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Hithium

Training on UL 9540A, NFPA 855 and large-scale fire validation of 6.25 MWh BESS containers (Global focus)

pv magazine webinars

3 March 2026

10:00 am – 11:00 am | CET, Berlin, Paris

5:00 pm – 6:00 pm | CST, Beijing

Tristan Rayner

Editor

pv magazine

Richard Ridgway

Senior Application Engineer

Hithium

Sean Yang

Lead R&D Engineer

UL Solutions

Welcome!

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Do you have any questions? ❓ 🙋

Send them in via the Q&A tab. 👉 We aim to answer as many as we can today!

You can also let us know of any tech problems there.

We are recording this webinar today. 🎥

We‘ll let you know by email where to find it and the slide deck, so you can re-watch it at your convenience. 👀 💡

Hithium ∞Power 6.25MWh LSFT Introduction

Contents

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01

Advances in Technology

Energy Storage Trend: Larger Capacity

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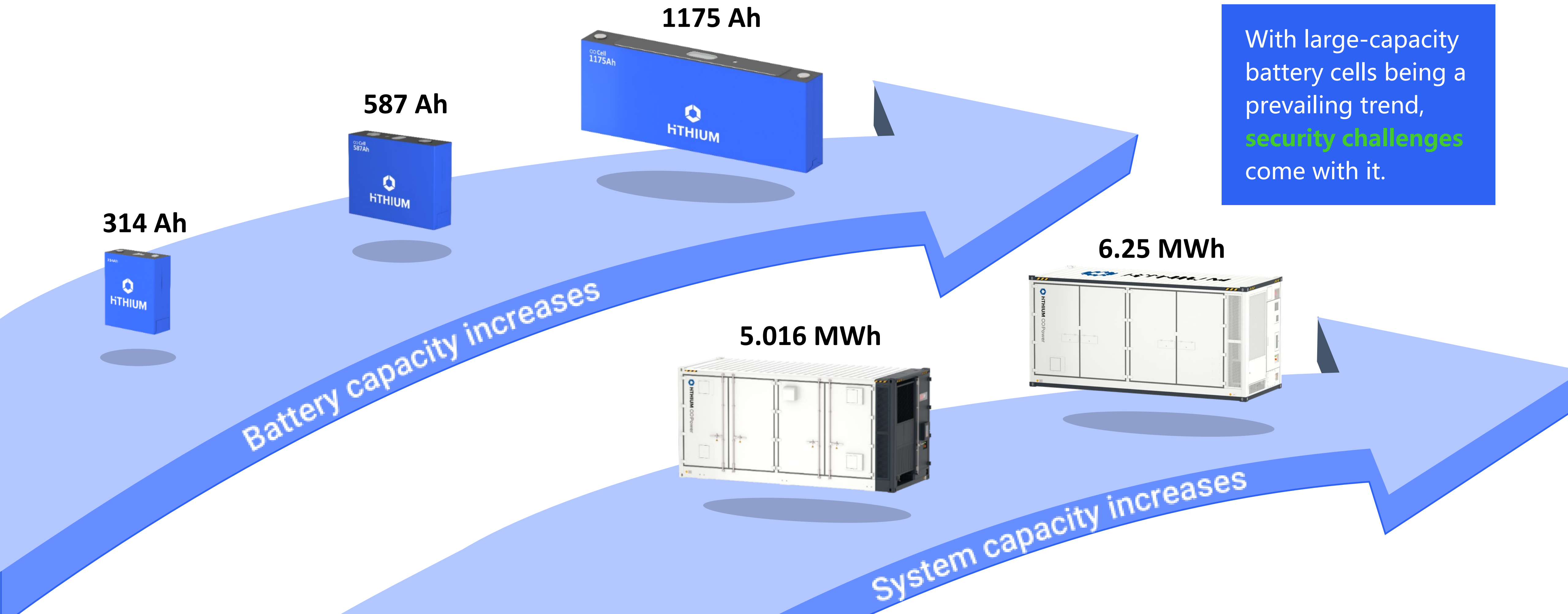
Large-capacity battery cells have become a prevailing trend.
Cell capacity has increased from **587 Ah** to **1175 Ah**, while system capacity has increased to **6.25 MWh**, driving continuous improvement in energy density and cost-effectiveness of energy storage systems.



With large-capacity battery cells being a prevailing trend, **security challenges** come with it.

ESS Fire Accidents around the world

Australia, July 2021

South Korea, June 2024

USA, May 2024

USA, January 2025

- More projects means greater risk and more media exposure
- Fires are still exceeding low probability
- Strategy is to stop spread but allow the fire to burn out

Sample incidents from the wider industry

2 Test Preparation

LSFT Test Standard

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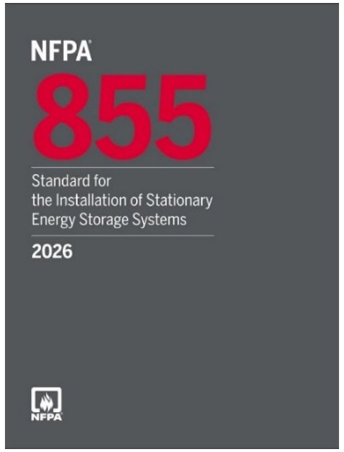
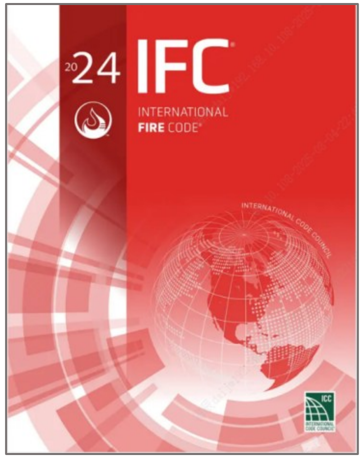
∞Power 6.25MWh's large-scale fire test complies with the latest standards: **NFPA 855 (2026)** and **UL 9540A (2025)**.





9.2.1 Where required elsewhere in this standard, fire testing in accordance with Section 9.2 shall be conducted on a representative ESS in accordance with UL 9540A and large-scale fire testing to collect data for gas production at a cell level, thermal runaway propagation at a module level, and thermal runaway propagation potential between ESSs.

1207.1.7 Large-scale fire test. Where required elsewhere in Section 1207, large-scale fire testing shall be conducted on a representative ESS in accordance with UL 9540A.

"NFPA 855 provides minimum requirements for the installation of stationary energy storage systems (ESS) to mitigate fire, explosion, and electrical hazards."

"**Maximized Space**. NFCC compliant and UL 9540A certified, enabling 3ft spacing for high-density BESS deployments"

Hithium Test Arrangement Plan

Target Cabin A (fully configured) was set with its cabin door, control cabinet door, and ventilation louvers open, and the fan inoperative; Cabins B, C, and D (single-cluster each) had their cabin doors closed.

With Heat Flux (*10)

More than 300 Thermocouples

More than 30 Voltage detectors

Gas Analysis

...

3 Test Result

∞Power 6.25MWh LSFT-Test Overview

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Start Heating

14:32

Smoke Generates

15:26

Ignite Fire

15:27

Flame Increase

17:17

Flame Peak

18:31

Visible Fire End

20:28

Complete Battery Combustion

Next day 08:00

Test Result

According to UL Solutions (Test Organization)'s evaluation, Hithium's ∞Power 6.25MWh container has passed large scale fire test.

Exposure	Limit	Comment	Result
Cells within the target enclosures	Average temperature of venting temperature from the Cell Level test, Section 7	The Max temperature measured for the battery cell is below the average venting temperature from Cell level test.	PASS

Test Highlights

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1 Test Condition

- World First All Open-door Fire Test
- 100%SOC full charged
- Fire Suppression System Deactivated
- 15 cm Minimal Spacing, Back to Back & Side by Side
- Heating 2 cells into thermal runway

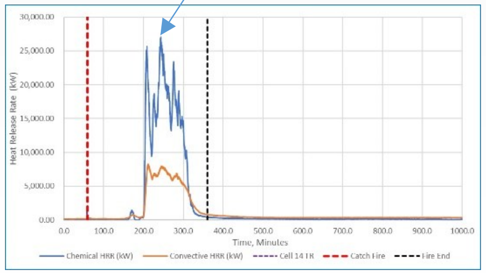
2 During Test

- Took about 1h to trigger thermal runway
- Successful ignition from igniter but not heating
- 4 hours on fire and total combustion exhausted at 14 hours

3 Test Result

- No propagation between containers
- Modules of target containers remained intact
- No critical structural deformation or collapse observed
- Heat release rate peaked multiple times.

Peak HRR: 27 MW



4 Post Test

- Gas composition analysis
- Residue analysis
- Smoke release rate
- Residue recycling

4

Hithium Product Safety Design

Multi-level Safety Design

Building multi-level safety protection from cell to pack to system, ensuring the safety of large-capacity energy storage systems.

Cell

Intrinsic safety (safety structure)

- Overhang Design
- Explosion Valve Design
- High-resistance Insulation Design

Intrinsic safety (chemical system)

- High thermal stability cathode: doping/coating
- High thermal stability anode: surface defect modification
- High-safety electrolyte: safety additives

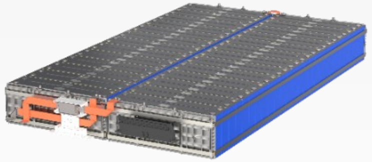
Pack

Passive safety (flame reisistance)

- Flame-resistant composite material casing
- Fiber + Resin RTM

Passive safety (thermal propagation prevention)

- Thermal insulation pad



Active safety (thermal management)

- Stamped liquid cooling plate
- High-efficiency heat exchange pipeline

System

Passive safety (explosion suppression)

- Active air intake and exhaust

Active safety (early warning)

- Real-time status monitoring
- Risk warning

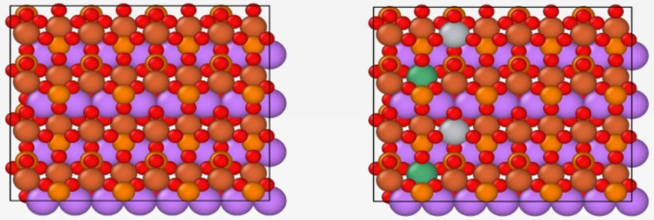
Passive safety (fire protection)

- Combustible gas detection
- Aerosol fire extinguishing agent

Intrinsic Safety Design: 1175Ah Cell

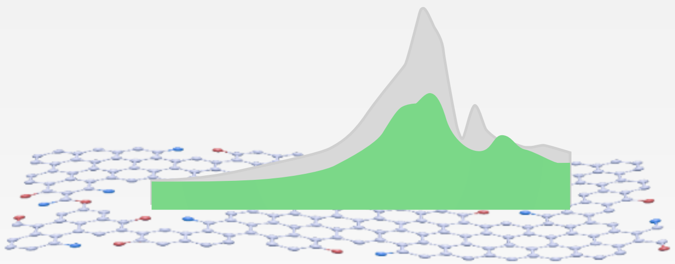
Greater capacity represents greater energy, making safety a critical challenge that must be overcome for large battery cells.

The research and development team has adopted the approach of **"proactive improvements and passive guidance"** to achieve effective control of safety risks in large batteries.



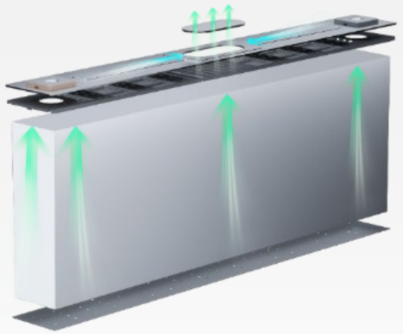
Multi-element doped lithium iron phosphate cathode material

By doping LFP with multiple elements, the structural stability and thermal stability of the LFP material under high-temperature environments are enhanced.



Low surface defect anode material reduces thermal effects

The anode utilizes thermally stable graphite to reduce surface defects and mitigate thermal effects.



3x3+1 three-dimensional air channel

Oversized explosion-proof valve with directional opening technology

Utilizes a three-dimensional airflow channel design, featuring three rapid gas pathways per dimension, achieving 360° gas transmission channels.

Safety Design: ∞Power 6.25MWh Module Fire Resistance

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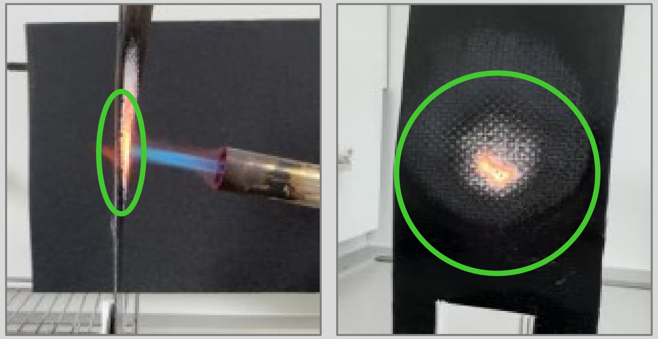
Top Cover Fire Test

Traditional material

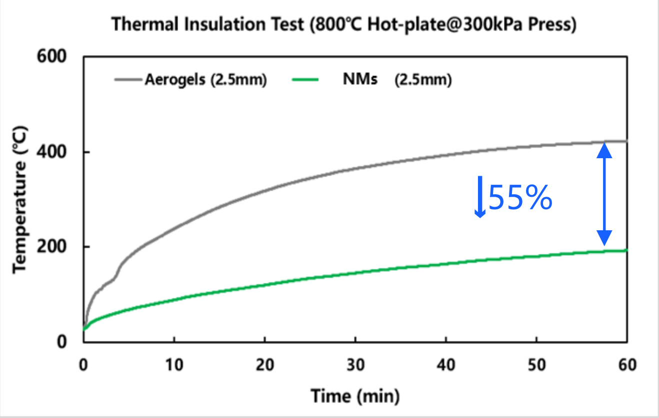


Penetrated after 5 minutes at 1000°C

Fiber + Resin RTM

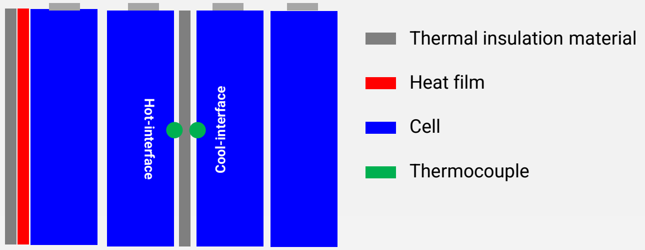
Intact after 15 minutes at 1000°C

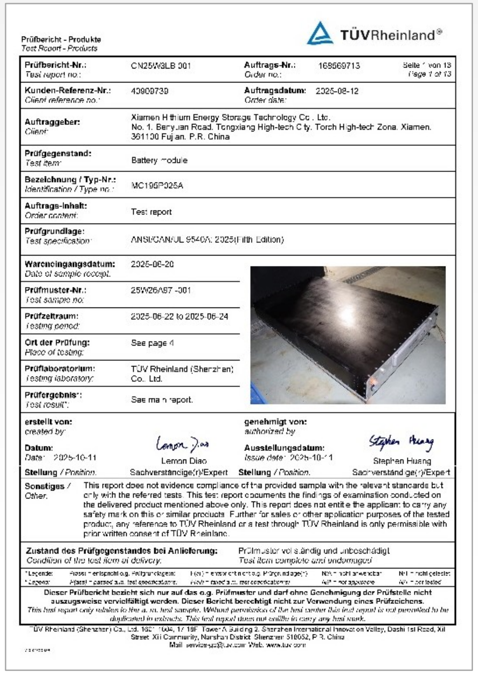
Thermal Insulation Test



- Superior Insulation: Thermal Insulation pad is 55% cooler than aerogel, with thermal conductivity of 0.015 W/(m·K) (RT) and ≤0.03 W/(m·K) (800 ℃).
- Enhanced Fire Resistance: 40% longer fire-resistance duration vs. aerogel under direct flame.
- Improved Thermal Management: Minimizes heat transfer to reduce temperature variation across cells.

UL9540A Test Report





Prüfbericht - Produkte
Test Report - Products

TÜVRheinland®

Prüfbericht-Nr.: *Test report no.:*	CN25W3LB 001	**Auftrags-Nr.:** *Order no.:*	169569713	Seite 1 von 13 *Page 1 of 13*
Kunden-Referenz-Nr.: *Client reference no.:*	40909739	**Auftragsdatum:** *Order date:*	2025-08-12	
Auftraggeber: *Client:*	Xiamen Hithium Energy Storage Technology Co., Ltd. No. 1, Beryuan Road, Tongxiang High-tech City, Torch High-tech Zone, Xiamen, 361100 Fujian, P.R. China			
Prüfgegenstand: *Test item:*	Battery module			
Bezeichnung / Typ-Nr.: *Identification / Type no.:*	MC195P025A			
Auftrags-Inhalt: *Order content:*	Test report			
Prüfgrundlage: *Test specification:*	ANSI/CAN/UL 9540A: 2025(Fifth Edition)			
Wareneingangsdatum: *Date of sample receipt:*	2025-06-20			
Prüfmuster-Nr.: *Test sample no.:*	25W26A97-001			
Prüfzeitraum: *Testing period:*	2025-06-22 to 2025-06-24			
Ort der Prüfung: *Place of testing:*	See page 4			
Prüflaboratorium: *Testing laboratory:*	TÜV Rheinland (Shenzhen) Co., Ltd.			
Prüfergebnis*: *Test result*:*	See main report.			
erstellt von: *created by:*		**genehmigt von:** *authorized by:*		
Datum: *Date:* 2025-10-11	Lemon Diao	**Ausstellungsdatum:** *Issue date:* 2025-10-11	Stephen Huang	
Stellung / *Position:*	Sachverständige(r)/Expert	**Stellung** / *Position:*	Sachverständige(r)/Expert	
Sonstiges / *Other:*	This report does not evidence compliance of the provided sample with the relevant standards but only with the referred tests. This test report documents the findings of examination conducted on the delivered product mentioned above only. This report does not entitle the applicant to carry any safety mark on this or similar products. Further for sales or other application purposes of the tested product, any reference to TÜV Rheinland or a test through TÜV Rheinland is only permissible with prior written consent of TÜV Rheinland.			
Zustand des Prüfgegenstandes bei Anlieferung: *Condition of the test item at delivery:*	Prüfmuster vollständig und unbeschädigt *Test item complete and undamaged*			

Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.
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Mail: service-gz@tuv.com Web: www.tuv.com

Safety Design – Proactive Multi-Modal Warning

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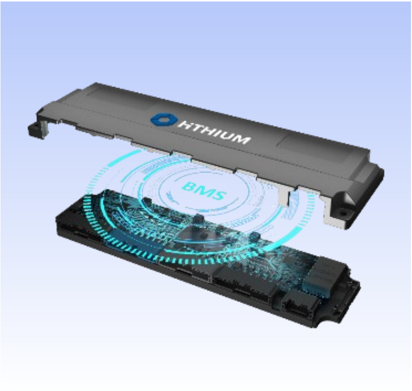
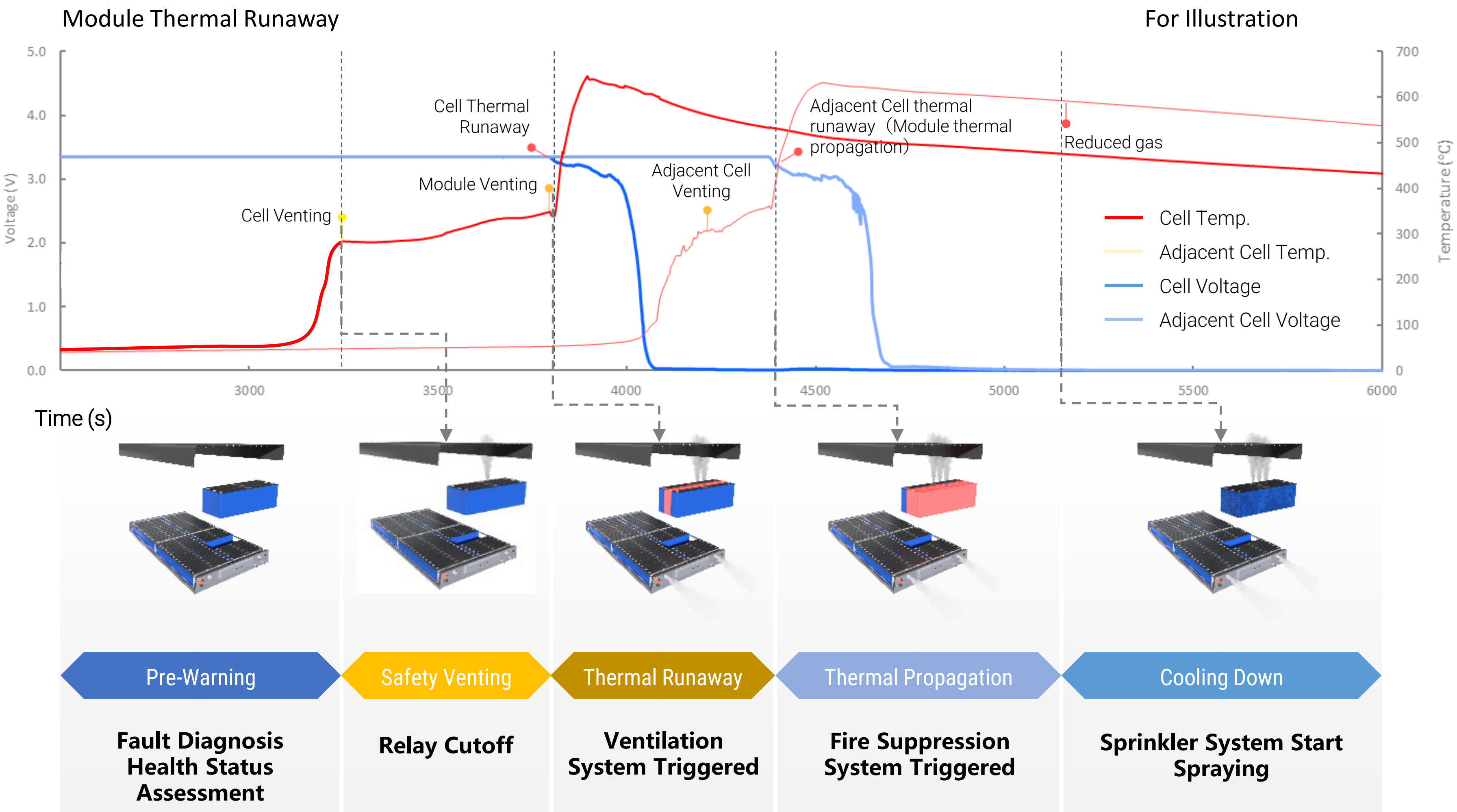
Active Safety: Proprietary multi-modal warning algorithms, multi-dimensional sensing, and redundant control technology enable precise warning, monitoring, and control, ensuring proactive safety performance of the energy storage system.





BMS	
Functional Safety SIL2	Cyber Security SL2

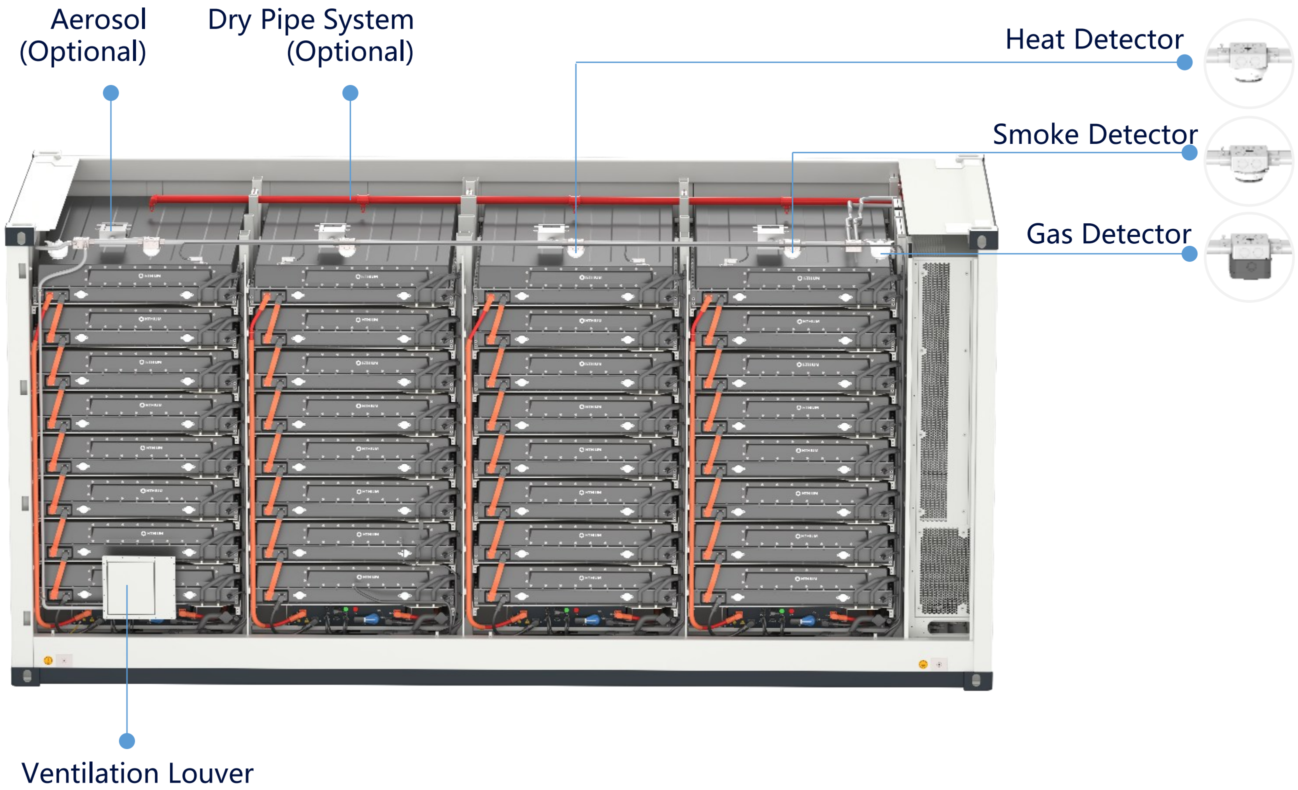
Passive Safety: Fire Protection System

Design in accordance with NFPA 855 Authorized 3rd Party Safety Validation

National Fire Protection Association:
Standards for stationary storage battery systems

- NFPA 68 Analysis (Optional)
- NFPA 69 Analysis
- NFPA 70E Assessment
- NFPA 72 Compliant Alarm System
- ESS Fire Extinguishing/ Suppression System Design Review
- Hazard Mitigation Analysis

All key components with UL and/or CE



Configurations of the Fire protection system may differ for specific projects

Together we create a more sustainable future…

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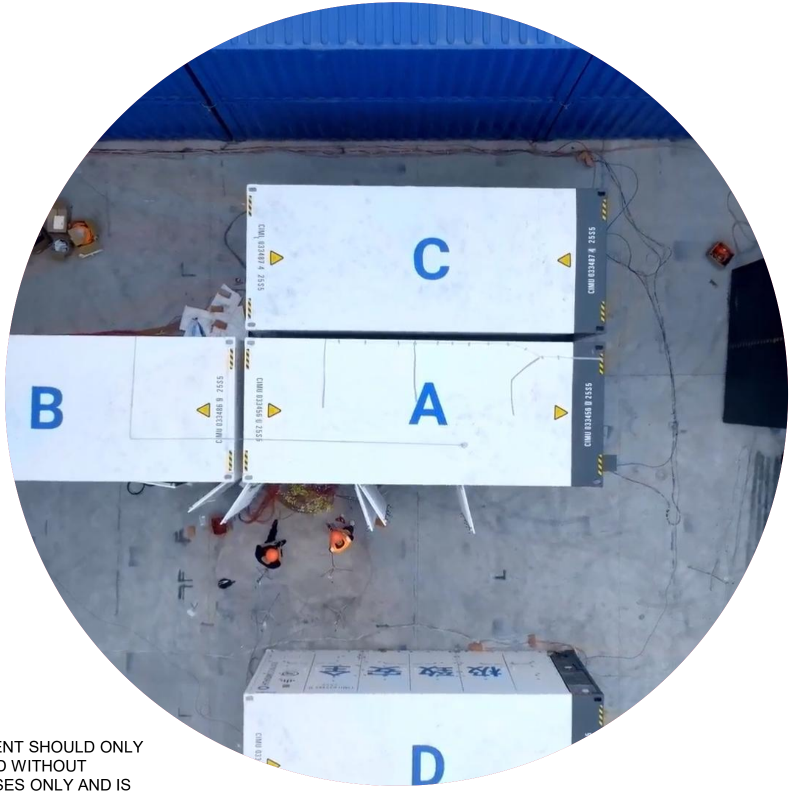
Large-Scale Fire Testing for Battery Energy Storage

What to expect with NFPA 855:2026 and upcoming UL 9540A publication



Introduction

Sean Yang

Lead R&D Engineer | UL Solutions

Sean Yang is a lead R&D engineer specializing in battery fire safety and thermal runaway research. Before joining UL Solutions, he worked at a Korean governmental company where he supported U.S. and European certification activities for gas-related appliances. Building on that foundation, he now conducts advanced research on battery fires and develops test methodologies to characterize thermal runaway behavior and associated fire hazards. Over his nine years with UL Solutions, he has certified renewable-energy products and led numerous projects involving UL 9540A, the Standard Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems.

Sean also contributed to the UL 9540A technical committee, helping update and refine large-scale fire testing requirements. His technical work includes developing methods to analyze battery cell energy release and thermal runaway propagation, running physics-based simulations, and applying machine learning to evaluate fire and explosion hazards in battery energy storage systems.

Brief history of energy storage system (ESS) codes and standards

Lithium-ion battery ESS (BESS) introduced to **International Fire Code®** **(IFC®)** (2006); Chapter 12, Energy Systems (2018); current edition: 2024

UL 9540, the Standard for Energy Storage Systems and Equipment, Ed. 1 (2016); current edition: 2025

UL 9540A*, Ed. 1 (2017), ANSI/CAN (2019); current edition: 2025 (ballot in progress)

IEC 62933-5-2, Electrical Energy Storage (EES) Systems – Part 5-2: Safety Requirements for Grid-Integrated EES Systems – Electrochemical-Based Systems, Ed. 1 (2020); current edition: 2020

NFPA 855, Standard for the Installation of Stationary Energy Storage Systems, Ed. 1 (2020); current edition: 2026

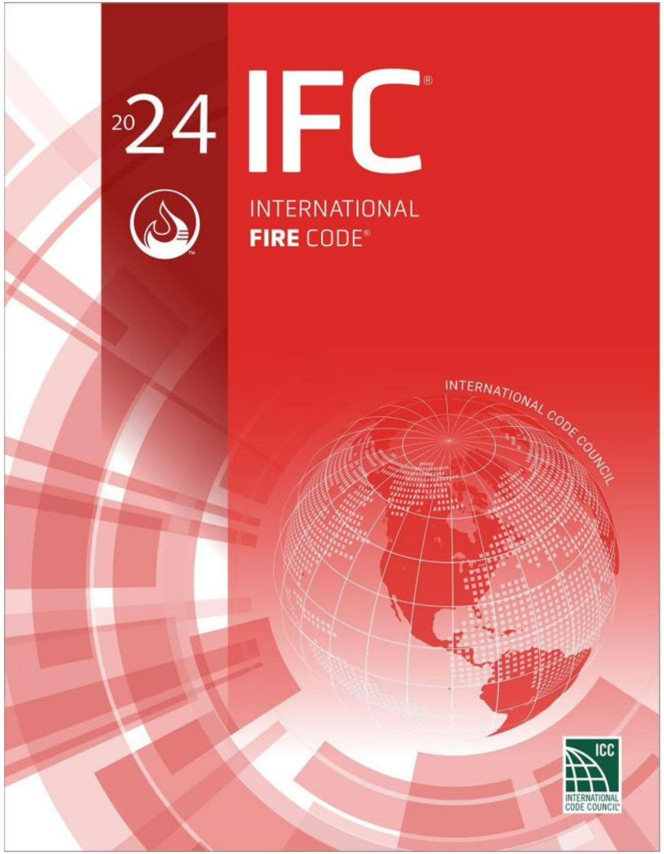
Present

*UL 9540A, the Standard Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems, Ed. 1

Codes regulating ESS

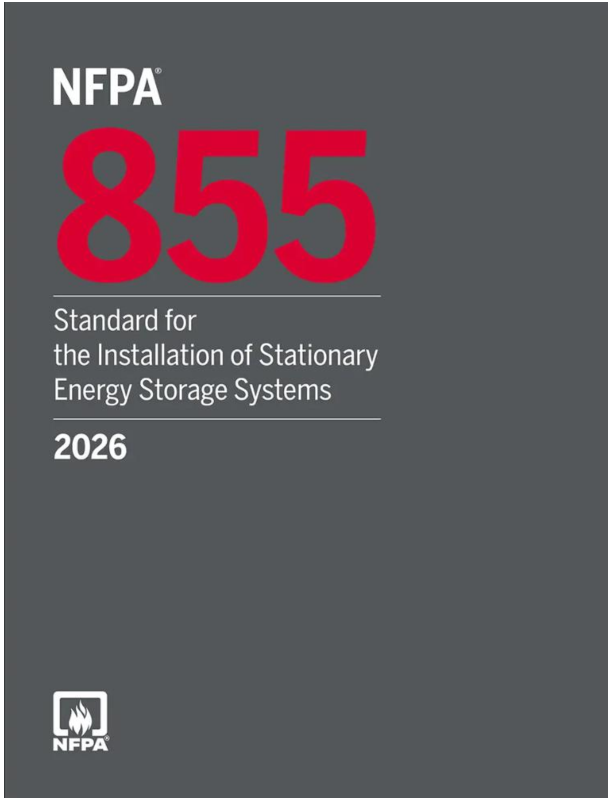
IFC 2024

- **Chapter 1207.1.7,** Large-scale fire testing (LSFT) – Where required elsewhere in Section 1206, LSFT shall be conducted on a representative ESS in accordance with UL 9540A.
- **Chapter 1207.3.1,** ESS listings – ESS shall be listed in accordance with UL 9540.



Codes regulating ESS

- **9.2.1 Testing.** Where required, fire testing shall be conducted on a representative ESS in accordance with UL 9540A and **Large-scale fire testing** to collect data for gas production at a cell level, thermal runaway propagation potential at a module level **and thermal runaway propagation potential between ESSs.**
- Objective of LSFT – Demonstrate that a fire involving one ESS unit will not propagate to an adjacent unit.
- Additional guidance now provided in NFPA 855:2026, Annex G11



ANSI/CAN/UL 9540A:2025

UL 9540A:2025, the Standard Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems

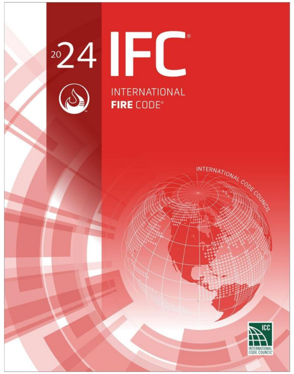
- Ed. 5, issue date March 12, 2025
- Binational Standard for Canada and the U.S.

Scope: Determines the capability of a battery technology to undergo thermal runaway and then evaluates the fire and explosion hazard characteristics of those BESS

Referenced in: NFPA 855, International Code Council (ICC) IFC, ICC International Residential Code (IRC), UL 9540

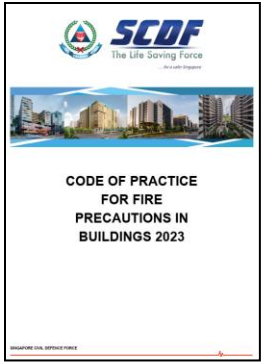
Global recognition of UL 9540A

U.S.



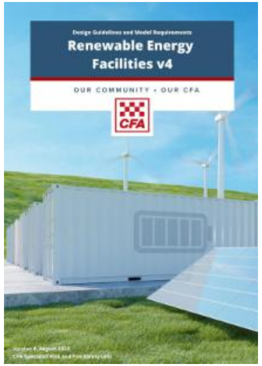
Referenced in IFC, which is the mandatory fire code for 41 states in the U.S.

ASEAN*



- Referenced in the fire code and guidelines in **Singapore and Malaysia**
- Approved for adoption as a national standard in **Singapore and the Philippines**

Australia



Referenced in the State of Victoria Country Fire Authority guidelines for renewable energy facilities and BESS

IEC**

- Referenced in IEC standards for LSFT requirements
- E.g., IEC 62933-5-2 for safety requirements for grid-integrated, electrochemical-based EES systems

*Association of Southeast Asian Nations (ASEAN)
**International Electrotechnical Commission (IEC)

IFC/NFPA 855: Large-scale fire test (LSFT)

The code authority can approve installations based on LSFT results for the following reasons:

- **Increased BESS size**
- **Reduced spacing to adjacent BESS and/or walls**
- Increased maximum allowable quantity (MAQ) in a fire area
- Decreased separation to means of egress
- Decreased outdoor separation distances
- Justification of alternate sprinkler densities or fire suppression systems

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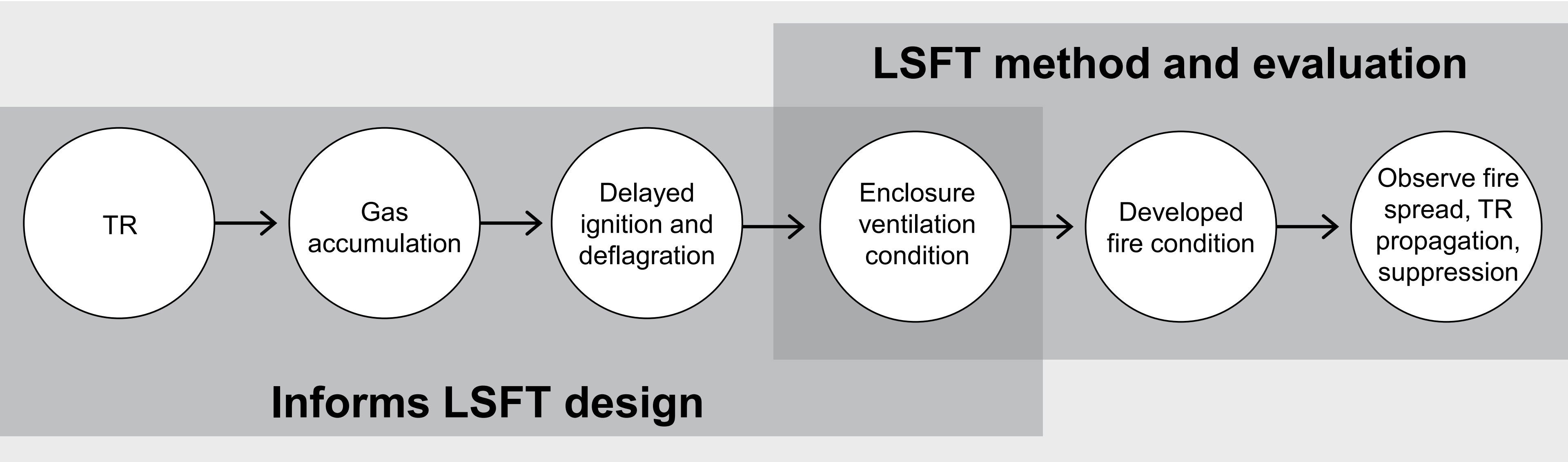
Objectives of LSFT

- Evaluate thermal exposure from a fire within one BESS to adjacent BESS for potential of fire spread to the batteries within the neighboring BESS
- Evaluate thermal exposure from a fire within one BESS to nearby structures
- Verify adequacy of manufacturer's proposed separation distances
- Determine whether a building's prescribed fire protection plan is adequate to control fire spread originating in batteries

Revisions to UL 9540A Installation-level test solidify expectations for LSFT

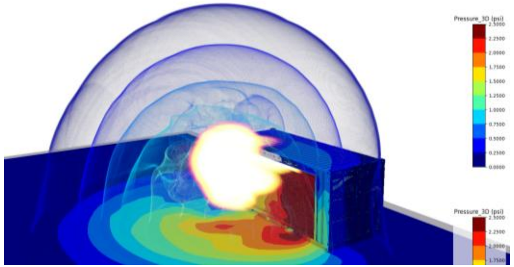


Assumptions behind "developed fire condition"

- Conservative fire condition is not directly attributed to any one failure mode
- Cells undergo TR and flammable gas is ignited promptly.
- Thermal runaway propagation prevention (TRPP) systems are inoperable or overwhelmed by the failure mode.
- More ventilation in the enclosure will support fire growth.
- Post-deflagration fire scenario is the most challenging ventilation condition for an unattended BESS

Solutions

Enclosure ventilation condition

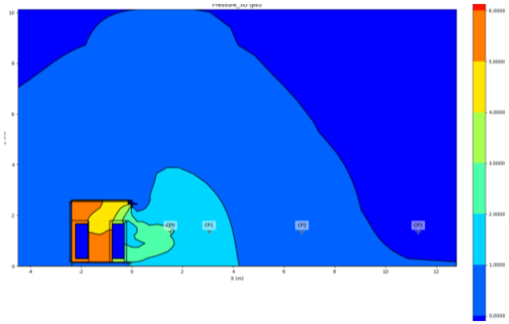


Deflagration vents

- NFPA 68, Standard on Explosion Protection by Deflagration Venting, typically used for design in North America
- Includes prescriptive and performance-based approaches
- Determined by calculation, simulation or testing

Alternative vent areas

- Testing used to determine post-deflagration ventilation condition
- Guidance in UL 9540A, Annex C (balloted)

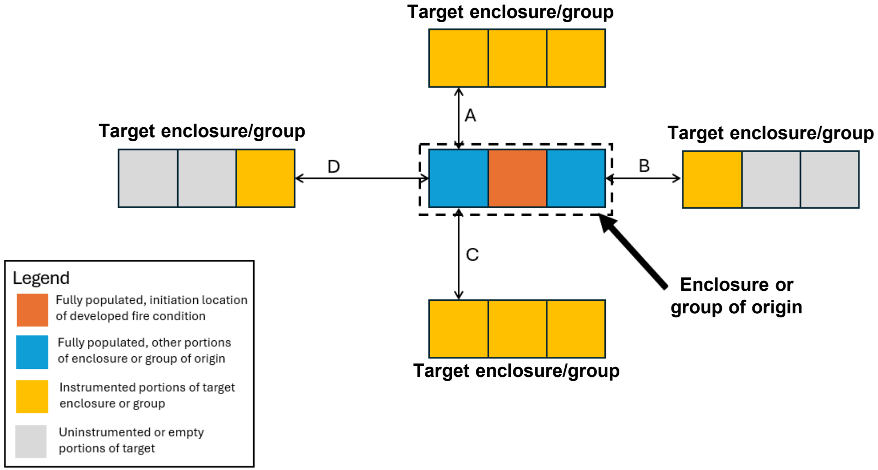


Doors and vents

- Open both vents and door(s)
- Open doors often considered as upper bound on thermal exposure to unit across aisle
- Includes commissioning and maintenance conditions

What a test looks like: Outdoor enclosures

- Developed fire condition to consume at least one vertical group of modules, e.g., rack
- Separation distances
- Fire suppression systems allowed
- TRPP systems disabled in enclosure of origin
- Openings on enclosure of origin represent fire following deflagration
- Target instrumentation related to the completeness of the target enclosure



Source: UL Standards & Engagement (ULSE), UL 9540A ballot recirculation

Measurements and data collection

Required for performance criteria

- Temperature in BESS of origin to monitor developed fire condition
- Temperature grid in target BESS – Criteria related to cell vent temperature
- Heat flux to structures, if nearby

Optional

- Heat release rate
- Gas concentrations in the plume
- Battery management system outputs
- Survivability of communications or critical safety systems
- Additional heat flux or validation data for modeling

Thank you

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3 March 2026

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Q&A

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Editor

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Richard Ridgway

Senior Application Engineer

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Lead R&D Engineer

UL Solutions

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Thursday, 19 March 2026
5:00 pm - 6:00 pm CET, Berlin, Madrid, Paris
12:00 pm - 1:00 pm EDT, New York City

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Tuesday, 31 March 2026
2:00 pm – 3:00 pm, GMT, London
3:00 pm – 4:00 pm CEST, Berlin, Madrid, Paris

Why BESS operators are losing time and revenue — insights from the 2026 BESS Pros Survey

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The Battery Business & Development Forum, hosted by pv magazine, Conexio-PSE, and SolarPower Europe, returns to Frankfurt March 31–April 1, 2026 for a high-impact, two-day exploration of Europe’s fast-growing grid-scale battery storage market.

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Tristan Rayner
Editor
pv magazine

Thank you for joining today!