

Application Bulletin: **Lithium-Ion ESS & BESS** • Technology: **FirePro Condensed Aerosol**

Application
Lithium-Ion ESS & BESS

The Risk
High energy density, electrical faults and thermal runaway, with self-sustaining chemical reactions that can generate flammable gases, rapid heat escalation and re-ignition.

This Bulletin Covers
- Design considerations
- Environmental requirements
- End user responsibilities
- Post-discharge procedure
- Myths & comparative analysis

Mandatory Message to End Users
"Following discharge, all electrical and battery system components must be inspected and cleaned as part of the recommissioning process."

Condensed Aerosol Fire Suppression in Lithium-Ion ESS & BESS

Design Considerations, Environmental Requirements, End User Responsibilities, Myths & Comparative Analysis

1. Introduction

Lithium-ion Energy Storage Systems (ESS) and Battery Energy Storage Systems (BESS) present a complex and evolving fire risk due to high energy density, electrical faults, and the potential for thermal runaway events.

Unlike conventional fire risks, lithium-ion battery fires involve self-sustaining chemical reactions that can generate flammable gases, rapid heat escalation, and potential re-ignition.

FirePro condensed aerosol (CA) technology provides an effective, LPCB-certified suppression solution for **early-stage fire control and fire spread prevention** in ESS/BESS environments, particularly where traditional gaseous or water-based systems are impractical due to enclosure integrity, cost, or infrastructure complexity.

This bulletin outlines the design considerations, environmental requirements, end user responsibilities, and common misconceptions relevant to FirePro systems in ESS/BESS applications.

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2. Purpose of FirePro in ESS & BESS Environments

FirePro is designed to:

- Suppress fire in its early stages
- Prevent fire propagation between battery modules
- Reduce the risk of full system involvement
- Protect surrounding assets and infrastructure

However, FirePro is **not designed to stop thermal runaway once fully established within a battery cell or module**.

> **Therefore:**
> *FirePro should be considered part of a layered fire protection strategy, including detection, monitoring, and system isolation.*

This requirement must be clearly communicated to the end user during design, installation, and handover.

3. Important Note on Residue and System Impact

FirePro is not a clean gas agent and does not provide zero-residue discharge.

A light, dry aerosol particulate may settle on surfaces after activation. Within ESS/BESS environments, this may result in:

- Surface deposits on battery enclosures
- Light accumulation on electrical panels and busbars
- Residue on ventilation paths

> **Mandatory message to end users:**
> *"Following discharge, all electrical and battery system components must be inspected and cleaned as part of the re-commissioning process."*

This is a mandatory operational requirement to ensure continued system safety and reliability.

4. Why Sprinklers and Water-Based Systems Are Challenging in ESS/BESS

Water-based systems present significant operational and safety challenges in lithium-ion applications.

4.1 Limited Effectiveness on Thermal Runaway

- Lithium-ion cells generate internal oxygen during thermal runaway
- Fire can continue despite external water application

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4.2 Electrical Hazards

- Water introduces risk of short circuits and arc faults
- Potential for system-wide electrical failure

4.3 Contaminated Run-Off

- Water used in suppression becomes chemically contaminated
- Requires controlled drainage and environmental management

4.4 Infrastructure Complexity

- Requires drainage, containment, and large water supplies
- Often impractical for containerised or remote BESS installations

4.5 Water Mist Limitations

- Limited penetration into sealed battery modules
- Still introduces moisture into sensitive electrical systems

5. Why FirePro Is Well Suited for ESS & BESS Protection

FirePro offers distinct advantages in battery storage environments.

5.1 Rapid Fire Suppression in Early Stages

- Interrupts combustion chain reactions
- Effective in suppressing off-gas ignition and secondary fires

5.2 No Water or Moisture Introduction

Eliminates risks of:

- Electrical damage
- Corrosion due to moisture
- System contamination

5.3 Supports Fire Containment Strategy

- Prevents propagation between racks or cabinets
- Helps maintain compartmentalisation integrity

5.4 No Cylinders or Complex Infrastructure

- Ideal for containerised BESS units
- Simplifies installation and retrofit

5.5 Minimal Pressure Rise

- No requirement for pressure relief venting
- Suitable for non-sealed enclosures

5.6 High Tolerance to Leakage

- Performs effectively in ventilated or semi-open structures

5.7 Long 15-Year Operational Life

- Reduced maintenance and lifecycle costs

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6. ESS/BESS Protection Requirements (Mandatory)

6.1 Multi-Layer Protection Strategy

FirePro must be used in conjunction with:

- Early detection systems (VESDA, gas detection, thermal monitoring)
- Battery Management System (BMS)
- Automatic shutdown and isolation controls

6.2 System Isolation

- Automatic disconnection of battery strings upon alarm
- Shutdown of charging/discharging operations

6.3 Ventilation Control

- HVAC systems must shut down on activation
- Controlled venting may be required post-discharge

6.4 Enclosure Management

- Containers and cabinets should remain closed during operation
- Access doors must be secured

6.5 Post-Discharge Inspection (Mandatory)

- Battery modules must be assessed for thermal damage
- Electrical systems must be inspected before re-energisation

7. Environmental Conditions

Maintaining stable environmental conditions improves FirePro effectiveness:

TEMPERATURE	HUMIDITY
Controlled, typically within battery operating parameters	Moderate and stable to prevent condensation
AIRFLOW	**POST-DISCHARGE VENTILATION**
Shutdown upon activation to allow aerosol concentration	Ventilate enclosure within 10–15 minutes

8. Design Considerations for ESS & BESS

8.1 Fire Load and Enclosure Volume

- Include full container/cabinet volume
- Consider internal segmentation and airflow pathways
- Apply leakage compensation

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8.2 Generator (Aerosol Unit) Placement

- Ensure even distribution across battery racks
- Avoid obstruction by cabinets or structural elements

8.3 Detection Integration

- Early detection is critical
- Recommended systems:
  - Off-gas detection
  - Smoke detection (VESDA)
  - Thermal monitoring

8.4 Electrical & Control Integration

Mandatory integration with:

- BMS
- Fire alarm system
- Emergency shutdown system
- HVAC shutdown

8.5 Thermal Runaway Considerations

- FirePro does not stop internal cell failure
- Design should prioritise:
  - Early intervention
  - Fire spread prevention
  - Safe system isolation

9. Post-Discharge Procedure

1. Initiate system shutdown and isolation (if not automatic)
2. Ventilate enclosure within 10–15 minutes
3. Conduct thermal imaging inspection of batteries
4. Inspect all modules for signs of damage or instability
5. Clean:
   - Electrical panels
   - Busbars
   - Enclosure surfaces
6. Confirm no risk of re-ignition
7. Recommission FirePro system

10. Common Myths & Factual Counterpoints

Myth 1: "Aerosol systems extinguish lithium-ion battery fires completely."

Fact: FirePro suppresses flames and prevents spread, but does not stop internal thermal runaway within damaged cells.

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Myth 2: "Water is the best solution for battery fires."

Fact: Water has limited effectiveness on lithium-ion chemistry and introduces electrical and environmental risks.

Myth 3: "Gas systems are more suitable for BESS containers."

Fact: Gas systems require airtight enclosures and pressure venting, which are difficult to maintain in containerised or outdoor installations. FirePro performs effectively without these constraints.

11. Transparency Statement

FirePro UK maintains full transparency:

- FirePro is designed to suppress fire, not stop thermal runaway inside cells
- FirePro is not a zero-residue agent; a dry particulate will be present after discharge
- Post-discharge inspection and cleaning are mandatory
- FirePro does not cool battery cells
- FirePro is not certificated for deep-seated or internal battery reactions
- FirePro is most effective as part of a layered protection approach
- FirePro introduces no water, avoiding electrical hazards and contamination

12. Summary

FirePro condensed aerosol provides an effective and practical fire suppression solution for lithium-ion ESS and BESS installations, particularly in containerised, remote, or infrastructure-limited environments.

Unlike water-based systems, FirePro avoids electrical damage and contaminated run-off. Unlike gas systems, it does not require airtight enclosures or complex infrastructure.

FirePro's strength lies in **rapid suppression, fire spread prevention, and system protection**, making it a critical component of a comprehensive battery fire safety strategy.

Key operational requirement:
FirePro must be integrated with early detection, system isolation, and post-discharge inspection procedures to ensure safe and effective protection of ESS and BESS assets.

If you would like to learn more about FirePro, or discuss an ESS / BESS application, please visit us at **www.fireprouk.com** – see contact details below.

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