West Haven - Battery Energy Storage System (BESS)

EMERGENCY RESPONSE PLAN

Rev. 0 | February 6, 2025

Summary

This document serves as a site-specific Emergency Response Plan (ERP) for the West Haven BESS Project located in West Haven, Connecticut.

This ERP provides information and instructions to guide first responders in preparing for, and safely responding to an incident, fire, or other emergency associated with the West Haven BESS.

NOTICE	
ⓘ	LIFE SAFETY SHALL BE THE HIGHEST PRIORITY DURING ANY TYPE OF EVENT

Prepared For:

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1-833-SAFE-ESS

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EMERGENCY CONTACT INFORMATION

IN CASE OF EMERGENCY CALL 911

FD DISPATCH / COMMUNICATIONS

West Haven Emergency Communications Center

Phone: **(203) 479-1061**

Address: 200 Sawmill Road
West Haven, CT 06516

LOCAL FIRE STATION

West Haven Fire Department

Phone: **(203) 937-3710**

Address: 366 Elm St
West Haven, CT 06516

LOCAL POLICE DEPARTMENT

West Haven Police Department

Phone: **(203) 937-3900**

Address: 200 Sawmill Road
West Haven, CT 06516

SYSTEM OWNER / OPERATOR

Eastpoint Energy

Phone: **(###) ### ####**

Address: TBD

PROPERTY OWNER

Fred & Suzanne Realty LLC

Phone: **(###) ###-####**

Address: 6 Victor Rd
North Haven, CT 06473

SUBJECT MATTER EXPERT

TBD

Phone: **(###) ### ####**

Address: TBD

REMOTE OPERATIONS CENTER (24/7)

TBD

Phone: **(###) ###-####**

Address: TBD

ESS MANUFACTURER

Sungrow USA

Phone: **(833) 747-6937**

Address: 3200 Park Center Dr Suite 850
Coasta Mesa, CA 92626

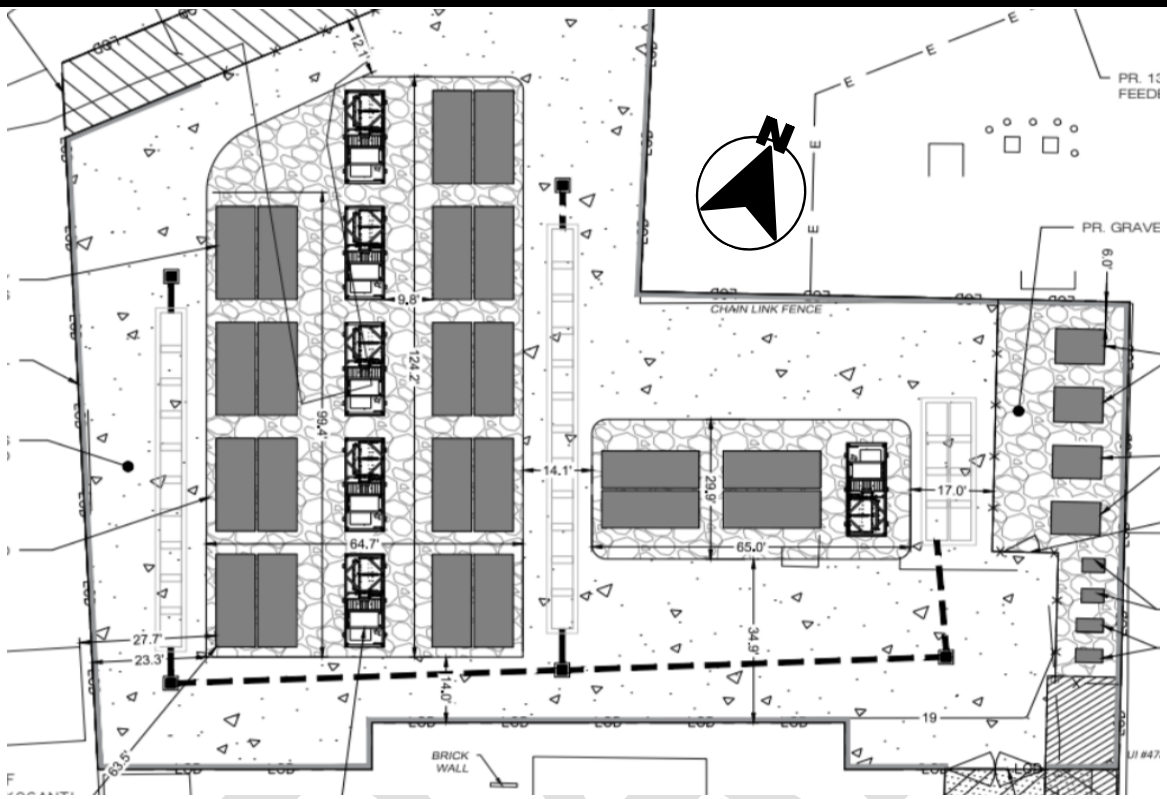
CENTRAL STATION

TBD

Phone: **(###) ###-####**

Address: **TBD**

West Haven BESS



Energy Storage System
Make / Model: Sungrow PowerTitan 2.0 **Total MW / MWh:** 15 MW / 60 MWh **kWh per Unit:** 5015 kWh **# of Units:** 22

Water Supply
A private hydrant is installed at the gate entrance as part of this project. Municipal fire hydrants are located: • 220 FT west at Savin Ave • 410 FT east at Campbell Ave

FIRE SUPPRESSION SYSTEM
The PowerTitan 2.0 can be equipped with an optional internal water-based sprinkler system. This system consists of internal piping from a DN50 interface leading to 12 fused sprinkler heads. Exact specification will be available upon final equipment selection

Deflagration Protection
The PowerTitan 2.0 can be configured to come with the optional six (6) passive deflagration vent panels designed in accordance with *NFPA 68.* Exact specification will be available upon final equipment selection

Fire Detection System
Each PowerTitan 2.0 enclosure has two (2) heat, and four (4) smoke detectors installed. Specifications available upon final equipment selection. Additional options include flammable gas detection, sounder beacons and exhaust ventilation. Exact specification will be available upon final equipment selection

Explosion Protection
The PowerTitan 2.0 can be configured with an optional exhaust ventilation system designed in accordance with *NFPA 69* to remove flammable gas from the enclosure. Exact specification will be available upon final equipment selection

Project Name	**West Haven BESS Project ERP**
Project No.	24-20480
Prepared For	***West Haven BESS*** 310 4th Street NE Charlottsville, VA 22902
Revision No.	Rev. 2
Date of Issue	03/10/2025

REVISION HISTORY

Revision No.	Date of Issue	Substance of Change
Rev. 0	02/06/2025	Draft issue
Rev. 1	02/13/2025	Updates based on technology changes
Rev. 2	3/10/2025	Addition of private fire hydarnt

Note 1: *The information in this document is subject to change while in DRAFT status and may be subject to change in the event of modifications to equipment or other factors affecting the design of the system or overall installation.*

Note 2: *During the operating life span of the project, it is expected that this document shall be reviewed annually, and that all pertinent information shall be appropriately updated as necessary. This ERP is compiled based upon current design and usage at the time of this writing.*

IMPORTANT NOTICE AND DISCLAIMER

Energy Safety Response Group LLC (ESRG) is providing an as-built final revision of this document based on an “as-built” system. This document should not be provided externally until agreed by all responsible parties.

The industry, related technology, and best practices are rapidly evolving and changing regularly. It has been observed that changes often occur to a project through the construction phase, be they to the battery itself or to the balance of system. As such, an “as-designed release” document should be considered final only if no changes are made to the system from design to construction to completion. If it is 100% accurate it will be released unchanged. However, should ESRG encounter deviations from the design, the document will be amended accordingly per the design changes and then released as a final document.

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DEFINITIONS

ACRONYMS

AR	Arc-Rated
AHJ	Authority Having Jurisdiction
BMS	Battery Management System
COD	Commercial Operations Date
E-Stop / EPO	Emergency Stop / Emergency Power Off
ERP	Emergency Response Plan
EMS / ESMS	Energy Management System / Energy Storage Management System
ERG	Emergency Response Guide (generic, product-level emergency response guide)
ESRG	Energy Safety Response Group
ESS / BESS	Energy Storage System / Battery Energy Storage System
FACP	Fire Alarm Control Panel
FCC	Fire Command Center
FDC	Fire Department Connection
IC	Incident Commander
ICP	Incident Command Post
ICS	Incident Command System
kW	Kilowatt(s)

kWh	Kilowatt-hour(s)
LFL / LEL	Lower Flammability Limit / Lower Explosive Limit
LFP	Lithium Iron Phosphate
LOCA	Letter of Conditional Acceptance
MW	Megawatt(s)
MWh	Megawatt-hour(s)
NCA	Nickel Cobalt Aluminum Oxide
NMC	Nickel Manganese Cobalt Oxide
O&M	Operations and Maintenance
PCS	Power Conversion System
PPE	Personal Protective Equipment
SCBA	Self-Contained Breathing Apparatus
SDS	Safety Data Sheet
SME	Subject Matter Expert
SOC	State of Charge
UC	Unified Command
UFL / UEL	Upper Flammability Limit / Upper Explosive Limit

ROLES AND RESPONSIBILITIES

Site Owner	The owner of the premises upon which the battery system is installed.
Site Operator	The entity responsible for site operations.
Incident Commander (IC)	The person responsible for the overall management of the incident and determines which Command or General Staff positions to staff to maintain a manageable span of control and ensure appropriate attention to the necessary incident management functions.
Subject Matter Expert (SME)	A person appointed by the site owner or operator to respond to the Fire Department technical requests or questions about the battery system.
Remote Monitoring Facility / Operations Center	Facility providing 24/7 remote monitoring of the battery Energy Storage Management System (ESMS) and provides notification to the System Owner and battery manufacturer.

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1 INTRODUCTION

1.1 Scope and Purpose

This Emergency Response Plan (ERP) is provided for the West Haven Battery Energy Storage System (ESS or BESS) facility located within West Haven, Connecticut. The purpose of this document is to provide guidance and pertinent information regarding the roles, responsibilities, and chain of communication and command for the System Owner / Operator, Property Owner, and other required Subject Matter Experts (SMEs) to prepare for, and safely respond to a fire, explosion, or other battery-related incident requiring a public safety response at the energy storage facility.

On-site personnel include the EPE Construction Manager during construction. After COD, the project will be handed over to the LTSA provider. “On-site personnel” include all individuals on the facility property who are direct employees of the Owner / Operator or affiliated contractors. The Owner / Operator and contractors are similarly responsible for establishing and maintaining contractor-specific Emergency Response Plans and reporting procedures that will work in conjunction with the overall energy storage facility plan.

NOTICE	
	LIFE SAFETY SHALL BE THE HIGHEST PRIORITY DURING ANY TYPE OF EVENT

1.2 Timeframe

This ERP covers the timeframe beginning at final approval of the local permitting Authority Having Jurisdiction (AHJ) to the finalization of decommissioning and removal of the energy storage system.

1.3 Activation

This ERP shall be activated during any emergency response to a battery-related incident on site.

1.4 Agency Jurisdiction

This plan has been strictly developed for the responding Fire Department(s) and does not cover multi-agency response.

1.5 Incident Command System (ICS)

The Subject Matter Expert (SME) shall integrate into the Incident Command System (ICS) for an emergency.

The SMEs, Remote Monitoring Facility staff, and all energy storage system related personnel shall comply with the orders of the Incident Commander (IC) and the Command Staff

1.6 Operations and Maintenance (O&M)

Normal O&M procedures for the energy storage facility and associated equipment are outside the scope of this document. This ERP, however, is applicable to this facility during construction, commissioning, and throughout the project's lifespan.

Refer to manufacturer O&M manuals for all associated equipment related to the site prior to beginning any work on this installation.

1.7 ERP Update Process

1.7.1 Issuance and Revisions

Dates for draft issuance, revisions, and final issuance of this ERP are provided on Page 5 of this document.

1.7.2 Updates and Document Maintenance

Updates to this ERP based on any major material changes to the installation are the responsibility of the System Owner / Operator and any other relevant entities. All revisions to this ERP shall be recorded in alignment with Section 1.7.1 above.

1.7.3 Annual Review

During the operating lifespan of this installation, it is expected that this document shall be reviewed annually, with all pertinent information updated as required. A log of regularly scheduled annual reviews is provided in Appendix C of this document.

1.7.4 Plan Retirement

All decommissioning procedures should be performed by trained and knowledgeable persons in alignment with the Decommissioning Plan provided for this installation. Decommissioning shall be performed under supervision of the System Owner / Operator responsible for this installation.

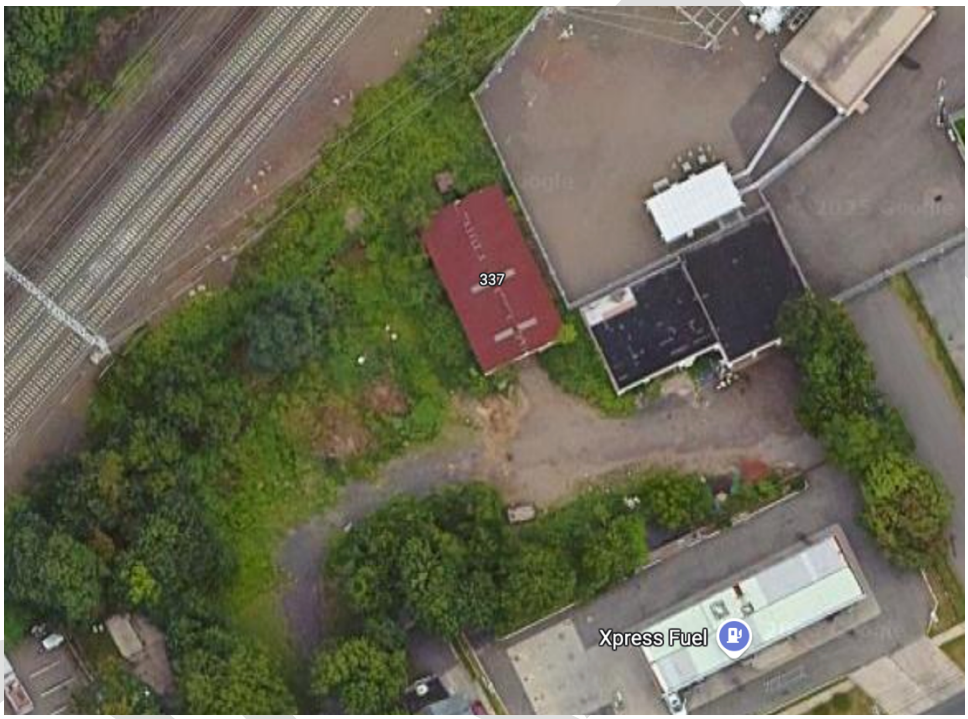
Notification of decommissioning shall be provided to the Fire Department by the System Owner / Operator and/or Subject Matter Expert responsible for this installation.

2 SITE DESCRIPTION

2.1 Site Location

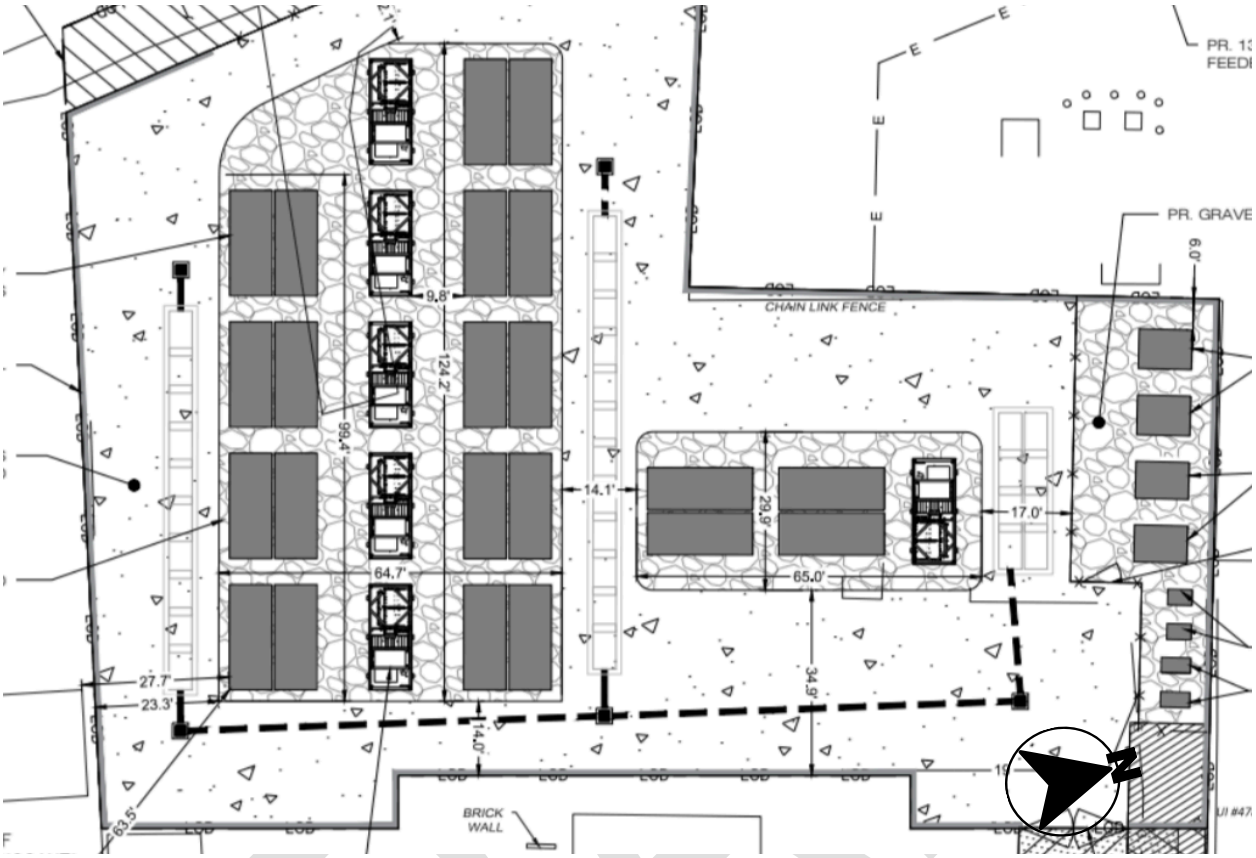
The West Haven BESS facility is located at 337 Elm Street, West Haven, Connecticut, 06516. Total site acreage is approximately .68 acres. Middletown MBLU is 42-293. The site sits in an NB "Neighborhood Business" zone. Fire department access to the site is provided via a 20' wide easement and gate located approximately 50' off of Elm Street.

Figure 1 - West Haven Site, Pre-Development Aerial View



SITE INFORMATION		
Site Address: 337 Elm Street, West Haven, Connecticut		
GPS Coordinates:	N 41* 16' 31.00" W 72* 57' 17.97"	**Special Flood Zone:** No

Figure 2 - Site Plan



The entire site is bordered by both a sound wall and a fence. A gravel access road surrounds the site equipment. The access easement driveway is 20.5 ft at its most narrow point.

2.2 Fire Department Access and Staging Area

The responding fire department(s) should begin staging at least 100 feet from the powered equipment until an assessment of incident severity demonstrates that such a separation distance can be reduced. If there is no visible flaming or smoking, responding units may proceed to the predetermined Fire Department Staging Area.

Fire Department access into the West Haven BESS is provided will be provided at the gate via a Knox Box. Final location to be determined during construction.

Figure 3 - FD Access and Knox Box

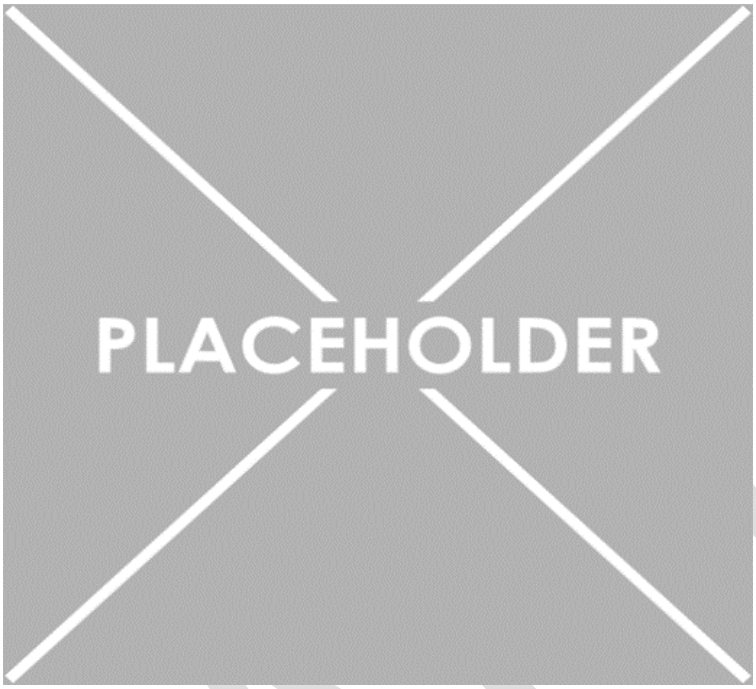
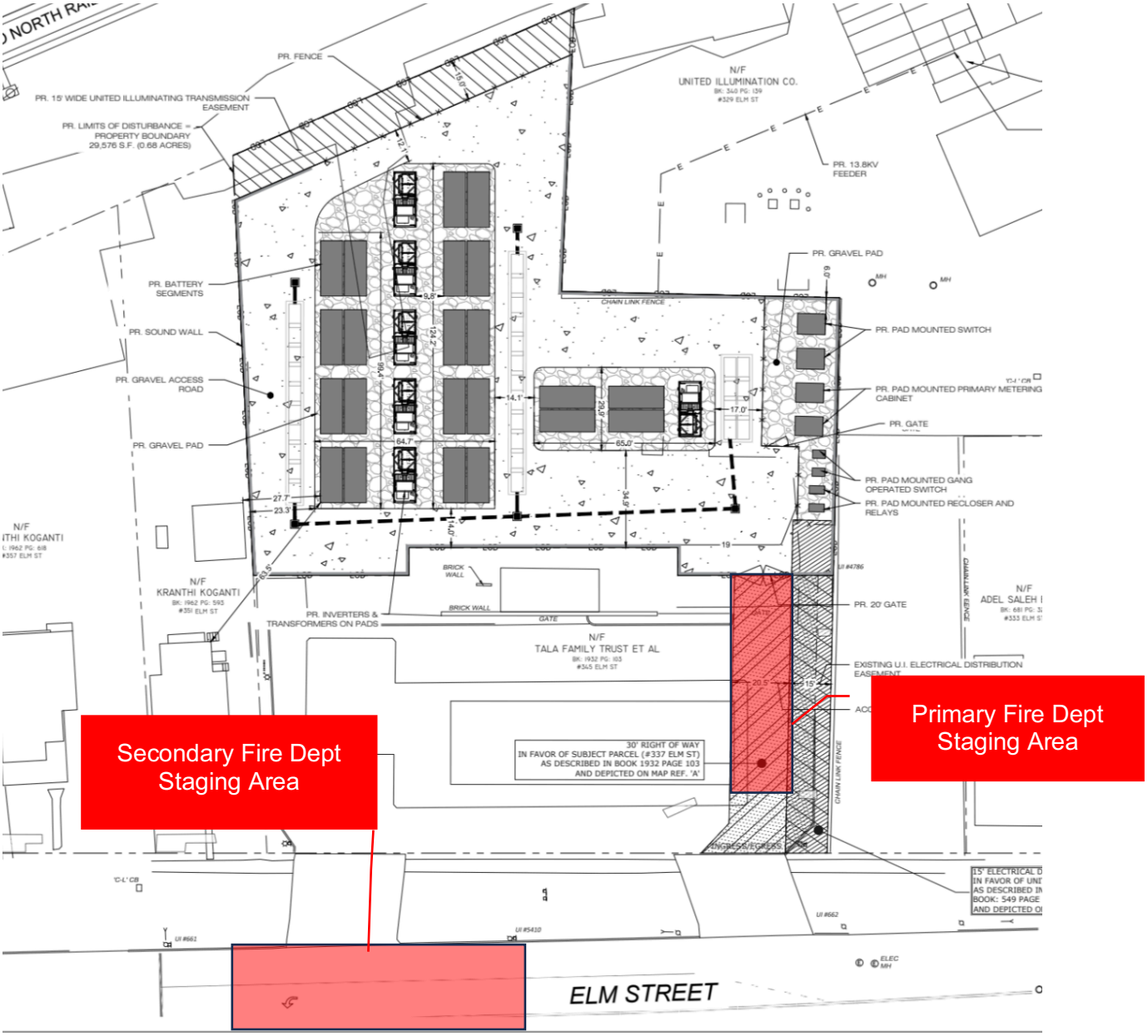


Figure 4 - Primary and Secondary Fire Dept Staging Areas



The Primary Fire Department Staging Area is in the easement driveway just outside of the main gate. This location provides access for initially responding fire apparatus. This places initially responding fire apparatus a minimum of 100 feet from any battery enclosure.

A Secondary Fire Department Staging Area may be determined by the Incident Commander during a fire event if the prevailing winds and smoke negatively impact the location of the primary staging area. Elm Street in either direction provides possible Secondary Fire Department Staging Areas.

NOTICE	
	The fire department should not attempt to approach the BESS enclosures unless there is a clear threat to life safety

2.3 Site Security Perimeter

Fire department access to the West Haven BESS is provided by a 20' wide gate within the driveway off Elm Street. The battery enclosure area is surrounded by a sound wall and perimeter fence.

2.4 Emergency Response Plan Access

Physical copies of the ERP, operational permits, O&M logs, product manuals, etc. will be provided to the Fire Department. Additional copies will be provided on site in a weatherproof enclosure.

2.5 Equipment Access

The PowerTitan 2.0 enclosures are only accessible for maintenance purposes via cabinet-style enclosure doors and cannot be physically entered by personnel at any time. Enclosure doors will be locked at all times, apart from during maintenance activities.

NOTICE	
	**<u>The Fire Department should not attempt to open enclosure doors at any time</u>**

2.6 Fire Department Water Supply

As part of the construction of this project, a private fire hydrant is being added on the north side of Elm Street, directly in front of 337 Elm.

Existing municipal fire hydrants are located along Elm Street:

- 220 ft west at Elm Street and Savin Avenue
- 410 ft east at Elm Street and Campbell Avenue

2.7 Nearby Exposures

The PowerTitan 2.0 units will be sited outdoors at grade level and the separation distances between enclosures within the secured facility meet or exceed the manufacturer's recommended separation distances.

A two-family home located at 351 Elm Street is located 63.5 ft to the south of the closest battery enclosure. Metro-North railroad lies to the west, with the closest rail being approximately 92 ft from the closest battery enclosure. To the north is fenced in United

Illumination outdoor electrical service equipment and switchgear. Approximately 74 feet to the south-east is a public gas station located at 345 Elm Street.

First Responder Staging Area

The Primary Fire Department Staging Area is in the easement driveway just outside of the main gate. This location provides access for initially responding fire apparatus. This places initially responding fire apparatus a minimum of 100 feet from any battery enclosure.

A Secondary Fire Department Staging Area may be determined by the Incident Commander during a fire event if the prevailing winds and smoke negatively impact the location of the primary staging area. Elm Street in either direction provides possible Secondary Fire Department Staging Areas.

2.8 Site Maintenance

The facility's access gate and interior access pathways shall be maintained to guarantee accessibility to the site for emergency personnel, especially during inclement weather. The System Owner / Operator shall ensure that applicable, ongoing upkeep activities are in place prior to construction (e.g., snow removal, landscaping, etc.).

3 ENERGY STORAGE SYSTEM

The Sungrow PowerTitan 2.0 is a modular, liquid-cooled stationary storage battery system used in medium and large-scale energy storage projects. The 19′-11″ x 8′ x 9′-6″ IP55-rated (NEMA 3S) enclosure utilizes a cabinet-style design, is fully populated by battery modules and associated electrical components and therefore cannot physically be entered at any time.

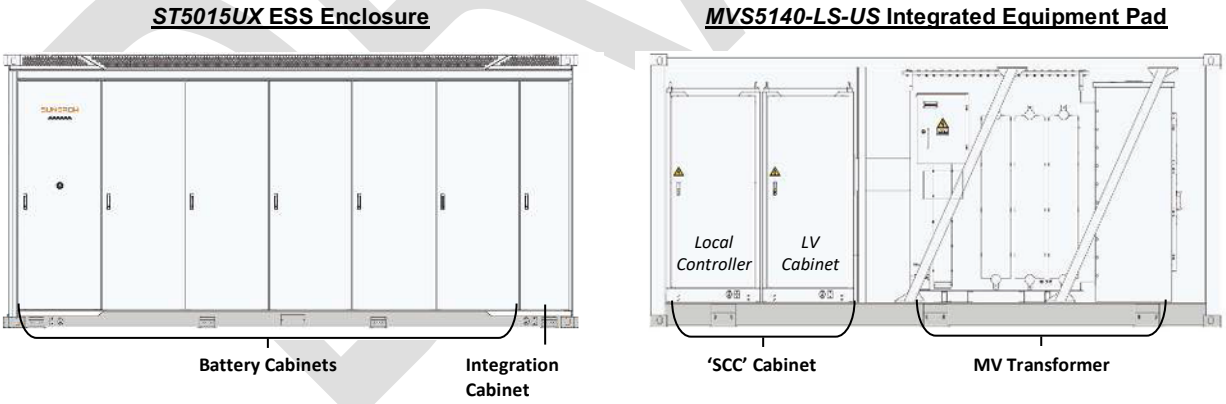
The system utilizes CALB L173F314 lithium iron phosphate (LFP) battery cells, which are packaged into battery modules (or "packs") consisting of 104 cells in series. Packs are contained within IP67-rated housing. Each PowerTitan 2.0 enclosure consists of twelve (12) racks (also referred to as clusters) for a total 48 battery packs and 4992 battery cells per enclosure. Each rack also includes a dedicated terminal box (TB) and Power Conversion System (PCS), as depicted in Figure 4 below. UL 9540A large-scale fire testing was conducted at the Cell, Module, and Unit level. The PowerTitan 2.0 is listed to UL 9540 (3rd Ed.)

WARNING: Risk of Re-ignition	
	Do **NOT** assume the fire is out as the fire event unfolds. A lithium-ion battery fire, which has seemingly been extinguished, may flare up again if all cells within the enclosure have not been completely consumed. The risk of battery re-ignition can remain present for hours or even days after the smoke / flame is initially detected.
WARNING: Risk of Explosion / Deflagration	

	An explosion / deflagration / overpressure event is a critical hazard, and any emergency on site should always be addressed with full awareness of potential factors which may lead to such an event. **<u>Any failure or alarm condition should result in the assumption of an explosion risk.</u>**

Figure 5 - Typical Sungrow PowerTitan 2.0 (ST5015UX) Enclosure

Figure 6 - Sungrow PowerTitan 2.0 Configuration Overview



The West Haven BESS utilizes 22 PowerTitan 2.0 units, each with 4-hour discharge durations, providing a total of approximately 15 MW / 60 MWh of energy storage power and capacity to the electrical grid.

3.1 Battery Cell

The PowerTitan 2.0 utilizes CALB prismatic LFP (lithium iron phosphate) battery cells, nominally rated 314Ah and 3.2V (model № *CBC00*). Battery cells are listed to UL 1973.

3.2 Battery Module / Pack

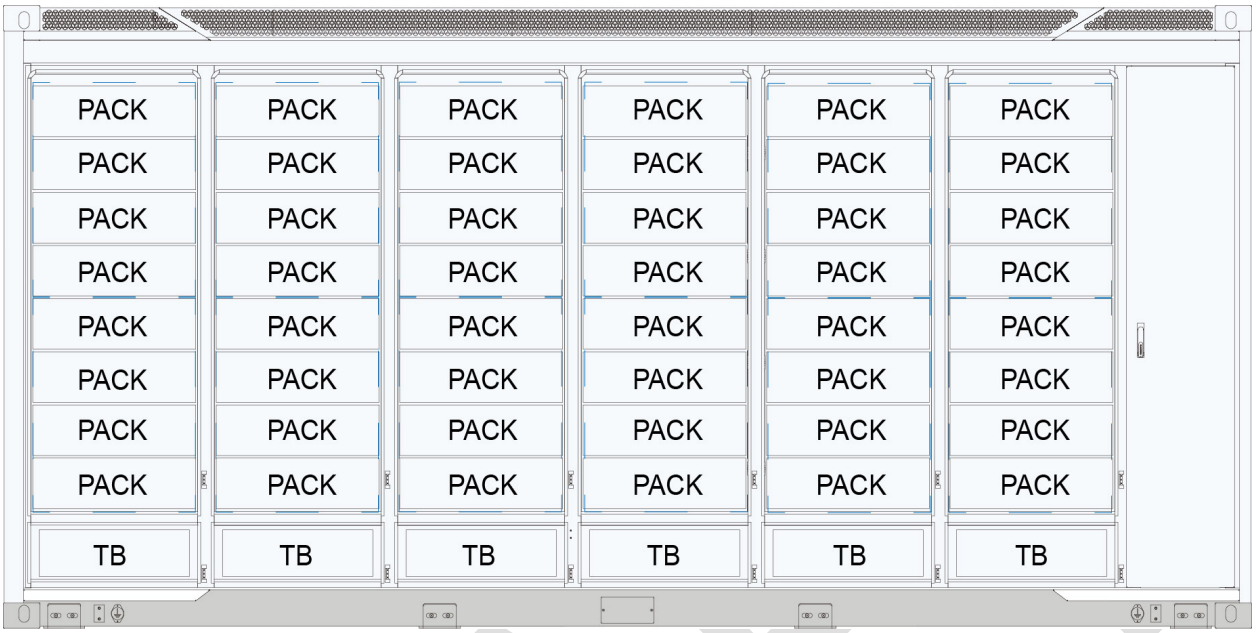
The PowerTitan 2.0 utilizes Sungrow battery modules, nominally rated 314Ah and 332.8V, consisting of 104 cells in series (model № *P1044AL-AHA*). Aerogel separation is provided to limit thermal propagation to adjacent cells. Battery modules are listed to UL 1973.

3.3 Battery Racks / Clusters

The PowerTitan 2.0 includes a total of 12 battery racks (also termed “clusters” by Sungrow), nominally rated 418kWh and 104.5kW, consisting of four (4) battery packs in series before terminating at a parallel connection. Enclosures are configured with two rack clusters stacked within each of the six (6) battery cabinet bays, with a dedicated terminal box and PCS at the bottom of each cabinet – 12 PCS (one per rack) in the 2-hr model, and six (6) PCS in 4-hr model (two per rack).

Figure 7 - PowerTitan 2.0 Battery Cell, Pack, Rack

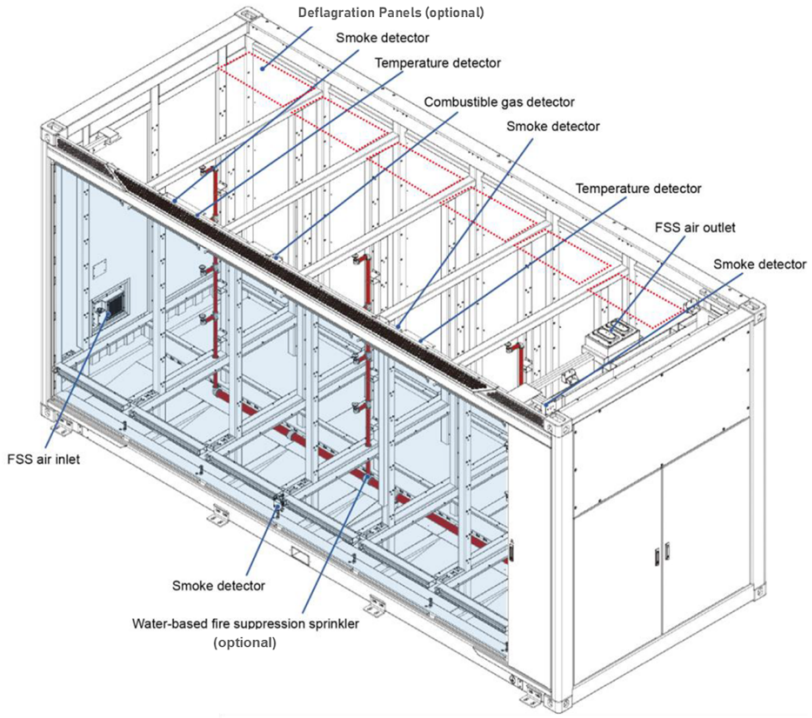
Figure 8 - Example Battery Stack Configuration



3.4 Fire Protection Features

The Sungrow PowerTitan 2.0 comes equipped with a number of built-in and optional fire safety features, the collection of which is designated by Sungrow as the “Fire Suppression System” (FSS). The FSS is designed to mitigate the propagation of a battery failure or potentially prevent the failure from occurring altogether. Two variants of FSS are available, each consisting of different configurations of protection systems to meet the specific customer requirements. The presence of the emergency ventilation system and other layers of protection drastically minimizes but cannot fully eliminate the possibility of an overpressure incident during a failure or fire event. First responders should exercise caution and always include that possible risk when developing their Incident Action Plans and Incident Safety Plans.

Figure 9 - Example Sungrow PowerTitan 2.0 Enclosure and Fire Protection Features



3.4.1 Heat and Smoke Detection

Four (4) smoke detectors and two (2) heat detectors, are provided as depicted in Figure 9 above. Smoke and heat detectors are listed to UL 268 and UL 521, respectively. Signals from the detectors are transmitted to the enclosure “Mini” FACP which communicates with the Battery System Controller (BSC), Local Controller (LC), and site-level Station FACP.

In the event of a single heat or smoke detector activation, a level 1 alarm is raised, resulting in automatic shutdown of the alarm battery cabinet. In the event that both smoke and heat detectors are activated simultaneously, a level 2 alarm is raised, resulting in shutdown of the whole block system. If the customer chooses to include the optional sounder beacon, this shall be triggered upon activation of either heat or smoke detection.

3.4.2 Gas Detection (Optional)

The PowerTitan 2.0 may also be equipped with Li-ion Tamer combustible gas detection system located in the center of the enclosure ceiling. The Li-ion Tamer system is sensitive to lithium-ion battery electrolyte vapor released during early stages of thermal runaway and is calibrated to trigger at 10% LEL, activating both alarms and optional exhaust ventilation system to remove flammable gas from the enclosure. Corresponding alarms will be sent to the FACP, BSC, LC, and responsible party.

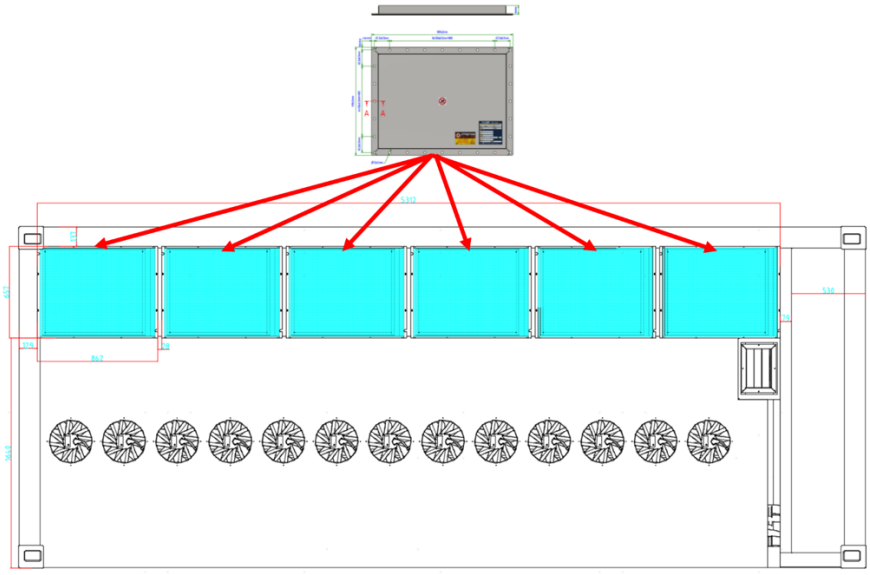
3.4.3 Deflagration Vent Panels (Optional)

The PowerTitan 2.0 can optionally be configured to come with six (6) passive deflagration vent panels designed in accordance with *NFPA 68 Standard for Explosion Protection by Deflagration Venting*. In the event of a potential explosion within the enclosure, the panels are intended to direct any blast overpressure upwards and away from the direction of any nearby exposures or emergency personnel who may be arriving on-site. In the event that the relief panels open, the BSC also transmits an alarm signal / feedback signal to the LC and the block system is shutdown.

Computational fluid dynamics modeling was performed for the PowerTitan 2.0, demonstrating that the panels shall adequately manage a deflagration event should it occur. It is also noted that routine maintenance (such as snow and ice removal) may be required to ensure vent panels are able to function properly during winter months.

WARNING: Electrical Shock Hazard	
	In case of flooding, stay out of the water if any part of the BESS or wiring is submerged.
CAUTION: Risk of Stranded Energy	
	Shutting off power to the BESS does not de-energize the battery and shock hazard may still be present. Always treat the batteries as Energetic Hazardous Materials, as they may maintain their State of Charge (SOC) long after the removal of power to the overall BESS.
WARNING: Risk of Fire and Explosion	
	Risk of fire or explosion may be present in the event of a battery failure. The Fire Department should not attempt to engage with any site or enclosure E-stops. Assistance in shut down should be provided by the System Owner / Operator and any other required SMEs.

Figure 10 – Optional Deflagration Vent Panels



3.4.4 Exhaust Ventilation System (Optional)

The PowerTitan 2.0 may also be equipped with an optional exhaust ventilation system designed in accordance with *NFPA 69: Standard on Explosion Prevention Systems* to remove flammable gas from the enclosure before an explosive atmosphere is allowed to accumulate. The system consists of one exhaust fan with rated flow rate of 750 m^3/h (441 CFM). In the event that the flammable gas detector is activated, the FSS air intake equipment and FSS exhaust equipment are triggered.

Computational Fluid Dynamics (CFD) modeling was performed for the PowerTitan 2.0 exhaust ventilation system, demonstrating that the system shall effectively reduce average concentration of flammable gases below 25% LFL.

3.4.5 Internal Sprinkler System (Optional)

The Sungrow PowerTitan 2.0 may also be equipped with an optional internal water-based sprinkler system. This system consists of internal piping from a DN50 interface at the bottom of the battery enclosure leading to 12 fused sprinkler heads (see Figure 9 above).

While water has proven to provide the most effective means of cooling to batteries undergoing thermal runaway, it will generally not completely extinguish a battery fire and, depending on the extent of the failure, may cause additional electrical shorting or prolong the incident significantly. Based on current large-scale fire testing and real-world incidents involving ESS, direct application of water inside the battery enclosures is generally not recommended.

If the optional system is installed, it is important to note that external piping should be properly designed and provided by the customer at a safe distance such that any responding first responders do not need to directly approach and engage with the DN50 interface directly on the ESS enclosure, as there may be risk of fire or explosion.

3.4.6 Battery Management System (BMS)

An integrated Battery Management System (BMS) monitors key datapoints such as voltage, current, and state of charge (SOC) of battery cells, in addition to providing control of corrective and protective actions in response to any abnormal conditions. Critical BMS sensing parameters include battery module over / under voltage, cell string over / under voltage, battery module over temperature, temperature signal loss, and battery module over current. In the event of any abnormal conditions, the BMS will first raise an informational warning, and then trigger a corresponding corrective action should certain levels be reached.

The Sungrow Battery Management System (BMS) adopts a three-level management structure design consisting of the following:

- **Battery Management Unit (BMU):** Manages a battery module, monitors battery status (voltage, temperature, etc.), and provides communication interface for the battery.
- **Battery Cluster Management Unit (CMU):** The battery cluster management unit realizes daily management and monitoring of battery clusters.
- **Battery Management System Controller (BSC):** Built into the BSP in battery cabinet and manages battery clusters within a single battery cabinet.

3.5 Fire Suppression System (FSS) Variants

As discussed above, two FSS variants (FSS1 and FSS2) are available to meet specific installation needs. Each consists of different configurations of fire protection features and control logic, as briefly described below.

3.5.1 FSS Variant 1 (Standard)

The standard FSS variant (FSS1) includes heat and smoke detectors, Fire Alarm Control Panel (FACP), and deflagration vent panels. Additional features which may include flammable gas detectors, flammable gas detection modules, sounder beacons, sprinkler heads, and a ventilation system.

Figure 11 - Communication of FSS1

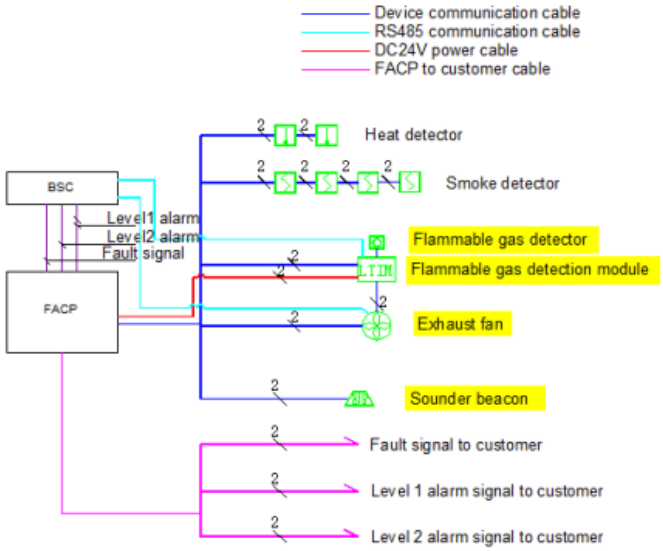
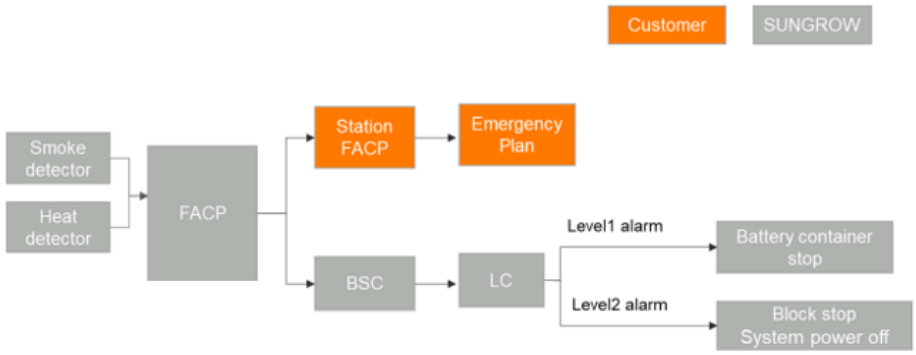


Figure 12 - FSS1 Fire Signal Control Logic (Standard and Optional Versions)

a) FSS1 Fire Signal Control Logic (Standard Version)



b) FSS1 Fire Signal Control Logic (Optional Version)

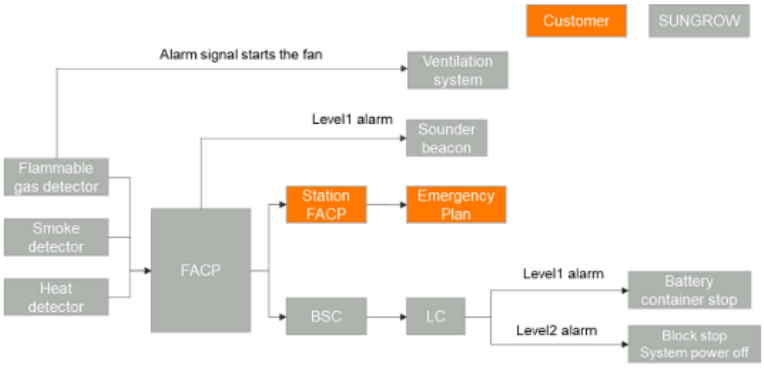
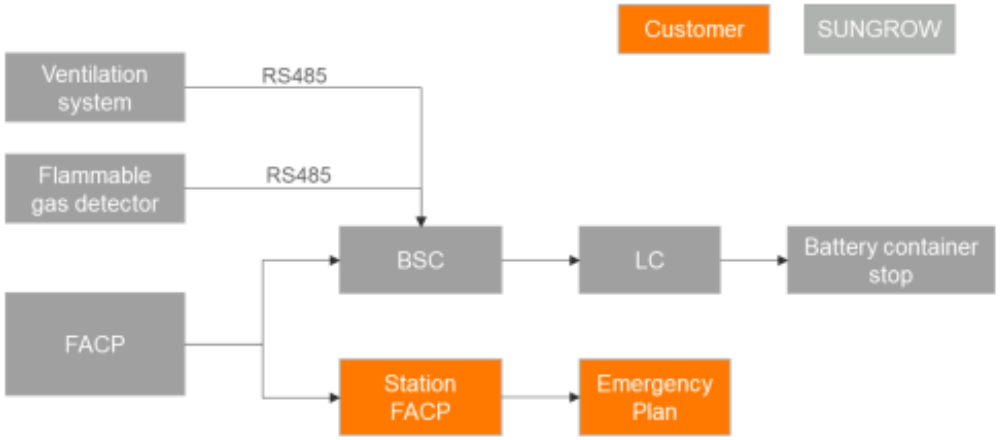


Figure 13 - Fault Signal Control Logic



3.5.2 FSS Variant 2 (Non-Standard)

The non-standard FSS variant (FSS2) includes heat and smoke detectors, six (6) explosion vent panels, a flammable gas detector, a flammable gas detection module, an I/O module, and a ventilation system.

Figure 14 - Communication of FSS2

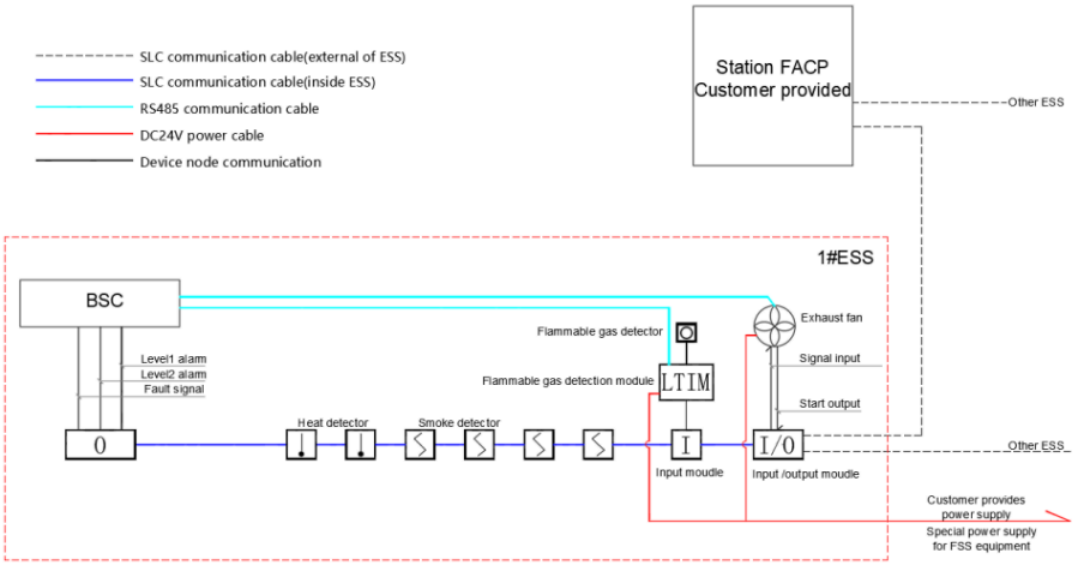


Figure 15 - FSS2 Fire Signal Control Logic

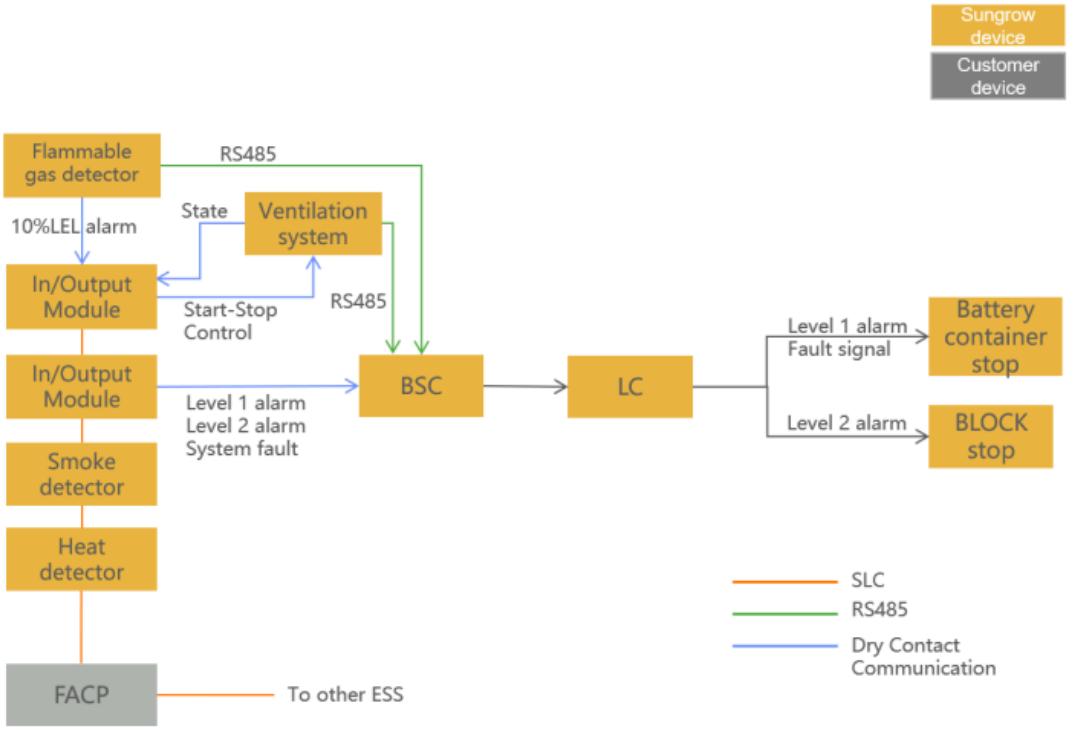
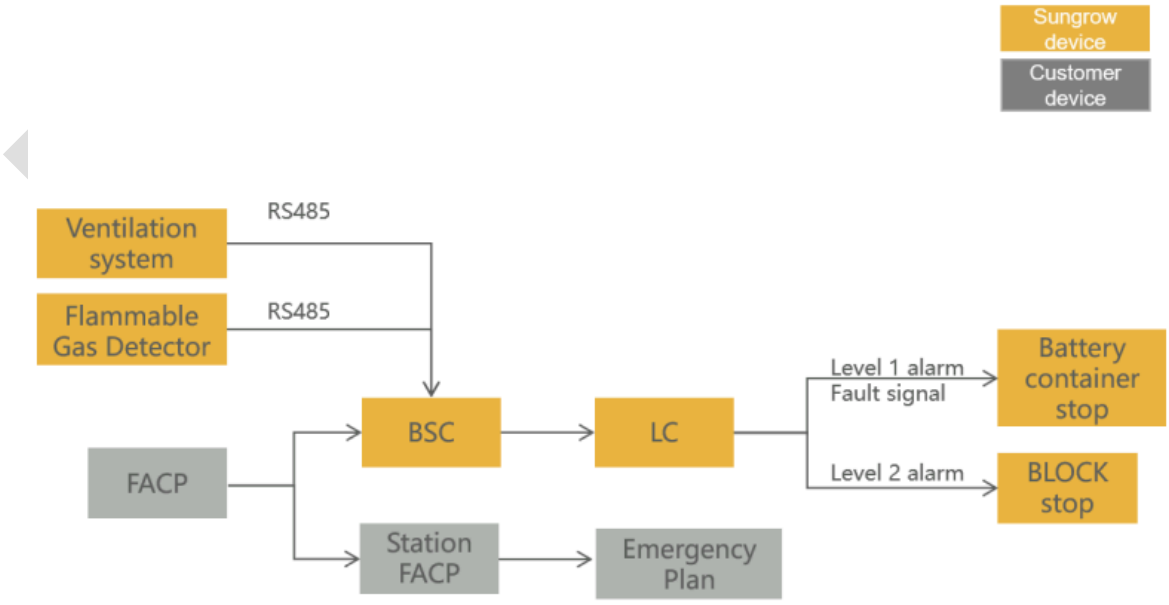


Figure 16 - FSS2 Fault Signal Control Logic



4 HAZARDS ASSOCIATED WITH LI-ION BATTERY ESS

Lithium-ion battery failures pose several major risks, as are briefly described in the sections below. Specific response procedures for different incident scenarios are provided in Section 8 of this document.

4.1 Thermal Runaway

The defining characteristic of lithium-ion battery failures is an event known as thermal runaway. Thermal runaway is a chemical process where self-heating in a battery exceeds the rate of cooling causing high internal temperatures, melting, off-gassing / venting, and in some cases, fire or explosion. Thermal runaway can be caused by thermal, mechanical, and electrical abuse; an internal short circuit from manufacturing defects; or the development of metallic dendrites over time that form an internal short circuit.

Flammable and potentially explosive gases – generally white in color – typically evolve when an ESS goes into thermal runaway and may be released in large quantities from battery cells or modules. Fire and explosive incidents may result, and precautions described in the following sections should be observed.

4.2 Fire and Re-ignition

Lithium-ion battery fires burn extremely hot (upwards of 1,000 – 1,500°C) and are generally not easily extinguished. Fire growth may be slow, fast, or ultra-fast (e.g., during a deflagration event) in nature, and may last for several hours before the battery modules are completely consumed. Furthermore, even when a lithium-ion battery fire appears to be fully extinguished, the risk of re-ignition may still be present hours or even days after there are no visible signs of fire.

Application of water directly to affected battery modules is not recommended and may potentially prolong the incident. In the event of a non-battery related fire or incipient fire, the decision to apply water should be made in coordination with the System Owner / Operator and any other required SMEs.

NOTICE	
	Indicators which may provide insight into what is happening or about to happen during an incident may include: ▪ Smoke or flames ▪ Changes in smoke color ▪ Changes in velocity or volume of smoke production ▪ Sounds – popping and / or hissing ▪ Smell – sweet odor

WARNING: Risk of Re-ignition	
	Do **NOT** assume the fire is out as the fire event unfolds. A lithium-ion battery fire, which has seemingly been extinguished, may flare up again if all cells within the enclosure have not been completely consumed. The risk of battery re-ignition can remain present for hours or even days after the smoke / flame is initially detected.

4.3 Explosion

Lithium-ion batteries release flammable off-gases during thermal runaway which, if allowed to accumulate within the enclosure, may create an explosive atmosphere, posing serious risk to first responders and nearby exposures. These gases may accumulate within the ESS enclosure at levels above the Lower Explosive Limit (LEL). At sufficiently high accumulations, gases can also exceed their Upper Explosive Limit (UEL), at which point ventilation may bring the environment back into flammable limits, creating a new explosion risk.

It may be difficult to discern conditions within the enclosure if smoke and gas are not visible outside of the enclosure. Furthermore, a single battery cell may release enough flammable off-gas to generate an explosive atmosphere within the enclosure. Therefore, any failure or alarm condition should always result in the assumption of a potential explosion risk.

WARNING: Risk of Explosion / Deflagration	
	An explosion / deflagration / overpressure event is a critical hazard, and any emergency on site should always be addressed with full awareness of potential factors which may lead to such an event. **Any failure or alarm condition should result in the assumption of an explosion risk.**

4.4 Electric Shock

Even if a battery may look to be destroyed by fire and / or other means, there is potential that the battery still contains stranded energy and remains energized. De-energization of the system or any removal of the battery or battery components shall only be performed by a trained and competent individual with appropriate PPE.

Normal overhaul of the ESS enclosure should not be attempted by the Fire Department under any circumstances, as there are considerations for handling damaged batteries requiring equipment and expertise not readily available. Once the scene is secured, these actions may be undertaken by trained experts under close supervision.

WARNING: Risk of Stranded Energy	
	Always treat the batteries as Energetic Hazardous Materials, as stranded energy is likely to remain present. Traditional Fire Department overhaul should not be conducted due to the potential for stranded energy.

4.5 Arc Flash

All ESS components and related electrical equipment shall always be treated as energized (Energetic Hazardous Material).

Appropriate PPE and training are required when working or accessing equipment within an Arc Flash Boundary. In general, when in direct proximity of the battery enclosure, wear a non-melting or untreated natural fiber long-sleeve shirt, long pants, safety glasses, hearing protection, and leather gloves. AR plant clothing is also acceptable. Maintain the Arc Flash Boundary until completion of any task.

4.6 Toxic Smoke and Gas Emission

Lithium-ion batteries may release large quantities of flammable and toxic gas when undergoing failure and pose an inhalation hazard. Materials and chemicals consumed during a thermal runaway event will produce copious amounts of smoke. The LFP cell vent gas composition will depend on several factors including state of charge and the cause of cell venting. Testing has demonstrated that LFP cells may release the following compounds when undergoing thermal runaway:

- Hydrogen (H_2)
- Carbon Monoxide (CO)
- Carbon Dioxide (CO_2)
- Methane (CH_4)
- Ethene (C_2H_4)
- Ethane (C_2H_6)
- Propene (C_3H_6)
- Propane (C_3H_8)

While some or all these compounds may be emitted during thermal runaway or a fire event, current data from a wide range of tests, as well as real world incident metering, reveal that these gases are comparable to those released from similar structure or commodity fires and do not pose a greater risk than those events. Additionally, studies have shown that toxic gas concentrations drop rapidly within a short distance from a failure location in low wind conditions.

The BESS site perimeter should not be entered during a fire or off-gassing event unless there is an imminent threat to life safety, at which time only properly trained and equipped public safety personnel may enter. This entry shall be with full firefighter protective gear including a self-contained breathing apparatus (SCBA).

A fog pattern from a handline or monitor nozzle may be an effective way to control the off-gassing event on the exterior of the battery container from migrating to unwanted areas. However, if water is used in extinguishing flames, these gases can become acids which may cause skin irritation.

WARNING: Toxic Gases	
	Large quantities of toxic smoke and gas may be emitted from the ESS during battery off-gassing or fire situations. **Proper PPE including SCBA should be worn by first responders.**

NOTICE	
	Typical composition of a battery off-gassing event may include: ▪ High concentrations (>10%) of Hydrogen, Carbon Monoxide, and Carbon Dioxide ▪ Lower concentration (<10%) of Methane, Ethane, or other flammable hydrocarbons

4.7 Additional Hazards and Considerations

For additional hazards associated with leaked coolant; leaked refrigerant; leaked electrolyte; emergency considerations during storage, operation, or transportation; first aid measures; or disposal procedures, please see product-level user manual.

5 EMERGENCY RESPONSE CONSIDERATIONS

5.1 Emergency Contacts

A list of emergency contacts associated with this installation is provided on page 3.

5.2 Personal Protective Equipment (PPE)

Full firefighter protective gear including SCBA shall be worn during response to any fire and / or explosion event or if there is any indication a fire may be present or likely to be present at any time during the event.

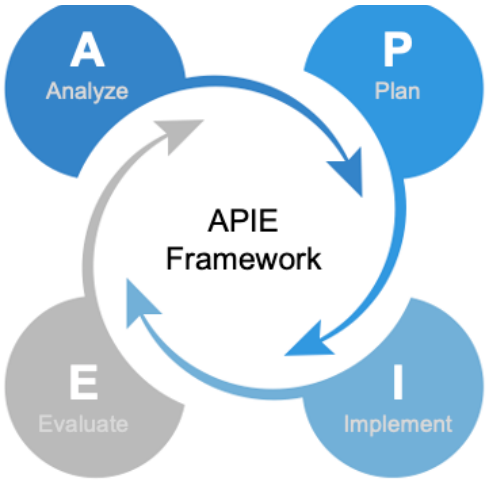
If there is no risk of fire or explosion present, arc-rated (AR) protective clothing to protect against arc flash and electrical shock shall be worn. Jewelry such as necklaces shall be removed to avoid contact with any electrical hazard.

Proper PPE shall include use of a Self-Contained Breathing Apparatus (SCBA)

5.3 APIE (Analyze, Plan, Implement, and Evaluate) Framework

APIE is a framework commonly used for emergency incidents to prepare and develop appropriate response protocol(s). The four elements of the framework are Analyze, Plan, Implement, and Evaluate. An example APIE framework with simplified sample details pertaining to an emergency incident is provided below:

Figure 17 - APIE Framework



Analyze: For first responder awareness, provide signs and monitoring signals that indicate incident escalation may take place (e.g., fire or explosion).

Plan: Delineate the danger zone to mitigate risks to first responders and bystanders (pedestrians, vehicular traffic, etc.).

Implement: Enforce protective actions; street closures; reduced pedestrian and first responder exposure; and other impact areas that have a life safety concern, as applicable.

Evaluate: Provide continuous incident monitoring and feedback and adjust accordingly to ensure ongoing safety of any bystander or responder in the impacted area.

5.4 General Size-Up

Initiation of emergency response shall be activated per current protocol. If there is any threat or potential threat to life or safety, 911 shall be called immediately to summon the aid of public safety responders. An initial scene assessment shall be conducted from all sides (360-degree scene size-up) if possible, and a clear, concise assessment shall be given to incoming responders. Hazards and facility safety concerns such as high voltage areas or other electrical concerns shall be communicated to all responders.

The scene assessment shall include the following in plain language (no codes or terms):

- Incident location
- What has happened
- What is occurring
- Any injuries or unaccounted for individuals
- Additional needs or other resources that may be necessary

The Incident Command System (ICS) shall be established immediately and shall include designation of roles. The Incident Command Post (ICP) shall be located at the Fire Department Staging Area. If Public Safety is summoned to the incident, the ICS shall incorporate a Unified Command (UC).

On-site staff (if applicable) shall immediately proceed to a designated muster point, which will be at the ICP location unless designated otherwise by the Incident Commander. Incident Command shall designate an individual to oversee personnel accountability. Accountability shall be reported as soon as possible. If available, another individual shall control any traffic and guide first responders to the scene.

At the same time as these activities are occurring, the designated SME shall immediately contact the ROC to obtain available data from the BMS and communicate this to the Incident Commander or other appropriate individual.

WARNING: Risk of Explosion / Deflagration	
	An explosion / deflagration / overpressure event is a critical hazard, and any emergency on site should always be addressed with full awareness of potential factors which may lead to such an event. **Any failure or alarm condition should result in the assumption of an explosion risk.**

WARNING: Toxic Gases	
	Large quantities of toxic smoke and gas may be emitted from the ESS during battery off-gassing or fire situations. **Proper PPE including SCBA should be worn by first responders.**

5.5 Determine Fire Protection Approach

The decision to provide thermal cooling via hose lines should be made in coordination with the System Owner / Operator and any other required SMEs.

Caution should be exercised if water is applied directly to the exterior of an affected ESS enclosure, as this will not stop a thermal runaway event and may potentially delay eventual combustion of the entire ESS product. Defensive firefighting tactics are generally recommended, with water being applied to nearby exposures for cooling, as necessary. Any hose line operations should be limited to hose and master stream application from outside of the site perimeter, as far back as hose stream ranges allow.

Critical safety systems – fire suppression, gas detection, active ventilation, and remote notification – require power to function correctly. These systems are powered by auxiliary power and, except for HVAC, are backed up by an uninterruptable power supply.

A fog pattern from a handline or monitor nozzle may potentially be utilized to control smoke and gases released from the affected enclosure and prevent them from migrating to unwanted areas.

In all instances, power shutdown and isolation involving any high voltage feeder lines must be confirmed before any defensive measures are taken involving application of water to the site.

WARNING: Risk of Re-ignition	
	Do **NOT** assume the fire is out as the fire event unfolds. A lithium-ion battery fire, which has seemingly been extinguished, may flare up again if all cells within the enclosure have not been completely consumed. The risk of battery re-ignition can remain present for hours or even days after the smoke / flame is initially detected.

5.6 Incident Monitoring and Evaluation

Continuous incident monitoring and feedback should be provided as the situation evolves. Consultation with the System Owner / Operator, and any other required SMEs, should be ongoing to guide incident response and determine appropriate next steps.

If available, real-time BMS data from the ROC should be utilized (e.g., temperature, voltage, or other critical measurements) to monitor the spread of failure and assess the health of adjacent ESS units. This data will help guide response procedures as the event unfolds.

6 INCIDENT SCENARIOS

6.1 Explosion Incident

Lithium-ion batteries release flammable off-gases during thermal runaway which, if allowed to accumulate within the enclosure, may create an explosive atmosphere, posing serious risk to first responders and nearby exposures. Furthermore, it may be difficult to discern conditions within the enclosure if smoke and gas are not visible outside of the unit.

In the case of a fire or thermal runaway event, an explosive or deflagration event may occur, potentially subjecting personnel to overpressure and projectile hazards. An initial exclusion zone should be established to guard against any blast overpressure, based on the discretion of the Incident Commander. Fire Department staging and operations should not be in direct alignment with the ESS units and should be established at angles relative to the sides of the enclosures, if possible. If available, shielding via the built environment should be utilized to protect against high temperatures, overpressure events, or projectile hazards.

A safe stand-off distance shall be maintained between individuals and the BESS enclosure(s) exhibiting fire conditions. Staging of personnel and equipment shall be located at angles relative to the ESS enclosure(s) to stay out of the potential blast radius of any enclosure doors or other possible projectiles.

WARNING: Risk of Explosion / Deflagration	
	An explosion / deflagration / overpressure event is a critical hazard, and any emergency on site should always be addressed with full awareness of potential factors which may lead to such an event. **Any failure or alarm condition should result in the assumption of an explosion risk.**

6.2 Fire Incident

A safe stand-off distance shall be maintained between individuals and the ESS enclosure(s) exhibiting fire conditions. Staging of personnel and equipment shall be located at angles relative to the ESS enclosure(s) to stay out of the potential blast radius of any enclosure doors or other possible projectiles. Attempt to extinguish the fire only if imminent threat to life safety exists.

If there is no immediate threat to life safety:

1. Allow the BESS to burn in a controlled fashion until all fuel sources inside are depleted.
2. A defensive approach should be considered, utilizing water to cool and protect adjacent exposures and to mitigate the spread of fire to areas outside of the fenced installation.

3. Manage the fire incident by utilizing the reach of the hose stream to protect exposures and control the off-gassing and smoke from the enclosure.
4. Remember that, even after the BESS is isolated from the electric grid, there may still be considerable stored energy in the batteries that poses a potential electric shock hazard to anyone in the nearby vicinity.

Additionally, chemicals released during a fire or explosion event will be in a gaseous form and primarily pose an inhalation hazard. A fog pattern from a handline or monitor nozzle may provide an effective means of controlling any off gases outside of the battery enclosure from migrating to unwanted areas such as public muster points, emergency responders, building intakes, etc.

If a fire develops inside of the enclosure, ESRG recommends applying water to adjacent exposures only as necessary in a defensive manner, rather than aggressively attacking the fire in the burning unit. The fire inside the enclosure is protected by several layers of metal and therefore, water does not have direct access onto the batteries. As such this will not stop the thermal runaway event and may only delay the eventual combustion of the entire BESS.

A battery fire may continue for several hours, or days, and it may take even longer for the battery packs to cool after it has been fully consumed by a thermal runaway event. A lithium-ion battery fire that has been seemingly extinguished can flare up again if all cells have not been consumed. ESRG recommends you allow the BESS product to fully consume itself and then cool the burned system by flooding it with water.

After all fire and smoke has visibly subsided, a thermal imaging camera can be used to actively measure the temperature of the unit from outside the enclosure. These findings can be relayed to the SME, ROC and IC to determine additional steps.

Hose streams may be also applied to adjacent exposures for cooling purposes. BMS data for the adjacent system(s) – available via the ROC – should be closely monitored for any indications of heat impact or water damage to any adjacent BESS units and relayed to the appropriate individual within the Incident Command System.

Following partial or complete consumption of the system by fire, batteries may continue to emit flammable and toxic gases for an extended period. Continuous monitoring of gas levels in and around the incident location is recommended. Full firefighter PPE and SCBA shall be utilized until gas levels are confirmed to be at a safe level. A fire watch shall be provided to ensure the continued safety of the site after the situation appears stable.

WARNING: Risk of Re-ignition	
	Do **NOT** assume the fire is out as the fire event unfolds. A lithium-ion battery fire, which has seemingly been extinguished, may flare up again if all cells within the enclosure have not been completely consumed. The risk of battery re-ignition can remain present for hours or even days after the smoke / flame is initially detected.

6.3 Thermal Runaway or Off-Gassing Incident

A thermal runaway incident, as described in Section 6.1, is the characteristic failure mode of lithium-ion batteries. A thermal runaway event may begin suddenly, and the nature of the situation may evolve rapidly depending on several different factors. Combustion of flammable gases may result in fire or explosion, and considerations in Section 8.1 and Section 8.2 should be implemented based on the nature of the event as it unfolds.

A thermal runaway event may result in large quantities of smoke and gas being released, which may or may not be visible outside of the BESS enclosure itself. Therefore, it is critical that any failure or alarm condition results in the assumption of an explosion or fire risk.

Under normal conditions, venting of electrolyte should not occur in an LFP cell. However, if subjected to abusive conditions or external heating an LFP cell can vent its electrolyte and electrolyte decomposition products as vapor. Each LFP cell contains a safety vent to provide a controlled release of internal pressure during abnormal conditions.

Vented gasses may be flammable and may ignite upon contact with a competent ignition source such as an open flame, spark or hot surface.

In the event of a thermal runaway or suspected off-gassing event, the following actions should be taken:

1. Move personnel to a safe location at a sufficient distance from the troubled enclosure.
2. If the alarm system has not already signaled the Fire Department, immediately call 911.
3. Call the Subject Matter Expert (SME) designated for the site.
4. Call the ROC listed on page 3.
5. Establish a safety perimeter around all sides of the ESS and remain outside the fenced area. Based on conditions, the safety perimeter may extend beyond the boundary of the fenced area. Stay upwind of any smoke or off-gassing. Do not allow personnel other than firefighters in proper PPE to enter the safety perimeter.
6. As the incident evolves, a fire or explosion event may occur. Procedures outlined in Section 8.1 and Section 8.2 should be followed based on the situation as it progresses.

WARNING: Risk of Explosion / Deflagration	
	An explosion / deflagration / overpressure event is a critical hazard, and any emergency on site should always be addressed with full awareness of potential factors which may lead to such an event. **Any failure or alarm condition should result in the assumption of an explosion risk.**

WARNING: Risk of Re-ignition	
	Do **NOT** assume the fire is out as the fire event unfolds. A lithium-ion battery fire, which has seemingly been extinguished, may flare up again if all cells within the enclosure have not been completely consumed. The risk of battery re-ignition can remain present for hours or even days after the smoke / flame is initially detected.

WARNING: Toxic Gases	
	Large quantities of toxic smoke and gas may be emitted from the ESS during battery off-gassing or fire situations. **Proper PPE including SCBA should be worn by first responders.**

NOTICE	
	Indicators which may provide insight into what is happening or about to happen during an incident may include: ▪ Smoke or flames ▪ Changes in smoke color ▪ Changes in velocity or volume of smoke production ▪ Sounds – popping and / or hissing ▪ Smell – sweet odor

6.4 Alarm Incident

In the event of an alarm activation, the following actions should be taken:

1. Move personnel to a safe location at a sufficient distance from the troubled enclosure.
2. If the alarm system has not already signaled the Fire Department, immediately call 911.
3. Call the Subject Matter Expert (SME) designated for the site.
4. Call the ROC listed on Page 3
5. Establish a safety perimeter around all sides of the ESS and remain outside the fenced area. Based on conditions, the safety perimeter may extend beyond the

boundary of the fenced area. Stay upwind of any smoke or off-gassing. Do not allow personnel other than firefighters in proper PPE to enter the safety perimeter.

Note: Depending on prevailing weather conditions, the safety perimeter may have to be adjusted/shifted. The Incident Commander may determine a secondary safety perimeter depending on the severity of the event and wind impact.

6.5 External Fire / Thermal Exposure Incident

Any type of external heat source or fire impingement (i.e., not stemming from the battery system itself) should be treated as an BESS emergency. The Incident Commander should be advised to obtain information on BESS state of health from the BMS data (e.g., increasing temperature in exposed BESS units) – available from the ROC – to evaluate severity of the incident. All precautions previously noted for fire and explosion incidents should be followed.

6.6 Emergency Response During Construction, Commissioning, and Maintenance

The PowerTitan 2.0 is shipped with battery modules installed and partially charged. This is not uncommon throughout industry but poses some challenges to emergency response which may not exist during normal operations. Once the batteries arrive, there will be some period until the fire protection system is fully commissioned, tested and verified.

During this period, fire service personnel should expect to interface with an SME, but no data regarding the conditions inside the enclosures may be available. As such, fire service personnel should take extreme caution when approaching any system which may be experiencing adverse conditions during this phase. Further, information regarding conditions in adjacent containers (relevant in the event of fire) may not be available. Fire service personnel should lean on their own experience and stakeholder expertise to determine risks to adjacent containers and assume direct fire impingement poses an enclosure-to-enclosure propagation risk.

Between delivery and commissioning of the fire protection system safety features of the BESS may not all be fully functional. In cases where an adverse condition exists inside the system, it should be assumed an explosive condition exists until proven otherwise.

6.7 External Impact Incident

If an enclosure is severely impacted, causing crushing or puncturing of the outer shell of the enclosure, treat this as an emergency – notify 911 and any other required parties.

7 POST-INCIDENT / HANDOFF PROCEDURES

7.1 Handoff Procedures

When an energy storage site is deemed safe, upon determination by the Incident Commander (IC), the Subject Matter Expert (SME) shall ensure that the site is safeguarded until the damaged system is removed, repaired, or replaced based on the approved Decommissioning Plan filed with this installation. Return of facility control from First Responders to an owner/operator for the purpose of commercial operation should occur only after damaged cells have been removed and a hazard analysis completed.

7.2 Activation of Decommissioning Plan

Decommissioning of the system shall take place in accordance with the approved Decommissioning Plan filed with this installation. Deactivation, de-energizing, dismantling, and removal of the system shall be conducted by trained and knowledgeable persons in accordance with manufacturer's specifications.

APPENDICES

APPENDIX A – Additional Site Photos

Figure A1 – Additional Site Photos

APPENDIX B – Signage / Placarding / IO Matrix

Figure B1 – Facility Signage / Placarding

Figure B2 - I/O Matrix

APPENDIX C – Annual ERP Review Log

The following table provides a log of reviews to be conducted on an annual basis for this Emergency Response Plan (ERP).

Date Conducted	System Owner Sign-Off	SME Sign-Off	Notes / Comments