



# Testing and Evaluation of Energy Storage Devices

## DOE Energy Storage Systems Research Program Annual Peer Review

This work was funded by the DOE Energy Storage Program

September 23 - 26, 2007  
San Francisco, CA

*Presented by:*

Tom Hund,

Nancy Clark, David Johnson, and Wes Baca

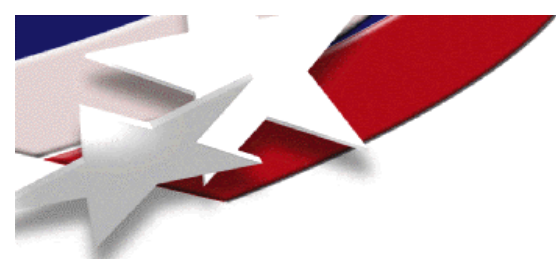
Sandia National Laboratories

Albuquerque, NM

(505) 844-8627

[tdhund@sandia.gov](mailto:tdhund@sandia.gov)

\*Sandia is a multi-program laboratory operated by Sandia Corporation, a Lockheed Martin Company,  
for the United States Department of Energy's National Nuclear Security Administration under Contract DE-AC04-94AL85000.



# Introduction (FY-07 Work)

- ◆ **Sandia/MeadWestvaco/NorthStar Supercap and Carbon Enhanced Lead-Acid Battery Work**
  - ❖ Prepared second generation of MWV carbon for testing in NorthStar and Battery Energy batteries
  - ❖ Abuse tested NessCap capacitors using propylene carbonate based electrolyte and compared electrical performance to the standard acetonitrile based electrolyte capacitors.
  - ❖ Tested East Penn gel and C&D CPV battery technology using a simulated utility cycle profile.
- ◆ **Sandia/ILZRO**
  - ❖ PSOC testing Battery Energy SunGel VRLA used in the ILZRO Peru RAPS system

# Energy Storage Devices Under Test (FY-07)

• **C&D CPV550 Battery**  
(Deep-Cycle Vented Solar Battery)



• **East Penn Solar Gel**  
(Deep-Cycle Solar Gel Battery)



# Energy Storage Devices Under Test (FY-07)

## •NessCap

(Symmetric Supercap Carbon/Carbon  
Propylene Carbonate Based Electrolyte)

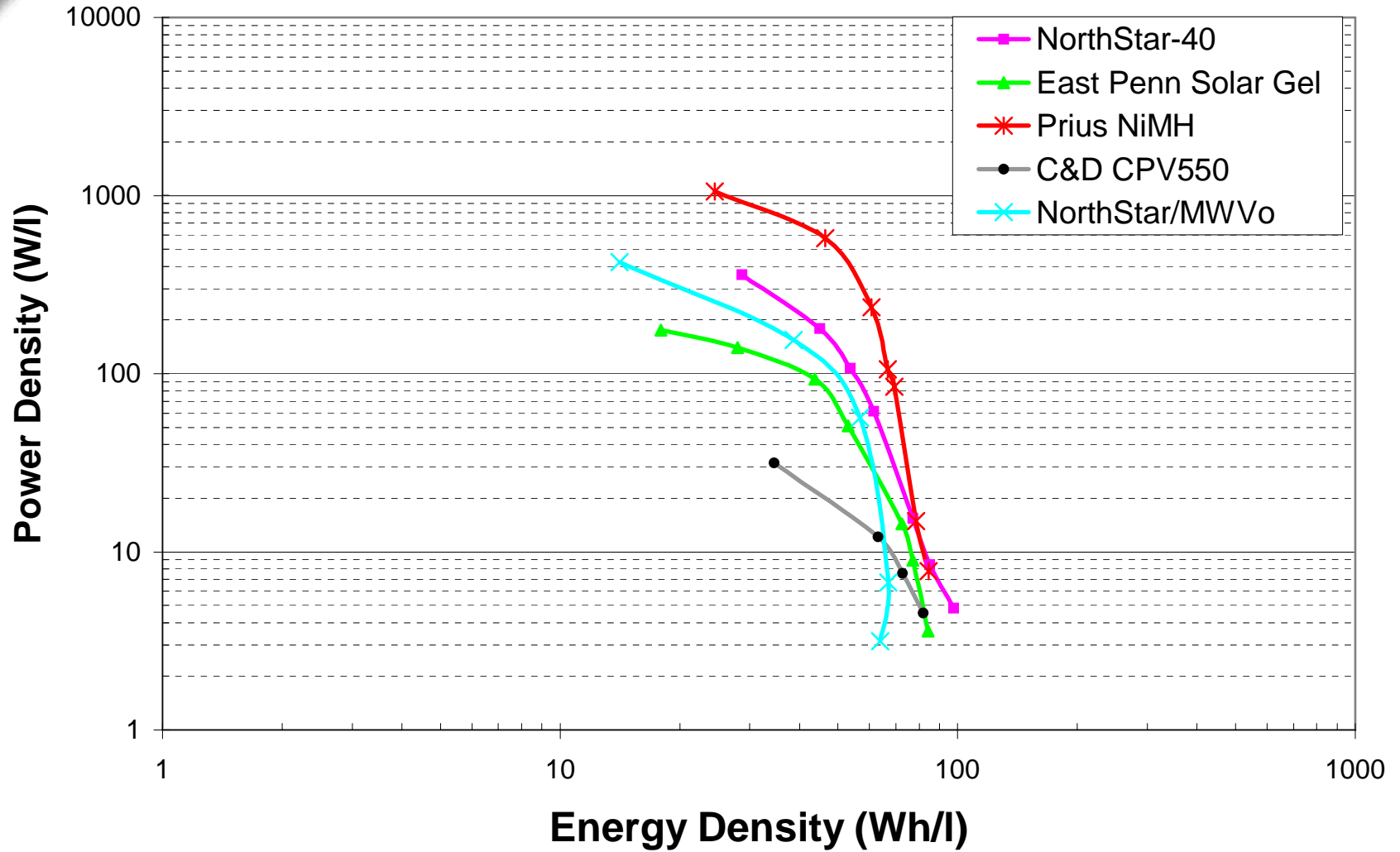


## •Battery Energy

(SunGel - VRLA Gel Battery  
Used In The ILZRO Peru RAPS)

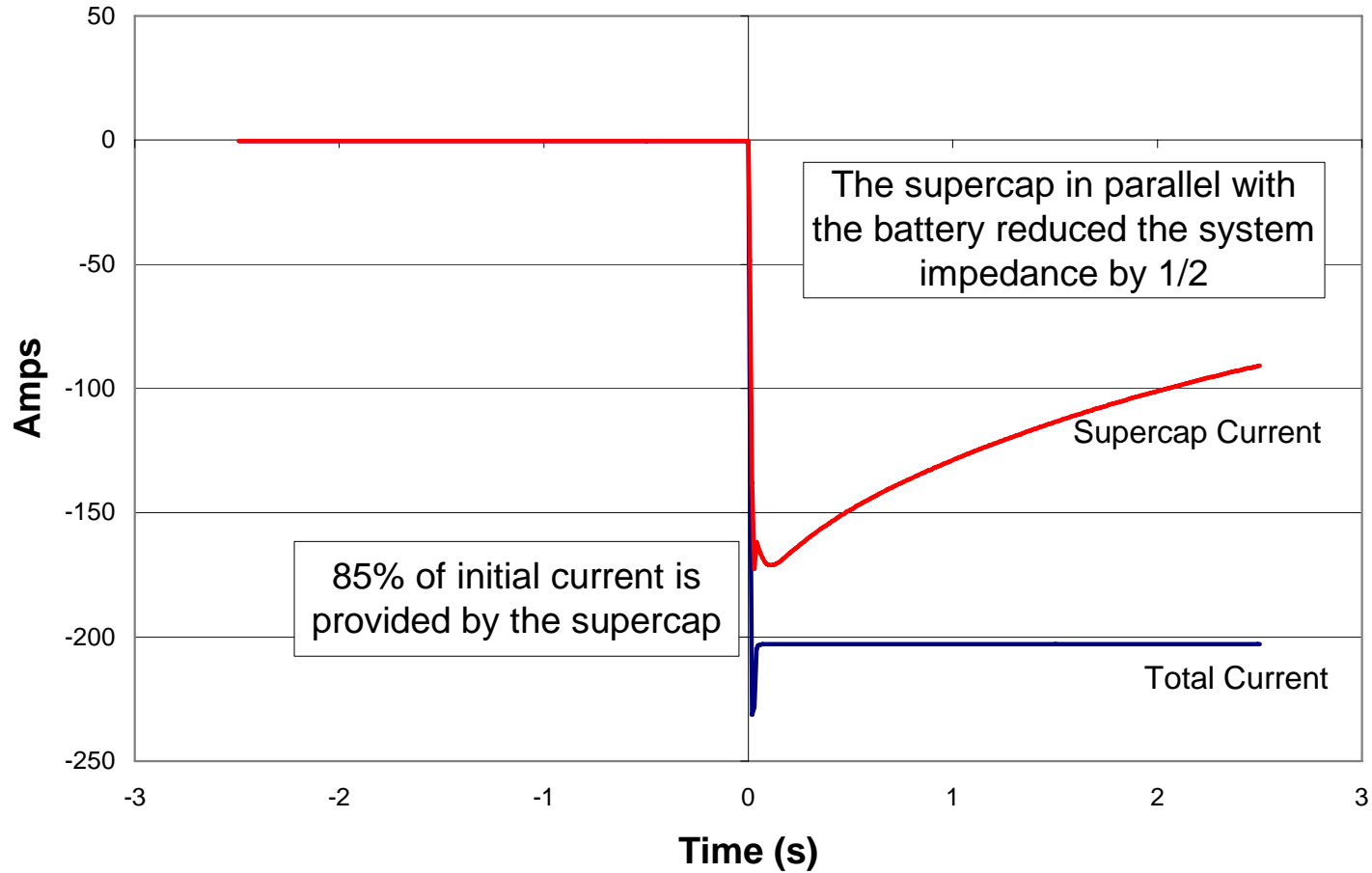


# Ragone Plot



# Supercap/Battery

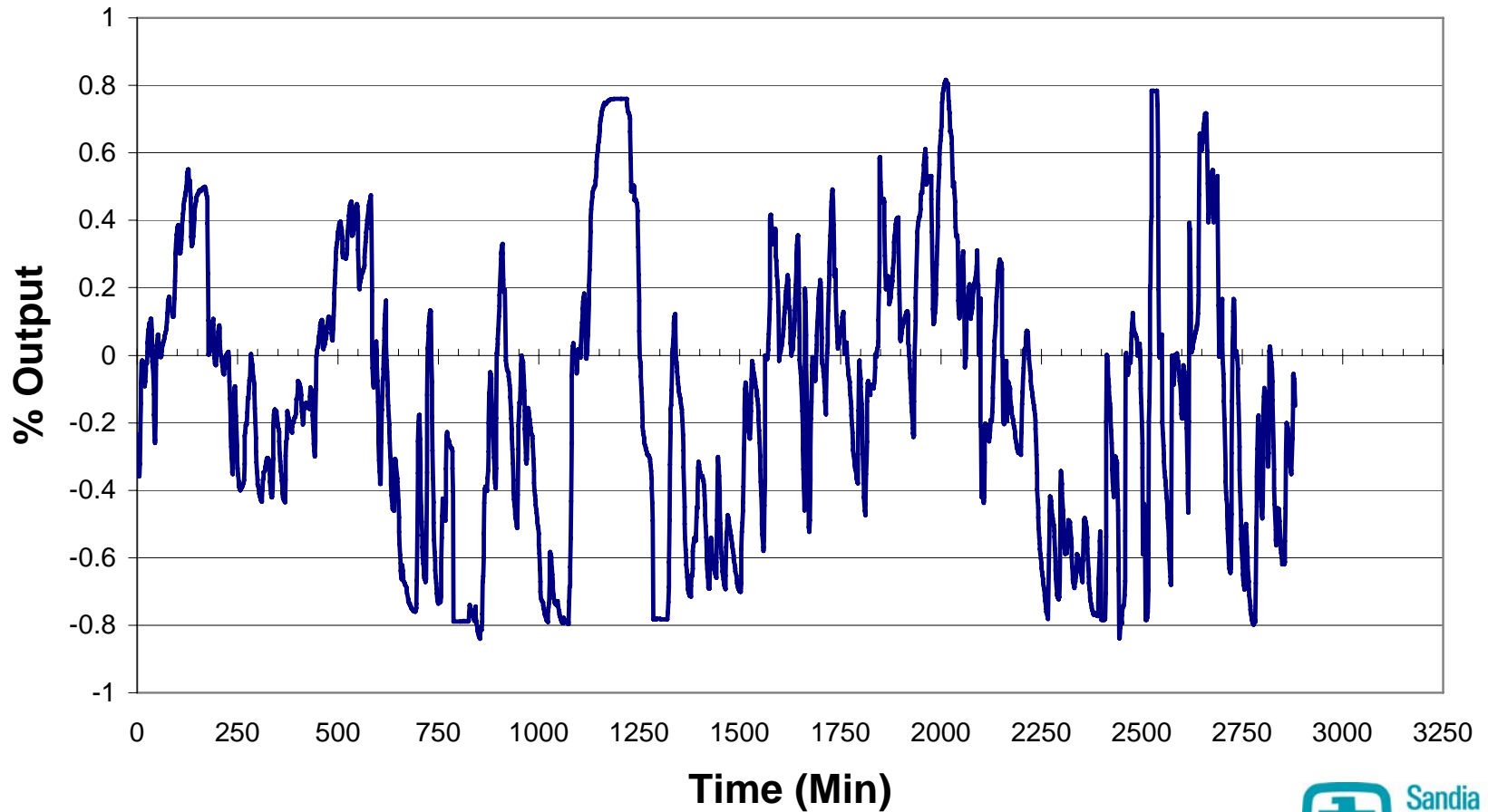
## VRLA Battery And Supercapacitor System





# Utility Cycling (Sample Profile)

**Utility Profile**  
(Charles Koontz, WPS)

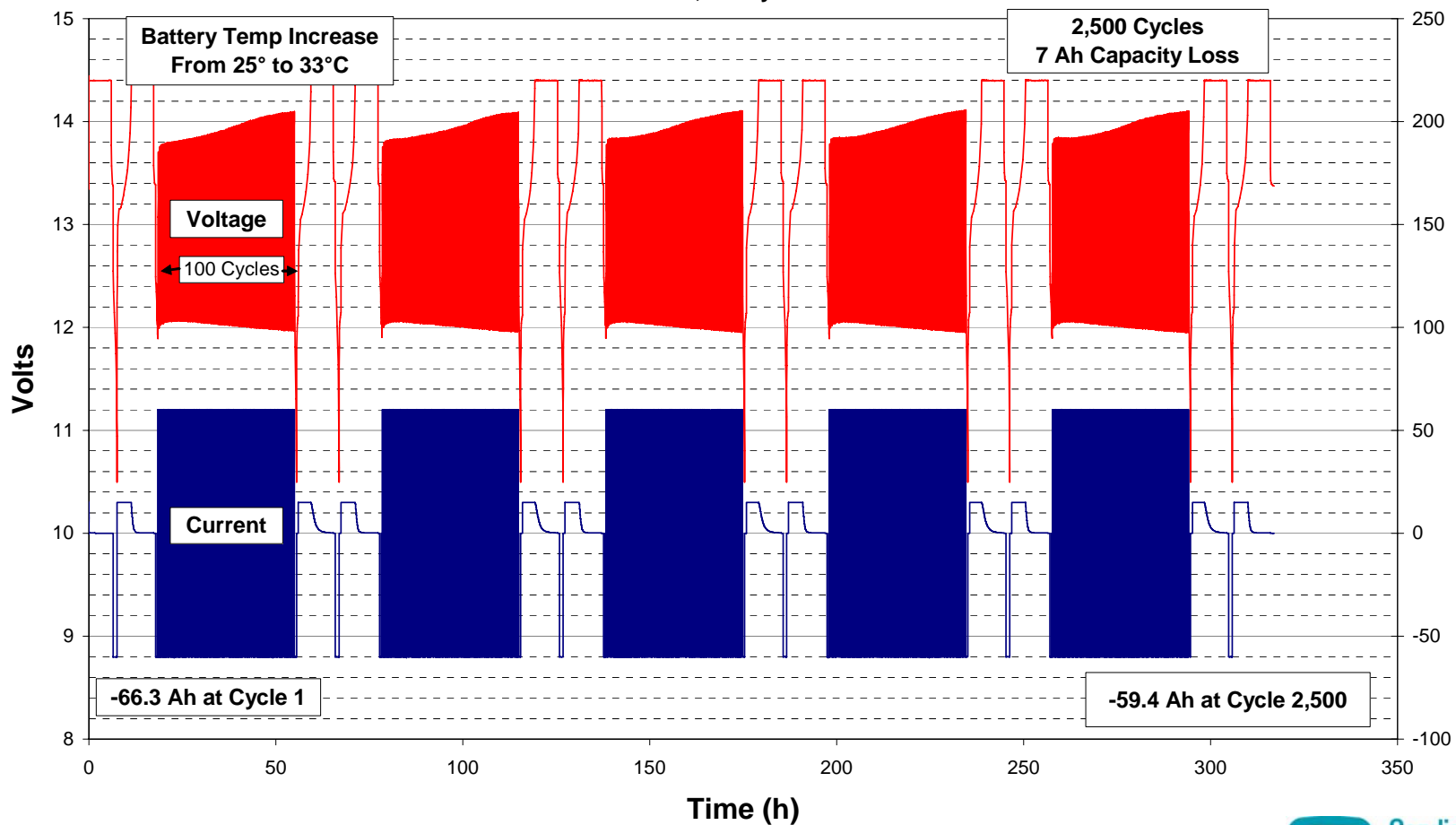


# East Penn Solar Gel Utility Cycling

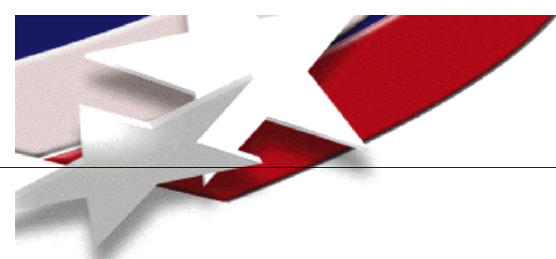
## East Penn Solar Gel Utility Cycle

(1C Charge/Discharge, 5 min Rest)

2,500 Cycles

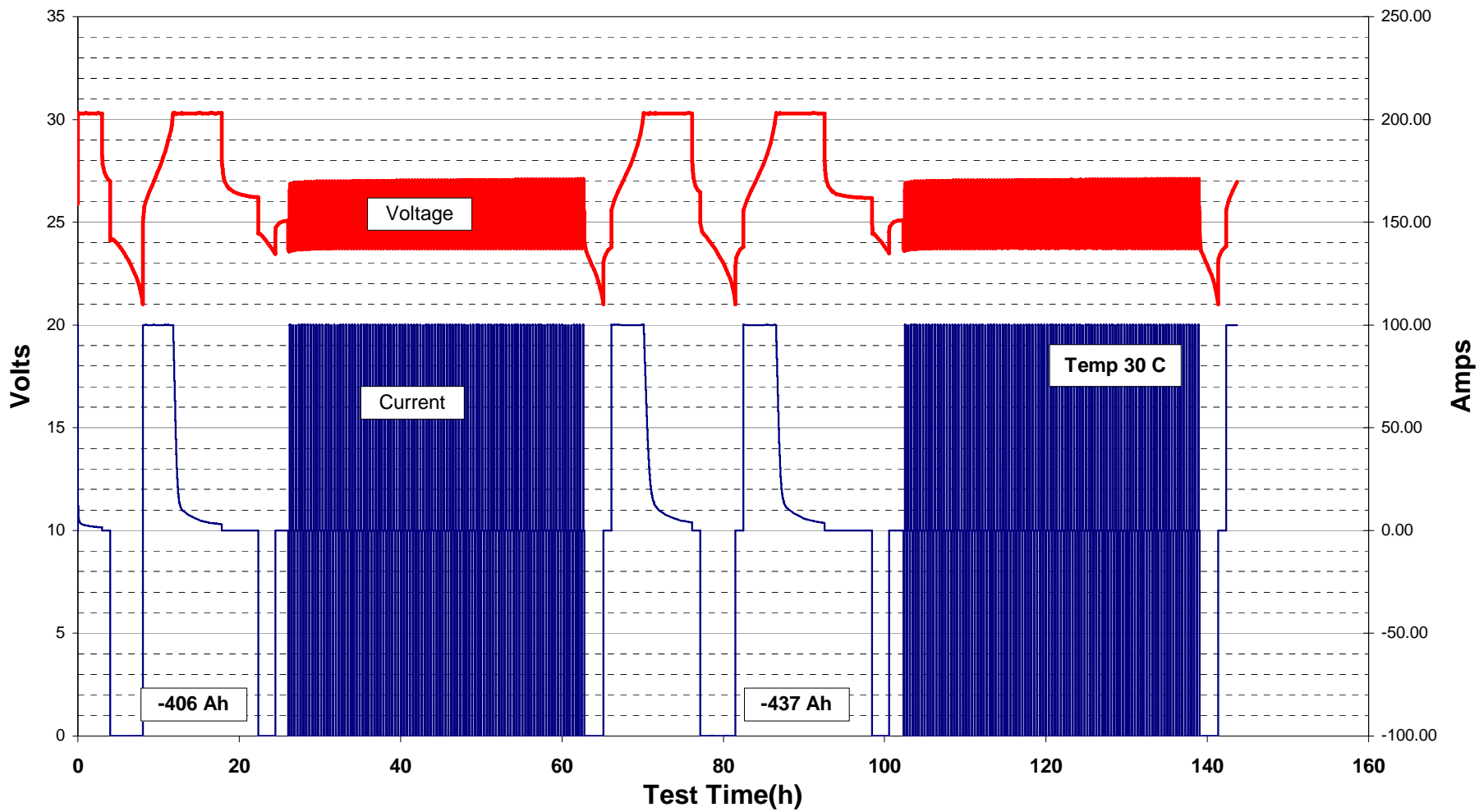






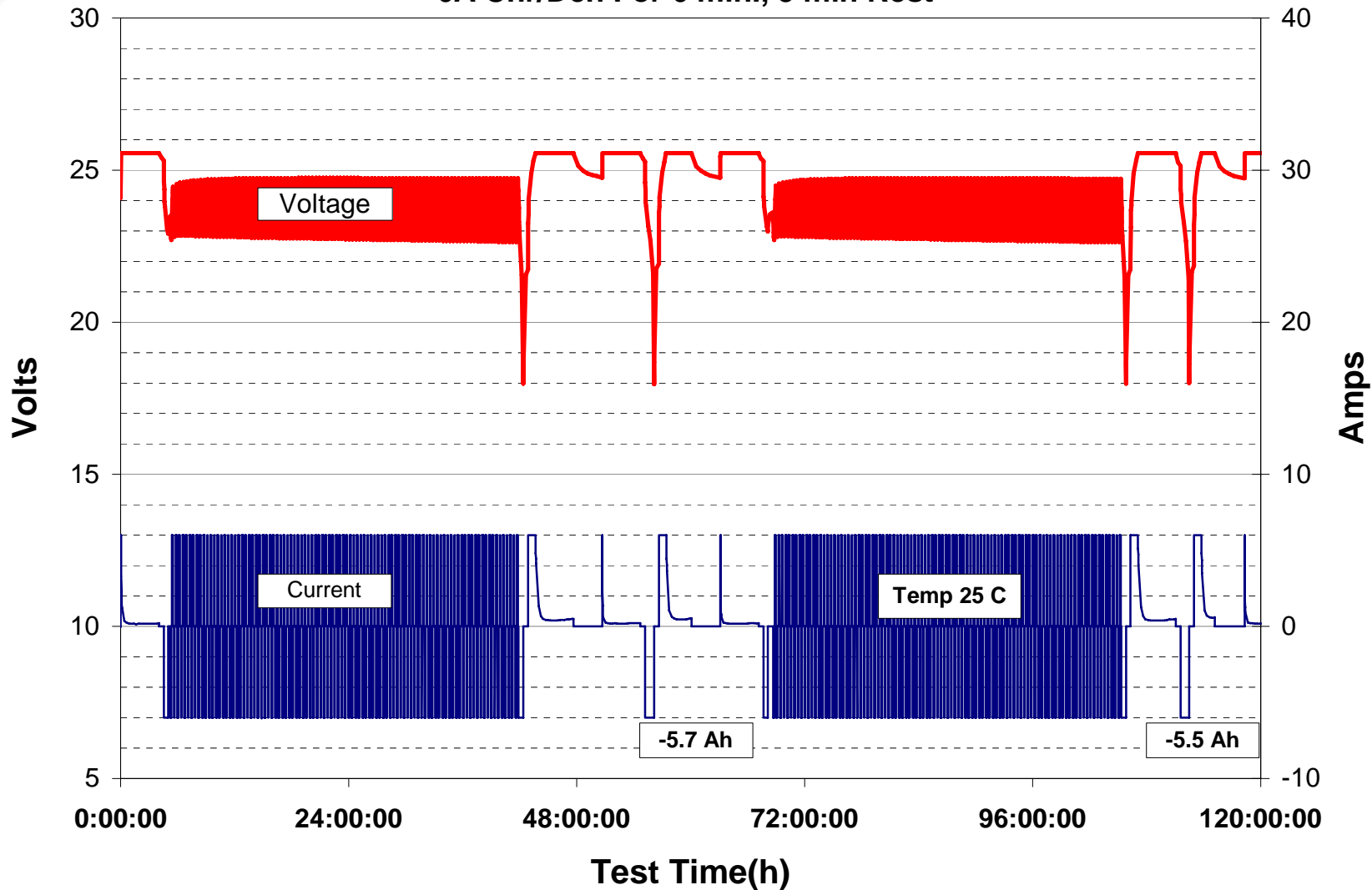
# C&D CPV550 Utility Cycle Test

100A Chr/Dch For 6 min., 5 min Rest

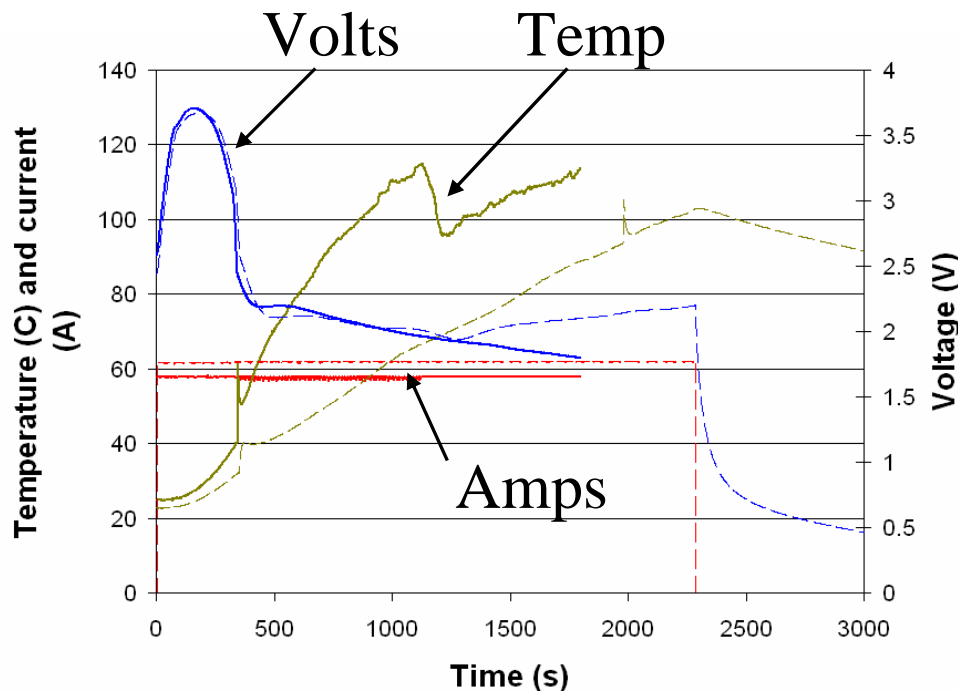


# Toyota Prius NiMH Utility Cycle Test

6A Chr/Dch For 6 min., 5 min Rest



# PC Supercap Abuse Testing (Over Voltage)



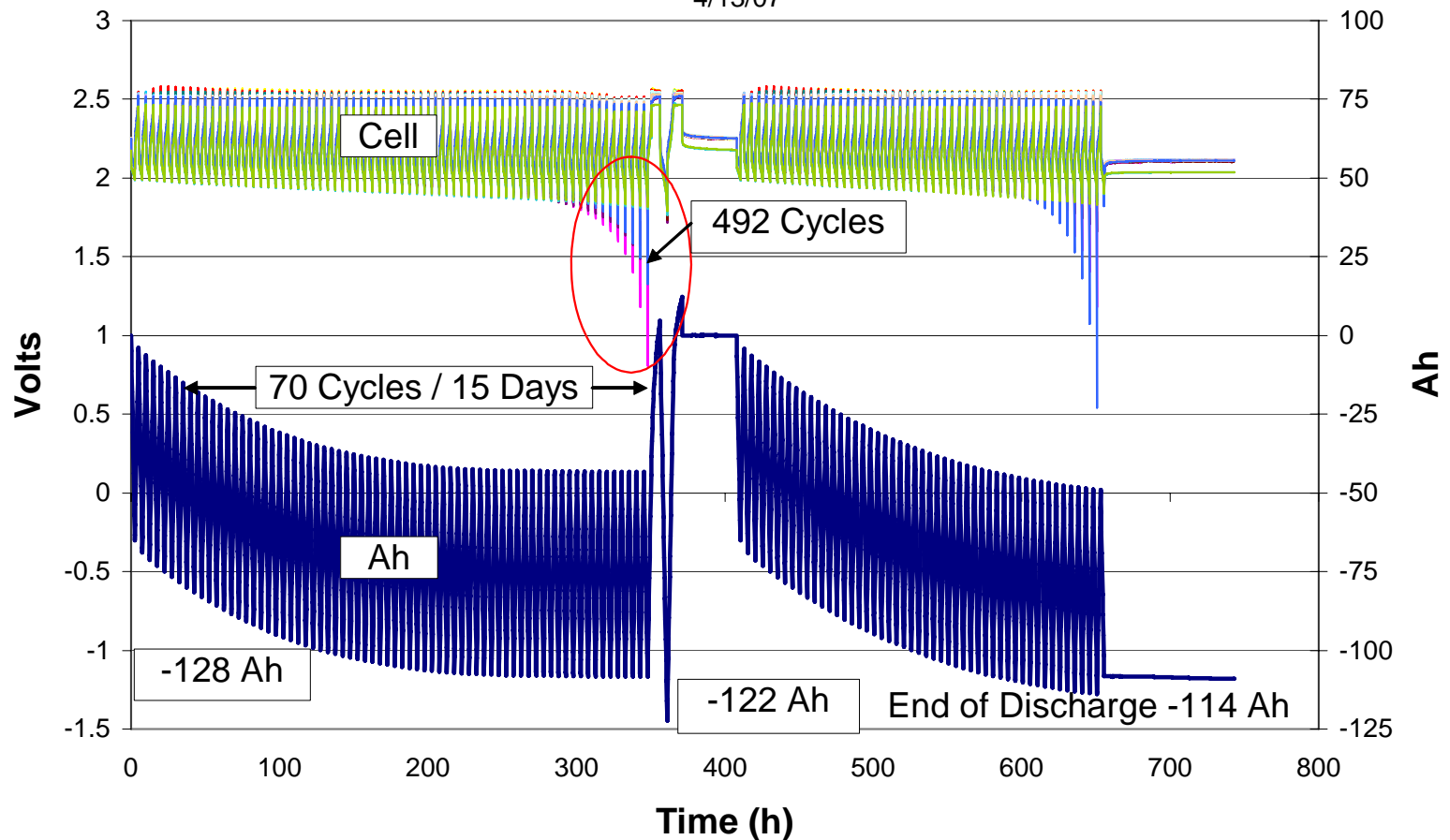
**Published supercapacitor abuse test results at 16th International Seminar on Double Layer Capacitors, Deerfield Beach, FL and at the 7th International Advanced Automotive Battery & Ultracapacitor Conference, Long Beach, CA (AABC-07).**

# SunGel PSOC Cycle Test

## SunGel PSOC Cycle-Life Test

50% DOD, 25C, 36V

4/13/07





# Summary

- ◆ **The DOE Energy Storage Program funded testing provides an unbiased resource for test information, which can be used at all levels in the decision making process.**
- ◆ **Effect of Test Results:**
  - ❖ **Demonstrated the hazards and performance of acetonitrile vs. propylene carbonate electrolyte in supercaps.**
  - ❖ **Testing support provides MeadWestvaco/NorthStar with timely performance results for advanced carbon formulations and design considerations.**



# Summary

- ◆ **Effect of Test Results:**
  - ❖ **Partial State of Charge (PSOC) cycling of the SunGel battery used in the ILZRO Peru RAPS system provides detailed charging requirements and performance measurements that can be transferred to the fielded system.**



## Work to Do

- ◆ **Complete testing using the MeadWestvaco second generation carbon enhanced NorthStar and Battery Energy batteries**
- ◆ **Complete Utility Cycle testing on the C&D CPV550 and Prius NiMH Battery**