SAND2020-7107PE

CENTER 2500
CSEP
COMPONENT SCIENCE, ENGINEERING, & PRODUCTION

Power Sources Products & Capabilities

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PRESENTED BY

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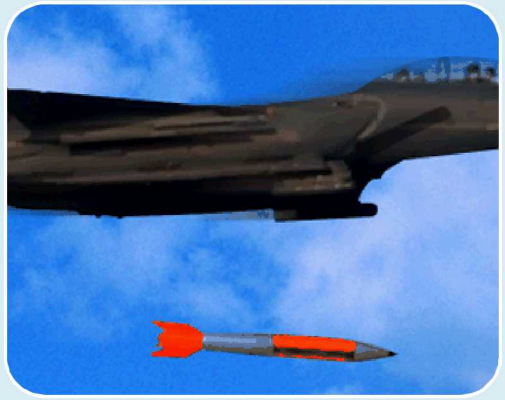
Power Sources Technology Group portfolio



Nuclear Deterrence

National Security

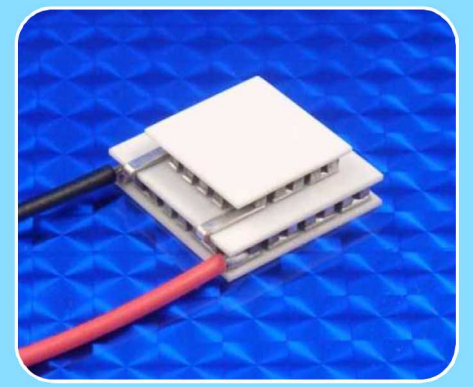
Transportation Energy

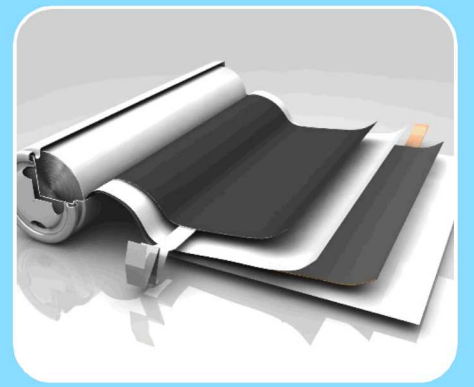
Stationary Storage

Energy Storage Technologies

Core Competencies and Capabilities

Power Sources Technology Group products





Thermal Batteries

Li-Primary Batteries

Conversion Technologies

Lithium-ion Batteries

Manufacturability

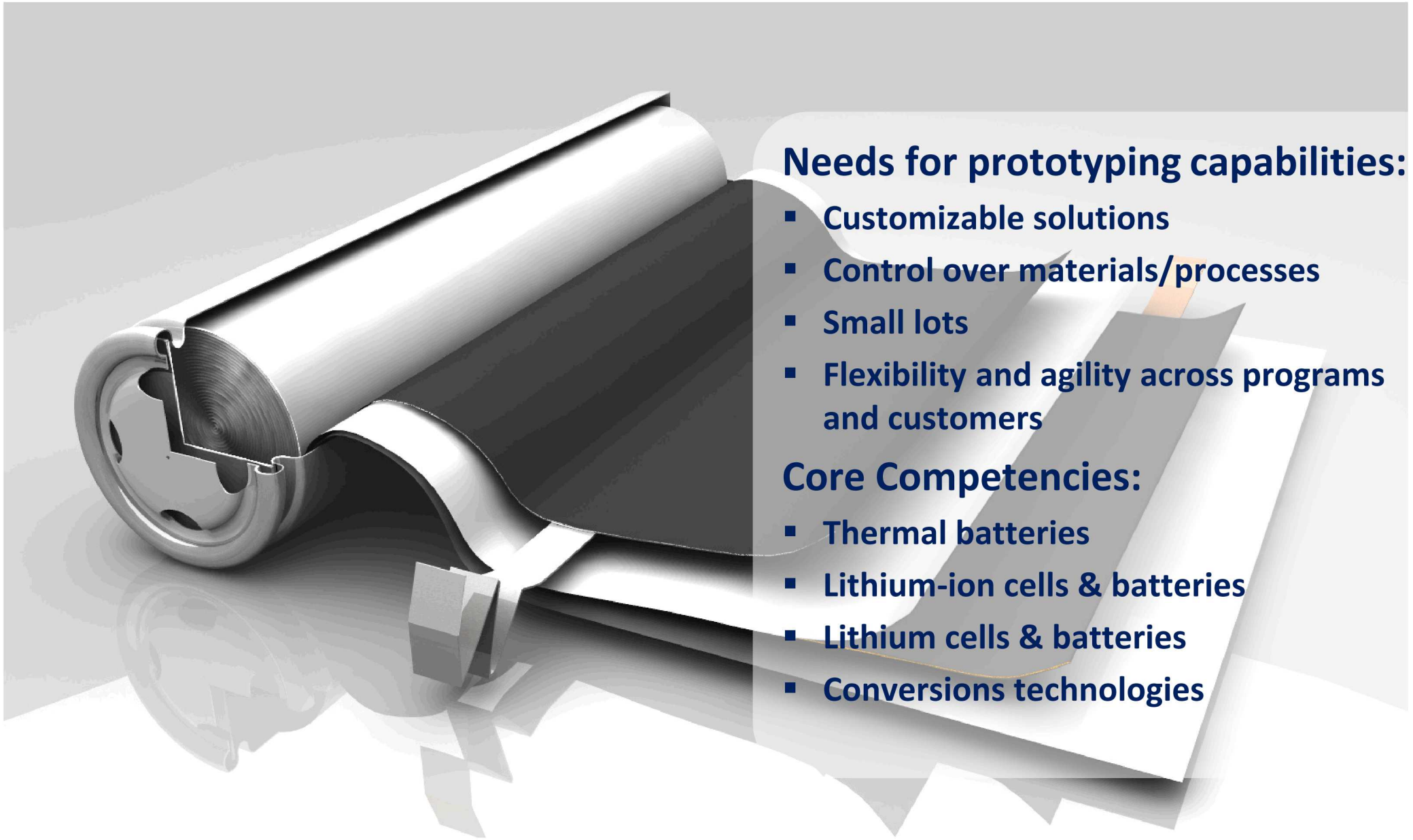
Agility

Strategic Materials

Program support & collaboration examples

CAPABILITIES

Rapid product realization



Needs for prototyping capabilities:

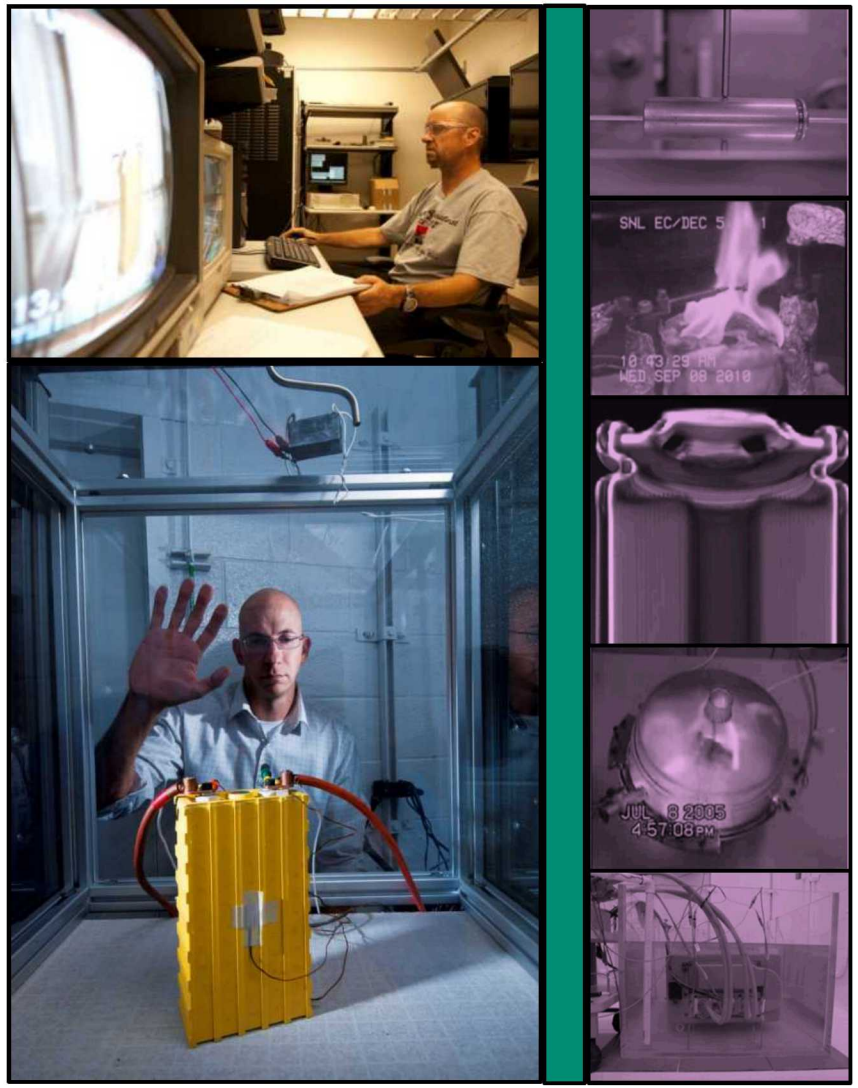
- Customizable solutions
- Control over materials/processes
- Small lots
- Flexibility and agility across programs and customers

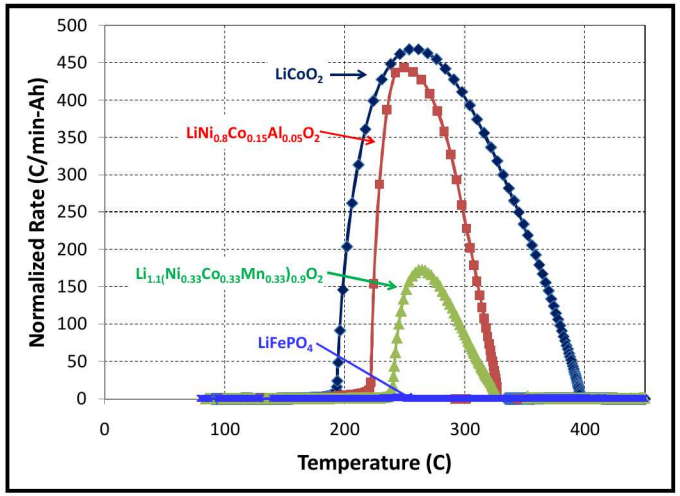
Core Competencies:

- Thermal batteries
- Lithium-ion cells & batteries
- Lithium cells & batteries
- Conversions technologies

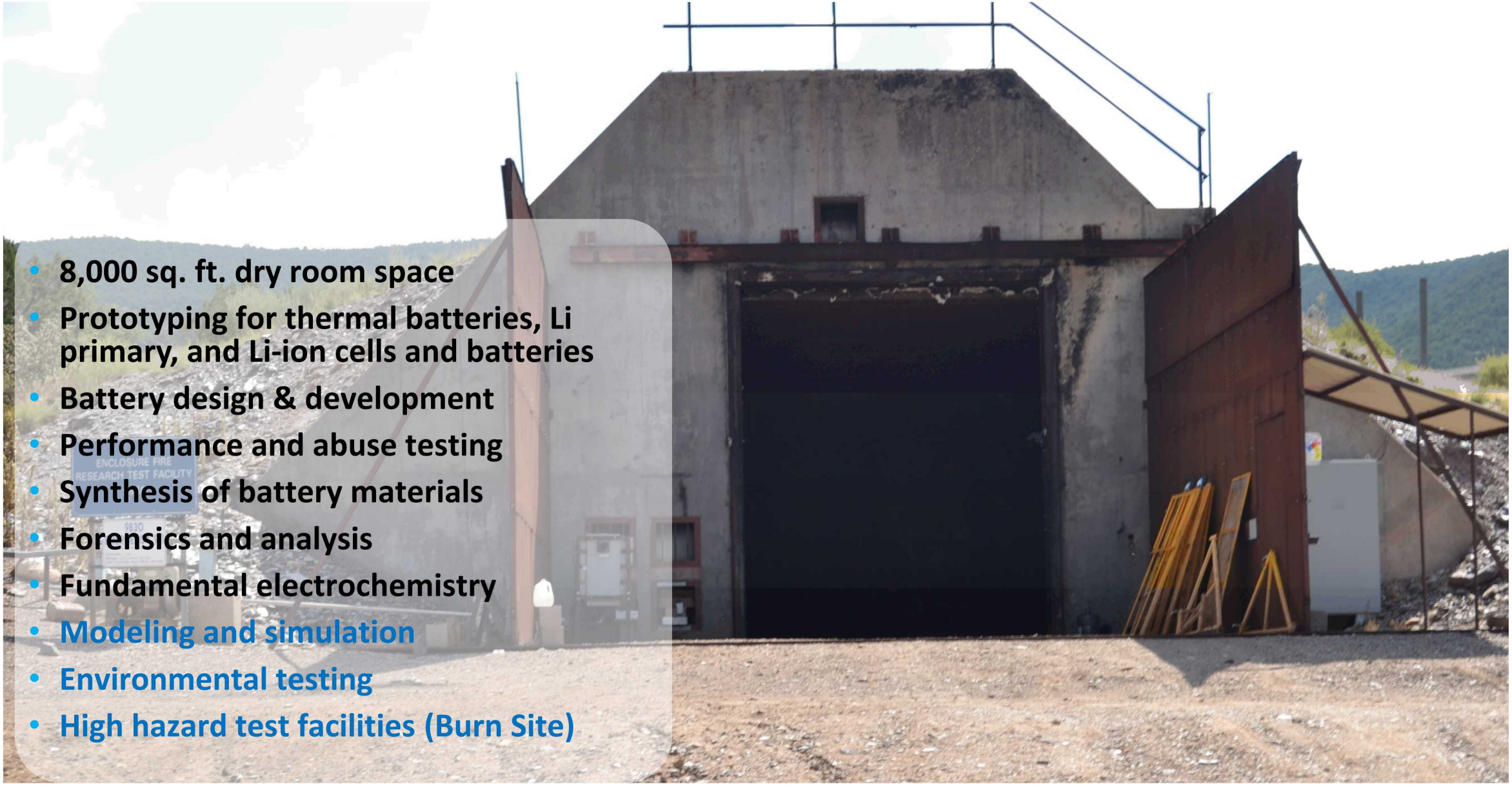
Battery Abuse Testing Laboratory (BATLab)

- Comprehensive abuse testing platforms for safety and reliability of cells, batteries and systems from mWh to kWh
- Mechanical abuse
  - Penetration
  - Crush
  - Impact
  - Immersion
- Thermal abuse
  - Over-temperature
  - Flammability measurements
  - Thermal propagation
  - Calorimetry
- Electrical abuse
  - Overvoltage/overcharge
  - Short circuit
  - Over-discharge/voltage reversal
- Characterization/Analytical Tools
  - X-ray computed tomography
  - Gas analysis
  - Surface characterization
  - Optical/electron microscopy





Additional capabilities



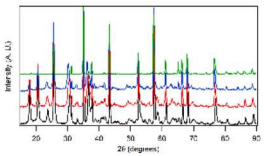
- 8,000 sq. ft. dry room space
- Prototyping for thermal batteries, Li primary, and Li-ion cells and batteries
- Battery design & development
- Performance and abuse testing
- Synthesis of battery materials
- Forensics and analysis
- Fundamental electrochemistry
- Modeling and simulation
- Environmental testing
- High hazard test facilities (Burn Site)

Dedicated facility for battery testing

- Hundreds of independent channels for testing, from coin cells to kWh modules
- 150 uA to 2000 A current range capability
- R&D 100 Green Technology-awarded high-precision testers
- 70+ thermal chambers, ranging from 1.2 ft3 to 25 ft3
- –72°C to 95°C temperature capabilities
- Static-controlled assembly benches
- Welding capabilities, including resistance, pinch, and spot

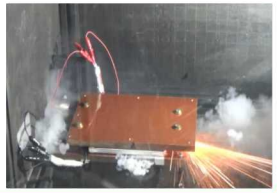
SELECT PROGRAM HIGHLIGHTS

Power sources safety R&D portfolio



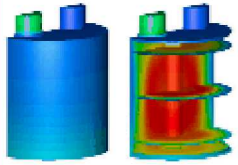
Materials R&D

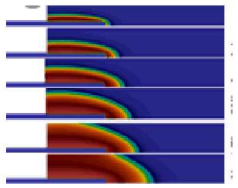
- Thermal stability and impact of aging on battery components
- Vent gas composition



Cell and Module Safety Science

- High precision cell cycling and degradation
- Electrical, thermal, mechanical abuse testing
- Failure propagation testing on batteries/systems





Simulations and Modeling

- Multi-scale models for understanding thermal runaway
- Fire Dynamic Simulations to predict the size, scope, and consequences of battery fires

Procedures, Policy, and Regulation

- Energy storage safety working group
- IEEE battery management system standard

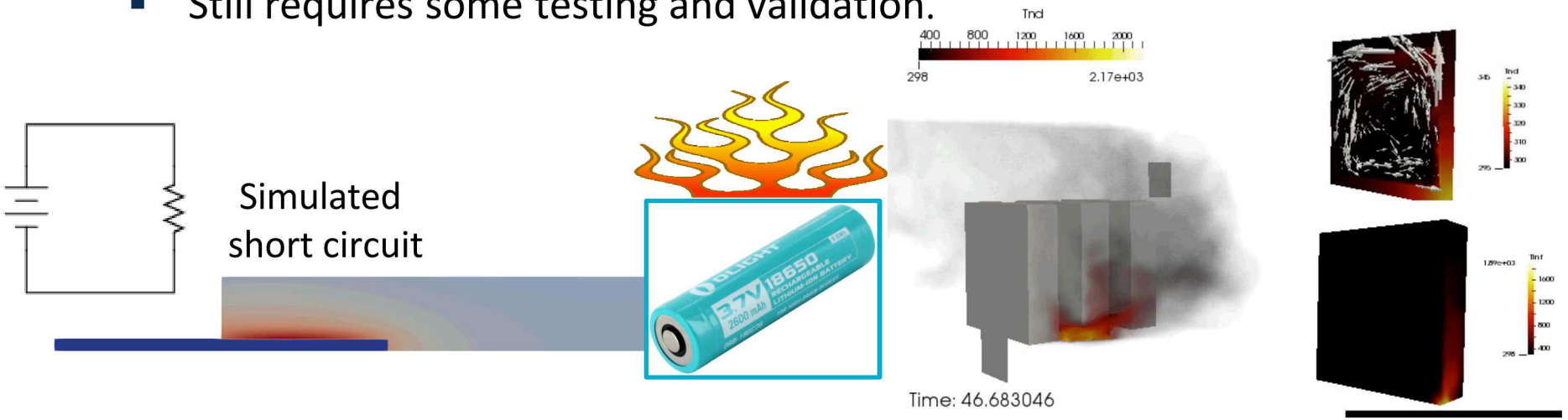
Approaches to designing in safety

The current approach is to test our way into safety.

- Large system (>1MWh) testing is difficult and costly.

Supplement testing with predictions of challenging scenarios and optimization of mitigation.

- Develop multi-physics models to predict failure mechanisms and identify mitigation.
- Build capabilities with small/medium scale measurements.
- Still requires some testing and validation.

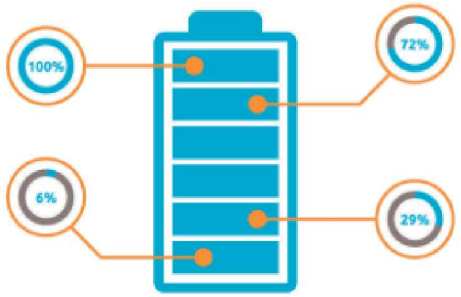


Commercial battery data archival

BatteryArchive.org

A repository for easy visualization, analysis, and comparison of battery data across institutions

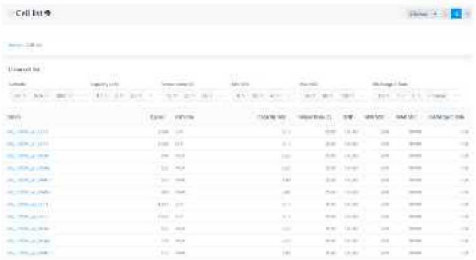
View Data



Features

1

Filter battery data



Query and filter for specific experimental conditions.

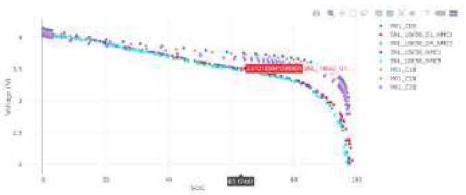
2

Visualize and compare data

Display battery data, including voltage curves and capacity fade.

3

Compare data with models



Apply performance and degradation models to battery data.

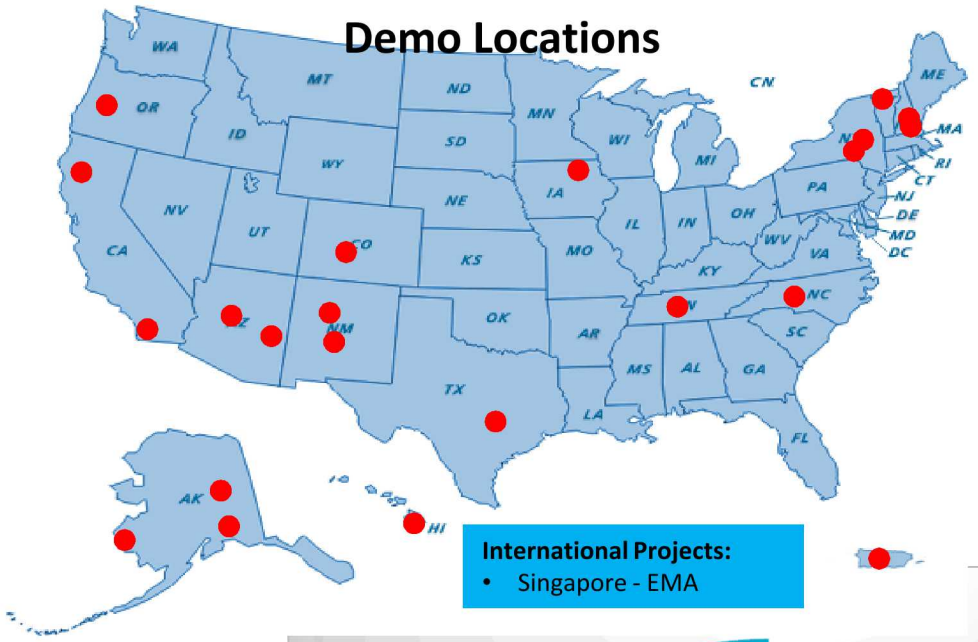
Energy Storage Field Demonstrations

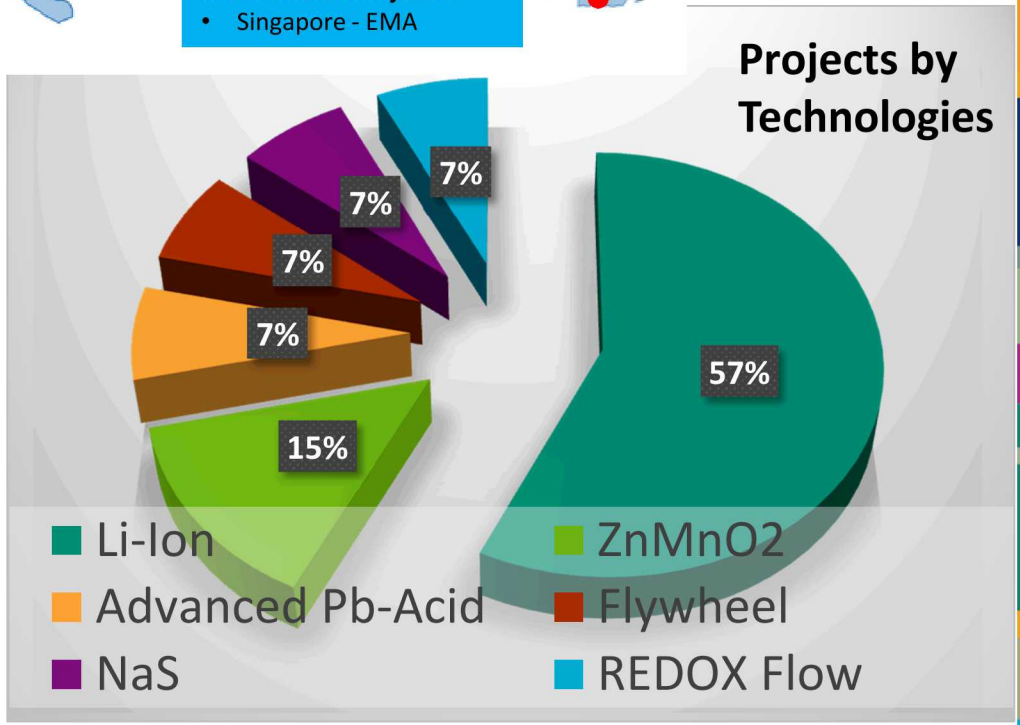
Collaborate with Utility, Industrial, Commercial, Private, State and International entities to:

- Provide third party independent analysis for cells and systems
- Support the development and implementation of grid-tied ES projects
  - Application/Economic analysis
  - RFI/RFPs
  - Design and Procurement Support
  - Commissioning Plan Development
- Monitor, collect and analyze operational data
  - Various applications
  - Optimization of energy management and lifecycle
  - Operational performance (State of Health, Degradation, etc.)
- Develop public information programs

Goal

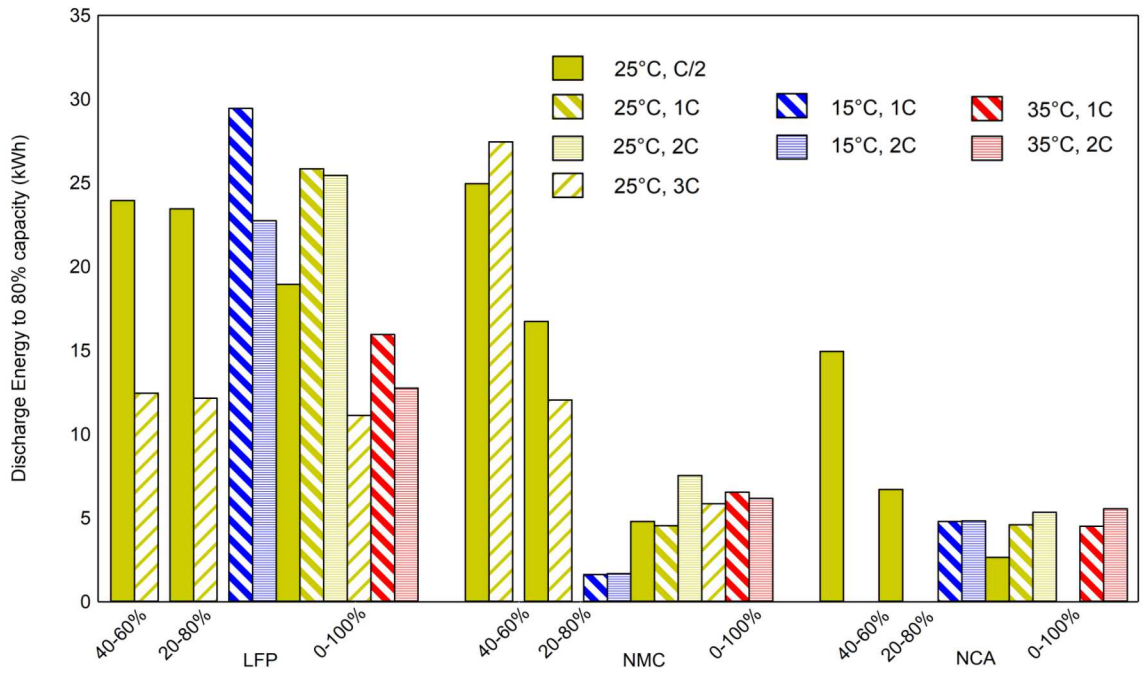
- Inform the public, work with standard groups and encourage investment





Commercial Battery Analysis

Quantify performance of popular Li-ion cells in apples to apples approach and identify 'tipping points'

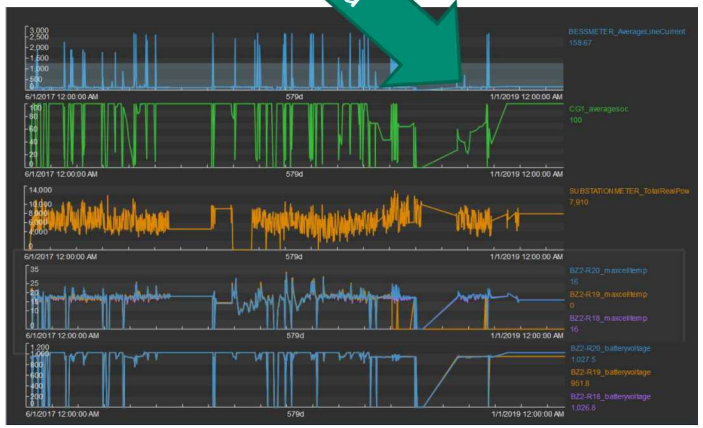


Link cell-level performance to system level performance

Performance Data

Determine

- Degradation
- State of Health
- Predicted Life Cycle
- Etc.

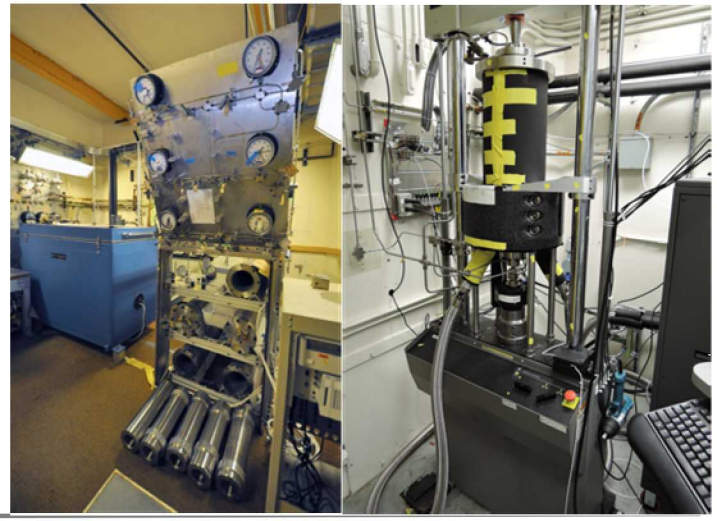


Leveraging broad Sandia capabilities

MESA MICROFAB
(ND)

JOINT BIO-ENERGY INSTITUTE
(AST)

COMBUSTION RESEARCH FACILITY
(AST)



MATERIAL MECHANICS IN HIGH-PRESSURE HYDROGEN FOR NUCLEAR WEAPONS & ENERGY SCIENCE
(ND) & (E/HS)

COMPUTING & INFORMATION SCIENCE
(ND & AST)

CENTER FOR INTEGRATED NANO TECHNOLOGIES
(AST)

EXTRA SLIDES