rational design, operation and control of electrochemical processes; studies on physiochemical methods for electrochemical research to aid the development of advanced tools for the detailed study of battery materials and processes; and modeling studies aimed at quantitative prediction of the dynamic behavior of cells, cell components and batteries.

Materials Research seeks to identify, characterize, and improve the materials and components to be used in batteries and electrochemical processes. Investigations of solid electrolytes, including those of ceramic (beta-alumina, NASICON), glass, and polymeric compositions, will continue, and advanced liquid electrolytes, such as low-temperature molten-salt mixtures and ionizing organic liquids, will be studied.

BASIC DEVELOPMENT OF NICKEL/ZINC BATTERIES

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The goal of this program is to gain information on the modes of operation of nickel and zinc electrodes from a study of well-defined, simplified, structural analogs and from the application of semiquantitative, theoretical concepts. The work is designed to yield useful information for hardware development by addressing that domain of dimensions and conditions that exists within the confines of pores in real porous electrodes, approximately 0.1 to 20 μm.

Moving picture photographs have been taken of growing dendrites and of the anodic reaction front as it entered the zinc pore. Coupled with optical microscopic studies, hydrogen bubbles were found to emanate from the base or stems of the dendritic masses. Reaction fronts penetrated at rates of 1×10^{-5} - 1×10^{-3} cm s^{-1}, depending on superficial current densities, corresponding to *ca.* 50 - 1000 mA cm^{-2}, respectively. In Task II, the maximum accumulated charge of Zn and NiOOH was determined for pores with openings of 1.0 cm $\times$ 2×10^{-3} cm. For Zn the accumulated charge depended on current density during charging, being limited by the onset of dendrite