2010 DOE Vehicle Technologies

U.S. Department of Energy Merit Review

JCS PHEV System Development-USABC

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Johnson Controls – Saft

April 9, 2010

Project ID #:
ES005

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Overview

Timeline

- Project Start – June, 2008
- Project Finish – April, 2011
- Percent Complete – 60%

Budget

- Total Project Funding
  - DOE Share - $5,255K
  - JCS Share - $5,255K
- Funding Received in CY09
  - $1,757K
- Funding for CY09
  - $1,386K (on track)
- Funding increase for scope change to prismatic cells

Barriers

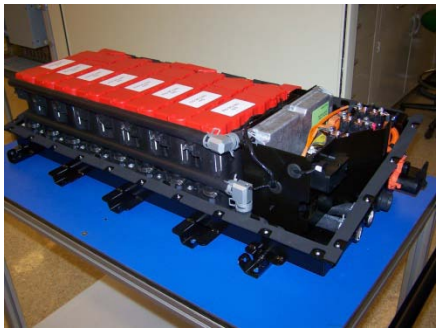
- System energy density of present systems is too low
- Cycle-life vs. useable energy in PHEV mode
- Cost tradeoffs to meet performance targets

Partners

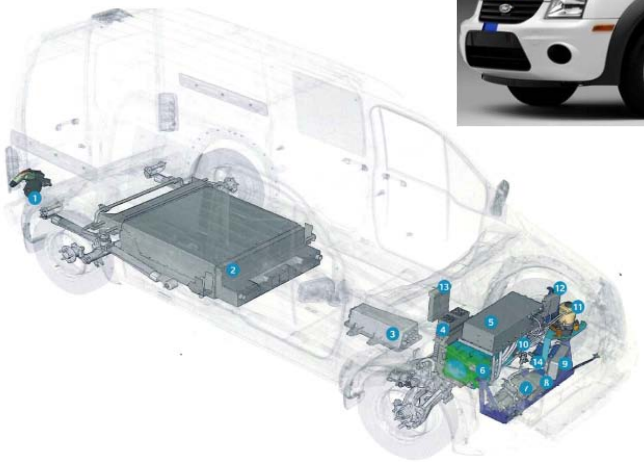
- Johnson Controls and Saft
- USABC Program Lead:

  Renata Arsenault
- DOE Contract Manager:

  David Howell



TRANSIT
connect
electric
AZD



Lithium-Ion
HYBRID

Johnson Controls
saft

Objectives

- Develop, build and test a prismatic cell for use in PHEV system design
- Develop Lithium-Ion PHEV Systems for 20 and 40 mile all-electric range applications.
- Optimize cell and system designs and hardware to meet program USABC targets and deliverables.

Milestones

- Deliver cell technology performance characterization comparison (July, 2009) – *Completed*
- Program scope change to prismatic cells and system (July, 2009) – *Approved*
- Decide final cell size for system design application. (June, 2010) - *In Progress*
- Deliver baseline energy NMC cylindrical cells for testing validation (June, 2010) – *In Progress*
- Deliver baseline prismatic cells for National Lab testing (November, 2010) – *In Progress*
- Deliver 20 and 40-mile thermal management design review summary (December, 2010) - *In Progress*

Collaborations

Saft - America

- Manufacturing, prototyping

Saft - France

- Electrode Manufacturing
- NMC Evaluations

Entek, Celgard

- Advanced Separator Development

Approach

- The initial development leveraged existing Saft prismatic cell manufacturing equipment and technology. Saft manufacturing equipment is capable for winding and stacking electrode options.
- Initial capacity target and system BSF calculated to use 30 Ah cells.
- JCS used a current Saft prismatic cell size and configuration to begin evaluation of the NMC cathode.
- JCS is redesigning cell mechanics for the target prismatic cell.
- Advance materials suppliers will be sought and appropriate materials qualified to increase energy density and meet abuse tolerance expectations.
- The system development approach for the 40-mile design will utilize this same prismatic cell, connected in parallel/series.

Technical Accomplishments/Progress/Results

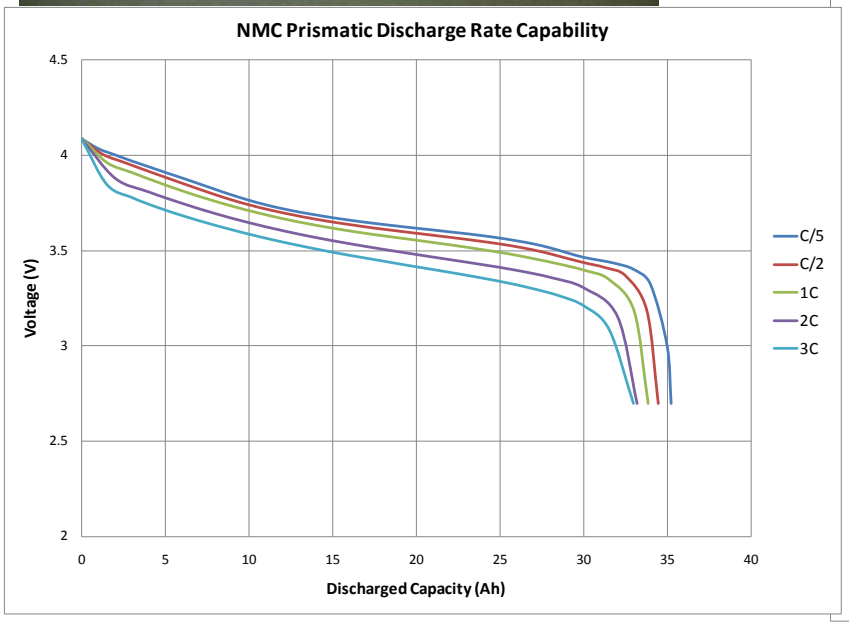
- Built initial prismatic energy cells.
- Designed cell mechanics for Proof of Concept build.
- Proof of Concept build is just concluding.
- Started System design.

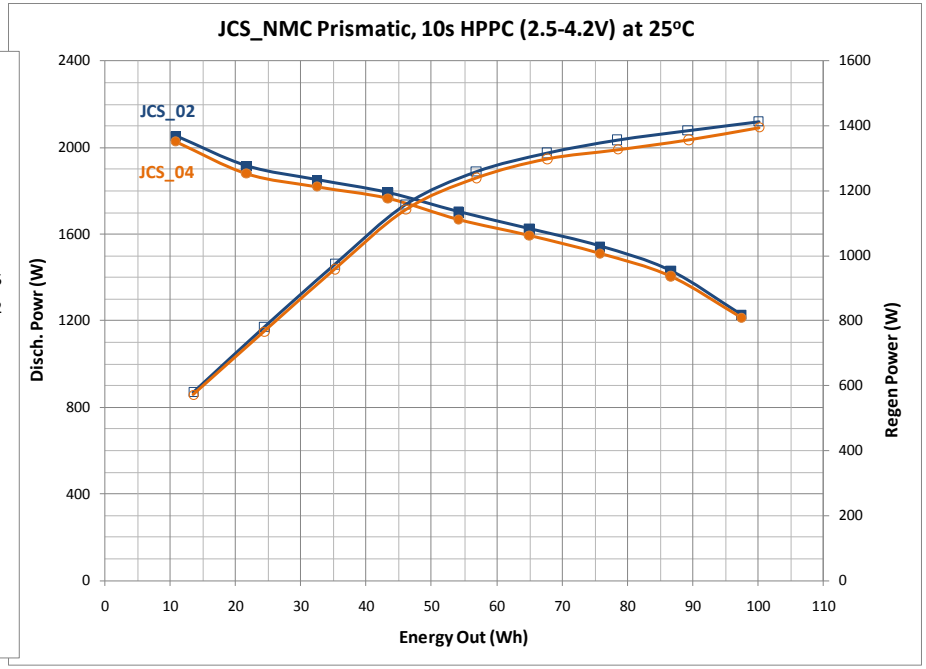
Reports

- Chemical Comparison – NCA to $LiFePO_4$
- Packaging Study – Cylindrical vs. Prismatic cells
- Thermal Report – Interim simulations
- Quarterly Cost Projection Reports

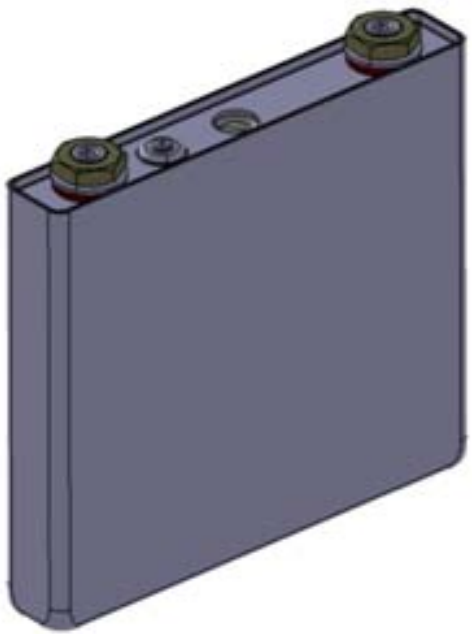
Initial Prismatic Cells

- NMC
- OTS mechanical hardware
- Charge to 4.1V
- Capacity: 35Ah
- Energy: 128 wh



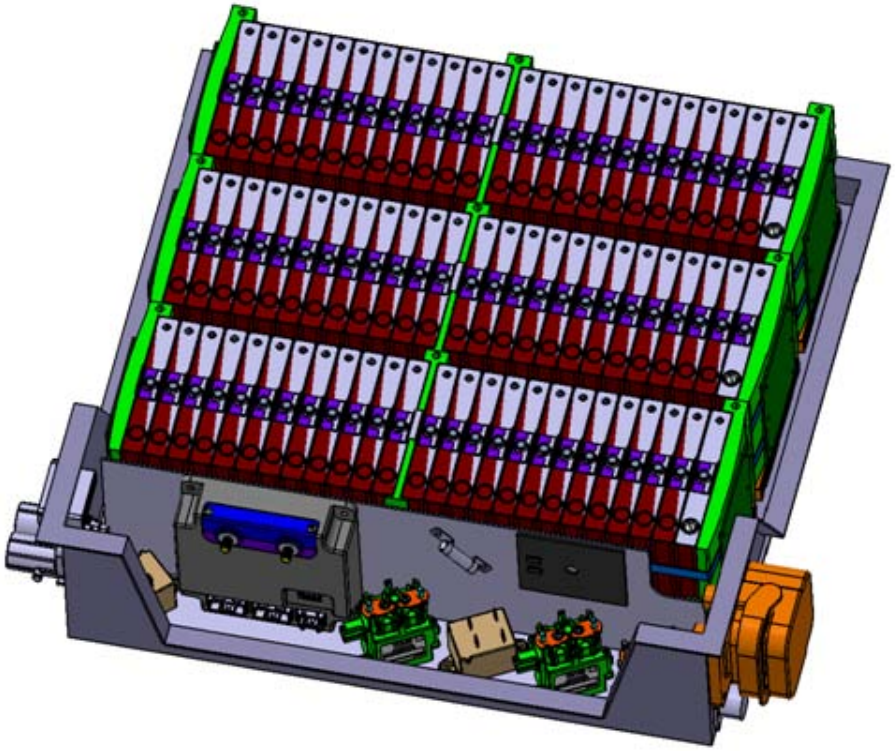


Hardware Deliverables



30 Ah Prismatic Cell

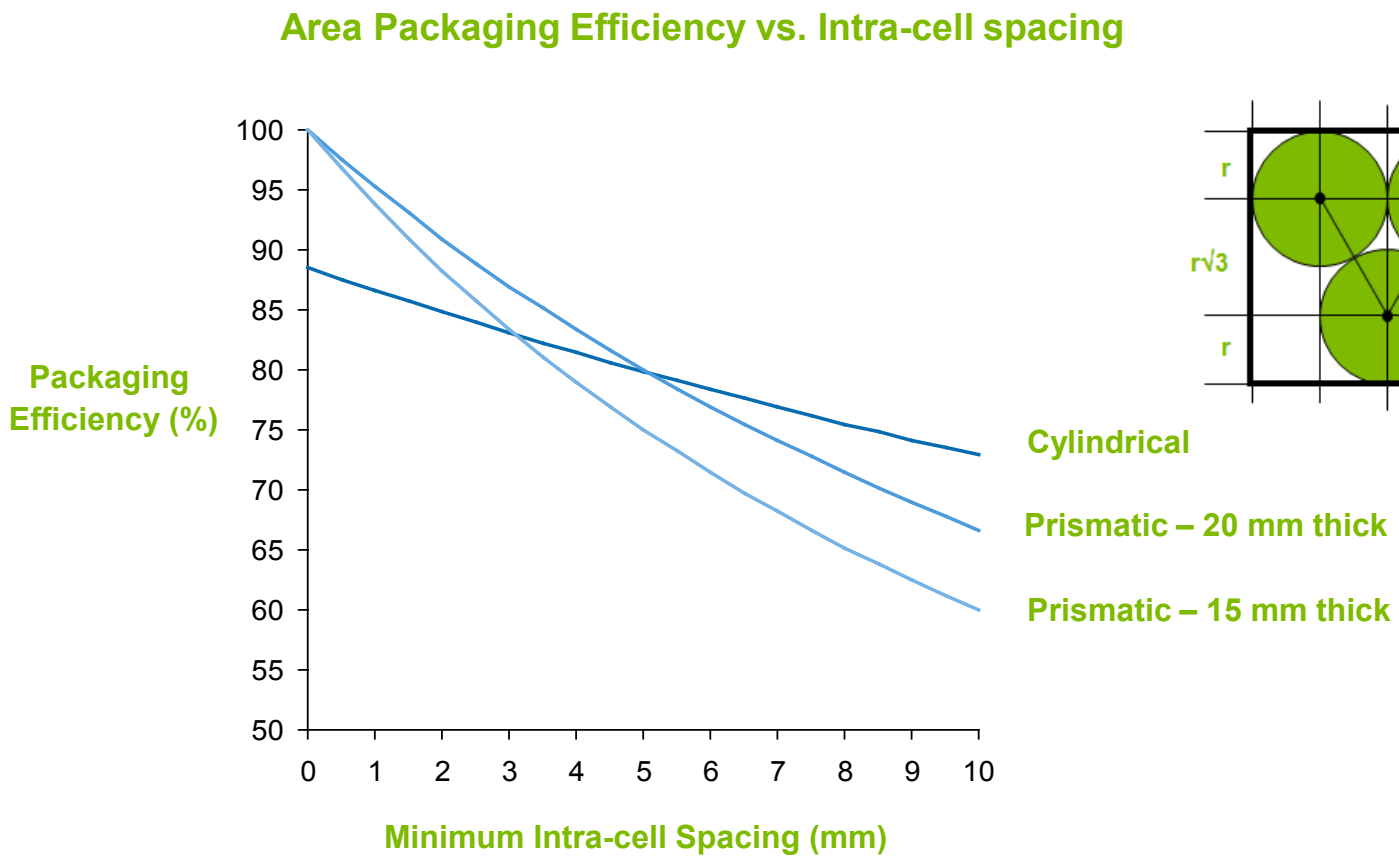
20-mile PHEV System



Cell Component Description

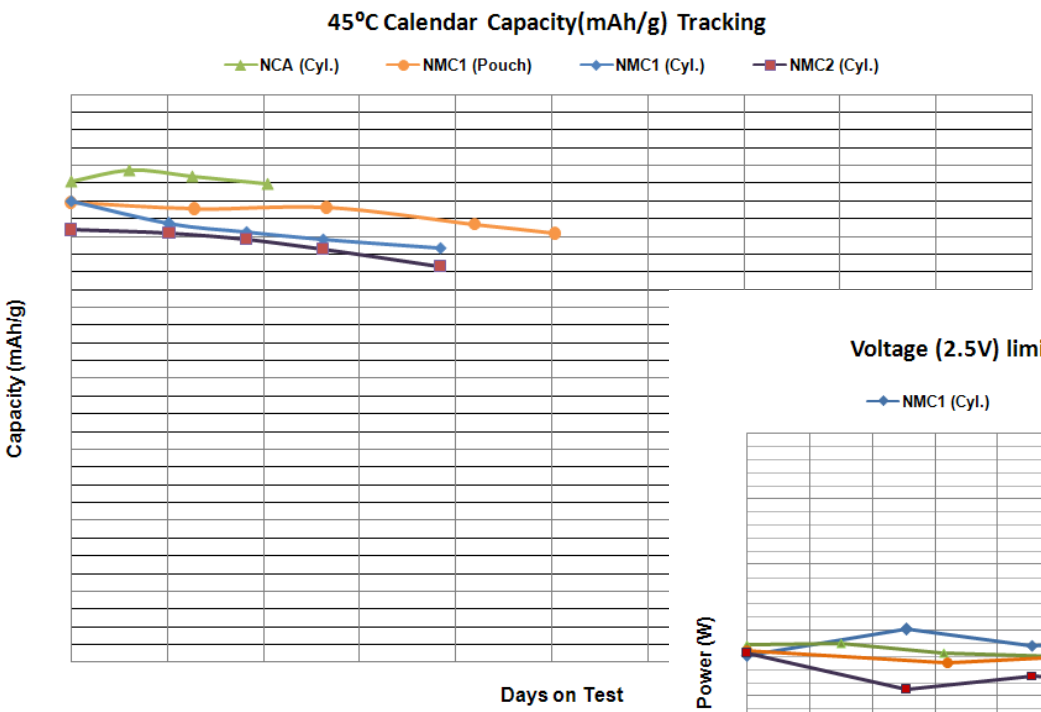
	Prismatic Proof of Concept	Comment
Overall Size:	140 x 124 x 23 mm	
Chemical:		
Cathode	NMC	
Anode	Graphite, surface-treated	
Separator	25µ thick, with shutdown feature	Evaluate high melt-point
Mechanical		
Can	Deep-drawn Aluminum	Develop thinner cell
Cover	Machined Aluminum, 1.8 mm thick,	to be stamped and thicker
Vent	OTS: 0.3 mm thk; Φ 2.5 mm (18650 ref)	to rectangular and larger
Terminals	Standard internal thread	considering options

Packaging Efficiency

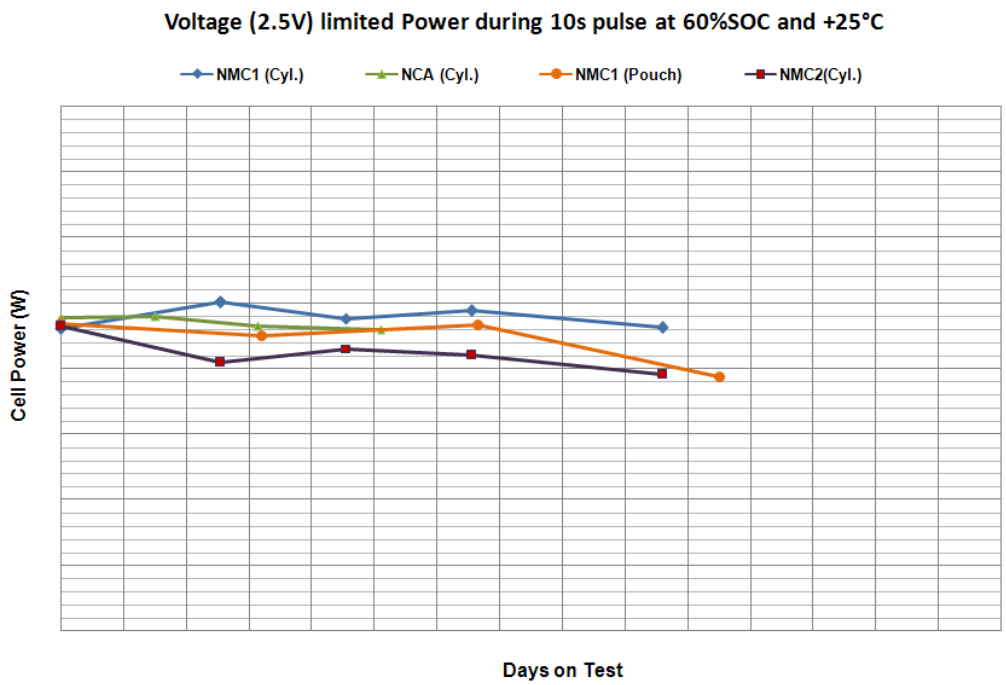


As intra-cell spacing required for cooling increases, the packaging advantage of prismatic cells is reduced.

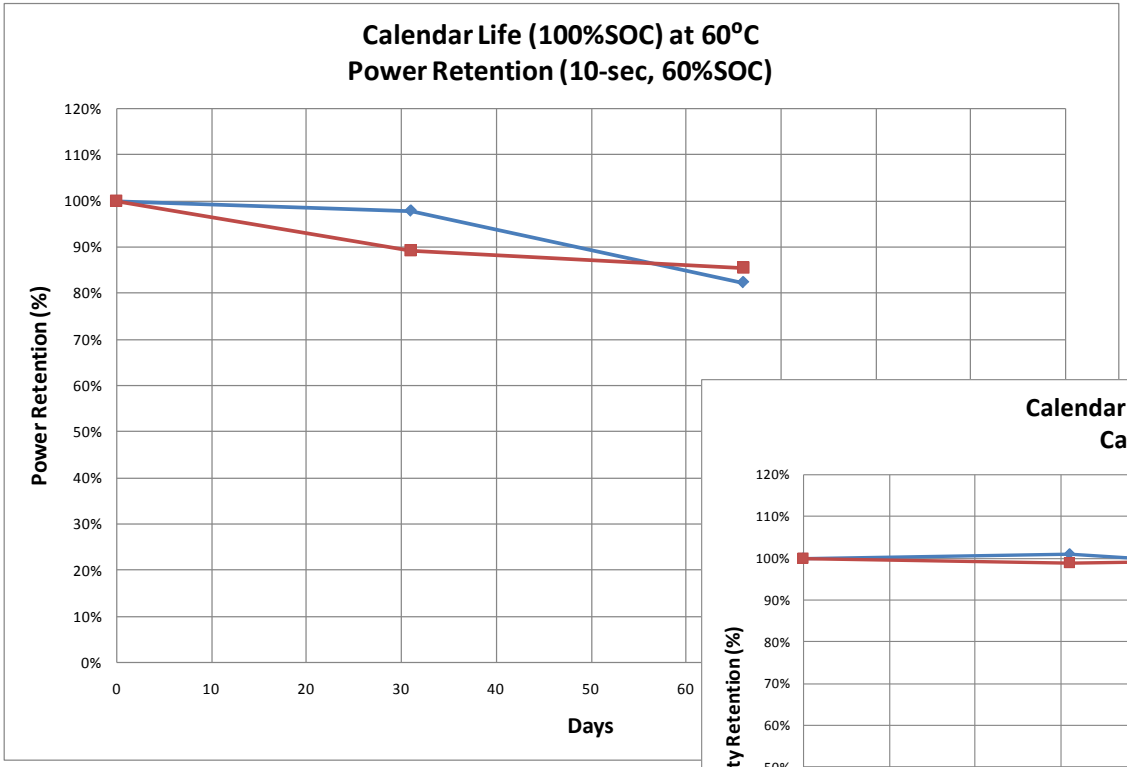
NMC Materials Calendar Life



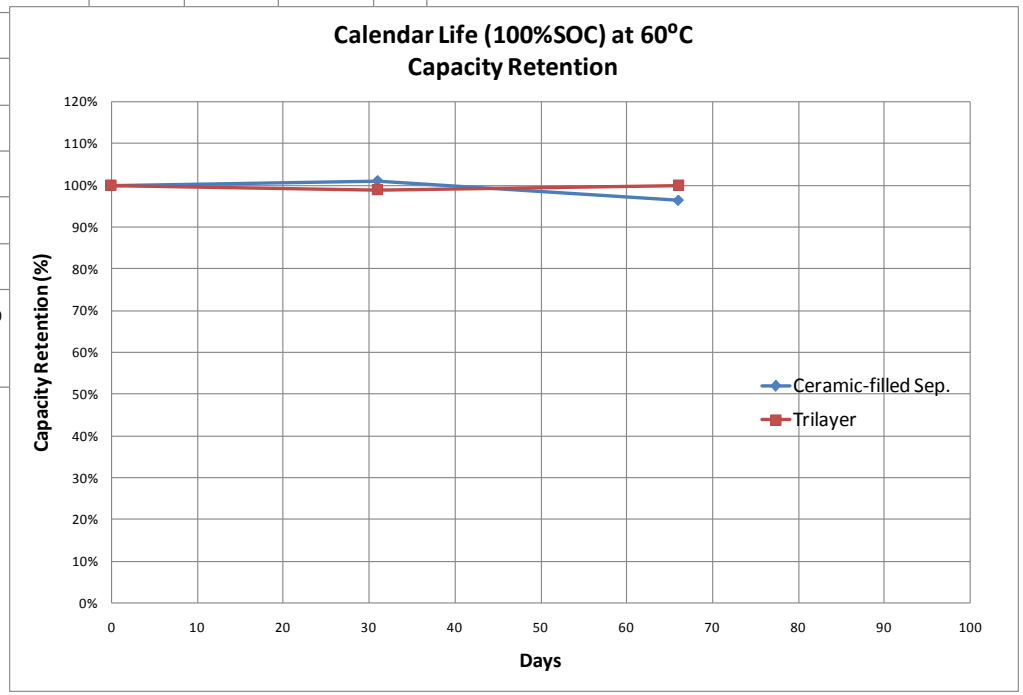
Calendar Life at 100% SOC and 45°C



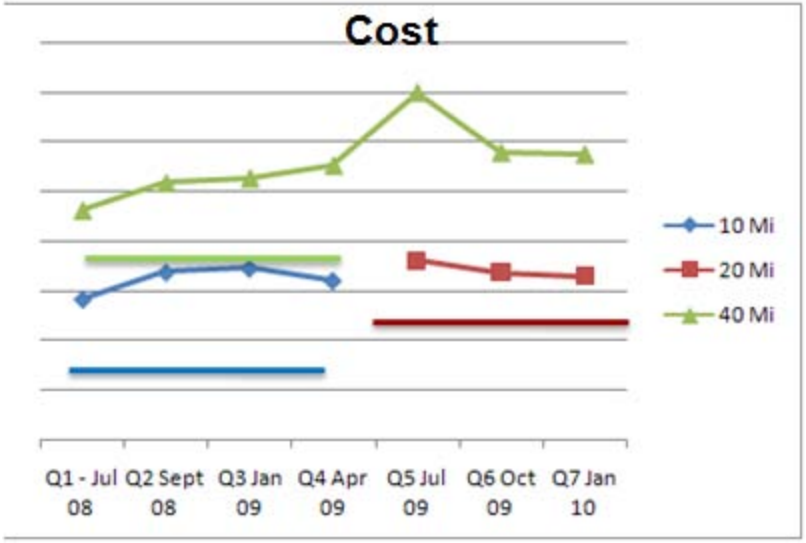
Calendar Life at 60°C

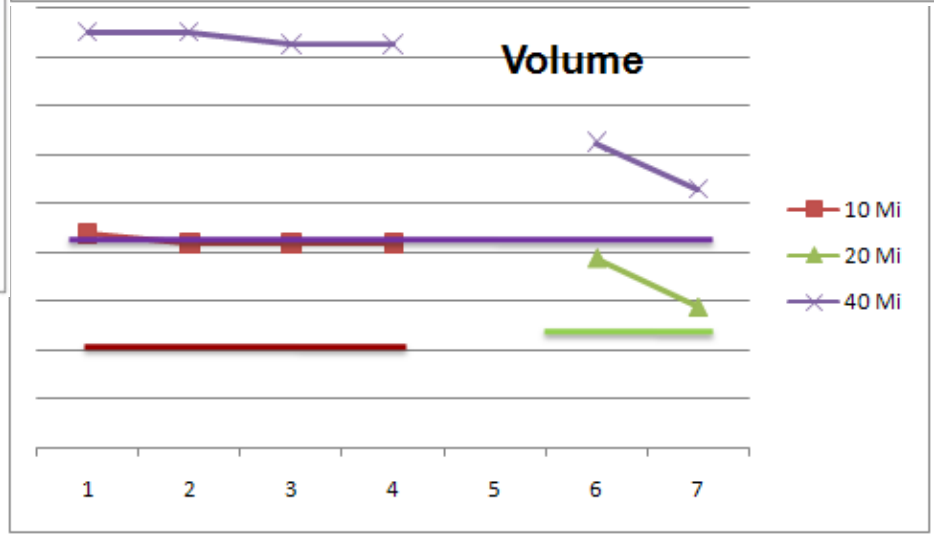


NCA VL9M with Ceramic-filled Separator



Progress on USABC Goals





Future Work

2010

- Confirm cell size and capacity.
- Build and evaluate A and B-sample cells
- Develop system design for optimized cost/size
- Develop design of 40-mile capable system using this same cell.

2011

- Build, test and deliver 1a 20-mile capable system.
- Develop and deliver 40-mile design

Summary

- Progress on prismatic cell design targeting end of year delivery of B-sample
- System design underway targeting 2011 delivery
- Building product portfolio and manufacturing capability to include prismatic energy and power cells

Thank you