UL operates in more than 143 COUNTRIES and across more than 20 INDUSTRIES. UL SERVES 1 OUT OF 3 Fortune 500 companies. WORKING FOR A SAFER WORLD since 1894.

UL has helped to set MORE THAN 1,600 standards defining safety, security, quality and sustainability. UL software is used by 10,000+ ORGANIZATIONS in OVER 10 INDUSTRIES.

UL MARKS APPEAR on more than 22 BILLION products globally. UL has supported a CENTURY OF INNOVATION from electricity to nanotechnology.
Worldwide experts

North America
5,500+ employees
70 locations

Africa, Europe, Latin America and Middle East
3,000+ employees
80 locations

Asia Pacific
5,500+ employees
80 locations

14,000 employees
230+ locations
Lithium-Ion Battery Cell Failure Modes

- Overheating and cell rupture is possible from:
  - Overcharging
  - Short circuits
  - Manufacturing defects
- Overheated cell can vent flammable gas
- Ignition source creates fire/explosion
- Lithium-ion batteries burn at 1500°C

Thermal runaway in one cell can readily spread to adjacent cells
28 Major ESS Fires in South Korea
2017 - 2019
ESS System Explosion in AZ
Thermal Runaway - 25 Lithium-Ion Cells
Thermal Runaway - 25 Lithium-ion Cells

Let’s do the math…

• A single 18650 Li-Ion cell is about 10 WH
• 25 cells is about 250 WH
• A typical ESS module has 5,000 WH
• A typical rack has 10 modules for 50,000 WH
• A typical rack has over 200 times more energy than the 25 cells in the video
• A typical 2 MW container has over 3,000 times more energy then the 25 cells in the video
**FIRE SAFETY & RISK MANAGEMENT**

**Installation Codes**
- **NEC:** National Electric Code (NFPA 70)
- **NFPA 855:** Standard for the Installation of Stationary Energy Storage Systems
- **IFC 2021:** The International Fire Code

**Battery Safety Certification**
- **UL 1642:** Lithium Batteries
- **UL 1973:** Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail (LER) Applications
- **UL 9540:** Energy Storage Systems and Equipment

**Testing for Performance**
- **UL 9540A:** Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems
It Is All About Risk Management

The use of good codes and standards, coupled with independent project oversight, is critical to managing the risk profile of battery energy storage projects.

• Financial Risks
• Operational & Performance Risks
• Safety Risks
• Environmental Risks