CONVERGENT

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Revision Number 4

Warwick ES3
Warwick, NY

Emergency Response Plan

September 14, 2020

Revision Status

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CONVERGENT

Table of Contents

1	**EXECUTIVE SUMMARY**	**3**
1.1	Purpose	3
2	**DEFINITIONS**	**4**
3	**SITE DESCRIPTION**	**5**
3.1	Facilities Description	5
3.1.1	Facility Lighting and Security	5
3.1.2	Site Access Route	6
3.1.3	Site Surrounding Area	6
4	**CONVERGENT ORGANIZATION & RESPONSE PLAN**	**7**
4.1	Organizational Structure	7
4.2	Emergency Response	8
4.2.1	General Facility Emergency Shutdown	9
4.2.2	Fire or Thermal Event	9
4.2.3	Medical Emergency	11
4.2.4	Chemical Spill	11
4.2.5	Unauthorized Access	12
4.3	Facility Site Plan / Layout	12
4.4	Facility Evacuation	12
5	**EMERGENCY CONTACTS**	**13**
5.1	Site Contact List	13
5.2	Local Emergency Contact List	14
6	**SYSTEM SAFETY CONSIDERATIONS**	**15**
6.1	Voltage	15
6.2	Arc-Flash	16
6.3	Thermal Runaway	16
6.4	Fire	16
6.5	Toxicity	17
6.6	Explosion	17
7	**BATTERY INFORMATION**	**17**
7.1	Reservoir Storage Unit (RSU) Specifications	17
7.1.1	Battery Cell Protection	20
7.1.2	Battery Module Protection	20
7.1.3	Blade (String) Level Protection	21
7.2	Reservoir Inverter Unit (RIU) Specifications	21
7.3	Standards and Compliance List	22
7.3.1	Energy Storage System	22
7.3.2	Batteries / Battery Racks	22
7.3.3	Inverters	23
7.3.4	Supplemental Information	23
7.4	Battery management System (BMS)	23
8	**BATTERY FIRE PROTECTION SYSTEMS**	**24**
8.1	Fire Detection System	24
8.1.1	Smoke Detection	24
8.1.2	Horn/Strobe	25
8.2	Fire Suppression System (FSS)	25
8.3	Ventilation System	26

9	**FIREFIGHTING CONSIDERATIONS**	**27**
9.1	Small Battery Fire Response	28
9.2	Larger Battery Fire Response	29
10	**POST-FIRE CONSIDERATIONS**	**30**
11	**APPENDICES**	**30**
11.1	Project Site Plan	30
11.2	Battery Reservoir Storage Unit Specifications	30
11.3	Battery Reservoir Inverter Unit Specifications	30
11.4	Fire Suppressant Specifications	30
11.5	Transformer Oil	30

1 EXECUTIVE SUMMARY

1.1 Purpose

The purpose of this document is to detail the proper emergency responses to potential events at Convergent's Battery Energy Storage System (BESS), Warwick ES3 facility, located in the Village of Warwick, NY within the Orange and Rockland (O&R) service territory.

The following events are considered in this document:

- Site Description
- Convergent Response Plan
- Emergency Contacts
- Failure and Hazard Risk Analysis
- Battery System Information
- Firefighting and Post-Fire Considerations

This document shall be activated at the start of site construction activities and be in effect during commissioning, normal operations and through the decommissioning of the facility.

All alarms from the BESS will be under 24-Hour central data and visual monitoring by the Convergent Network Operations Center (NOC). In any event, Convergent will coordinate all the response as it pertains to the BESS facility. Convergent will directly contact local emergency responders including the Warwick Fire Department, as soon as an event requiring emergency response is reported, and the O&R control room will be notified in the event of an emergency but is not expected to perform any actions unless specifically requested.

In the event of an Emergency please call Convergent Energy & Power at 917-508-0275.

Convergent will periodically update this document with regards to input from stakeholders, Federal, county, and local requirements, and facility updates. Appropriate parties will be notified of any revisions to this document.

2 DEFINITIONS

BESS – Battery Energy Storage System

BMS – battery Management System

Convergent – Convergent Energy & Power

ERT – Emergency Response Team

E-Stop – Emergency Stop

FDS – Fire Detection System

FSS – Fire Suppression System

GE – General Electric

IEC – International Electrotechnical Commission

IEEE – Institute of Electrical and Electronics Engineers

NEC – National Electric Code

NEMA – National Electrical Manufacturers Association

NFPA – National Fire Protection Association

NOC – Network Operations Center

O&R – Orange & Rockland Utility Company

OSHA – Occupational Safety and Health Administration

PCB – Polychlorinated Biphenyls

PPE – Personal protective Equipment

RIU – Reservoir Inverter Unit

RSU – Reservoir Storage Unit

SCBA – Self-Contained Breathing Apparatus

UL – Underwriter Laboratories

3 SITE DESCRIPTION

3.1 Facilities Description

The Warwick ES3 BESS with total current nameplate rating of 4 MW / 17.9 MWh will be comprised of two identical energy storage blocks, with each block consisting of three (3) Reservoir Storage Units (RSU) connected to one Reservoir Inverter Unit (RIU) manufactured by General Electric (GE). The facility will also include an auxiliary transformer and switchboard, and a metal enclosed switchgear. A conceptual rendering of the facility is provided in Figure 1 below.

Figure 1: Facility Rendering

Each of the battery cabinets is designed to contain an integrated Fire Detection System (FDS) and Fire Suppression System (FSS) utilizing the Stat-X potassium-based aerosol solution, as well as fire alarms/strobe lights.

The BESS also incorporates a SCADA system that communicates all necessary operations data to the Convergent NOC. The BESS can also be operated remotely by the NOC via SCADA. The installed system is always connected in stand-by mode except when charging, discharging, or off-line for maintenance. The system is unmanned and controlled / operated remotely from Convergent Energy & Power's New York based NOC.

3.1.1 Facility Lighting and Security

The energy storage facility will be equipped with flood lighting for visibility after daylight hours and security cameras strategically placed for 24-Hour monitoring. The facility is also

proposed to be fenced around the perimeter and to have a Knox box with standardized locks for access inside the fence line buy the Warwick Fire Department. No individual shall be permitted to enter the facility without the express consent of Convergent.

3.1.2 Site Access Route

The facility shall be accessed via Church Street, off Forester Avenue in the Village of Warwick, NY. The access route for emergency services to the facility is as shown in Figure 2 below.

Figure 2: Site Access Route

A staging plan will be developed in agreement with the property owner and emergency services during commissioning of the facility to ensure all emergency responders can conveniently access the facility in parallel in the event of an emergency. The access road to the BESS site shall always be maintained to guarantee accessibility to the site by emergency personnel, especially during inclement weather. Convergent will ensure that maintenance contracts for snow removal, landscaping and other ongoing upkeep activities are in place by the start of the site development.

3.1.3 Site Surrounding Area

The parcel the facility is sited on is located on the east side of 28 Church Street, Warwick, NY 10990. The parcel features a commercial building with designated parking areas for around the building. Normal business hours for the building are 5am – 7pm. The land parcel

is flanked by private residential dwellings to the northeast, wetlands to the east, a railroad to the south, more commercial land parcels and to the West and the Warwick Fire Department conveniently located to the northwest.

A total of two (2) fire hydrants have been identified in proximity to the BESS site. These water sources are identified on the Facility Evacuation Plan in Section 4.4, Figure 6. The fire hydrant shall be periodically checked for compliance with NFPA 24.

Approved signage shall be provided on or adjacent to all BESS cabinets. The signage shall include the following verbiage or equivalent.

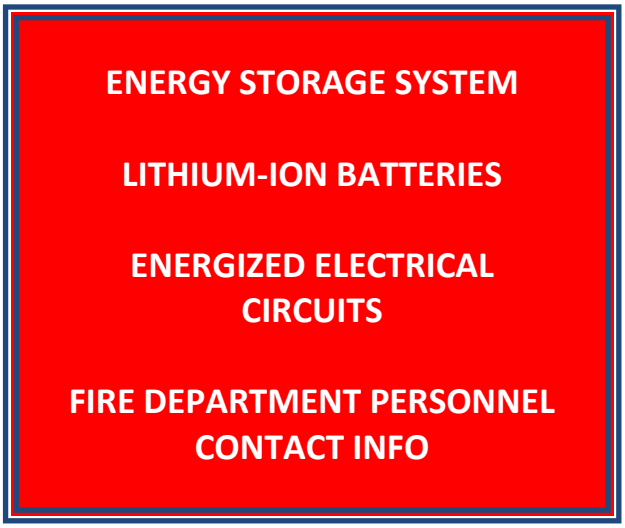

Figure 3: Typical Signage

4 CONVERGENT ORGANIZATION & RESPONSE PLAN

4.1 Organizational Structure

Convergent Emergency Response Team (ERT) shall manage and control the facilities remotely by monitoring and operating of both the BESS and interconnection equipment including all emergency alarms. A full Convergent ERT contact list is provided in Section 5.1, Table 1.

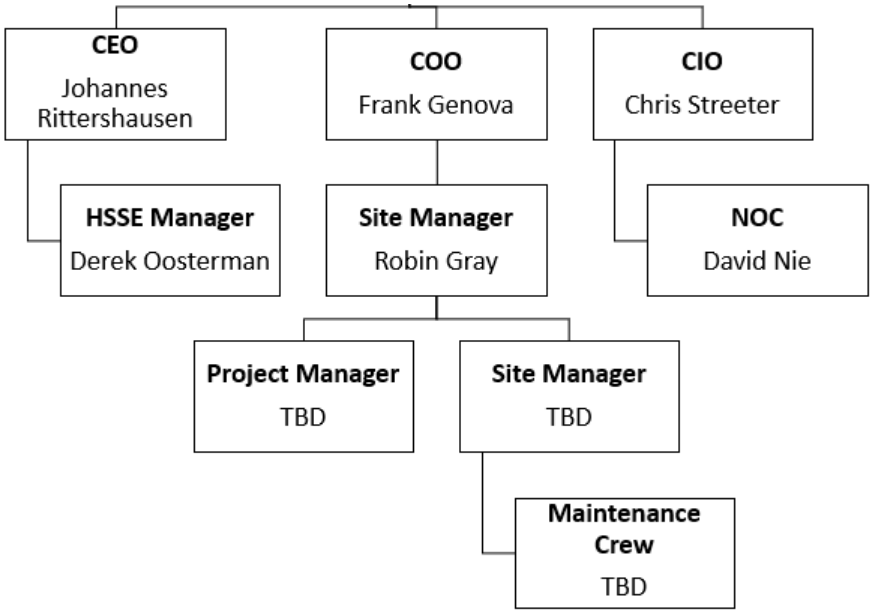

Figure 4: Convergent Organizational Chart

4.2 Emergency Response

In the event of an emergency at the BESS facility, the response will be spearheaded by the Convergent ERT. The ERT will keep the O&R control room informed as to the facilities status per normal or emergency communication protocol. For an emergency stemming from the O&R power grid, the ERT will remove or return the BESS to service at O&R's direction. The ERT is staffed by the NOC. All relevant Convergent and O&R contact information are listed in Section 5.1.

The following responses to events are considered:

- General Facility Emergency Shutdown
- Fire or Thermal Event
- Medical Emergency
- Chemical Spill
- Unauthorized Individual

In the event of an Emergency please call Convergent Energy & Power at 917-508-0275. EMERGENCY RESPONDERS ARE ADVISED TO REMAIN OUTSIDE OF THE FENCED AREA OF THE FACILITY.

IN NO SITUATION SHOULD THE BESS CABINETS BE OPENED BY ANY UNAUTHORIZED PERSONS OR EMERGENCY RESPONDERS; ALL RESPONSE IS TO BE COORDINATED BY CONVERGENT AND ITS SUBVENDORS. DO NOT APPLY WATER TO A BURNING UNIT. THE VILLAGE OF WARWICK IS ADVISED TO PROTECT OUTSIDE OF THE FENCED AREA ONLY.

4.2.1 General Facility Emergency Shutdown

In the event of a power system failure within the BESS, on the O&R power grid, or at the direction of the O&R control room, Convergent will:

- Log the status of the facility equipment.
- Obtain communication with O&R and report facility conditions. Obtain permission to re-establish connection.
- Get as much equipment ready for re-start as possible while awaiting re-connection or permission to reconnect.
- Re-start facility equipment and ready BESS equipment for synchronization / operation.
- Operate the BESS equipment in accordance with O&R.

Specific details pertaining to the BESS operations, including equipment isolation procedure in a shut-down will be provided in the Facility Operations and Maintenance Procedures. It should be noted that impact to the grid will be kept to the minimum during an emergency shutdown. The NOC will work in a coordinated effort with the O&R control room to ensure that the system will still shut down in a controlled manner and grid support or stability will not be minimally affected if at all.

4.2.2 Fire or Thermal Event

Convergent will provide training for local emergency responders pertaining to emergencies with the BESS. This training will be administered in collaboration with the battery supplier, a Professional Fire System consultant and coordinated directly with the local emergency teams during the permitting process. Refreshers will be offered periodically as needed and revisions to this document will be highlighted.

In the event of a fire or thermal event in the battery cabinets, transformer or other electrical equipment, the SCADA or site controller will notify the NOC, the ERT, and the O&R control room. The ERT will lead the response and notify all other relevant responding agencies. In

the event the system is in distress and the NOC does not receive any indication, individuals present at or near the facility may contact local emergency responders. See below for specific responses for battery cabinet and transformers / other electrical equipment.

a) Battery Cabinets

The battery cabinets are intended to be left alone and will respond to any thermal event automatically. It is essential to maintain the integrity of battery cabinet until a Convergent representative is onsite. A Convergent representative shall be on-site in response to an event within an hour of notification. DO NOT OPEN THE CABINET DOORS. The battery cabinets are designed with an integrated fire detection and suppression system including a fire suppression clean agent to prevent the spread of fire.

A single smoke alarm in a battery cabinet alerts the Convergent NOC and generates a warning. A second smoke/heat alarm assumes that there is a fire and triggers Stat-X Aerosol fire suppression agent release. In a case that the Fire Suppression System (FSS) signal indicates that the system has released the fire suppression agent, the Convergent ERT will contact the Warwick Fire Department to respond to the event. Specific Fire Fighting considerations are provided in section 8. If the alarms are determined to be due to a fault, the fault will be investigated, and repairs will be promptly scheduled by Convergent.

Local emergency responders shall be directed to standby on site (outside the fence line) only to prevent the spread of fire outside the battery cabinet IF NECESSARY. No one shall attempt to extinguish the battery fire on or within the battery cabinets. Please refer to Section 8 for more detailed battery fire considerations for firefighters.

b) Transformers and Other Electrical Equipment

The standard response to fires in a substation should be followed when responding. They are summarized below:

- The NOC will open the breaker to isolate and deenergize the affected equipment.

- Any individuals present should be staged uphill / upwind until the arrival of emergency responders.

- The ERT shall ensure that isolation exists on both the line and load side of the transformer through the operations of breaker and disconnect switches.

- Local emergency responders should perform the following actions:

i. Do not engage the burning equipment, it may still be energized.

ii. Isolate the surrounding area and keep unauthorized individuals away.

iii. Monitor for oil runoff and redirect runoff away from surface water and drainage ditches.

iv. Monitor the transformers for possible fumes and oil releases, staying upwind and consider evacuating downwind for at least 100'.

v. Remain alert for potential transformer explosions.

vi. A smaller fire can be suppressed using Carbon Dioxide which has a class C rating to 100,000V.

i. Dry Chemical is not recommended as it offers no cooling. Transformer failures are persistent because the internal fault/arc retains heat in the windings and surrounding metal keeping oil above its autoignition temperature.

ii. For a larger fire, a 25' standoff distance is required, agents should be applied using a combo nozzle (bubble cup) employing a 30-degree fog pattern, no straight streams.

4.2.3 Medical Emergency

In the event of a medical emergency within the BESS facility, the NOC should be notified. Depending on the severity, local emergency responders will be requested. See Section 5.2, Table 2 for contact information of medical emergency responders.

4.2.4 Chemical Spill

Chemical spills can potentially come from three major sources: battery electrolyte, transformer oil or HVAC condensate. Spills are highly unlikely and remote monitoring and periodic facility inspections during routine maintenance of the BESS facility are adequate to recognize them in a timely manner. Once identified, spills will be cleaned up by Convergent's designated maintenance contractor for the project under the direction of Convergent's designated Project Manager / Site Manager. Any required risk mitigating actions have been taken by Convergent personnel in the design of the facility. It should be noted that all electrical insulating oil used at the site is free of PCBs.

4.2.5 Unauthorized Access

Personnel visiting the BESS facility will only do so with the express consent of the NOC, and Convergent will be notified to their expected presence at the facility in advance of arrival. The NOC will monitor the facility through remote surveillance and appropriate action will be taken if the presence of unauthorized individuals is suspected. Trespassing individuals will be asked to leave the facility, and local law enforcement will be asked for assistance as required. All Convergent BESS sites are equipped with cameras and 24-hour monitoring.

4.3 Facility Site Plan / Layout

The facility site plan is shown below. A detailed facility layout showing the as-built positions of all BESS and interconnection equipment shall be provided upon construction completion.

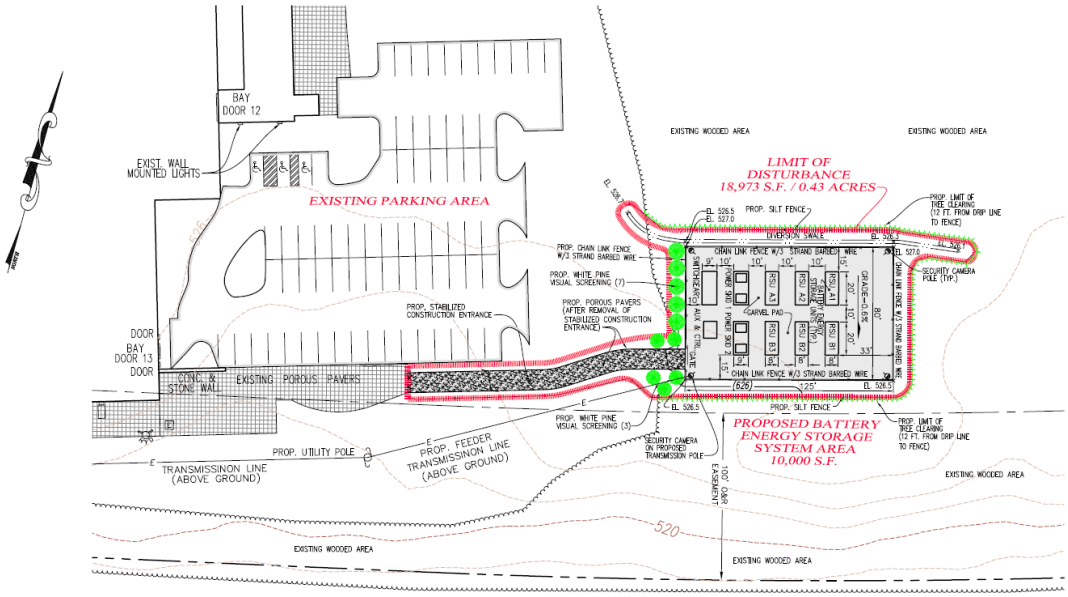

Figure 5: Facility Site Plan

4.4 Facility Evacuation

On hearing the evacuation alarm, all contractors, visitors, and Convergent employees must evacuate the BESS facility and rendezvous at a nearby Meeting Point (shown in Figure 6) for a head count. Convergent personnel at the BESS facility will follow a pre-determined evacuation route as shown below. This route is subject to revision based on input from the local AHJs. A sign will be located at the Meeting Point to ensure safety. The Warwick Fire Department will be alerted to provide support with evacuations and firefighting.

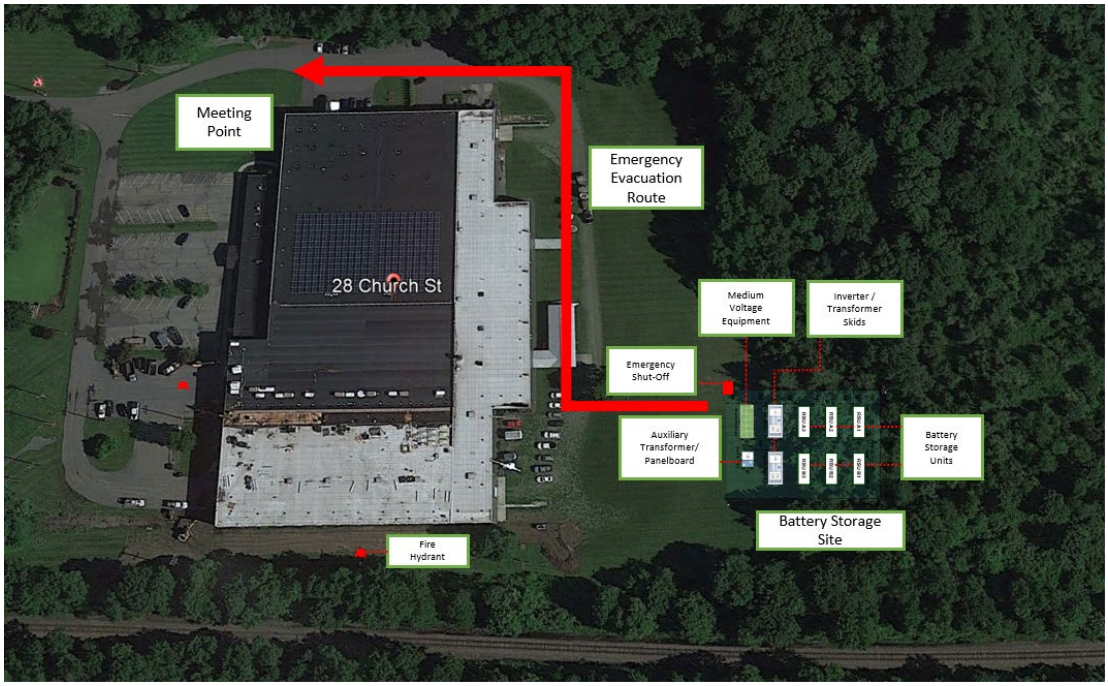

Figure 6: Facility Evacuation Route

5 EMERGENCY CONTACTS

5.1 Site Contact List

In the event of an Emergency please call Convergent Energy & Power at 917-508-0275.

The following list represents other parties who may also be contacted in the event of an emergency. The Alternate Contacts should be used when the Primary Contact is unavailable.

Primary Contact Position/Name	Primary Contact Number	Alternate Contact Position/Name	Alternate Contact Number
Site Manager Robin Gray	646.465.2625	Derek Longo	484.515.9191
NOC & ERT Chris Streeter	617.939.3805	David Nie	419.348.0986

Primary Contact Position/Name	Primary Contact Number	Alternate Contact Position/Name	Alternate Contact Number
On-Call Phones Frank Genova	646.210.3247	Johannes Rittershausen	917.508.0191
Convergent HSSE Manager Derek Oosterman	612.325.1167		
O&R Control Room Contact	877.434.4100 (To be Confirmed)		
Warwick Fire Department Mr. Daniel Schweikart	845.986.3473		

Table 1: Site Contact List

5.2 Local Emergency Contact List

The following list represents the local emergency contacts for the Village of Warwick who should be contacted in the event of an emergency.

POLICE	**Warwick Police Department**	**Emergency Only 911** **Non-Emergency 845.986.3423**
AMBULANCE	**Warwick Community Ambulance Service**	**Emergency Only 911** **Non-Emergency 845.986.4136**
FIRE	**Warwick Fire Department**	**Emergency Only 911**
HOSPITAL	**St. Anthony's Community Hospital**	**845.986.2276**

O&R	**Emergency Gas Hotline**	**800.533.5325**
OTHER	**Orange County Emergency Management Office**	**845.615.0400**

Table 2: Local Emergency Contact List

6 SYSTEM SAFETY CONSIDERATIONS

The proposed GE BESS safety features and Battery Management Systems (BMS) work together to help protect against common industrial battery failure modes due to abuse, damage or other external factors. These protections are evaluated with a comprehensive Safety Risk Assessment for the equipment and designed to meet applicable UL, NEC, and NFPA standards.

The LI-ion batteries are sourced from Tier-1 suppliers with products that have a track record of utilizing technology and components that renders the likelihood of a safety event low. Such an event could be isolated by the module cabinets, rack assemblies, and steel shell of the storage unit. However, the system design requires at least 10’ of separation from the adjacent cabinets and intentional setback from native fuels to provide a buffer for minimizing the likelihood of engaging materials beyond the site boundaries.

A key aspect in battery safety is adhering to the recommended operating practices. If safe operating limits are exceeded, the BMS are designed to isolate the affected batteries and racks from the system. The BMS continues to monitor operating conditions and will return the battery to service when conditions warrant availability.

Potential hazard sources are identified and discussed as follows.

6.1 Voltage

The BESS is expected to operate in the range of 500VDC to 1500VDC. The National Fire Protection Agency's (NFPA) standard 70E on electrical safety in the workplace establishes a limited approach boundary for unqualified workers at 3.3’. This boundary is observed in

the system design to prevent those who are unable to avoid hazards from coming within arm's reach of the exposed electrical conductors. It should be noted that non-contact electrical detectors cannot be used to determined what equipment may be energized. Also, operating any E-Stops and disconnects in an emergency may not discharge the BESS, emergency responders should assume electrical conductors remain hazardous.

6.2 Arc-Flash

High string voltage affects both the potential for shock and the potential for arc flash/blast, which results from components of an electric arc (e.g. vaporized copper) and depends greatly on the equipment and environment involved in the arc. Industry accepted controls to prevent injury from arc flash include increasing separation between positive and negative conductors, regular maintenance to prevent equipment failure, and providing arc-rated PPE for electrical workers.

6.3 Thermal Runaway

Thermal runaway is a process where self-heating in a battery cell can exceed the rate of cooling thereby causing internal temperatures to increase beyond normal operating limits. Under these conditions, battery cells may experience melting, off-gassing/venting, and in extreme cases, fire. Thermal runaway events can occur due to mechanical or electrical abuse as well as manufacturing defects or metallic dendrites that form an internal short over time. The BESS is designed and supplied with various devices and/or mechanisms to prevent, detect and minimize the impact of thermal runaway. For instance, 24/7 system monitoring, along with automatic detection and isolation at the cell level is included to prevent a thermal runaway event from taking place. In addition, the system is designed with barriers and controls in place, such, that thermal runaway cannot propagate from one stack to adjacent stacks.

6.4 Fire

Lithium ion batteries contain flammable liquid electrolyte that may vent, ignite, and produce sparks when subjected to high temperatures (> 150°C (302°F)), when damaged, or abused (e.g., mechanical damage or electrical overcharging). Materials within a battery energy storage system, including plastics, electrolyte, wire insulation, thermal insulation and others may be flammable, acting as a potential fuel source during a fire. Without proper ventilation a combination of gasses can build up in an enclosed space spreading the fire.

The BESS has been designed with integral exhaust ventilation in addition to smoke and automatic fire detection systems to help mitigate and contain potential fires. All material

components of the system are also appropriately rated, sized and protected to prevent overheating or mechanical damage that could lead to a fire hazard.

6.5 Toxicity

Any contact by personnel with battery electrolyte or battery emissions may be irritating to skin, eyes, and mucous membranes. In the event of a battery fire, irritating, corrosive and/or toxic gases such as toxic hydrogen fluoride gas could be produced which may cause dizziness or suffocation to personnel close by. The use of a positive pressure breathing apparatus and SCBA gear is recommended for emergency response personnel whenever responding to battery system fires.

6.6 Explosion

Explosion is a very rare but potential risk with battery systems. However, the battery cabinets have built-in ventilation system located on the sides of the cabinets, powered by an independent power source and an activation mechanism located away from the cabinets. This system ensured continuous venting to help maintain flammable gas emissions in the battery cabinets below 25% Lower Flammable Limit (LFL) and prevent potential explosions due to cabinet pressure build-up of battery emissions. The battery cabinets also feature a deflagration panel located on the side of the cabinet for venting in case of a deflagration event.

7 BATTERY INFORMATION

The BESS is comprised of two identical energy storage blocks, with each block consisting of three (3) Reservoir Storage Units (RSU) connected to one Reservoir Inverter Unit (RIU), manufactured by General Electric (GE). All units have been designed with protections and a safety approach to energy storage. Each component configuration and system conform to industry standards and certification requirements.

7.1 Reservoir Storage Unit (RSU) Specifications

Each 20’ ISO cabinet is designed to be reach-in only and includes a fully integrated thermal management, fire detection / suppression and control system. They have a relatively high energy density of up to 4.1MWh / cabinet. The high-density battery loading minimizes unoccupied space in the RSU leaving minimal room for gas build-up. The cabinets are NEMA 3R rated and feature more than 4” of fire-barrier grade insulation upgrade.

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Specifications are given below.

RSU-4000 Series

Overview	RSU-4000/20
	RSU-4000/20
Overview	
Nameplate Energy Capacity (KWh.dc, usable)	4184
Individual Battery Blades - Factory Installed	20 of 20
Maximum Power - Factory Installed (KW.dc)	1200
Maximum DC Current - Factory Installed (A)	1600
Available Augmentation Capacity (% BOL)	0%
Available Augmentation Capacity (kWh.dc)	N/A

Battery Information		
Battery Chemistry		Lithium-Ion, NCM
Battery Module Design		Energy
Continuous C-Rate		<C/3
Pulse C-Rate		<C/3
Voltage Class		1500V
Nominal DC Voltage (V)		1300
Minimum DC Voltage (V)		770
Mechanical Information		
Package Format		20' ISO w/Exterior Acces
Dimensions (mm) (L X W X H)		6058 x 2438 x 2890 mm
Weight (kg)	37k	31k
Fully Integrated HVAC		Dual Self-Contained 3 Ton Units (High Efficiency 10. EER)
- Hot Climate Upgrade		+33% Cooling Capacity
- Cold Climate Upgrade		+ Electric Heating Package
Fire Suppression - Aerosol		Optional
Installation		Pad/Pier
Cable Entry		Bottom
Weatherization		NEMA 3R, IP54
Design Conditions		
Min Operating Temperature (C)		-40°C
Max operating Temperature (C)		50°C (55°C w/ hot climate upgrade)
Maximum Altitude (m)		2000
Maximum Relative Humidity (%)		95%, non-condensing
Seismic Zone		UBC Zone-4
Audible Noise		<60 dB at 3M

Figure 7: 20’L x 8’W x 9.5’H ISO Cabinets

Figure 8: Reach-In Only Cabinet Design

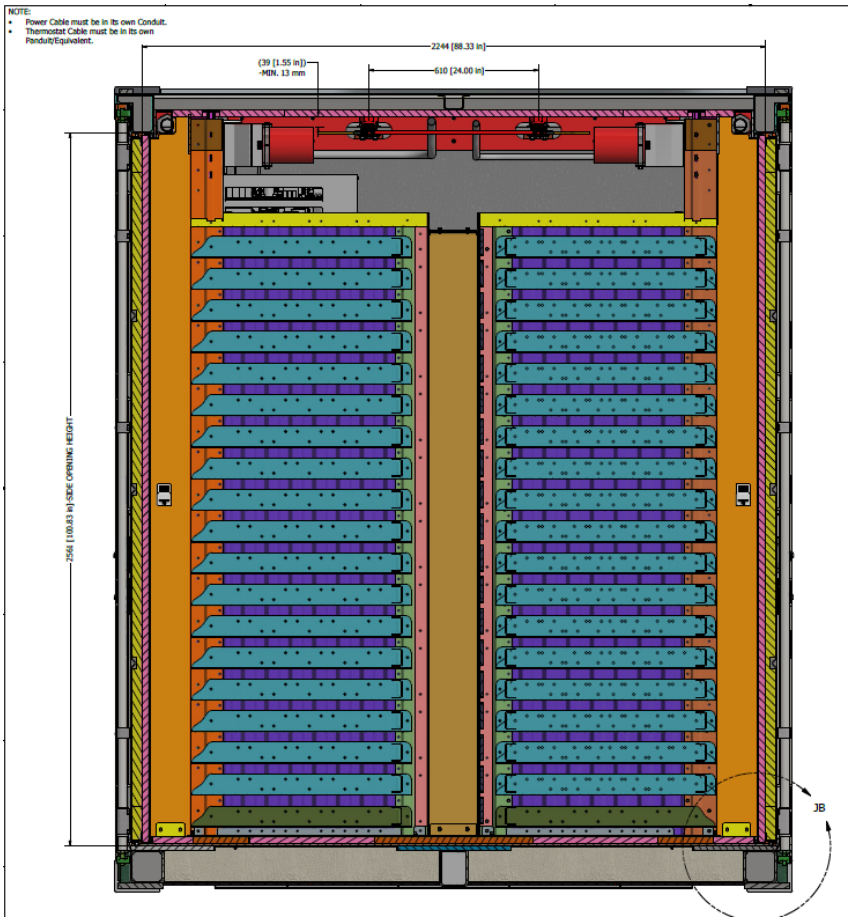

Figure 9: Reservoir Design Detail

7.1.1 Battery Cell Protection

• Each cell has Safety Function layer that maintains electrical separation even if the polymer separator is damaged.

• Each cell has an overcharge safety device designed to prevent current flow once activated. The fuses are designed to cut the current path when abnormally high current flows.

• Cell vents are used for controlled release under abnormal conditions or abuse.

7.1.2 Battery Module Protection

• Tested to applicable UL Standards to demonstrate resistance to thermal runaway.

• Monitoring system provides multiple measurements of voltage and temperature.

• Rate Fuses that are designed to open on an overcurrent condition.

• Integrated Manual Service Disconnect (MSD) to help to isolate faults within a string. Also helps to preserve that the PPE required no great than HRC Level 2.

7.1.3 Blade (String) Level Protection

• Blade Protection Units (BPU) can detect and respond to fault conditions.

• Coordinated BPU controls are designed to limit current during abnormal conditions (Temperature, SOC, Voltage, etc.) to help to minimize secondary effects and prevent cascading failures.

• String level fuses to help to minimize string contribution to system failures.

• Monitoring system provides multiple measurements of voltage, current, temperature and independent SOC/SOH estimations.

• Unit and Plant Level Control system can enable blade level shut down rack during fault conditions.

7.2 Reservoir Inverter Unit (RIU) Specifications

Each 20' RIU is outdoor rated, 3-phase 2.5 MVA Power Conversion units, consisting of a power transformer close coupled (550V) with an AC inverter system (RIU) capable of sub-second response times and fault detection. Specifications are given below.

SPECIFICATIONS	UNITS	RIU-2500
AC Parameters		
Nominal Power (at 45°C)	kVA_{AC}	2500
Max Power (at 40°C)	kVA	2750
Rated AC Operating Voltage (10-35kV)	V_{AC}	550
AC Operating Voltage Range	%	+ / - 10
Grid Frequency (+/-5 Hz)	Hz	50 / 60
Power Factor Range		-1.0 to 1.0
DC Parameters		
DC Input Range	V_{DC}	800-1500
Max DC Current	A	3508
Operational Parameters		
Max Efficiency	%	98.73
CEC Efficiency	%	98.50
Power Consumption at Stop	W	370
Max Power Consumption	kW	4.3
Audible Noise (at 1m)	dBA	<80

Transformer	
Transformer rated power	2500 kVA
Transformer max. power	2750 kVA
LV / MV voltage	0.55 kV / 10 – 35 kV
Transformer vector	Dy11
Transformer cooling type	ONAN (Oil Natural Air Natural)
Oil type	Mineral oil (PCB free) or degradable oil on request

Figure 10: 20'L x 8'W x 9.5'H Reservoir Inverter Unit

7.3 Standards and Compliance List

7.3.1 Energy Storage System

UL 9540 - Energy Storage Systems and Equipment

IEC 62933 - Series Electrical energy storage (EES) systems

IEC 61000-6-2: Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments

UL 9540A* - Test Method for Evaluating Thermal Runaway Fire Propagation in ESS

NFPA 855 - Standard for the Installation of Stationary Energy Storage Systems (system adaptations in process)

7.3.2 Batteries / Battery Racks

UL 1642 - Standard for Lithium Batteries

UL 1973 - Standard for Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail (LER) Applications

IEC 62133 - Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety

IEC 62619 - Safety requirements for secondary lithium cells and batteries, for use in industrial applications

7.3.3 Inverters

IEEE Std 1547 Series – Standard for Interconnecting Distributed Resources with Electric Power Systems

UL 1741 - Standard for Inverters, Converters, Controllers and Interconnection System Equipment

IEC 62477-1 - Safety requirements for power electronic converter systems and equipment - Part 1: General

IEC 61000-6-2: Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments

7.3.4 Supplemental Information

- * Battery manufacturer has completed Cell and Module testing – GE will leverage that data and execute relevant rack/system testing in near future
- Fire Risk Assessment (FRA) has been completed for similar projects
- NFPA 68, Explosion Protection by Deflagration Venting in process with 3rd party

7.4 Battery management System (BMS)

Battery Monitoring System (BMS) is integrated into the BESS and will disconnect electrical equipment or place it in a safe operating condition if potentially hazardous temperatures or other conditions such as short circuits, overvoltages, overcurrents, etc are detected. BMS is designed to monitor, relay and balance battery cell voltages, currents and temperatures. System shall have the ability to isolate affected modules from the rest of the system and communicate directly with the NOC.

8 BATTERY FIRE PROTECTION SYSTEMS

8.1 Fire Detection System

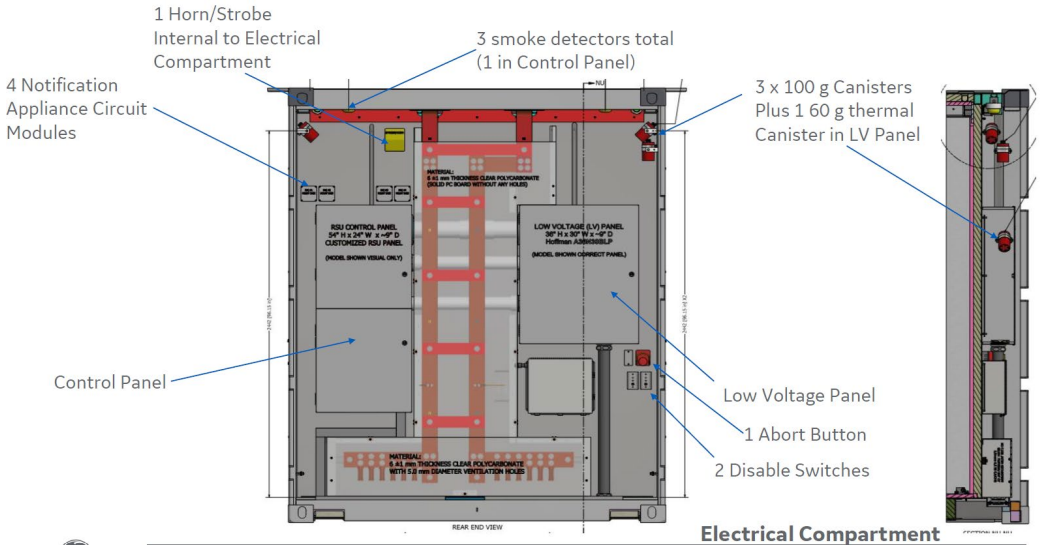

Figure 11: Cabinet Interior Fire System Components

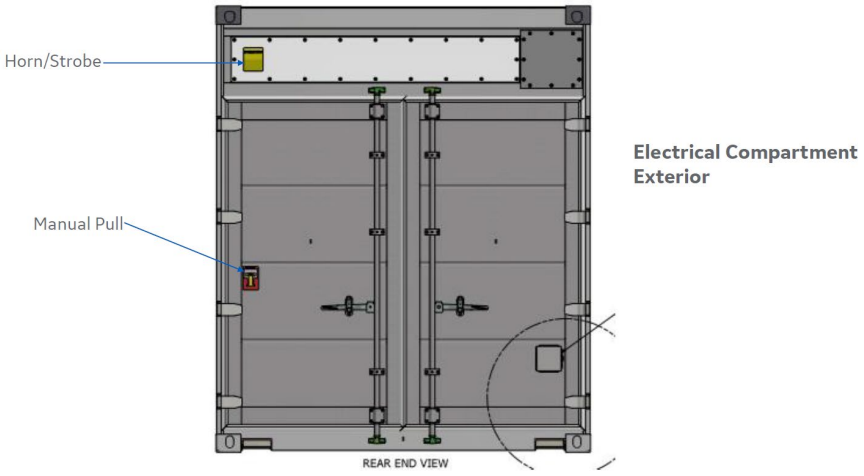

Figure 12: Cabinet Exterior Fire System Components

8.1.1 Smoke Detection

Carbon monoxide programmed gas detector shall be installed to detect smoke before temperature rise significantly. Each RSU is designed with two (2) detection zones - Battery compartment and Electrical Compartment. Battery compartment contains a total of 4 x conventional (non-addressable) photoelectric smoke detectors, type CPS-24. Electric

compartment contains a total of Total of 3 x Addressable Photoelectric Smoke Detector detectors, type PAD100-PD.

8.1.2 Horn/Strobe

A horn strobe is included in the fire detection system to provide audible and visual notification of a potential fire incident in the battery cabinets.

8.2 Fire Suppression System (FSS)

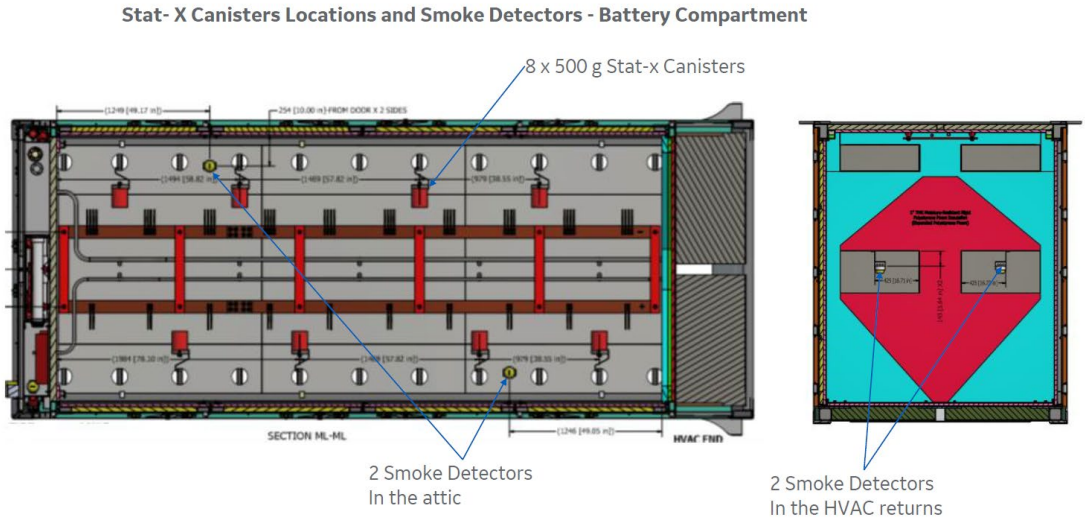

Figure 13: Fire Suppression Clean Agent Details

The Figure 13 above illustrates the general layout of the FSS components in an RSU battery compartment. Each RSU will be provided with two (2) detection zones:

- Battery compartment (4 smoke sensors and 8 Stat-X Cannisters)
- Electrical compartment (3 smoke sensors)

In the event of a battery fire in a single RSU, the following response will occur:

- The first smoke detector in the affected zone triggers an alarm, a second triggers the FSS.
- The affected RSU block is shut down automatically.
- The Stat-X aerosol agent will be automatically dispersed to contain fire.

- The battery temperature, alarms, smoke detector, FSS discharge (by RSU) are actively monitored by the battery management system (BMS).
- The BMS also works to pinpoint the exact origin of the fire and determine if external sprinkler zones should be activated.
- Convergent NOC will coordinate with emergency first responders to contain fire safely and adequately.

8.3 Ventilation System

Deflagration control in the cabinets will be partially accomplished by maintaining flammable gas emissions below 25% Lower Flammable Limit (LFL) using a specifically designed ventilation system powered by an independent power source.

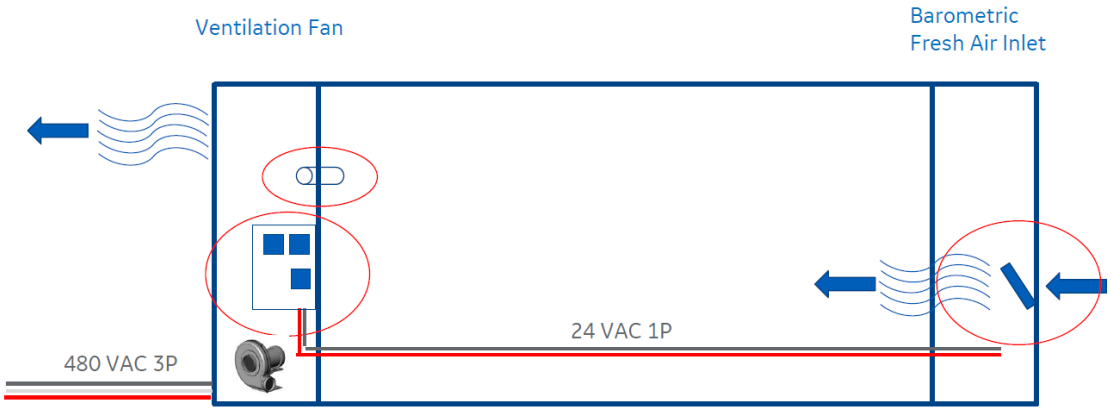

Figure 14: Ventilation System Design

Th cabinet design features a deflagration panel placed on the side/end of the cabinet, which helps avoid failure due to debris or other build-up on top of the cabinet in the event of deflagration. The ventilation system features an interlock to prevent use of the system while the FSS agent is fighting fire.

The components of the system are designed and sized based on the following assumptions:

a) Single cell failure

b) Thermal runaway

c) Rack system shut down

d) Total of 3 adjacent cells in thermal runaway

e) Smoke & FSS Deployment

f) HVAC E-stop

The general layout of the ventilation system components is shown below.

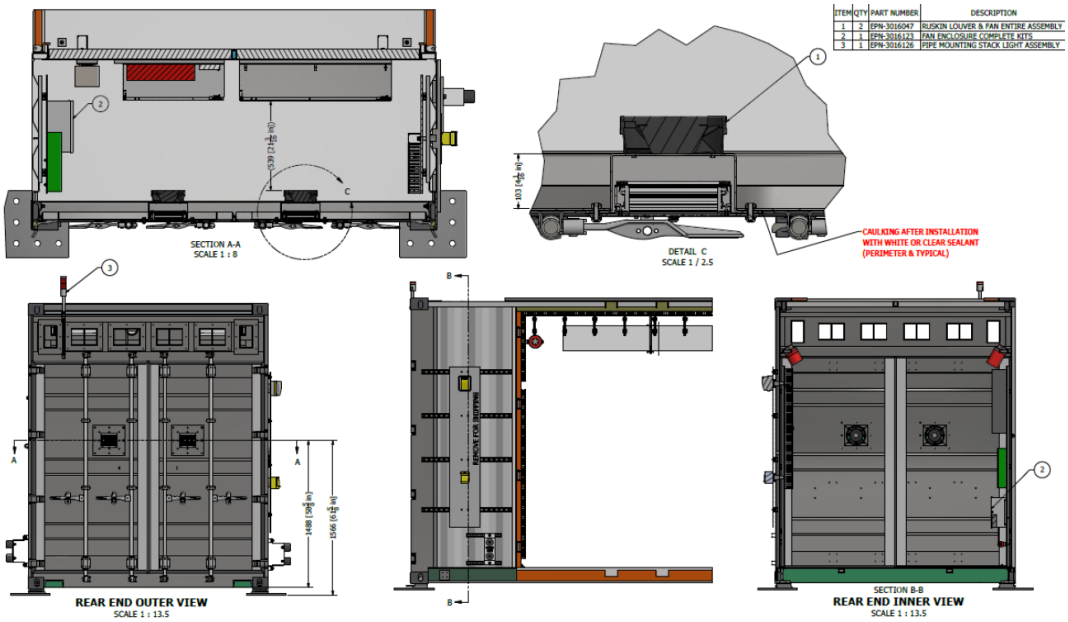

Figure 15: Deflagration / Ventilation System Details

9 FIREFIGHTING CONSIDERATIONS

In the event of an emergency, Convergent should be immediately notified at 917-508-0275.

IN NO SITUATION SHOULD THE BESS CABINETS BE OPENED BY ANY UNAUTHORIZED PERSONS OR EMERGENCY RESPONDERS; ALL RESPONSE IS TO BE COORDINATED BY CONVERGENT AND ITS SUBVENDORS. DO NOT APPLY WATER TO A BURNING UNIT. THE VILLAGE OF WARWICK FIRE DEPARTMENT IS ADVISED TO PROTECT OUTSIDE OF THE FENCED AREA ONLY.

9.1 Small Battery Fire Response

A small battery fire shall be defined as an event whereby a the FSS signal indicates that the fire suppression agent has been released and / or there are visible signs of fire including

smoke and heat, however, smoke and/or fumes are contained within one battery cabinet.

Convergent and GE recommend adherence to the NFPA's BESS EMERGENCIES QUICK REFERENCE GUIDE. During incidents involving a BESS, responders should follow the steps: IDENTIFY, SHUTDOWN, WATCHOUT!

Identify - Once a fire is identified, it should be reported to Convergent and other emergency response units. Convergent, with the aid of the NOC and the BMS, will coordinate with GE to locate the affected unit configurations and components. A remote shutdown will then be employed accordingly.

Shutdown - The BESS should be shut down physically by emergency responders if safely possible. The BESS can be shutdown automatically by the Emergency Stop System. Emergency responders should locate the E-stop, which will be marked as such and highlighted on emergency response documents.

Watch Out - Emergency responders should be on the lookout for high voltage, exposed wires, moving parts, and other hazards. The site should also be monitored for potential reignition and toxic fumes in the air. The use of a positive pressure breathing apparatus is recommended for emergency response personnel whenever responding to battery system fires.

Every fire emergency is unique and requires a customized approach, but a typical battery incident may include the following response:

• A firefighter would arrive on scene and identify the situation

• Calls for support would be made as necessary

• Convergent's NOC should be contacted for assistance in evaluating system status

• The site shall be periodically monitored by Convergent for re-ignition for 24 hours after initial fire has been suppressed

• Convergent ERT will then investigate incident and commence appropriate next steps

9.2 Larger Battery Fire Response

A larger battery fire shall be defined as an event whereby a the FSS signal indicates that the fire suppression agent has been released and / or there are visible signs of fire including smoke and heat, however, the smoke or fumes have spread to two or more battery cabinets and/or the surrounding BESS facility area. An explosion will also be considered a larger battery fire.

Assuming a larger battery fire that has breached the battery cabinet and risks spreading, the following sequence of response should occur:

a. The Heat or Smoke detectors in the storage unit could detect a fire and initiate de-energization.

b. The Stat-X aerosol fire suppression system is activated to contain the fire until firefighters arrive.

c. The affected storage unit and associated reservoir inverter unit would be automatically de-energized by the control system. As a precaution and depending on the severity of the incident, adjacent storage units (up to the entire system) may be de-energized as a precaution.

d. Non-essential personnel should evacuate the affected area.

e. The BESS should be shut down physically by emergency responders if safely possible. The BESS can be shutdown automatically by the Emergency Stop System. Emergency responders should locate the E-stop, which will be marked as such and highlighted on emergency response documents.

f. Any area surrounding the BESS facility (outside of the BESS perimeter) that has been affected by a battery fire could be cooled by blanketing with low velocity water stream or water fog.

g. The site shall be periodically monitored by Convergent for re-ignition for 24 hours.

h. Cabinet doors should not be opened by any emergency response personnel, including the Warwick Fire Department until a thorough analysis has been done by GE and there is no indication of rising temperatures inside the container.

i. Due to the composition of gases vented during a Li-ion battery fire, the air in the surrounding area of the facility should be considered potentially corrosive, toxic, and/or flammable.

j. Batteries which are exposed to excessive heat beyond their recommended temperature range are at risk for explosion. During thermal decomposition from a fire, chlorine, hydrogen chloride, and sulphur dioxide can be formed. Thus, it is of utmost importance that responders do not enter the BESS perimeter during a fire.

k. It is recommended that full PPE including SCBA gear should be worn by any Warwick Fire Department personnel responding to a fire event at the BESS facility.

10 POST-FIRE CONSIDERATIONS

Following a fire event, Convergent will coordinate with the battery manufacturer and system provider, GE, to ensure that any affected equipment are safe-guarded, then safely taken out of service and eventually removed from the site. Please refer to the Warwick ES3 Decommissioning Plan for additional details regarding the decommissioning procedures.

11 APPENDICES

11.1 Project Site Plan

Attached.

11.2 Battery Reservoir Storage Unit Specifications

Attached.

11.3 Battery Reservoir Inverter Unit Specifications

Attached

11.4 Fire Suppressant Specifications

Attached.

11.5 Transformer Oil

To be provided upon transformer procurement.