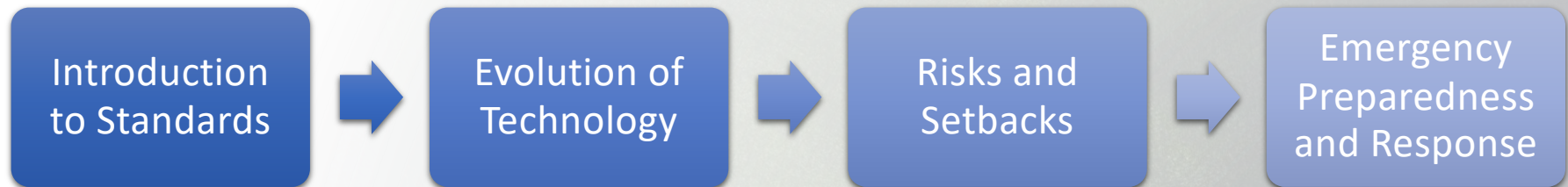




Safety Standards for BESS Interconnection

Presented by
Hydro One & Fire & Risk Alliance

Agenda



Robert Reinmuller

Quyen Diep

Ajay Garg

Farooq Qureshy

Hemant Barot



Team

Team

Anthony
Natale

Derek Post

Noah Ryder

Jeffrey Reetz



FIRE & RISK
★ ★ ALLIANCE ★ ★

Anthony Natale

- **CERTIFICATIONS:**

- Fire Instructor I, II - ProBoard Certified New York State
- Incident Command System Instructor FEMA Cert E-449
- Incident Command System 100, 200, 300, 400, 700 & 800a
- All Hazards Liaison Officer – FEMA Certification
- Incident Management Level 3 New Jersey DFS
- HazMat On-Scene Incident Commander New Jersey DFS
- Hazardous Material Technician II (120 hr.) FDNY
- Firefighter 1 New Jersey DFS
- Advanced Exterior Industrial Brigade - NFPA 1081 Texas A&M
- Interior Structural Industrial Brigade NFPA - 1081 Texas A&M
- Refrigeration Operating Engineer FDNY
- Underground Storage Tank System Operator NYS DEC
- NFPA 18 Technical Committee
- NFPA 855 Technical Committee



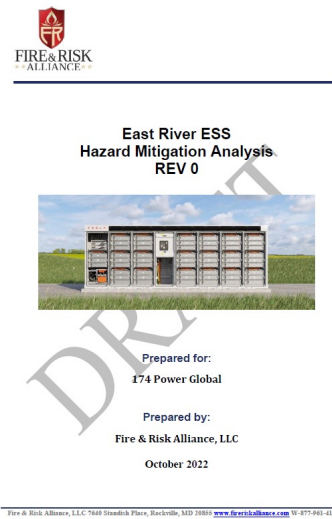
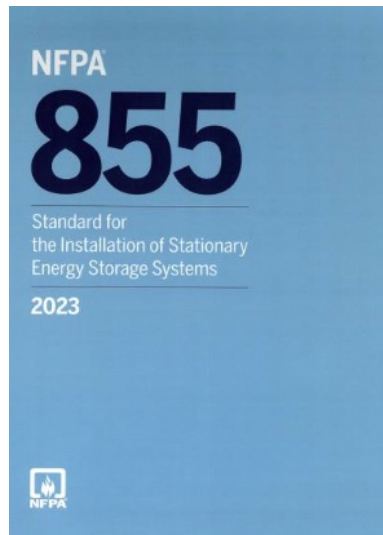


Overview

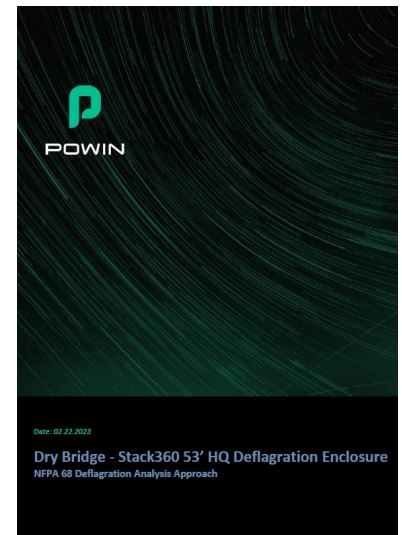
Section 1

Introduction

Develop Fire Protection & Risk Assessment Standard



UL 9540A Report Cell Report		Ed. 2019-12-2	
UL CELL TEST REPORT UL 9540A Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems (AACD)			
Project Number.....	4789764715		
Date of issue	2021.04.27		
Total number of pages	39		
UL Report Office	UL-CCIC Company Limited (Guangzhou Branch)		
Applicant's name	Contemporary Ampere Technology Co., Limited		
Address	No.2 Xianggang Road, Zhangwan Town, Jiaocheng District Nindde, Fujian, 352100 CN		
Test specification:	4 th Edition, Section 7, November 12, 2019		
Standard.....	UL 9540A, Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems		
Test procedure.....	7.1 – 7.6		
Non-standard test method	N/A		
Copyright © 2021 UL LLC All Rights Reserved.			
General disclaimer: The test results presented in this report relate only to the sample tested in the test configuration noted or list of the attachments.			
UL LLC did not select the sample(s), determine whether the sample(s) was representative of production samples, witness the production of the test sample(s), nor were we provided with information relative to formulation or identification of component materials used in the test sample(s).			
The issuance of this report in no way implies Listing, Classification or Recognition by UL and does not authorize the use of UL Listing, Classification or Recognition Marks or any other reference to UL on the product or system. UL LLC authorizes the above named company to reproduce this Report provided it is reproduced in its entirety. UL's name or marks cannot be used in any packaging, advertising, promotion marketing relating to the data in this Report, without UL's prior written permission.			
UL LLC, its employees, and its agents shall not be responsible to anyone for the use or non-use of the information contained in this Report, and shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use of, or inability to use, the information contained in this Report.			

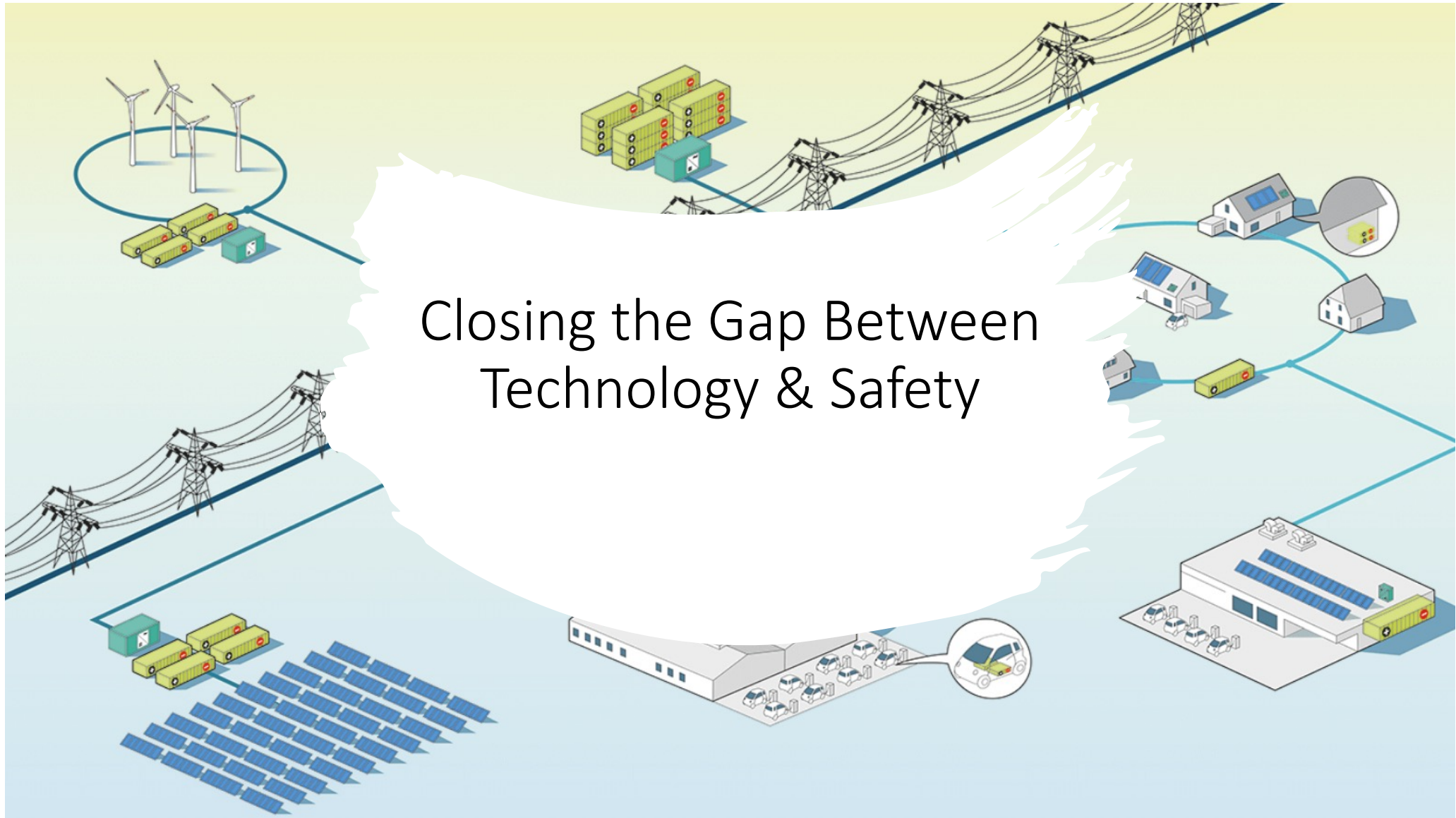




A photograph of a power substation. In the foreground, there are several rows of white, rectangular electrical cabinets or control units, each sitting on a concrete pad. The cabinets have doors with small windows. In the background, there is a complex of high-voltage electrical equipment, including metal structures, insulators, and power lines. The sky is clear and blue. The text "Interconnection Safety Standard" is overlaid in white on the image.

Interconnection Safety Standard

Closing the Gap Between Technology & Safety



—

No Risk to Transmission Assets from BESS Failure





Requirements

Section 2

A photograph of a server rack with a fire damage overlay. The server units are visible, but the image is dark and textured, suggesting a fire scene. The text "Fire Propagation Analysis" is overlaid in white, with a white underline below it. Below the underline, the text "Successful Results" is written in a smaller, italicized font.

Fire Propagation Analysis

Successful Results

NMC VS LFP

LI-ION TECHNOLOGY

Battery Chemistry

Nickel Manganese Cobalt

Vs

Lithium-Iron Phosphate

Manageable Hazards

NMFC

LFP



Nickel Manganese Cobalt (NMC)



NMC vs LFP

Nail Penetration Test

wattsonic
Life's Innovation

Nickel Manganese Cobalt (NMC)



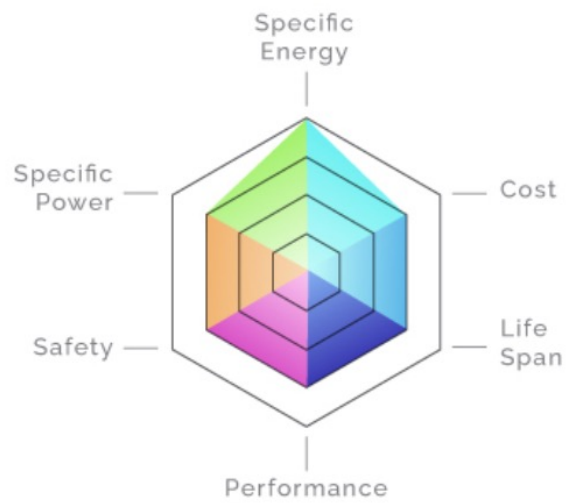
NMC vs LFP

Nail Penetration Test

wattsonic
Life's Innovation

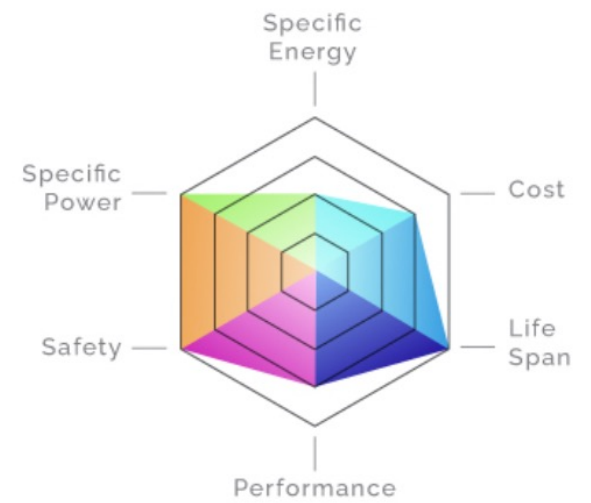
**LITHIUM NICKEL MANGANESE
COBALT OXIDE**

NMC



LITHIUM IRON PHOSPHATE

LFP



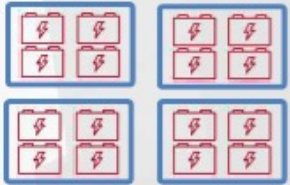
UL 9540A Test Hierarchy



Cell Level Test



Module Level Test



Unit Level Test



Installation Level Test

- Whether cell can exhibit thermal runaway
- Thermal runaway characteristics
- Gas composition (flammability)
- Propensity for propagation of thermal runaway
- Heat and gas release rates (severity/duration)
- Flaming/deflagration hazards
- Evaluation of fire spread
- Heat and gas release rates (severity/duration)
- Deflagration hazards
- Re-ignition hazards
- Effectiveness of fire protection system(s)
- Heat and gas release rates (severity/duration)
- Deflagration hazards
- Re-ignition hazards

Module Test



No Fire
Propagation
Beyond the
Module



Hazard Mitigation Analysis Analysis (HMA)



Hazard Mitigation Analysis for Outside Ground Mounted Battery Energy Storage Systems: Dry Bridge BESS Facility, Chesterfield County, Virginia

DRAFT REPORT | REV0 | June 8, 2023





Explosion Mitigation

APS, Surprise AZ - April 19th, 2019

*No Provisions for NFPA
68/69 Compliance*





NFPA 68



NFPA 69

NFPA 68 or NFPA 69 Analysis

Powin Stack 360 53-ft Dual-Duct Roof C1D1 Exhaust Fan Explosion Prevention Analysis

**Powin Stack 360 53-ft Dual-Duct
Roof C1D1 Exhaust Fan Explosion
Prevention Analysis**

SUPPORTS NFPA 69 ANALYSIS

Date: 02.22.2023

Dry Bridge - Stack360 53' HQ Deflagration Enclosure
NFPA 68 Deflagration Analysis Approach

Number of Cells Required to Reach LFL

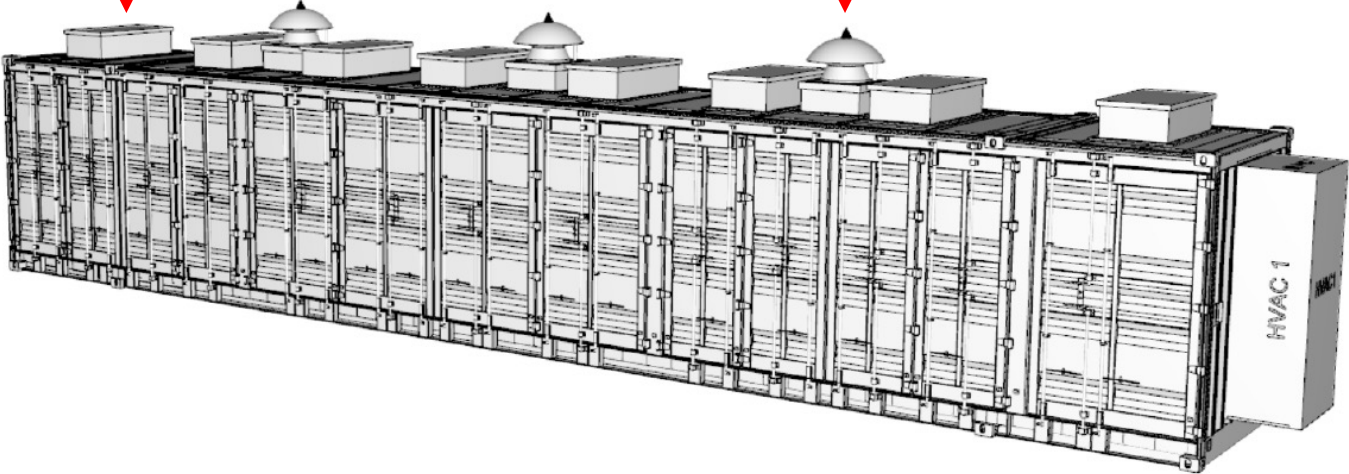
<i>Event Description</i>	<i>Number of Cells involved</i>	<i>Failure Mode</i>	<i>Average gas release rate (g/s)</i>	<i>Total Duration (min.)</i>	<i>Assumptions</i>
Single module failure	9	Cell overheating or power surge affecting one module	1.65	14.5	Propagation to all cells in one module


NFPA 855 Requires 1 Explosion Control Method

NFPA 68



NFPA 69

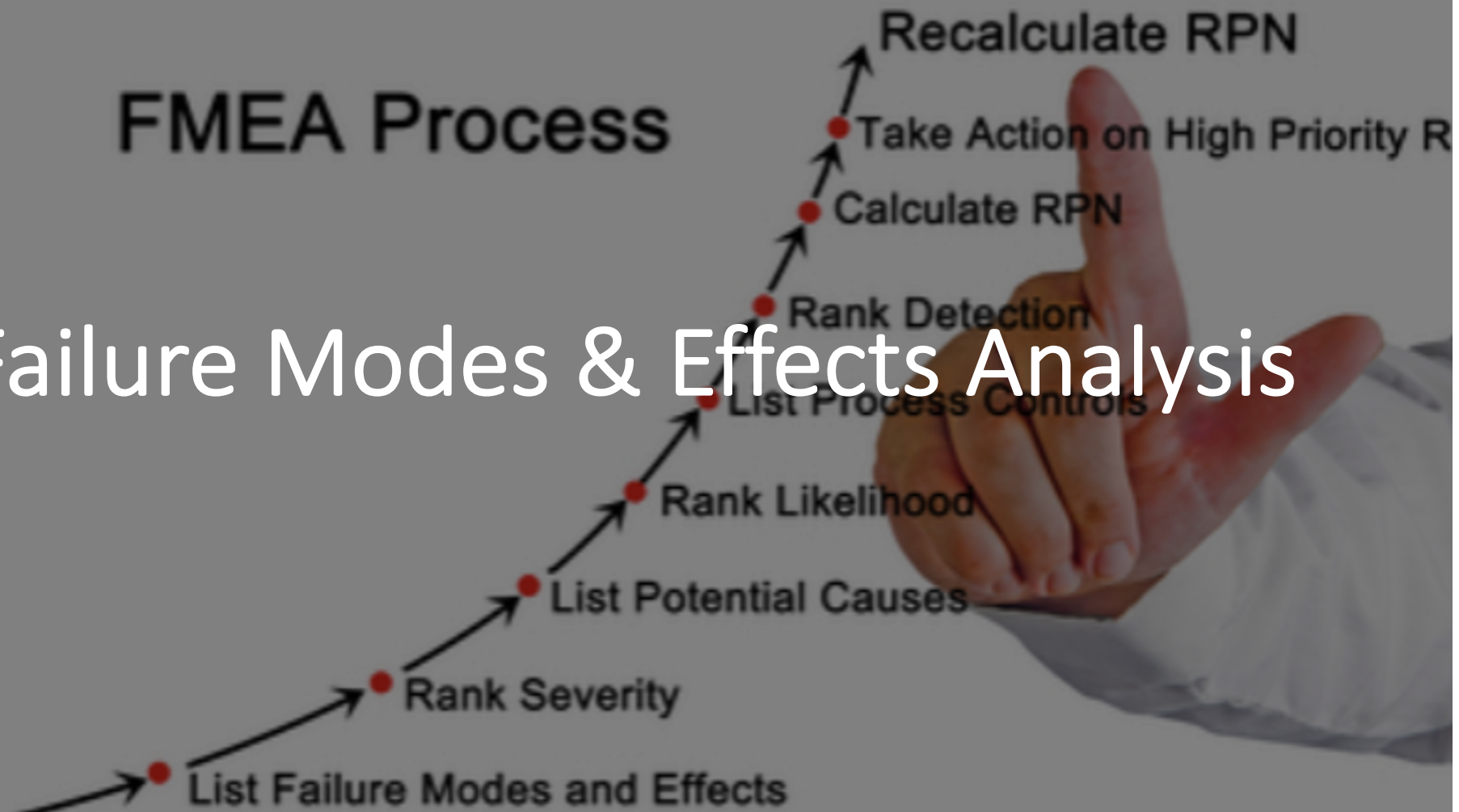




Tesla Explosion Control
22 Roof Vents w/ 12 Sparkers

FMEA Process

Failure Modes & Effects Analysis





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ALLIANCE



WÄRTSILÄ Quantum Cube

**Fire Safety Assessment for Outdoor Ground Mounted
Battery Energy Storage Systems:
Moccasin Pointe, La Porte, TX**

REV3 | April 14, 2023

Fire Risk Assessment

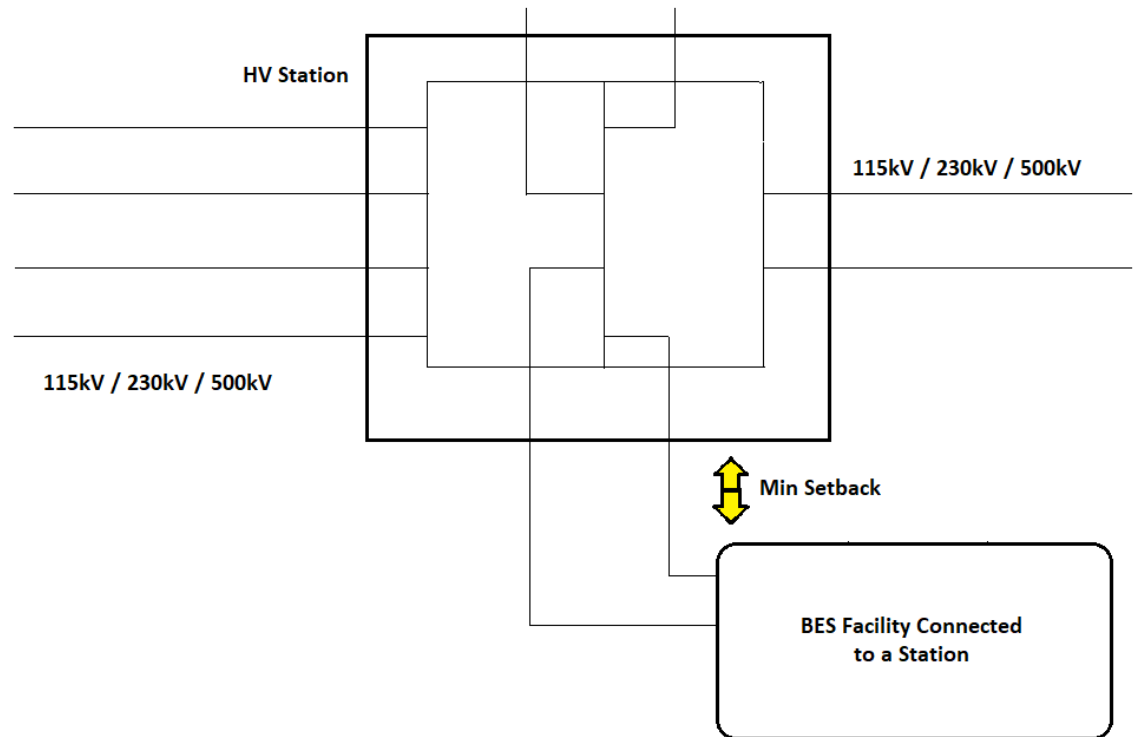
Community Risk
Assessment



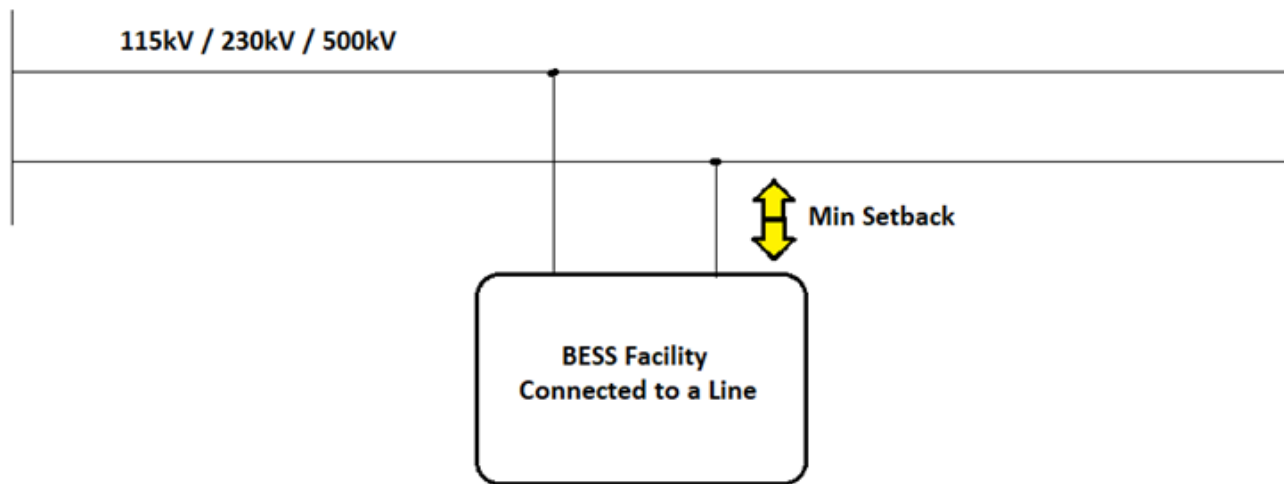


Required Setbacks

Substation Setback



Transmission Corridor Setback





Setback Table

Item #	Hydro One Facilities	Hydro One Setback Distance ^{1,2}
1	Hydro One – 500 kV Right of Way (ROW)	150 meters
2	Hydro One – 230 kV ROW	100 meters
3	Hydro One – 115kV ROW	60 meters
4	Hydro One – 500 kV Substation	300 meters
5	Hydro One – 230 kV Switching Substation	200 meters
6	Hydro One 115kV Switching Substation or Hydro One 230kV & 115kV step down Substation	120 meters
<p>1. All distances are from the edge of right of way or Hydro One station property line.</p> <p>2. For proponents that have acquired property rights or own the BESS property prior to January 1, 2023, and cannot meet the above distances, the layout must be discussed with Hydro One for assessment and approval.</p>		

Assessments

Required Assessments	Up to 250m from Lines ROW	Up to 400m from Stations Property Line
<ul style="list-style-type: none"> • Hazard Mitigation Analysis (HMA) <ul style="list-style-type: none"> ○ Code Review ○ UL 9540 Listing ○ UL 9540A Test Report ○ Fault Condition Assessment 	Required	Required
<ul style="list-style-type: none"> • Fire Risk Assessment (FRA) <ul style="list-style-type: none"> ○ Community Risk Assessment ○ Air/Gas Dispersion Study 	Required	Required
<ul style="list-style-type: none"> • Fire Protection Design Documentation <ul style="list-style-type: none"> ○ Passive Fire Protection System ○ Active Fire Protection Systems 	Required	Required
<ul style="list-style-type: none"> • Commissioning Plan 	Required	Required
<ul style="list-style-type: none"> • Emergency Response Plan 	Required	Required

Detection



Fire Strobe



Alarm Bell



Heat
Detector



Smoke
Detector



Combustible gas
detector
CO, H₂, CH_x



Fire Alarm
Control panel

NFS-320

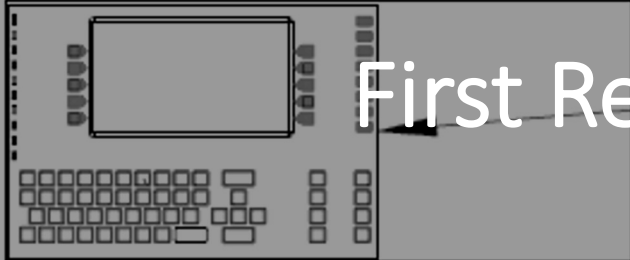
FACP to Central Station Monitoring

 **NOTIFIER**
by Honeywell

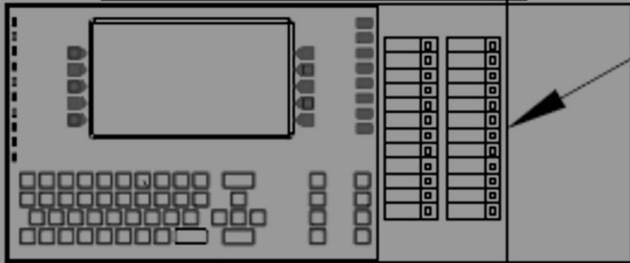
First Responder Station

Gas Readings
Purge Control
FACP Data

GAS LEVEL MEASUREMENT



FIRE ANNUCIATOR PANEL



14




A photograph of a fire at a power substation at night. Several firefighters in full gear are positioned around a large, bright fire that is consuming a piece of equipment. They are using high-pressure water hoses to spray the fire from multiple angles. The scene is illuminated by the fire and the substation's lights. The ground is covered in snow. The background shows the complex structure of the substation with many vertical poles and overhead power lines.

Fire Suppression

Changing Tactics



Why Do We Extinguish Fires ?
Life Safety & Preservation of Property



What They Think & What Actually Happened

[Home](#) > [Future Tech](#) > [Electric Vehicles](#)

**TESLA'S CAR CRASH NEEDED 32,000
GALLONS OF WATER TO PUT OUT THE
FIRE**

Thermal Runaway

*Vent Pressure
100 psi*





Single Failure Loss



Spatial Separation

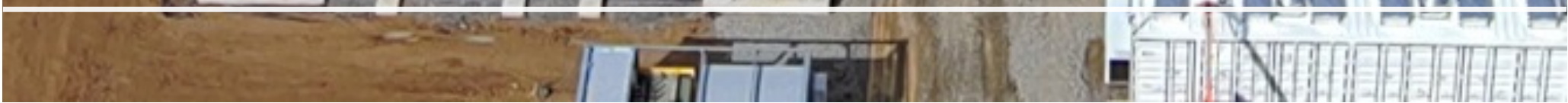
NFPA 855 3'

FM Global 20'

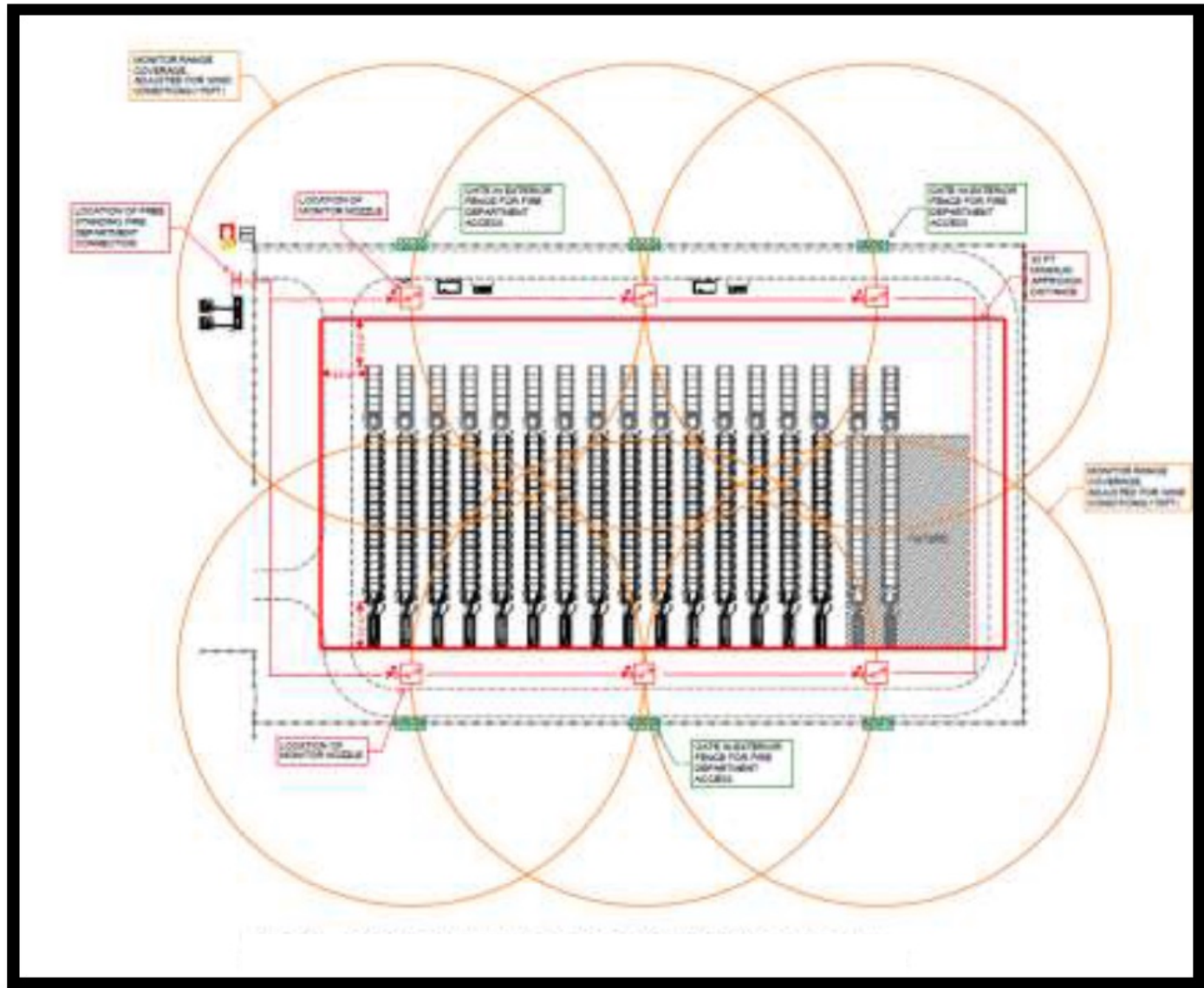
Utility Standard 25'



Do Not Install MVSkid Between Containers



Exposure Control





Vegetation Management

Required Plans

NFPA[®]

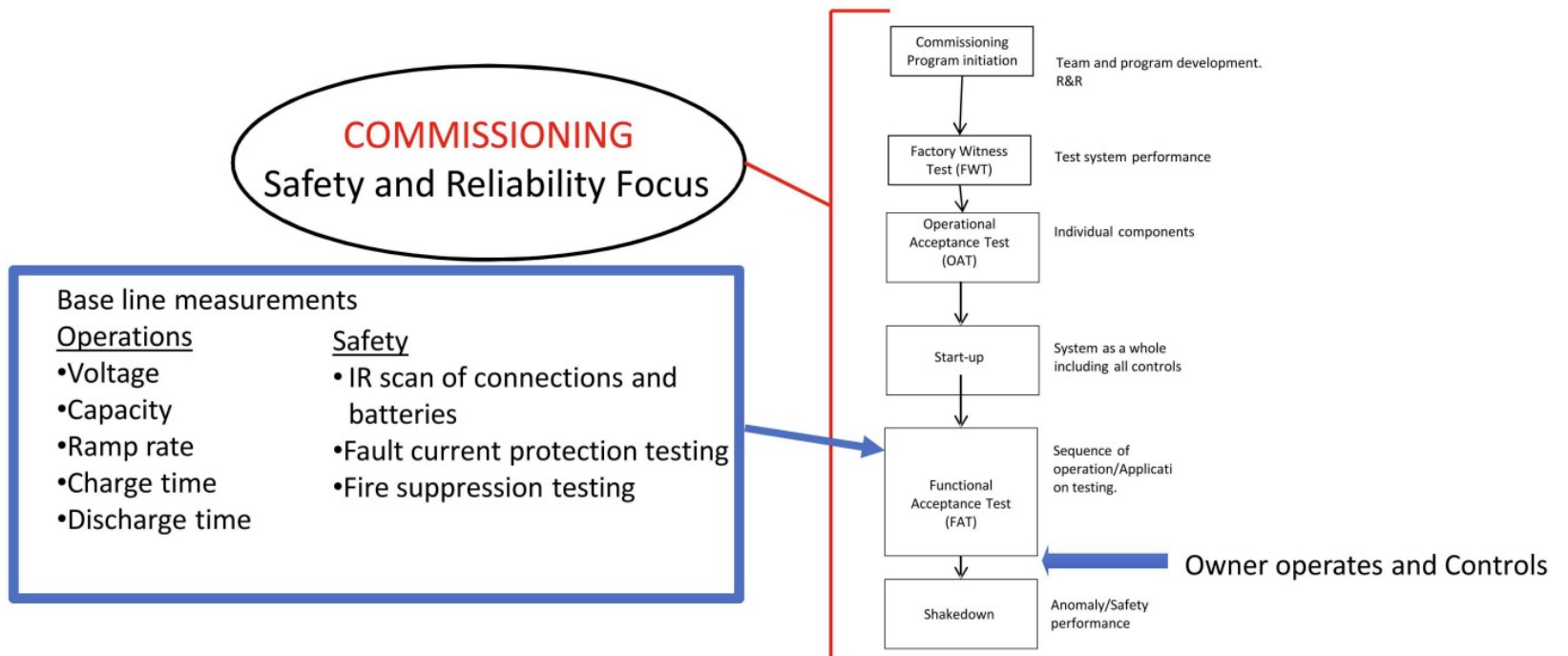
855

Standard for
the Installation of Stationary
Energy Storage Systems

2023

Commissioning Plan

15 Commissioning / Testing Process details




Operations & Maintenance Plan




Megapack 2 Operation and Maintenance Manual

CONFIDENTIAL INFORMATION - SHARED UNDER NDA ONLY - REV 1.1

Decommissioning Plan




WÄRTSILÄ



FIRE & RISK
ALLIANCE

Wärtsilä GridSolv Quantum
ESS Decommissioning Plan



ESS Decommissioning Plan Rev_0

REV_0 | Date: May 1st, 2023

This plan has been developed to assist customers with end of useful life and post incident decommissioning of Wärtsilä's GridSolv Quantum energy storage system battery installations.

This generalized document and supporting material should be consulted prior to performing decommissioning on Wärtsilä GridSolv Quantum equipment.

Approved By
Wärtsilä
485 Springpark Place, Suite 1500
Herndon, VA 20170

Fire & Risk Alliance, LLC.
7640 Standish Place
Rockville, MD 20855
fireriskalliance.com
1-877-961-4118

Confidential
Document No. 594-002 Wärtsilä BESS Decommissioning Plan

CONFIDENTIAL AND PRIVILEGED; Attorney-Client Communication/Party Representative Work Product Self Critical Analysis/Self Evaluation Privilege Contains Mental Impressions, Conclusions and Opinions Respecting the Value or Merit of a Claim or Defense or Strategy or Tactics

Emergency Response Plan



Dry Bridge BESS

Chesterfield County, Virginia
Battery Energy Storage System

This plan has been developed to assist the local emergency responders with important safety and emergency response information concerning the Powin Stack 360E energy storage system.

This generalized document and supporting material should be consulted prior to any fire service personnel performing firefighting operations or entering the Dry Bridge BESS site.

Confidential

Document No. ERP-680-006

Emergency Response Plan Rev_02

Approved By: Strata Clean Energy

Approved By: Dominion Energy

Draft Date: June 8, 2023

CONFIDENTIAL AND PRIVILEGED; Attorney-Client Communication/Party Representative Work Product Self Critical Analysis/Self Evaluation Privilege Contains Mental Impressions, Conclusions and Opinions Respecting the Value or Merit of a Claim or Defense or Strategy or Tactics.

The background image shows the entrance to the FDNY Fire Academy. A dark metal fence runs across the middle ground. In the foreground, a large, dark, rectangular sign is mounted on a concrete base. The sign features the text 'FDNY' in large, bold, serif capital letters, with 'Fire Academy' written in a smaller, sans-serif font below it. To the left of the sign, a paved area leads to a building entrance where a few people are visible. The sky is overcast and grey. The overall scene is dimly lit, suggesting an overcast day.

Fire Department Training

Hazards & Response Tactics for BESS Emergencies



Familiarization Tours

Design Documentation

- Recommended documents to be submitted to Hydro One:
- Hazard Mitigation Analysis (HMA)
 - Code Review
 - UL 9540 Listing
 - UL 9540A Test Reports
 - Fault Condition Assessment
- Fire Risk Assessment (FRA)
 - Community Risk Assessment
 - Air/Gas Dispersion Study
- Fire Protection Design Documentation
 - Passive Fire Protection Systems
 - Active Fire Protection Systems
- Commissioning Plan
- Emergency Response Plan
- Signed and Sealed Document Assembly- Self Certification Document

Next Steps

Hydro One will post the Fire Protection Risk and Response Standard (FRRAS) on the [Transmission Connected Generator](#) page by 21st July 2023.

Your comments are expected before 4th August 2023

For any questions or comments, please email us with a Subject Line “BESS Setback Enquiry” to: largeaccounts@hydroone.com



Questions

The Hydro One logo is displayed on a dark teal background. It features the word "hydro" in a lowercase, sans-serif font, followed by a stylized white icon of a water drop or wave. Below "hydro" is the word "one" in a bold, lowercase, sans-serif font.

hydro
one