



**Demonstration of a 2-MWh Peak
Shaving Z-BESS**

ACKNOWLEDGMENTS

- This project is part of the collaboration between the California Energy Commission (CEC) and the Energy Storage Systems Program of the U.S. Department of Energy (DOE/ESS) through Sandia National Laboratories (SNL).

Project Contributors

- California Energy Commission
 - Funding
- ZBB Energy Corporation
 - Energy Storage System
- Distributed Utility Associates
 - Integration and Site Testing
- DOE, Sandia National Laboratories, EPRI Solutions
 - Data Acquisition and Analysis

Goals of Program

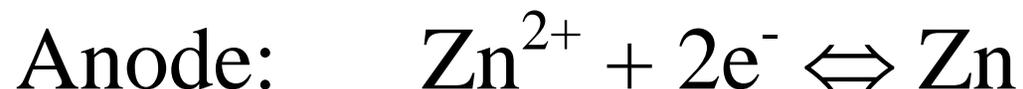
- Manufacture a battery system
 - 2 MWh of energy capacity
 - 2 MW output capability
- Demonstrate the battery for utility peak shaving
 - Test 500-kWh unit at DUIT facility
 - Test 2-MWh system at utility demonstration site
- Evaluate economic benefits of the system
 - performance
 - availability

50 kWh Zinc/Bromine Battery Module

- 50 kWh (dc)
- 50 kW (dc) peak power
- Open Circuit:
108 Volts (dc)
- 0-600 amps discharge
- 12.8 ft² footprint
- Approx. 3000 lbs.



Chemical Reactions



Complexation:



50-kWh Battery Module Assembly

Electrolyte Storage Tanks with Plumbing Connections



50-kWh Battery Module Assembly Module Containment Frame



50-kWh Battery Module Assembly

Installation of Pumps



50-kWh Battery Module Assembly

Module Assembly with Tanks, Controls and Pumps





50-kWh Battery Module Assembly Installation of Battery Stacks

Assembly of 50-kWh Battery Modules

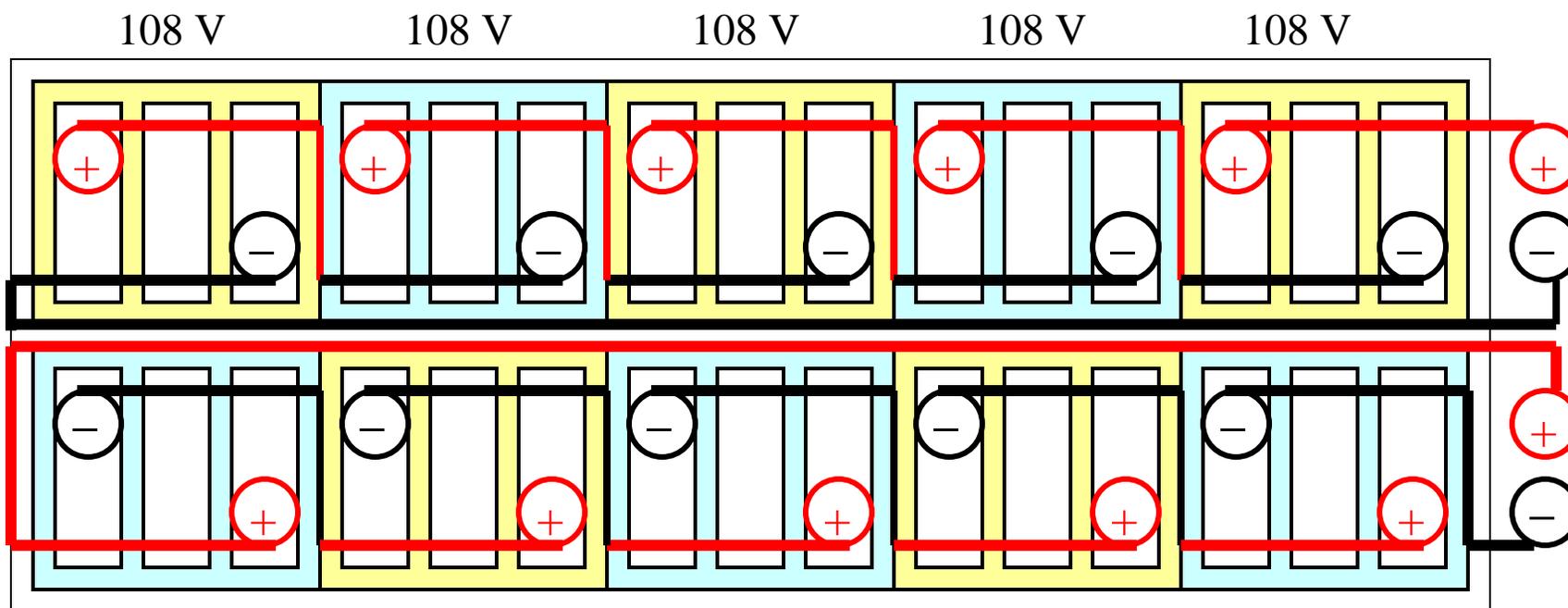


500-kWh Battery Design

- Two strings of five 50-kWh battery modules
- Housed in a 20-foot military cargo container
- Full side opening access doors
- 250 gallon sump capacity
- Active and passive battery cooling
- Container weight 8,900 lbs.
- Total weight approximately 40,000 lbs.

500-kWh Battery Configuration

String #1



String #2

500-kWh Zinc/Bromine Battery Container



Loading Modules into 500-kWh Container



Loading Modules into 500-kWh Container



Fully Loaded 500-kWh Zinc/Bromine Battery Container



500-kWh Battery Summary

	50-kWh Module	500-kWh System
DC Interface	120 Volts (dc) max. 108 Volts (dc) OC	600 Volts (dc) max. 540 Volts (dc) OC
Capacity	50 kWh – 2 to 4 hour discharge	500 kWh – 2 to 4 hour discharge
Power	25 kW continuous 50 kW peak	250 kW continuous 500 kW peak
Configuration	Three battery stacks connected electrically in parallel	10 modules, 2 parallel strings of 5 modules in series
Dimensions	44"W x 42"D x 78"H	20'L x 8'W x 8'6"H
Weight	Approx. 3,000 lbs.	Approx. 40,000 lbs.

500-kWh System Design

- 500 kWh battery housed in a 20-foot military cargo container
- 500-kW / 625-kVA PCS
- Battery, PCS and cooling equipment mounted on 45-ft. flatbed trailer
- Total weight approximately 50,000 lbs.

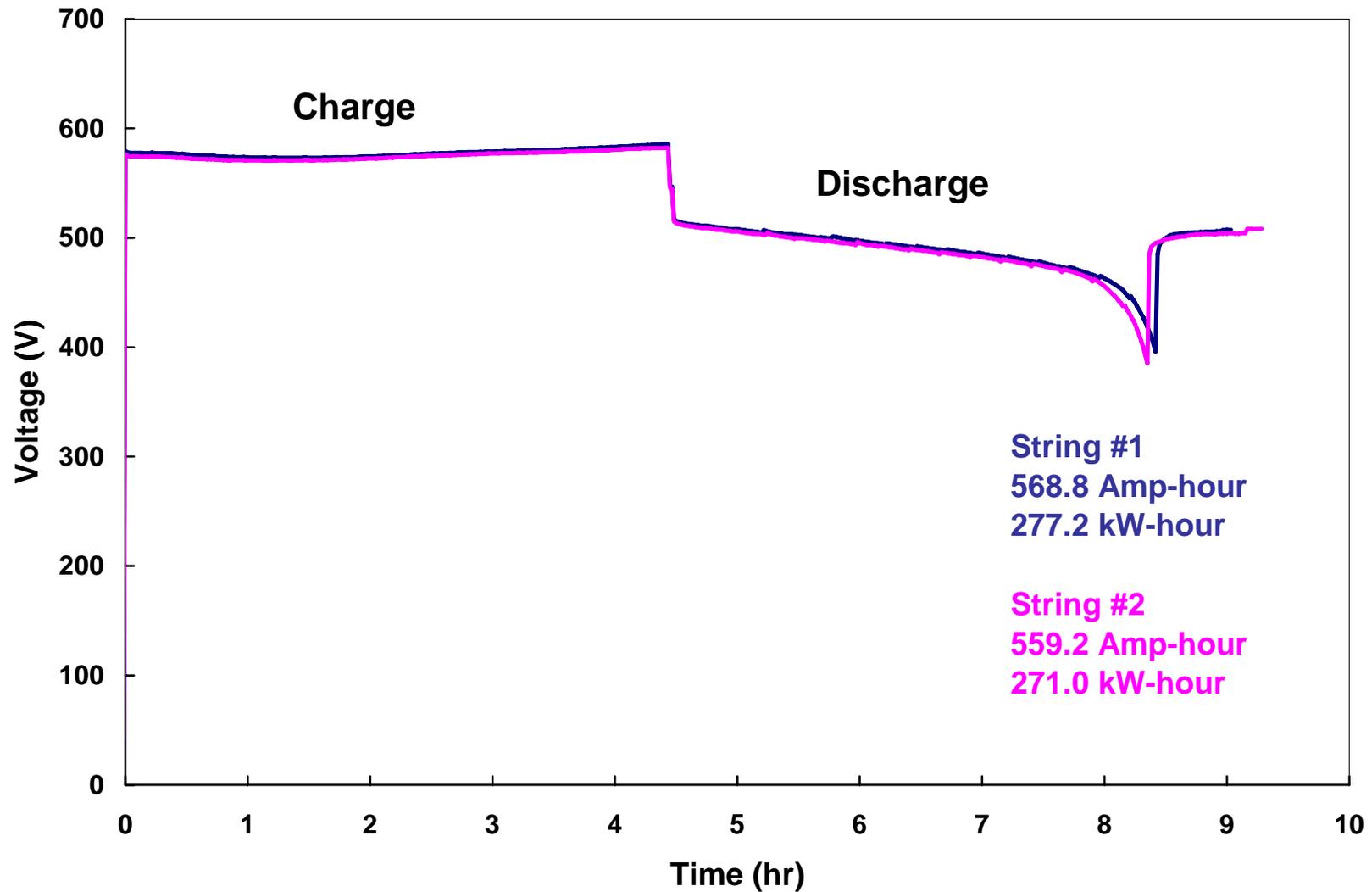
Power Conditioning System

PCS Specifications

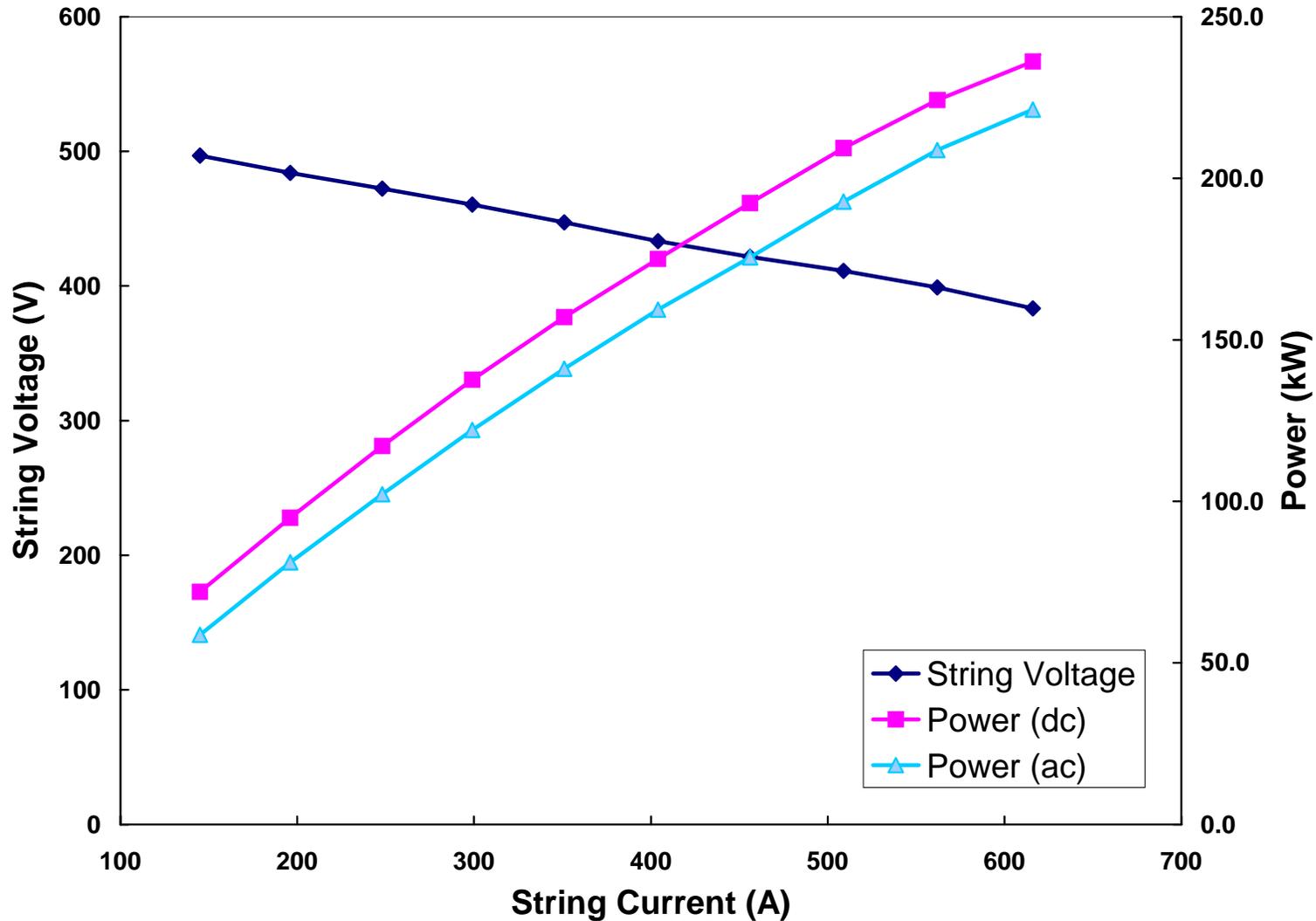


- 500 kW / 625 kVA
- 3 ϕ output, 480 Vac, 60 Hz
- Bi-directional, full four quadrant control
- Aux. Power: 3 ϕ , 208 V
- 96"W x 57"D x 98"H
- Weight = 10,100 lbs.

500-kWh Battery Voltage Profile (Sept. 12, 2005)



250 kWh String Power Curve (Sept. 19, 2005)



Future Work Schedule

- Delivery of first 500-kWh to DUIT
- Testing of first unit
- Complete manufacture three additional units
- Delivery of four units to demonstration site
- Testing at utility demonstration site