



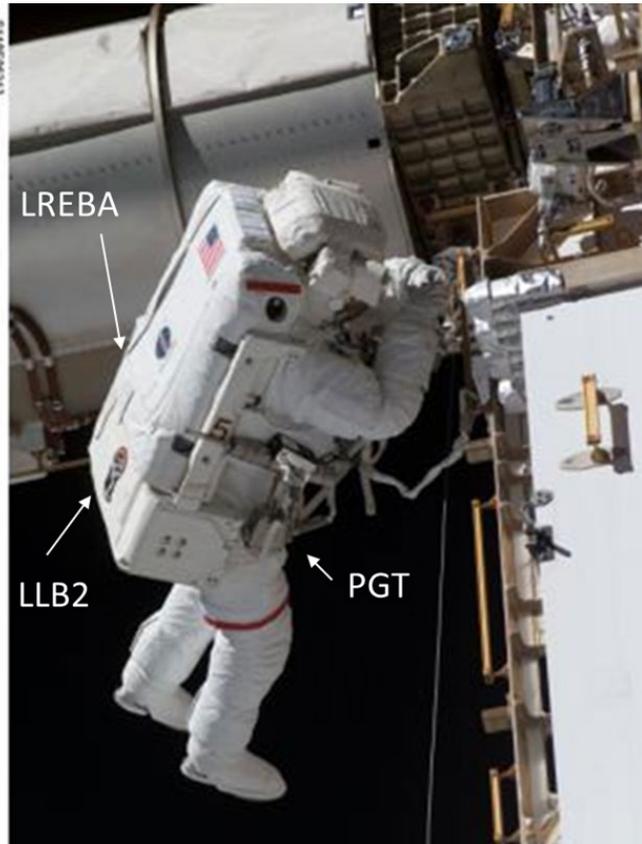
NASA Johnson Space Center, Propulsion and Power Division, Electrical Power Systems, Energy Storage

February 2025



Human Space Flight Batteries

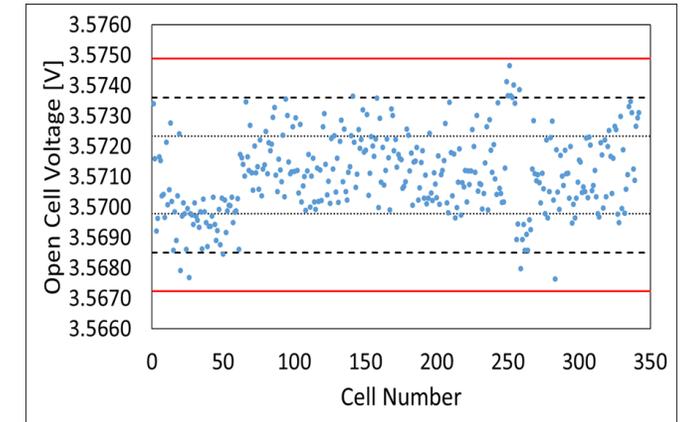
Powering Human Space Flight



Mitigate Catastrophic Failure Risk



Screening



Design

5 Design Driving Factors for Reducing Hazard Severity from a Single Cell TR

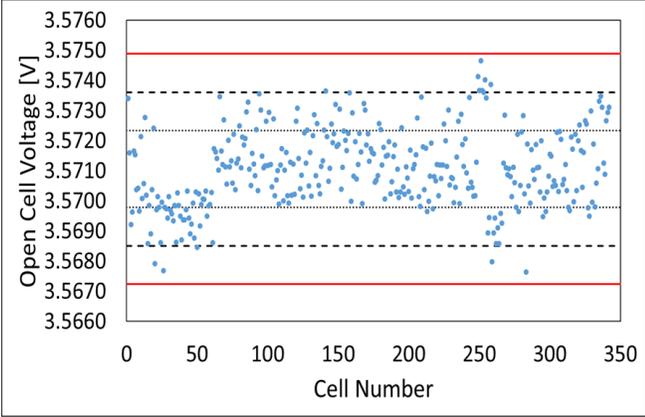
- **Reduce risk of cell can side wall ruptures**
 - Without structural support most high energy density (>660 Wh/L) designs are very likely to experience side wall ruptures during TR
 - Battery should minimize constrictions on cell TR pressure relief
- **Provide adequate cell spacing and heat rejection**
 - Direct contact between cells nearly assures propagation
 - Spacing required is inversely proportional to effectiveness of heat dissipation path
- **Individually fuse parallel cells and strings**
 - TR cell becomes an external short to adjacent parallel cells and heats them up
 - TR cell in a string in parallel with other strings needs fusing
- **Protect the adjacent cells from the hot TR cell ejecta (solids, liquids, and gases)**
 - TR ejecta is electrically conductive and can cause circulating currents
- **Prevent flames and sparks from exiting the battery enclosure**
 - Provide tortuous path for the TR ejecta before hitting battery vent ports equipped flame arresting screens



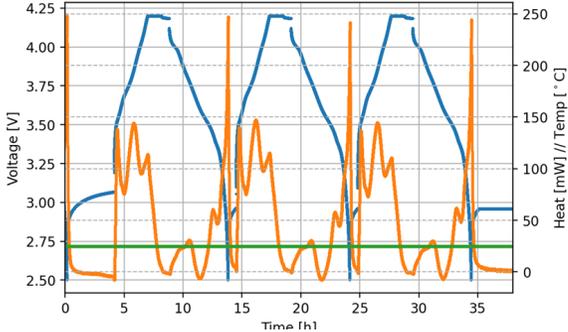
Reference: Darcy, E. C., Jacob, D., Walker, W., Finegan, D. P. & Shearing, P. Driving Design Factors for Safe, High-Power Batteries for Space Applications. in Advanced Automotive Battery Conference (2018).

Screening

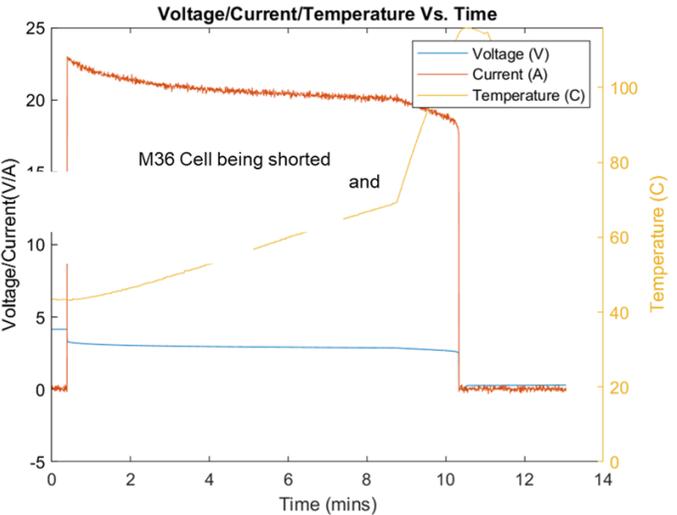
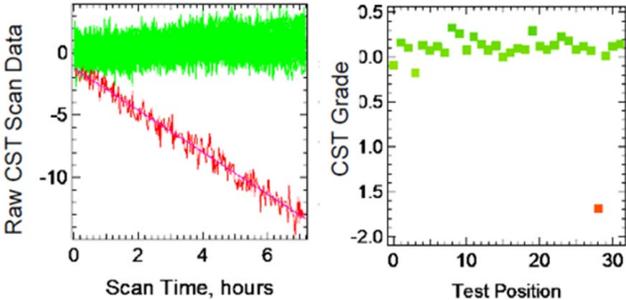
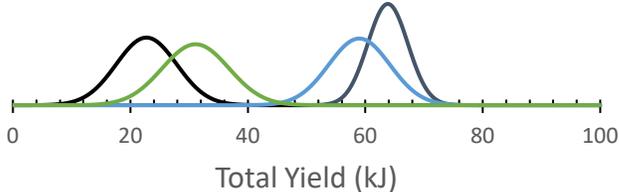
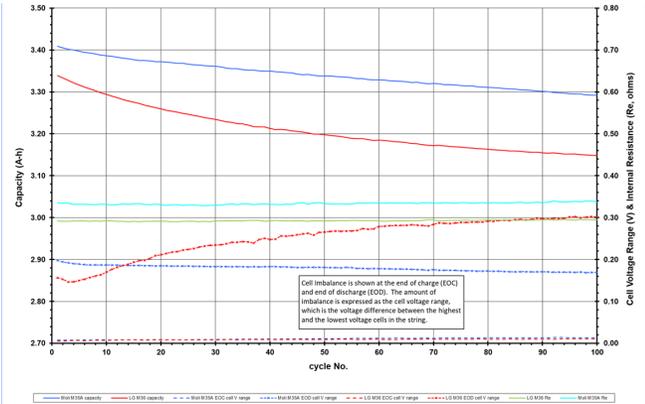
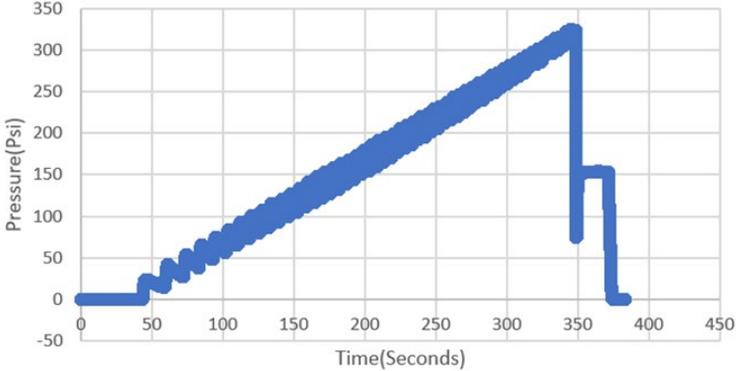
Performance



Attributes

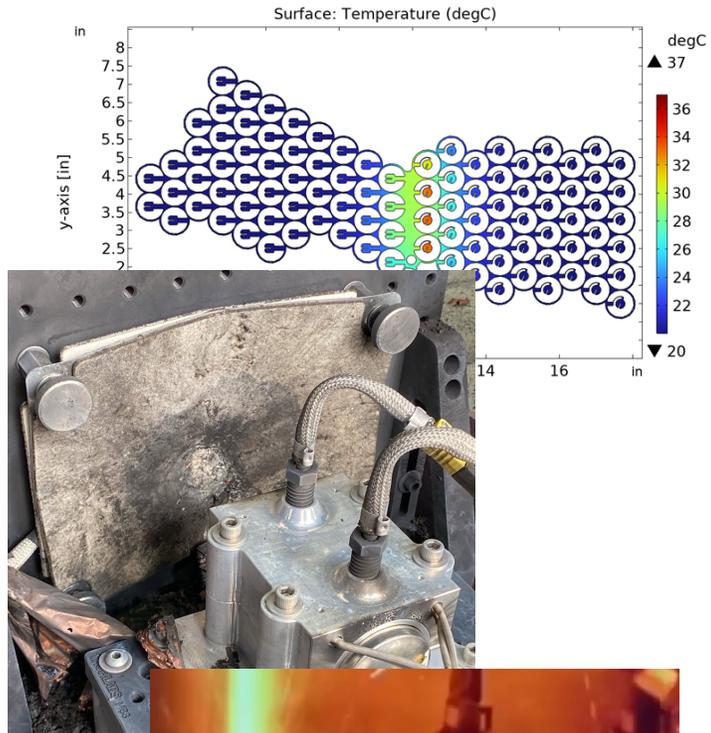


Verification



Design

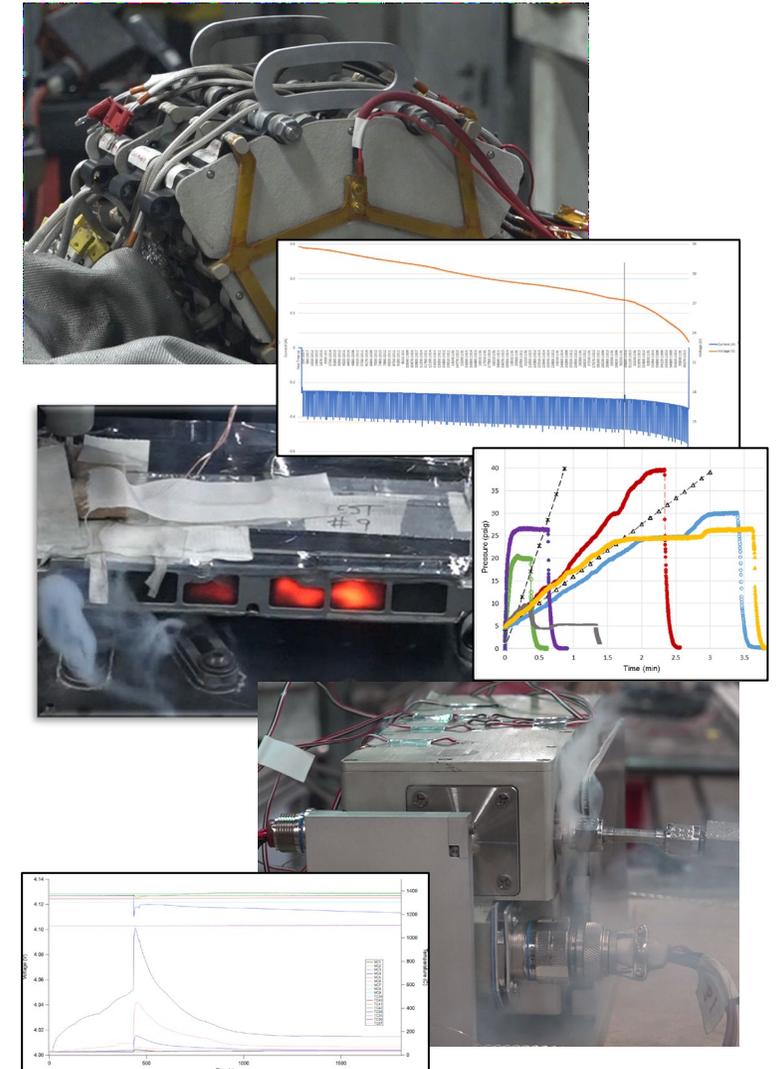
Materials



Behavior



Verification

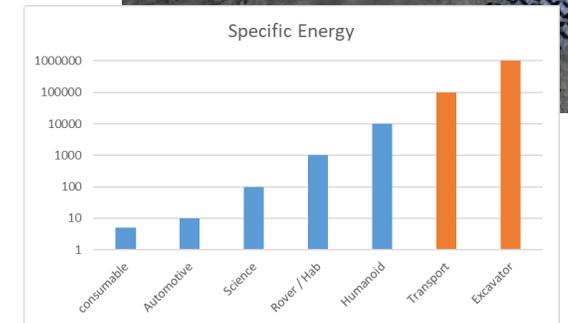
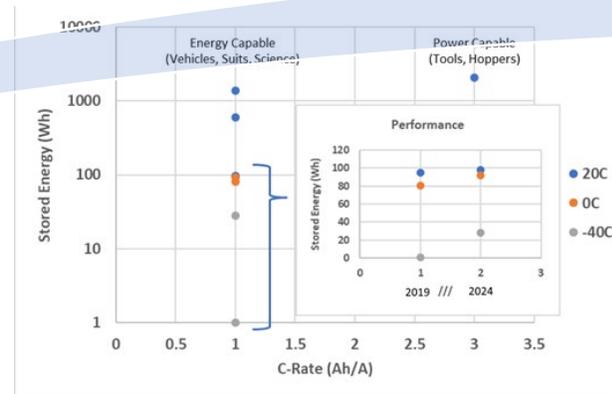
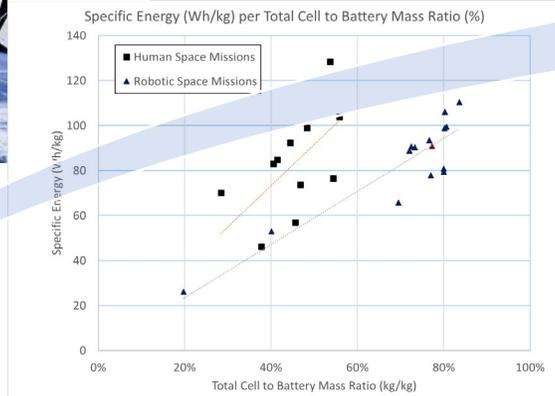
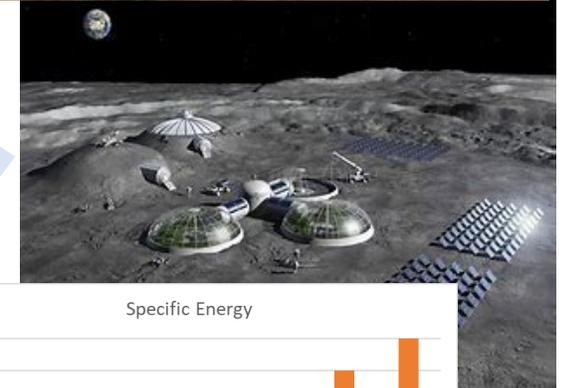
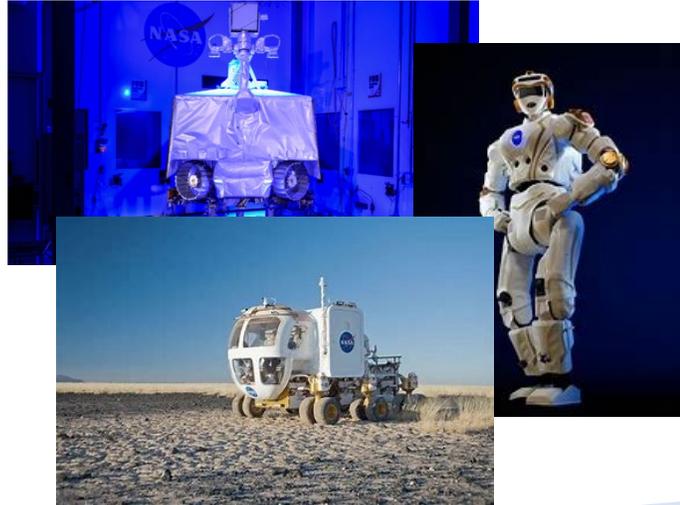
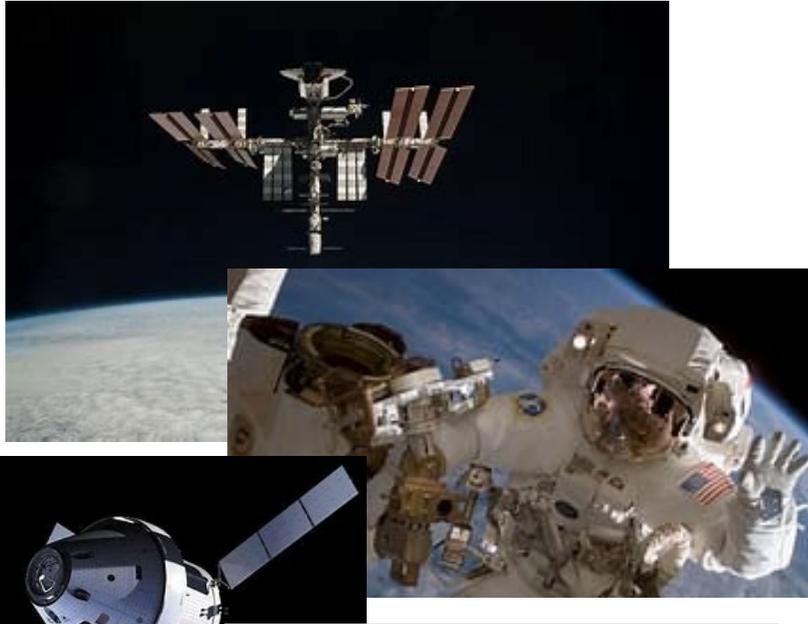


Powering Exploration

Methods and Techniques

Evolving Technology

Sustainable Systems



Contact & Interests



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- ✓ Battery Performance
- ✓ Manufacturability
- ✓ Scalability
- ✓ Interoperability

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