

Inside the BESS Fire Safety Revolution

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May 2026

Speaker introduction: Mishaal SyedNaveed



- ✓ Leads Wärtsilä Energy Storage's **product roadmap related to ESS fire and safety compliance, testing, and R&D**
- ✓ Member of Technical Committees
 - UL 9540 / UL9540A
 - C801 - Testing Protocol for Evaluating Effectiveness of Detection and Suppression Systems for Battery Failure Events
- ✓ Former FPE for a major US-based utility
- ✓ Licensed Professional Engineer (P.E.) in Fire Protection
- ✓ B.S. Fire Protection Engineering & M.S. Energy Systems Engineering

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Overview — Who Are We?

Wärtsilä Energy Storage combines 16+ years of proprietary software leadership with energy storage solutions and lifecycle services to provide **comprehensive and fully integrated** energy solutions for utilities, developers and independent power producers (IPPs) worldwide.

Facts and figures

- **20GWh+** of energy storage awarded, contracted, in deployment
- **Top 10** energy storage integrator globally
- **500+ employees**
- **Global team of experts across all major markets**

Our core business offering:

Energy storage
hardware

+

GEMS Digital
Energy Platform

+

Lifecycle
Services

Highlighted awards and accolades:



TIME Best Inventions and
Most Influential Companies, 2025

POWER

Game Changer Award, 2023



Top Product of the Year, 2023

Environment
+ Energy
LEADER

E+E Leader, 2022 and 2021



The Global Power & Energy Elites, 2022

POWER & ENERGY
AWARDS

Power and Energy Award, 2022

POWER

POWER Magazine Smart Grid Award, 2021

Platts
Global Energy
Awards

S&P Global Platts Energy Awards, 2021 & 2019



Energy Globe National Award, 2021

THE
CLEANIE
AWARDS

Cleanie Awards, 2021

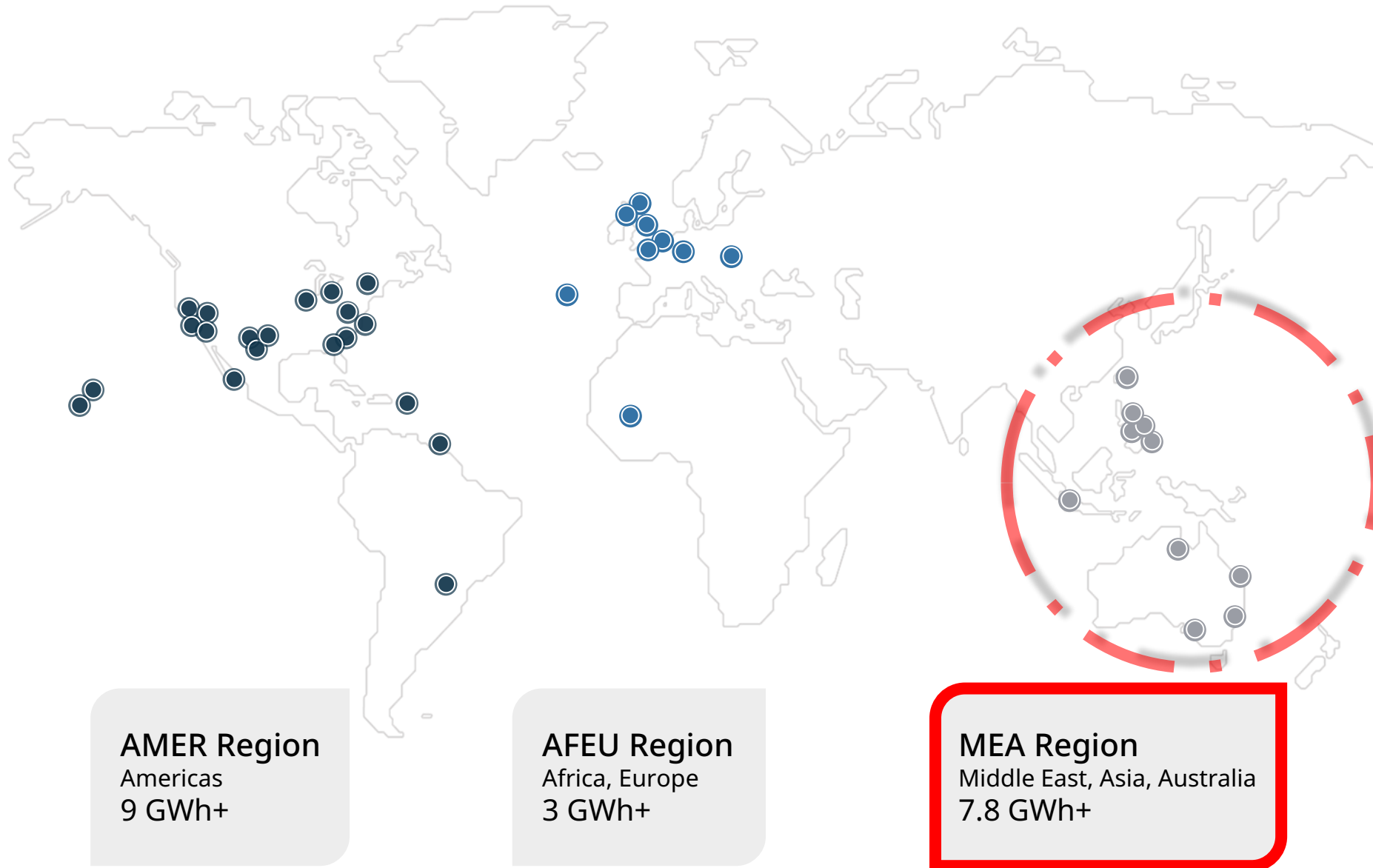
CREF2019

CREF Industry Awards, 2019

Environment
+ Energy
LEADER
100

E+E Leader 100, 2019

A globally recognised energy storage solutions provider



20 GWh+

awarded, contracted, in deployment

130+

projects

16+

year track record
of growth & industry leadership

BESS Jargon: Cell to System Level



Cell

Cell-level testing

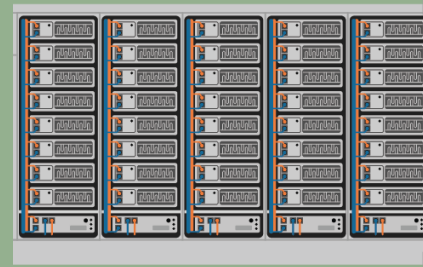
Passive pressure relief



Module

Module-level testing

Passive pressure relief,
electrical protection,
and battery monitoring
(52 cell per module)



Racks/Unit

Unit-level testing

Rack level electrical
protection and battery
monitoring
(8 modules per rack)
(10 racks per unit)



Enclosure

Complete system
integration

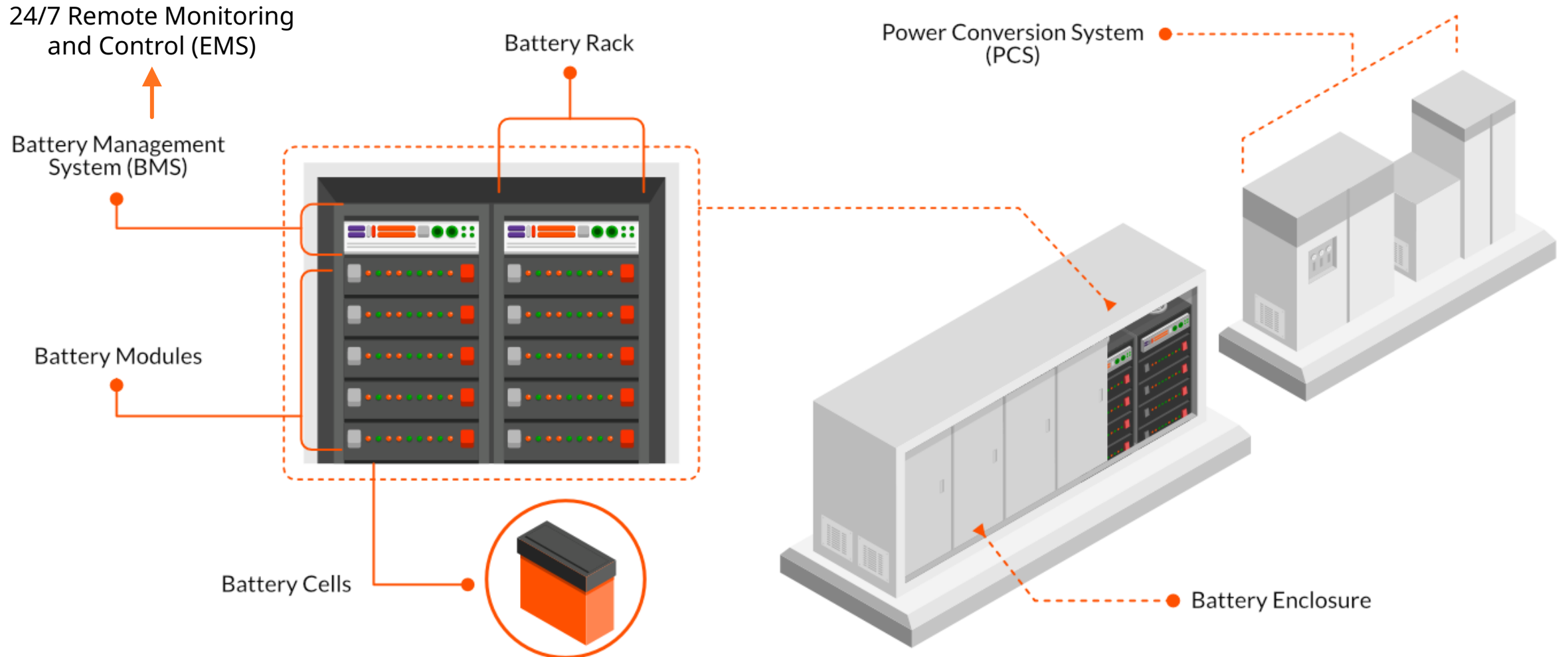
Includes safety systems
BMS, detection,
notification, PLC, remote
monitoring, thermal
management system,
explosion control.

Typical battery energy storage (BESS) site layout

Millions of battery cells comprising a large-scale BESS



Typical Site-level System Components



Typical Layers of Protection

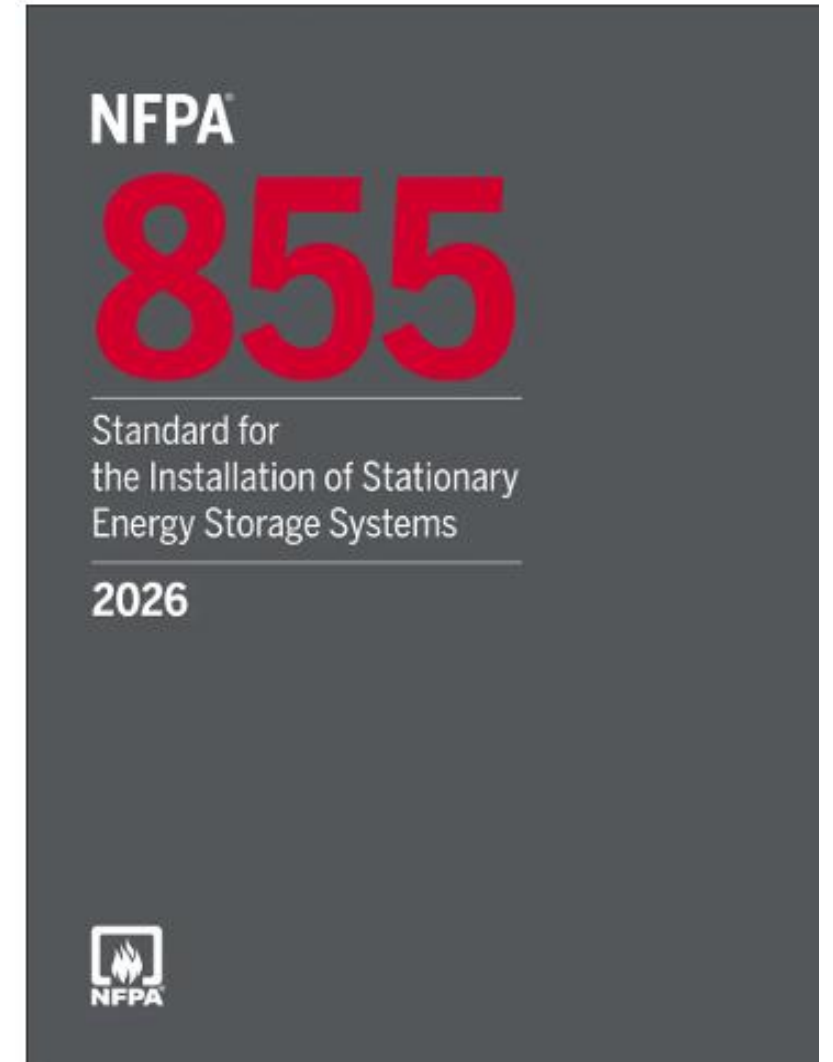
- 1** IP67 LFP prismatic module
- 2** Advanced BMS capabilities
- 3** Extensive Certifications and Testing
- 4** Fire-resistant modular design
- 5** Explosion Mitigation Systems
- 6** Fire Alarm System
- 7** Cabinet environment monitoring and conditioning



Safety improvements driven by code

Typical permitting submittals include:

- Community Risk Assessment (CRA/FRA)
- Hazard Mitigation Analysis (HMA)
- Design / Product listings
- UL 9540A testing
- Large scale fire testing
- Explosion control
- Commissioning plans
- Decommissioning plans
- Bushfire risk and mitigation
- Response preparation / Training



Major Shifts in Codes/Standards



Updates to UL 9540A 6th Edition

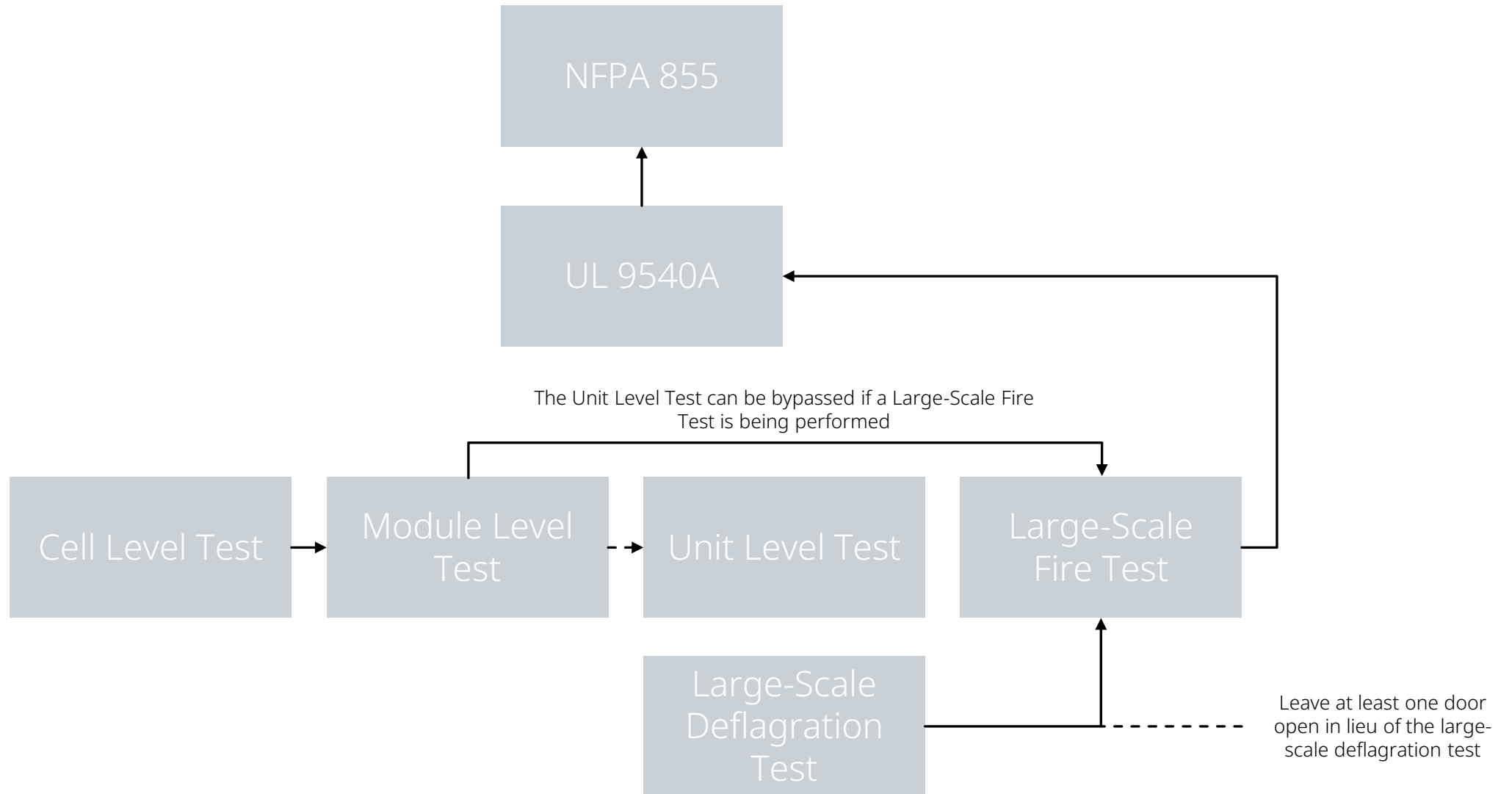
- ✓ The update formally incorporates large-scale fire testing into the certification framework to demonstrate that a thermal runaway event in one BESS does not propagate to adjacent systems
- ✓ This shift aligns with NFPA 855-2026, which emphasizes performance-based fire safety outcomes over prescriptive design
- ✓ Focus moves from component-level to **system-level** fire safety evaluation

CSA/ANSI C800:25

- ✓ A broader reliability and quality assurance standard covering durability under extreme environmental, mechanical, and fire conditions; not a safety certification standard
- ✓ Requires the BESS under test to become **fully involved** in a sustained fire → explicitly testing the worst-case scenario regardless of propagation outcome
- ✓ Collects a much broader set of engineering-grade data including peak heat release rate (HRR), BMS response, detection system activation timelines, fire/damage impact on critical safety systems, and viability of communication pathways

LSFT is now referenced in recent Australian technical guidance documents

Fire Compliance Path to NFPA 855 with UL 9540A LSFT Update



Suppression

Aerosol usage:

- Aerosol fire suppressions systems **do not offer suppression** by cooling and cannot stop a thermal runaway event once initiated
- The installation of an aerosol fire suppression system has the **potential to create a higher risk** of explosion by extinguishing a flaming fire that is consuming thermal runaway off-gas, leading to a buildup of unburned flammable gases

Water usage:

- Offensive fire suppression use **increases risks and complicates water containment** issues, including water intrusion on energised electrical components, which can cause short-circuiting and reignition hazards that may persist for several days
- The recommendation is **non-intervention**, with exposure protection as the appropriate response tactic
- Should a Fire Authority, Insurer, Developer, or Utility mandate the use of suppression, a **fixed water spray system should be installed** above the BESS enclosures



Large-Scale Fire Testing

Large Scale Fire Testing (LSFT)

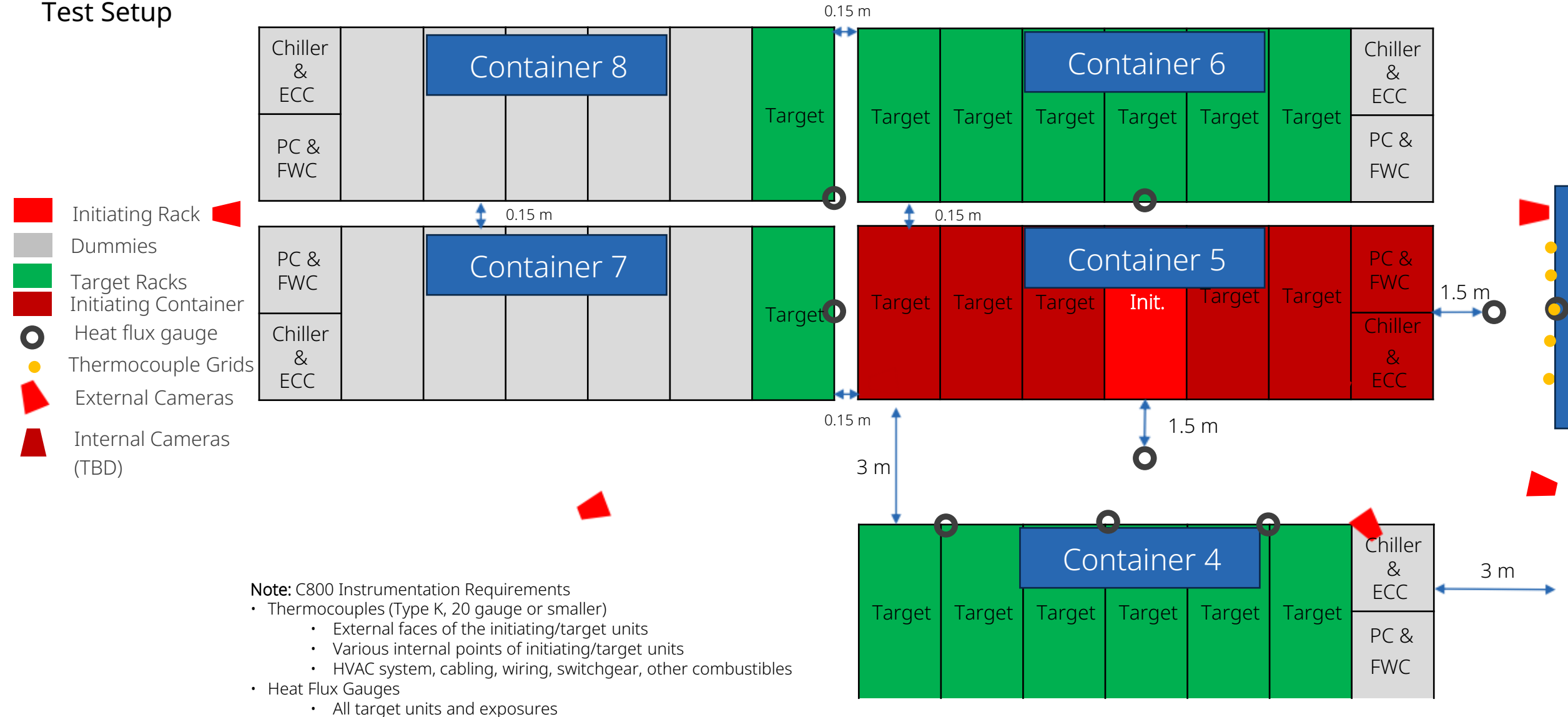
- CSA/ANSI C800:25 and UL 9540A are the only two published LSFT standards
- NFPA 855 2026 will require the following:
 - UL 9540A testing shall be conducted on a representative ESS
 - Large scale fire testing shall be conducted on a representative ESS
- Manufacturers should be able to demonstrate that in a reasonably worst-case scenario, **there will not be unit-to-unit or row-to-row propagation**
- Initiated with pre-mixed flame burner until self-sustaining
- Module temperatures remained below cell venting temperature and no cooling or suppression utilised

Controlled Wärtsilä LSFT test (2024)



Test Overview

Test Setup



Pre-test Photos



Testing Photos



6:00 PM



6:07 PM

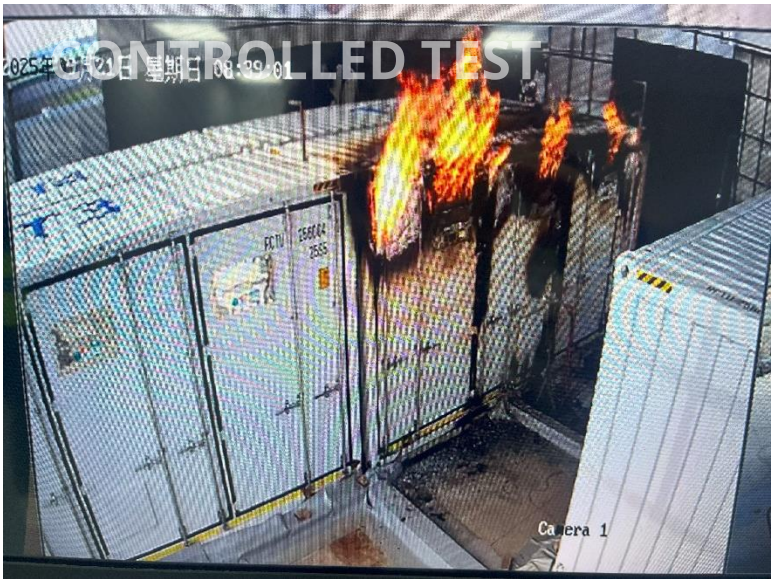


8:32 PM

Testing Photos



7:46 AM



8:39 AM



8:39 AM

Post-test Photos: Overall Site



Post-test Photos

Overall Site



Full test-site, Container 8 (left), Container 7 (middle), and Container 4 (right)

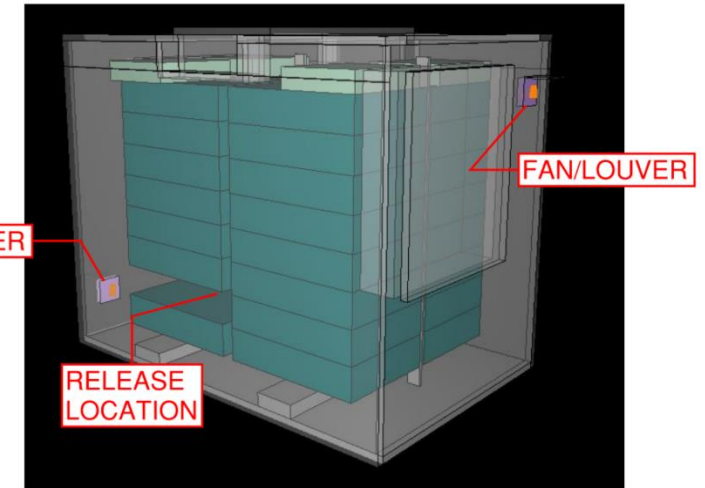


Back side of Container 4 and view of chillers of Container 4 (left), Container 5 (middle), and Container 6 (right)

No unit-to-unit propagation was observed throughout the 22-hour burn

Approach to Explosion Control in Compliance with NFPA 855-2026

- Explosion Control Systems Options
 - Exhaust Ventilation System (NFPA 69 compliance)
 - Deflagration Panels (NFPA 68 compliance)*
- Performance Based
 - Spark Assisted Explosion Control (AIMS)
 - Door Openers



Exhaust Ventilation System



Deflagration Panels

Deflagration
Panels
w/restraint



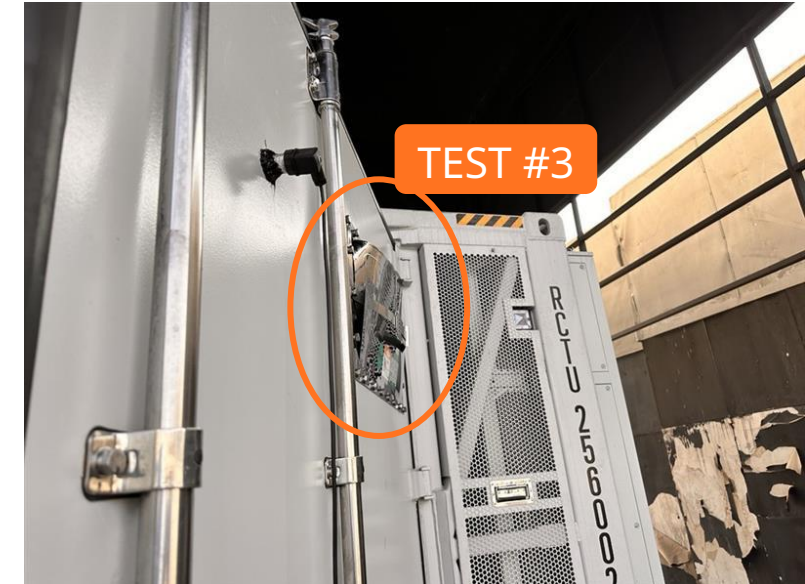
AIMS (Controller +
Coil - 1 per rack)

Active Ignition Mitigation System (AIMS)



AIMS Testing – Results

- Three tests (multiple gas release locations) to validate AIMS ability to mitigate hazardous deflagration events during a simulated TR scenario
- Test #1
 - Actual gas released: 188 L (equivalent to 1 cell off-gas)
 - Duration: 2 minutes
 - No temperature & no pressure change
- Test #2
 - Actual gas released: 188 L
 - Duration: 2 minutes
 - No temperature & no pressure change
- Test #3
 - Actual gas released: ~203 L
 - Duration: 2 minute 10 seconds
 - Max pressure recorded: 0.04067 bar
- Test #3 resulted in a single deflagration panel opening. Hence, the explosion hazard was mitigated.
- All three tests demonstrated that AIMS is successfully able to manage the deflagration hazard with no issues structurally



Stakeholder BESS evaluation

No two manufacturers are the same. What are some things to look out for when evaluating a BESS supplier?

- ✓ Documentation availability and evaluation by a registered design professional
- ✓ Long-term service agreements (LTSAs) throughout the lifecycle of the project
- ✓ Ensure no reliance on fire suppression for risk mitigation
- ✓ Fully tested and compliant explosion control systems
- ✓ UL 9540A, LSFT, Explosion System Test results
- ✓ Large scale fire testing completed
- ✓ Utilising listed components
- ✓ Industry track record





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