

**Agreement between California Energy Commission  
and  
Premium Power Corporation**

**Title:** Demonstration of Zinc-Flow Energy Storage System  
**Amount:** \$394,082  
**Term:** 36 months  
**PIER Contact:** Anish Gautam  
**RD&D Committee:** 12/3/2009

### Funding

FY	Program	Area	Initiative	Budget	This Project	Remaining Balance	
08	Electric	IAW	Emerging Technologies	\$1,000,000	\$394,082	\$0	0%

For the 2008 fiscal year, the total Electric budget is \$62.5 million. Within the Electric program, the IAW program area budget is \$5.5 million and, from this amount, \$1 million was allocated to the Emerging Technologies budget initiative. If approved, the remaining initiative balance will be \$0.

### Recommendation

Approve this agreement with Premium Power Corporation for \$394,082, with \$113,995 in match funding. Staff recommends placing this item on the discussion agenda of the Commission Business Meeting.

### The Problem

Lead-acid battery technology currently dominates the energy storage marketplace and is used in nearly all uninterruptible power supply (UPS) application for backup power needs. This technology works ideally when infrequent and short duration backup power is required. However, lead-acid technology cannot be deeply discharged without adversely affecting the battery's life and performance, it is also unreliable and expensive to maintain. Premium Power's Zinc Flow energy storage technology is designed to operate in peak shaving and load management applications where longer duration discharges and frequent cycling are required. Zinc Flow technology offers 30 years of unlimited cycles, 100% depth of discharge, 70% round trip efficiency and is fully autonomous allowing for remote operation. This project will provide operational experience as well as measurement and validation of the technical and economic performance of the technology provided by a recognized user and supported by one of California's major utilities.

## Proposed Research

Premium Power, Wal-Mart and San Diego Gas and Electric (SDG&E) will work together to demonstrate the technical and economic performance of a 150kWh Zinc-Bromide (Zn-Br) PowerBlock150 energy storage system (ESS), connected on the customer side of the meter. A successful demonstration of the Zn-Br flow battery energy storage technology at the site would provide critical data that would pave the way for applications at other Wal-Mart stores, other industrial and commercial customers in California and utility sites in California where peak load reduction, load management and demand response is needed, and emissions and noise are a concern.

Wal-Mart has been on the leading edge of adoption of energy-efficient technologies for its stores and will demonstrate this project as a peak load reduction tool; if the demonstration is successful Wal-Mart has shown interest in deploying this technology at other California locations.

## Research Justification and Goals

This project "[will develop, and help bring to market] increased energy efficiency in buildings, appliances, lighting, and other applications beyond applicable standards, and that benefit electric utility customers" (Public Resources Code 25620.1.(b)(2)), (Chapter 512, Statutes of 2006)); and supports California's goal to align RD&D funding with public policy goals for new renewable technologies and greenhouse gas mitigation technologies, including efficiency, renewable generation technologies, and energy storage per the Energy Action Plan 2005 by:

- Demonstrating long term, commercial scale operation of a high-efficiency peak shift energy storage system, with the capability to withstand daily deep discharge cycling and maintain a 30+ year design life.
- Providing peak shaving in order to reduce demand charges and lower Wal-Mart's overall utility bills.
- Shifting off-peak power to on-peak periods to assist the utility in load leveling generation resources.
- Studying the feasibility of using ESS at other California store locations with high demand or TOU rate structures.

These proposed award also supports the general goal of SB 1250 (Perata, Chapter 512, Statutes of 2006), which states, in part, "the Public Interest Research, Development, and Demonstration Program is to develop, and help bring to market, energy technologies that provide increased environmental benefits, greater system reliability, and lower system cost, and that provide tangible benefits to electric utility customers."

## Background

The proposal was submitted through the following competitive solicitation, Emerging Technology Demonstrations Grants Program (ETDG) Opportunity Notice 08-006. This opportunity notice was structured to solicit proposals under four categories 1) Data Center, 2) Electricity Storage for Customer-

side, 3) Industrial Energy Efficiency and 4) Water and Wastewater. This proposal was ranked 3 out of 4 proposals received through the solicitation under the Electricity Storage for Customer-side application category.

Wal-Mart and San Diego Gas and Electric (“SDG&E”) have undertaken preliminary evaluations of Premium Power’s Zinc Flow energy storage technology for a peak shaving application. Wal-Mart has provided their support in pursuing this demonstration program and is willing to consider further adoption of the technology at other store locations in California provided the economics and reliability of the system can be demonstrated.

This project will demonstrate the technical and economic performance of a 100kW / 150kWh PowerBlock<sup>®</sup> 150 (“PB150”) energy storage system (“ESS”), connected on the customer side of the meter. The ESS is a commercially available product manufactured, distributed and serviced by Premium Power based in North Reading, MA. A successful demonstration of the flow battery energy storage technology at the site would provide critical data that could pave the way for applications at other Wal-Mart stores, other industrial and commercial customers in California and utility sites in California where peak load reduction, load management and demand response is needed, and emissions and noise are a concern.

The project will use an off-the-shelf system that has been thoroughly tested in-house and shipped to several domestic and international utilities, energy companies and telecoms for evaluation for commercial adoption. The ESS is certified by the National Fire Protection Agency (NFPA); Underwriter’s Laboratory (UL), Federal Communications Commission (FCC) and meets all National Electric Code (NEC) standards.

The system will be mounted on a trailer with a chiller and transfer switch and will provide power to a portion of the facilities load. This configuration will enable the system to store power during off-peak hours and to discharge during on-peak hours as well as provide UPS capability to the load as required. The energy storage system will have system monitoring software installed and will be connected via the Ethernet, which can be accessed via an IP address. The partners will study the load profiles of the site prior to system installation and pre-program the system to function in various modes of operation based on load and grid conditions. These modes and decision criteria for charge/discharge can be modified by authorized project partners as the need requires.

The key barriers to historic energy storage technologies have been installed costs and life of the technology. The PowerBlock 150 utilizes the same building block technology that is incorporated into all of Premium Power’s systems. This battery blocks are constructed with milk-jug grade plastic and the electrolyte consists of readily available and inexpensive salt brine complex. Because the plating surface of the electrode is plastic and does not participate chemically in the plating process the cells and modules are estimated to last at least 30 years when regularly scheduled maintenance is preformed. Due to the inexpensive and readily available materials the commercial cost of Premium Power’s Zinc Flow technology is estimated to be \$200 per kilowatt-hour at this price Zinc Flow technology is

competitive on an initial cost with today's lead acid battery technology and outperforms on a life-cycle cost basis.

Operational experience will provide a basis for Wal-Mart and others the data necessary to evaluate the functionality, reliability and potential economic viability of the technology and assist in establishing the market feasibility.