NASA Battery Workshop Report

Jan 20 - Jan 21, 2026
Houston Texas

Workshop Overview

25+ technical presentations | Aerospace, drones, eVTOL focus

Industry shift toward reliability engineering and safety-by-design

Key Themes

- Sampling → comprehensive screening
- Pack-only → cell-intrinsic safety
- Active → passive thermal management
- Silicon anodes reaching flight platforms
- Supply-chain resilience as qualification gate

Technological Advances

High-throughput CT & ultrasound | Metallized plastic collectors | Oscillating heat pipes | Model-based diagnostics

Key Cell Innovations

KULR & South8: Electrolyte Innovation

- KULR and South8's LIGAS gaseous electrolyte enables operation down to -60°C and exhibits unusual venting behavior that can prevent sustained thermal runaway
- Fundamental change in electrolyte chemistry offers enhanced low-temperature performance and altered failure physics for safer, more robust cells

Rincell

- Manufacturing batteries in India, focusing on scalable production and supply chain localization
- Working on sodium batteries alongside lithium ion manufacturing, positioning for cost, availability, and diversification

University of Arkansas

- Exploring novel materials and manufacturing techniques to create intrinsically safer battery components
- Advancements could lead to batteries with improved abuse tolerance and extended lifespan for aerospace and defense systems

NASA Passive Cell Safety (Eric Darcy)

- NASA's passive safety combines metallized plastic current collectors, ceramic-coated anodes, and isotropic separators, achieving zero thermal runaway in tests
- Design allows cells to fail safely by failing open, significantly reducing the need for heavy pack-level mitigation

EnerSys (ABSL): Extreme Cold Performance

- Cold storage to -60°C for 28 days shows minimal immediate impact, but cold cycling introduces core collapse and mechanical deformation over 150+ cycles
- Low-temperature qualification and protocol design are critical for aerospace and stratospheric platforms where repeated thermal cycling is unavoidable

American Lithium Energy (ALE): Zero Voltage Behavior

- Focus on zero voltage behavior, what happens when a cell is driven to 0 V and how it responds after deep discharge events
- Real systems see undervoltage faults, storage edge cases, and abuse scenarios, 0 V behavior can determine safety and recoverability for aerospace, drones, and eVTOL

Takeaway: Cell-level safety features reduce pack mass and improve abuse tolerance, but qualification remains system-level.

> "The biggest reliability failures start as tiny physical defects. The real mass [weight] savings come not from reducing metal inside the cell, but from reducing safety elements in the battery pack when cells are inherently safer." — Honeywell

Quality Assurance Advancements

Glimpse: Scalable CT for Space

- Full-cell scans in two minutes at 14-micron resolution, data compression under 100MB per scan
- 200-cell sampling achieved 90% confidence for 60,000-cell flight lot, identifying critical defects

Lumafield: CT scanning at Scale

- High-throughput industrial CT scans 100-1,000 cells, prismatic cells scanned in minutes
- Distribution tails and QQ plots reveal systematic variation crucial for battery reliability

Honeywell: Ultrasound Detection

- Ultrasound detects physical defects at 30-micron resolution missed by electrical tests
- One-cell-per-second throughput enables 100% automated factory-scale screening

CamX Power: Self-discharge Screening

- Electrochemical self-discharge testing is 50× more sensitive than 14-day voltage monitoring
- Screened 18,000 cells, rejecting 189 with elevated self-discharge that passed conventional QC

Key Takeaway: Traditional sampling methods are giving way to comprehensive screening that detects rare but catastrophic defects before integration.

Workshop Insights

Thermal and Extreme Temperature

- **ThermaVant:** Oscillating heat pipes deliver 2.1× conductance vs solid aluminum, 12% lighter, 11.5M+ orbit hours
- **SwRI:** Discharge heat dwarfs charge heat, 42.1W at 1C discharge vs 0.3W charge, creating accumulation risk
- **EnerSys (ABSL):** Cold storage manageable to -60°C, but cold cycling causes deformation over 150+ cycles, performance electrolyte-dependent below -80°C

Takeaway: Thermal design must address high heat duty cycles and cold cycling degradation

Silicon Anodes

- **Amprius:** Silicon cells flying in Zephyr drones, integration depends on compression and thermal management
- **GDI:** Planar silicon via plasma deposition bonds directly to collector, no binder or carbon, drop-in substitution, best cycling above 3.2V

Takeaway: Silicon architectures diverging, integration limits and operating windows decide viability

Transport and Emissions

- **Canadian Light Source (CLS):** Fast charging drives salt gradients and edge depletion, electrolyte distribution limits fast charge and high power
- **Amphenol and SwRI:** Breakdown gases include CO2 and water vapor, hydrogen buildup hazardous in enclosed spaces, emissions testing informs vent design

Takeaway: Internal transport limits and gas characterization must be designed in early

Space Applications

- **SpaceX Starlink:** Reliability at scale via pack testing and telemetry across 10,000+ satellites, 100+ MWh in orbit, demise requirements constrain designs
- **Total Energies/SAFT:** Cell redesign emphasizes benign failure modes and non-propagating safety validation

Takeaway: Space programs optimize for reliability and controlled failure under unique constraints

Pack Architecture

- **University of South Carolina:** Bus bar layout changes heating and gradients, "clocked" layouts and fusible links improve balance and fault isolation
- **SpaceX Starlink:** Pack validation includes interconnect and sensor checks, reliability driven by integration and handling, not just cell specs

Takeaway: Pack architecture spans electrical, mechanical, and test design as primary safety lever