Hazard Mitigation Analysis

for

PowerNode Nexus

STATEMENT OF COMPLIANCE

For Level 3 EV Charging Station with BESS

2216 WA-530, Arlington, WA 98223

Project Information:

Applicant: Aviat Group, LLC

Project: 8-Stall Level 3 EV Charging Station with 233kWh BESS

Location: 2216 WA-530, Arlington, WA 98223

Compliance with AMC 20.114.145 - Project Review:

1. Environmental Review:

- Completed SEPA Environmental Checklist
- Addressed potential environmental impacts

2. Site Plan Review:

- Detailed site plan submitted showing:
  * Property boundaries and dimensions
  * Location of all proposed structures
  * Parking layout
  * ADA compliance measures

3. Technical Review:

- Engineering plans for:
  * Electrical systems
  * Utility connections

Compliance with AMC 20.114.150 - Notice Requirements:

1. Public Notice:

- Posted site notice at property
- Published notice in local newspaper
- Mailed notices to properties within 500 feet
- Notice provided to affected agencies

2. Notice Content:

- Project description
- Location information
- Application details
- Comment period dates
- Contact information
- SEPA determination

3. Documentation:

- Affidavit of posting
- Proof of publication
- Mailing list
- Copy of notices

Additional Compliance Measures:

1. Safety:

- Safety signage plan

2. Construction:

- Construction management plan
- Erosion control plan
- Waste management plan

Declaration:

I hereby certify that this project complies with all requirements set forth in Arlington Municipal Code sections 20.114.145 and 20.114.150. All information provided is true and correct to the best of my knowledge.

Signature: _____

Company: Aviat Group, LLC

Name: Randy Hanson

Title: Project Consultant

Date: 12/20/24

Hazard Mitigation Analysis

for

PowerNode Nexus

Electric Era Technologies
Seattle, WA, USA

Bowtie Hazard Mitigation Analysis

Product	PowerNode Nexus
Product version	V2.2
Document version	V3.0
Author	Brian Sennett
Reviewer	Carter Timm
Release date	December 6, 2024

Hazard	Threat	Consequence	Barrier	Name	Description
x				External risk	The BESS is subject to factors during installation and normal use that are not internal to its design.
	x			Impact	Something has struck the battery system, causing mechanical damage or deformation.
			x	Facility design	Bollards are installed per Site Design Guide and local regulations to prevent vehicle contact with the battery.
			x	Enclosure resiliency	Enclosure has been tested to withstand impacts, shocks, or other mechanical abuse. See drop test report and UL1973 test report.
			x	Module resiliency	Module has been tested to withstand impacts, shocks, or other mechanical abuse. See UL1973 test report.
			x	Cell resiliency	Cell has been tested to withstand impacts, shocks, or other mechancial abuse. See UL1973 and UL1642 test report.
	x			Mechanical shock/drop	The battery rack or module is subject to mechanical shock or drop during factory or field installation handling.
			x	Process control	Proper tooling, such as lifting eyes, slings, chain hoists, and cranes, is recommended and used to prevent mishandling of systems.
			x	System design and quality control	Battery rack has been designed to withstand such shocks.
			x	Enclosure resiliency	Enclosure has been tested to withstand impacts, shocks, or other mechanical abuse. See drop test and UL1973 test report.
			x	Module resiliency	Module has been tested to withstand impacts, shocks, or other mechanical abuse. See UL1973 test report.
			x	Cell resiliency	Cell has been tested to withstand impacts, shocks, or other mechancial abuse. See UL1973 and UL1642 test report.
	x			Water damage - flooding	The system is flooded with water.
			x	Facility design	The placement of the battery is such that flooding is unlikely.
			x	Passive circuit protection	Breakers and fuses will protect the circuit in overcurrent situations.
			x	Module design	Modules are designed to IP66 to discourage water ingress.
			x	Emergency action plan	Operation manual provides instructions for how to inspect and operate a battery after a flood.
	x			Water damage - condensation	The system is subject to uncontrolled condensation.
			x	Passive circuit protection	Breakers and fuses will protect the circuit in overcurrent situations.
			x	Module design	Modules are designed to IP66 to discourage water ingress.
			x	Electronics enclosure design	Enclosures containing critical electronics are sealed against moisture ingress, to IP66, NEMA 4, or similar.
	x			Salt water exposure	Long term exposure of the system to environments that may result in long term corrosion.
			x	System design and quality control	System has been designed to withstand such exposure.
			x	System maintenance	Regular maintenance will minimize the impact of environmental effects.
	x			Human factors	An adverse condition caused by the result of human interaction, or error.
			x	Training adequacy	Commissioning, maintenance and decommissioning are carried out by trained, qualified, licensed staff using applicable manuals.
			x	Access controls	Wiring, switches, and other controls or potential hazard sources are located behind locked, impact-resistant guards.
	x			Shipping and construction	An issue during shipping or construction resulting in adverse conditions.
			x	Process control	Proper tooling, such as lifting eyes, slings, chain hoists, and cranes, is recommended and used to prevent mishandling of systems.
			x	Enclosure resiliency	Enclosure has been tested to withstand impacts, shocks, or other mechanical abuse. See drop test and UL1973 test report.
			x	Module resiliency	Module has been tested to withstand impacts, shocks, or other mechanical abuse. See UL1973 test report.
			x	Cell resiliency	Cell has been tested to withstand impacts, shocks, or other mechancial abuse. See UL1973 and UL1642 test report.
	x			Particulate accumulation	Accumulation of particulate may result in adverse conditions.
			x	Process control	Quality control during manufacturing has been put in place to prevent accumulation of particulate from manufacturing processes.
			x	Preventative maintenance	Regular maintenance recommended by Electric Era, such as fan filter cleaning, will minimize the impact of environmental effects.
			x	Module design	Modules are designed to IP66 to prevent particulate ingress.
	x			External fire impingement	A fire is impinging on the system from outside.
			x	Facility design	The placement of the battery is such that external fires are unlikely to impact the battery per NFPA 855.
			x	Cascading protection	Module design limits external temperatures from heating cells to thermal runaway. See UL9540A test report.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
	x			Seismic activity	An earthquake may occur, inducing unusual loading onto the battery rack.
			x	Site installation	Battery is to be installed at sites that are within the seismic design threshold according to full system seismic analysis.
			x	Enclosure resiliency	Enclosure has been tested to withstand impacts, shocks, or other mechanical abuse. See drop test and UL1973 test report.
			x	Module resiliency	Module has been tested to withstand impacts, shocks, or other mechanical abuse. See UL1973 test report.
			x	Cell resiliency	Cell has been tested to withstand impacts, shocks, or other mechancial abuse. See UL1973 and UL1642 test report.
		x		Single cell combustion	A single cell has failed and is producing flames or combusting.
			x	Fire suppression	Fire suppression system in the unit releases ultra fine Potassium salts with secondary inert gases.
			x	Cascading protection	Module design limits external temperatures from heating cells to thermal runaway. See UL9540A test report.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.

Hazard	Threat	Consequence	Barrier	Name	Description
		x		Single cell venting	A single cell has failed and is producing off-gas.
			x	Fire suppression	Fire suppression system in the unit releases ultra fine Potassium salts with secondary inert gases.
			x	Cascading protection	Module design limits external temperatures from heating cells to thermal runaway. See UL9540A test report.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
		x		Multiple cell or module combustion	Multiple cells have failed and are producing flames or combusting.
			x	Fire suppression	Fire suppression system in the unit releases ultra fine Potassium salts with secondary inert gases.
			x	Cascading protection	Module design limits external temperatures from heating cells to thermal runaway. See UL9540A test report.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
		x		Multiple cell or module venting	Multiple cells have failed and are producing off-gas.
			x	Fire suppression	Fire suppression system in the unit releases ultra fine Potassium salts with secondary inert gases.
			x	Cascading protection	Module design limits external temperatures from heating cells to thermal runaway. See UL9540A test report.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
		x		Deflagration	Accumulation of off-gas creates explosion risk.
			x	Deflagration venting	Battery rack cabinet design allows deflagration (either upward or outward) without damage to rack structure or nearby personnel.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
		x		Physical damage to batteries	Batteries are subject to thermal, electric, or physical abuse which would make their continued use subject to risk.
			x	Cell physical abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
		x		Battery damage or excessive degradation	Batteries are subject to excessive degradation due to adverse conditions, resulting in premature end of life.
			x	Cell physical abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
x				Non-cell thermal issues	Components of the BESS that generate heat, or nearby components, are subject to damage.
	x			Hazardous cell temperature	High temperature at the cell level during normal operations without thermal runaway.
			x	Cell cooling	Active liquid cooling via bottom coldplate removes heat from the cells.
			x	Cell temperature monitoring	BMS provides active cell temperature monitoring at several points throughout each battery module.
			x	System disconnect	Contactors will open during overtemperature or undertemperature events.
			x	Cell thermal abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
	x			Hazardous module temperature	High temperatures at the module level during normal operations without thermal runaway.
			x	Cell cooling	Active liquid cooling via bottom coldplate removes heat from the cells.
			x	Cell temperature monitoring	BMS provides active cell temperature monitoring at several points throughout each battery module.
			x	System disconnect	Contactors will open during overtemperature or undertemperature events.
			x	Cell thermal abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
	x			Hazardous unit temperature	High temperatures at the BESS level during normal operations without thermal runaway.
			x	Cell cooling	Active liquid cooling via bottom coldplate removes heat from the cells.
			x	Cell temperature monitoring	BMS provides active cell temperature monitoring at several points throughout each battery module.
			x	System disconnect	Contactors will open during overtemperature or undertemperature events.
			x	Cell thermal abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
			x	Inverter cooling	Inverters are actively air-cooled with multiple fans based on internal temperature sensors at enclosure and IGBT levels.
			x	Control Enclosure cooling	Control panel is actively air-cooled with fan based on internal temperature sensor.
	x			Liquid coolant failure	Mechanical or electrical failure of the liquid coolant or chiller system will result in higher cell temperatures.
			x	Cell temperature monitoring	BMS provides active cell temperature monitoring at several points throughout each battery module.
			x	System disconnect	Contactors will open during overtemperature or undertemperature events.
			x	Cell thermal abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
	x			Non-battery fire inside unit	Fire in unit from faulty system resulting in dangerously high temperatures.
			x	Fire suppression	Fire suppression system in the unit releases ultra fine Potassium salts with secondary inert gases.

Hazard	Threat	Consequence	Barrier	Name	Description
			x	Cell cooling	Active liquid cooling via bottom coldplate removes heat from the cells.
			x	Cell temperature monitoring	BMS provides active cell temperature monitoring at several points throughout each battery module.
			x	System disconnect	Contactors will open during overtemperature or undertemperature events.
			x	Cell thermal abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
			x	Cascading protection	Module design limits external temperatures from heating cells to thermal runaway. See UL9540A test report.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
	x			Non-battery fire outside unit	Fire outside of unit may heat the unit to dangerous temperatures.
			x	Site design	Unit is located away from flammable and volatile substances. Bollards are installed to prevent vehicle contact.
			x	Cell cooling	Active liquid cooling via bottom coldplate removes heat from the cells.
			x	Cell temperature monitoring	BMS provides active cell temperature monitoring at several points throughout each battery module.
			x	System disconnect	Contactors will open during overtemperature or undertemperature events.
			x	Cell thermal abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
			x	Cascading protection	Module design limits external temperatures from heating cells to thermal runaway. See UL9540A test report.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
	x			Electrical hotspot or loose connection	Hotspots may form for unknown reasons, such as loose connections.
			x	Preventative maintenance	Regular maintenance and monitoring of the system will observe loose connections or increased resistance.
			x	Cell cooling	Active liquid cooling via bottom coldplate removes heat from the cells.
			x	Cell temperature monitoring	BMS provides active cell temperature monitoring at several points throughout each battery module.
			x	Temperature monitoring and alarms	Temperature and smoke monitoring in the unit will alert supervisory staff.
			x	System disconnect	Contactors will open during overtemperature or undertemperature events.
			x	Cell thermal abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
			x	Connector torque verification	Bolted connections are torqued to specification in factory and visibly striped during field installation to check for loosening.
		x		Single cell combustion	A single cell has failed and is producing flames or combusting.
			x	Fire suppression	Fire suppression system in the unit releases ultra fine Potassium salts with secondary inert gases.
			x	Cascading protection	Module design limits external temperatures from heating cells to thermal runaway. See UL9540A test report.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
		x		Single cell venting	A single cell has failed and is producing off-gas.
			x	Fire suppression	Fire suppression system in the unit releases ultra fine Potassium salts with secondary inert gases.
			x	Cascading protection	Module design limits external temperatures from heating cells to thermal runaway. See UL9540A test report.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
		x		Multiple cell or module combustion	Multiple cells have failed and are producing flames or combusting.
			x	Fire suppression	Fire suppression system in the unit releases ultra fine Potassium salts with secondary inert gases.
			x	Cascading protection	Module design limits external temperatures from heating cells to thermal runaway. See UL9540A test report.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
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			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
		x		Deflagration	Accumulation of off-gas creates explosion risk.
			x	Deflagration venting	Battery rack cabinet design allows deflagration (either upward or outward) without damage to rack structure or nearby personnel.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
		x		Physical damage to batteries	Batteries are subject to thermal, electric, or physical abuse which would make their continued use subject to risk.
			x	Cell physical abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.

Hazard	Threat	Consequence	Barrier	Name	Description
			x	Fire service response	Fire department response includes active firefighting suppression.
		x		Battery damage or excessive degradation	Batteries are subject to excessive degradation due to adverse conditions, resulting in premature end of life.
			x	Cell physical abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
x				Controls failure	BESS safety controls may experience single-point failures.
	x			Inverter failure	Inverter or power electronics fail in a way that poses risk to the batteries.
			x	System disconnect	Contactors will open during overcharge, overdischarge, or overcurrent events.
			x	Passive circuit protection	AC breaker and DC fuses will protect the circuit in overcurrent situations.
			x	Cell physical abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
	x			Sensor failure	A sensor inside the system fails, resulting in incorrect reporting of system properties.
			x	Redundant failure detection	Every cell is monitored for voltage, and multiple cells per module are monitored for temperature.
			x	System disconnect	Contactors will open during overcharge, overdischarge, or overcurrent events.
	x			BMS failure	Cell or module level monitoring and controls fail, resulting in inability to report adverse conditions.
			x	Redundant failure detection	Every cell is monitored for voltage, and multiple cells per module are monitored for temperature.
			x	System disconnect	Contactors will open during overcharge, overdischarge, or overcurrent events.
			x	Passive circuit protection	DC fuses will protect the circuit in overcurrent situations.
			x	Cell physical abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
	x			MBMU failure	Failure of the controller at the system level which results in adverse condition of the system.
			x	Redundant failure detection	Every cell is monitored for voltage, and multiple cells per module are monitored for temperature.
			x	System disconnect	Contactors will open during overcharge, overdischarge, or overcurrent events.
			x	Passive circuit protection	DC fuses will protect the circuit in overcurrent situations.
			x	Cell physical abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
	x			Site control failure	Failure of the site controller or other system controller which results in adverse conditions of the system.
			x	Redundant failure detection	Every cell is monitored for voltage, and multiple cells per module are monitored for temperature.
			x	System disconnect	Contactors will open if loss of positive heartbeat communication from site controller is detected.
			x	Passive circuit protection	AC breaker and DC fuses will protect the circuit in overcurrent situations.
			x	Cell physical abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
	x			Shutdown/isolation failure	Failure of the system to shutdown or isolate itself when an adverse condition is detected.
			x	Passive circuit protection	AC breaker and DC fuses will protect the circuit in overcurrent situations.
			x	Cell physical abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
	x			Communications failure	Failure of the system to properly report an adverse condition to local or remote monitoring.
			x	System disconnect	Contactors will open during overcharge, overdischarge, or overcurrent events.
			x	Passive circuit protection	AC breaker and DC fuses will protect the circuit in overcurrent situations.
			x	Cell physical abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
	x			Balancing failure	Failure of the system to maintain cell voltage balance, resulting in unstable or unbalanced system.
			x	Sensing and control	BMS is able to detect cell imbalance and properly return system to balance through passive balancing.
			x	System disconnect	Contactors will open during overcharge, overdischarge, or overcurrent events.
			x	Passive circuit protection	AC breaker and DC fuses will protect the circuit in overcurrent situations.
			x	Cell physical abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
		x		Single cell combustion	A single cell has failed and is producing flames or combusting.
			x	Fire suppression	Fire suppression system in the unit releases ultra fine Potassium salts with secondary inert gases.
			x	Cascading protection	Module design limits external temperatures from heating cells to thermal runaway. See UL9540A test report.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
		x		Single cell venting	A single cell has failed and is producing off-gas.
			x	Fire suppression	Fire suppression system in the unit releases ultra fine Potassium salts with secondary inert gases.
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			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
		x		Multiple cell or module combustion	Multiple cells have failed and are producing flames or combusting.

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			x	Cascading protection	Module design limits external temperatures from heating cells to thermal runaway. See UL9540A test report.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
		x		Multiple cell or module venting	Multiple cells have failed and are producing off-gas.
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			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
		x		Deflagration	Accumulation of off-gas creates explosion risk.
			x	Deflagration venting	Battery rack cabinet design allows deflagration (either upward or outward) without damage to rack structure or nearby personnel.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
		x		Physical damage to batteries	Batteries are subject to thermal, electric, or physical abuse which would make their continued use subject to risk.
			x	Cell physical abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
		x		Battery damage or excessive degradation	Batteries are subject to excessive degradation due to adverse conditions, resulting in premature end of life.
			x	Cell physical abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
x				Electrical risks	The system contains hazardous voltage and fault current capabilities that may cause catastrophic damage if not contained.
	x			Hazardous voltage condition	High voltage at the cell, module, pack, or unit level.
			x	Voltage monitoring	Every cell is voltage monitored, as well as full rack voltage monitoring.
			x	BMS control	BMS monitors cell voltage and has ability to shut down system for overvoltage or undervoltage.
			x	System disconnect	System has ability to open contactors when cell, module, or rack voltage is outside of acceptable limits.
			x	Inverter/PCS controls	Inverter will shut down in case of inverter overvoltage or undervoltage condition.
			x	Passive circuit protection	AC breaker and DC fuses will protect the circuit in overcurrent situations.
			x	System electrical abuse tolerance	Battery rack is designed and tested to withstand overvoltage and overcurrent situations. See UL1973 test report.
	x			Hazardous current condition	High current from inverter, battery rack, or interconnection to grid.
			x	Inverter/PCS controls	Inverter will shut down in case of inverter overcurrent condition.
			x	BMS control	BMS monitoring has the ability to shut down system during unacceptable current conditions.
			x	Passive circuit protection	AC breakers and DC fuses rated for maximum available fault current will protect the circuit in overcurrent situations.
			x	System electrical abuse tolerance	Battery rack is designed and tested to withstand overvoltage and overcurrent situations. See UL1973 test report.
	x			Ground fault/insulation fault	Local shorting of cells, modules, battery rack, or interconnection high-voltage poles to earth ground.
			x	Insulation monitoring	System continually monitors insulation integrity of high-voltage DC circuits via Insulation Monitoring Device.
			x	BMS control	BMS monitoring has the ability to shut down system during unacceptable current conditions.
			x	Passive circuit protection	DC fuses will protect the circuit in overcurrent situations.
			x	System electrical abuse tolerance	Battery rack is designed and tested to withstand overvoltage and overcurrent situations. See UL1973 test report.
	x			Cell premature end of life	Cell degrades prematurely such that it results in high resistance or open circuit.
			x	BMS control	Monitors cells with ability to shutdown system if anomaly detected.
			x	Cell electrical abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
		x		Single cell combustion	A single cell has failed and is producing flames or combusting.
			x	Fire suppression	Fire suppression system in the unit releases ultra fine Potassium salts with secondary inert gases.
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Hazard	Threat	Consequence	Barrier	Name	Description
			x	Fire service response	Fire department response includes active firefighting suppression.
		x		Multiple cell or module combustion	Multiple cells have failed and are producing flames or combusting.
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			x	Fire service response	Fire department response includes active firefighting suppression.
		x		Deflagration	Accumulation of off-gas creates explosion risk.
			x	Deflagration venting	Battery rack cabinet design allows deflagration (either upward or outward) without damage to rack structure or nearby personnel.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
		x		Physical damage to batteries	Batteries are subject to thermal, electric, or physical abuse which would make their continued use subject to risk.
			x	Cell physical abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
		x		Battery damage or excessive degradation	Batteries are subject to excessive degradation due to adverse conditions, resulting in premature end of life.
			x	Cell physical abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
		x		Arc flash	Large amount of energy discharged from making or breaking electrical contact.
			x	Arc design protections	There are no locations for making or breaking contact in the design that are not hermetically sealed.
			x	Passive arc flash protection	Enclosures and guards prevent arc flash energy discharge outside of equipment during normal use.
			x	Process control	Arc flash labels on relevant access panels, and commissioning and maintenance procedures, advise of hazard and recommended PPE.
x				Cell internal failure	A single battery cell may experience failure for internal or external reasons.
	x			Single cell thermal runaway	A single cell has entered thermal runaway, resulting in flames or combustion or production of off-gas.
			x	Passive cell protections	Cell spacing, separators, and insulation prevents propagation to neighbor cells. See UL9540A test report.
			x	Active cell protections	Liquid cooling system, use of non-flammable materials, and fire suppression system.
			x	Cell thermal abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
	x			Multiple cell thermal runaway	Multiple cells have entered thermal runaway.
			x	Passive cell protections	Cell spacing, separators, and insulation prevents propagation to neighbor cells. See UL9540A test report.
			x	Active cell protections	Liquid cooling system, use of non-flammable materials, and fire suppression system.
			x	Cell thermal abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
	x			Internal defect	A cell has failed as a result of an internal defect, creating a short circuit, open circuit or other adverse condition.
			x	Cell quality control	Cell manufacturing tests and inspects cells for quality and performance.
			x	BMS control	BMS monitoring has the ability to shut down system during unacceptable current conditions.
			x	Passive cell protections	Cell spacing, separators, and insulation prevents propagation to neighbor cells. See UL9540A test report.
			x	Active cell protections	Liquid cooling system, use of non-flammable materials, and fire suppression system.
			x	Cell thermal abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
	x			End of life or degradation failure	A cell has reached end of life, resulting in adverse conditions.
			x	Cell quality control	Cell manufacturing tests and inspects cells for quality and performance.
			x	BMS control	BMS monitoring has the ability to shut down system during unacceptable current conditions.
			x	Active cell protections	Cell spacing, separators, and insulation prevents propagation to neighbor cells. See UL9540A test report.
	x			Cell pressure buildup	A cell has begun to build internal pressure as a result of gas generation.
			x	Cell quality control	Cell manufacturing tests and inspects cells for quality and performance.
			x	Passive cell protections	Cell spacing, separators, and insulation prevents propagation to neighbor cells. See UL9540A test report.
			x	Active cell protections	Liquid cooling system, use of non-flammable materials, and fire suppression system.
			x	Cell thermal abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.

Hazard	Threat	Consequence	Barrier	Name	Description
		x		Single cell combustion	A single cell has failed and is producing flames or combusting.
			x	Fire suppression	Fire suppression system in the unit releases ultra fine Potassium salts with secondary inert gases.
			x	Cascading protection	Module design limits external temperatures from heating cells to thermal runaway. See UL9540A test report.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
		x		Single cell venting	A single cell has failed and is producing off-gas.
			x	Fire suppression	Fire suppression system in the unit releases ultra fine Potassium salts with secondary inert gases.
			x	Cascading protection	Module design limits external temperatures from heating cells to thermal runaway. See UL9540A test report.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
		x		Multiple cell or module combustion	Multiple cells have failed and are producing flames or combusting.
			x	Fire suppression	Fire suppression system in the unit releases ultra fine Potassium salts with secondary inert gases.
			x	Cascading protection	Module design limits external temperatures from heating cells to thermal runaway. See UL9540A test report.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
		x		Multiple cell or module venting	Multiple cells have failed and are producing off-gas.
			x	Fire suppression	Fire suppression system in the unit releases ultra fine Potassium salts with secondary inert gases.
			x	Cascading protection	Module design limits external temperatures from heating cells to thermal runaway. See UL9540A test report.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
		x		Deflagration	Accumulation of off-gas creates explosion risk.
			x	Deflagration venting	Battery rack cabinet design allows deflagration (either upward or outward) without damage to rack structure or nearby personnel.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
		x		Physical damage to batteries	Batteries are subject to thermal, electric, or physical abuse which would make their continued use subject to risk.
			x	Cell physical abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
		x		Battery damage or excessive degradation	Batteries are subject to excessive degradation due to adverse conditions, resulting in premature end of life.
			x	Cell physical abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
x				System failure	Incipient or fully evolved fire in BESS.
		x		Multiple cell or module venting	Multiple cells have failed and are producing off-gas.
			x	Fire suppression	Fire suppression system in the unit releases ultra fine Potassium salts with secondary inert gases.
			x	Cascading protection	Module design limits external temperatures from heating cells to thermal runaway. See UL9540A test report.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.
		x		Deflagration	Accumulation of off-gas creates explosion risk.
			x	Deflagration venting	Battery rack cabinet design allows deflagration (either upward or outward) without damage to rack structure or nearby personnel.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
		x		Fire service response	Fire department response includes active firefighting suppression.
			x	Physical damage to batteries	Batteries are subject to thermal, electric, or physical abuse which would make their continued use subject to risk.
			x	Cell physical abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
		x		Fire service response	Fire department response includes active firefighting suppression.
			x	Battery damage or excessive degradation	Batteries are subject to excessive degradation due to adverse conditions, resulting in premature end of life.
			x	Cell physical abuse tolerance	Cells are able to withstand some abuse without instigating additional thermal runaway. See UL1642 test report.
			x	Emergency action plan	Battery rack heat and smoke detectors will alert remote Central Station to contact first responders.
			x	Fire service response	Fire department response includes active firefighting suppression.