Appendix D6

Hazard Mitigation Analysis and Emergency Response Plan Peer Review

DUDEK
MAIN OFFICE
605 THIRD STREET
ENCINITAS, CALIFORNIA 92024
T 800.450.1818 F 760.632.0164

TECHNICAL MEMORANDUM

To:	Peter Eichar, AICP, Program Manager, Climate and Sustainability, Port of San Diego
cc.	Matthew Valerio, Dudek Principal/Coastal Services Manager
From:	Dudek Fire Protection Planning Team, Douglas Nickles, Sr. Fire Protection Specialist
Subject:	Tidelands Avenue Electric Truck Hub Peer Review – Hazard Mitigation Analysis, Emergency Response Plan and Hazards and Hazardous Materials
Date:	September 30, 2025
Attachment(s):	1 – Hazard Mitigation Analysis with comments 2 – Emergency Response Plan with comments 3 – Site Plan with comments

Introduction

This memorandum transmits the findings of a peer review of the Hazard Mitigation Analysis and Emergency Response Plan (technical documents) for the Tidelands Avenue Electric Truck Hub prepared by Energy Safety Response Group (September 2025). Based on our experience preparing documents for energy storage systems, along with expertise with Fire Code requirements and emergency response tactics, we have provided recommended edits, clarifications, and appropriate response, as applicable.

This peer review focuses on the adequacy of the documents' analyses and findings with respect to a complete analysis in accordance with the applicable Fire Code, NFPA and Underwriter's Laboratory standards related to battery energy storage systems (BESS). In addition to this memorandum, comments have also been provided within the aforementioned documents.

Project Description

The Tidelands Avenue Electric Truck Hub Project includes the construction of a drayage truck stop consisting of 70 electric vehicle (EV) charging positions; electrical infrastructure for the chargers; carport solar [three canopies]; a convenience store/restrooms; and a battery energy storage system. The BESS is anticipated to have an up to 2.8-MW capacity and could store up to 6.8-MWh in a containerized storage system. The container is expected to include a battery, power and battery management system, and a power conditioning system for

conversion of AC to DC. No external fire protection would be included.[1] [Note: The BESS is an outdoor installation with non-occupiable cabinets.]

Location

The Project would be constructed on approximately 4.8 acres of an approximately 8.2-acre paved site located at 1640 Tidelands Avenue in the city of National City in San Diego County, California (CA). The site is immediately south of the Port District's General Services building located at 1400 Tidelands Ave, National City, CA. The site is bound on the east by Tidelands Avenue, on the south by W 19th Street and on the west by Military areas.[2]

Peer Review of the Hazard Mitigation Analysis

The Hazard Mitigation Analysis (HMA) was prepared "to assess the anticipated overall effectiveness of protective barriers in place to mitigate the consequences of a battery-related failure"[3] for the Project.

The following codes and standards are applicable for energy storage systems (see HMA Sec. 1.2 and App. E):

- *California Fire Code §1207 Electrical Energy Storage Systems*, 2022 Edition
- *California Electrical Code, 2022 Edition*
- *California Building Code, 2022 Edition*
- *UL 9540A Standard for Test Method for Evaluation Thermal Runaway Fire Propagation in Battery Energy Storage Systems,* 4th Edition
- *UL 9540 Standard for Energy Storage Systems and Equipment,* 2nd Edition
- *NFPA 68 Standard on Explosion Protection by Deflagration Venting,* 2013 Edition
- *NFPA 72 National Fire Alarm and Signaling Code,* 2022 Edition
- *NFPA 76 Standard for the Fire Protection of Telecommunications Facilities,* 2016 Edition
- *NFPA 855 Standard for the Installation of Stationary Energy Storage Systems*, 2020 Edition

In response to the applicable code requirements for installation of an outdoor BESS, the analysis addressed the specific requirements listed per *2022 CFC §1207* and *2023 NFPA 855*.

2022 CFC

- *§1207.1.4 Hazard mitigation analysis.*
- *§1207.1.4.1 Fault condition. The hazard mitigation analysis shall evaluate the consequences of the following failure modes.*
- *§1207.1.4.2 Analysis approval. The fire code official is authorized to approve the hazardous mitigation analysis provided that the consequences of the hazard mitigation [are demonstrated.]*

[1] San Diego Unified Port District, National City Zero Emissions Truck Stop Project, Project No. 172466, June 13, 2024
[2] Ibid
[3] HMA pg 8

Table 1. Peer Review of the Hazard Mitigation Analysis

Applicable Codes and Standards 2022 CFC and 2021 IFC	1.2, p.9	California Fire Code International Fire Code §1207 Electrical Energy Storage Systems, 2022 Edition.	Clarify to reference the 2022 CFC and 2021 IFC.
Applicable Codes and Standards 2022 CFC §1207.1.2	1.2, p.9	The design of each battery energy storage "unit" be submitted for review and approval by the local fire code official as part of the permitting process.	No recommended changes to the analysis – for reference only.
Applicable Codes and Standards 2022 CFC §1207.1.4.2	1.2, p.9	The local fire code official shall be permitted to approve the hazardous mitigation analysis as documentation of the safety of the ESS installation, provided the consequences of the analysis demonstrate	No recommended changes to the analysis – for reference only.
Summary of Findings 2022 CFC §1207.1.4.1	1.3, p.10	The HMA finds that adequate protections are provided for the fault conditions listed per 2022 CFC §1207.1.4.1 and 2023 NFPA 855 §4.4.	No recommended changes to the analysis – for reference only.
Summary of Findings	1.3, p.10	The proposed BESS facility and location pose minimal risk to public or life safety and property by way of being on a secured site away from public spaces or roadways with limited public access to the site.	While there is limited access, the BESS is immediately adjacent to a public roadway, and any potential risk should be properly identified.
Nearby Exposures	2.2, p.15	Figure 2: Layout is outdated.	Provide an updated figure with the new layout.
Nearby Exposures	2.2, p.16	- San Diego Port – The San Diego Port is located on multiple sides of the site. - Pacific Ocean – The Pacific Ocean is located approximately 800 feet to the west of the site.	- Be more specific if referring to the Port District which covers a large area and has many facilities, e.g. which facilities, or parts of the Port are exposed.

			- Clarify if the reference is in regard to the Pacific Ocean, or the San Diego Bay.
Fire Department Access and Water Supply	2.3, p.16	Access to/from the site will be off Tidelands Avenue and provided with two access gates. There will be an access road throughout the site.	Provide clarification for access locations in the site and/or BESS facility locations. Include details and code-compliance of the various features mentioned. A Fire Department Access Plan/Figure is recommended.
	Throughout	Unclear terminology	- Be more specific when using the terms, site, facility, area, fence and gates, as the entire facility, and also the BESS portion, appear to be referred to interchangeably with these terms. - Consider adding a Glossary to include: Units, Modules, Enclosures, Cabinets

Peer Review of the Emergency Response Plan

The Preliminary Emergency Response Plan (ERP) "provides information and instructions to guide first responders in preparing for, and safely responding to, an incident, fire, or other emergency associated with the energy storage facility."[4]

California Public Utilities Code 761.3 and Government Order 167

The emergency response plan must:

[4] ERP pg 1

- Establish response procedures for an equipment malfunction or failure;
- Include procedures, established in consultation with local emergency management agencies, that provide for the safety of surrounding residents, neighboring properties, emergency responders; and
- Establish notification and communication procedures between the battery storage facility and local emergency management agencies.

Additionally, the plan may consider responses to potential offsite impacts such as poor air quality, threats to municipal water supplies, water runoff, and threats to natural waterways. The plan also may include procedures for the local emergency response agency to establish shelter-in-place orders and road closure notifications when appropriate.

Table 2. Peer Review of the Emergency Response Plan

Topic/Regulatory Section	Report Section(s)/Page	Issue/Excerpt	Recommended Action
PUC 761.3(g)(1)		Each battery energy storage facility shall have an emergency response and emergency action plan that covers the premises of the battery energy storage facility.	No recommended changes to the plan – for reference only.
GO 167		Implement and enforce standards for the maintenance and operation of electric generating facilities, power plants, and energy storage systems.	No recommended changes to the plan – for reference only.
Site Location	2.1, p.15	Figure 4	Revise the figure as the Preliminary Site Layout does not reflect the current proposed layout.
Staging Area	2.2, p.16	- Fire Department Level 2 staging and safety assembly area for any onsite personnel is located along 19th Street, east of Tidelands Avenue, or along Civic Center Drive, east of Tidelands Avenue. - It is recommended that the Fire Department staging is established at angles relative to the sides of the ESS enclosures to reduce potential impact from	- Provide a figure (i.e., Fire Department Access Plan) that identifies the locations of the staging and safety assembly areas. - Provide example of recommended staging on a figure (i.e., Fire

		flying projectiles or debris from a possible overpressure event.	Department Access Plan).
First Responders Station	2.3, p.16	A First Responder's Station housing with a physical copy of the Emergency Response Plan (ERP), operational permits, O&M logs, and product manuals.	Provide location of the station on a figure (i.e., Fire Department Access Plan).
Site Access	2.4, p.16	A site access gate will be provided for fire department access. As noted above, the Fire Department should not attempt to enter the site fence line unless there is a clear threat to life safety.	Need to clarify between the facility site access and BESS site access and fence lines.
Equipment Access	2.5, p.16	The Tesla Megapack enclosures are only accessible for maintenance purposes via cabinet-style enclosure doors and cannot be physically entered by personnel at any time.	Clarify terminology regarding units, enclosures and containers.
Water Supply	2.6, p.16	There will be approved hydrants on the site, even though engaging a battery fire directly with water is not recommended based on best industry practice.	Clarify if hydrant locations are proposed within the BESS facility.
Nearby Infrastructure and Natural Features	2.7, p.17	- The San Diego Port is located on multiple sides of the site. - The Pacific Ocean is located approximately 800 feet to the west of the site.	- Be more specific as the port covers a large area and has many facilities - Clarify if this reference is in regard to the ocean, or San Diego Bay.
Site Maintenance	2.8, p.17	The facility's interior access roads shall be maintained to guarantee accessibility to the site by emergency personnel, especially during inclement weather.	Clarify if the access roads include the BESS portion as well.
Energy Storage System Overview	3, p.18	The IR Detection Zones are shown in Figure X.	Provide figure.

Natural Disasters PUC 761.3(3)(g)(2)(C)	6.7, p.24	If a wildfire impacts the site, the fire detection system will detect the fire and immediately contact the fire department.	Clarify if the system will contact the fire department directly, or through a monitoring company.
General Emergency Response Recommendations PUC 761.3(3)(g)(2)(B)	7.4, p.27	Table 2. A safe stand-off distance of at least 100 ft shall be maintained between individuals and the ESS enclosure(s) exhibiting fire conditions.	Provide justification for recommending 100 feet as a safe distance, which would require the closing of Tidelands Ave.
Overpressure Incident 761.3(g)(2)	8.1, p.29	If available, shielding via the built environment should be utilized to protect against high temperatures, overpressure events, or projectile hazards.	The BESS is open on all sides and adjacent to Tidelands Avenue - no built environment is readily available. Provide alternative options.
	Appendix B, p.36	ERP: Sample placards.	- Indicate where placards will be placed. - Include “Apply No Water” placard for BESS.

Site Plan Review

- EV charging stall 23 would block access to the BESS enclosures if occupied and should therefore be moved/removed from the parking plan
- The recommended 100-foot safe zone for Fire Department defensive position would require closure of all lanes of Tidelands Avenue and could impact vehicles utilizing stalls 13 to 26
- Show roadway meeting fire lane requirements through BESS area for Fire Department access

Conclusions

The Hazardous Mitigation Analysis was completed in accordance with the required codes and standards, except for those deficiencies noted in Table 1.

The Emergency Response Plan was completed in accordance with the required codes and standards, except for those deficiencies noted in Table 2.

References

2022 California Fire Code §1207

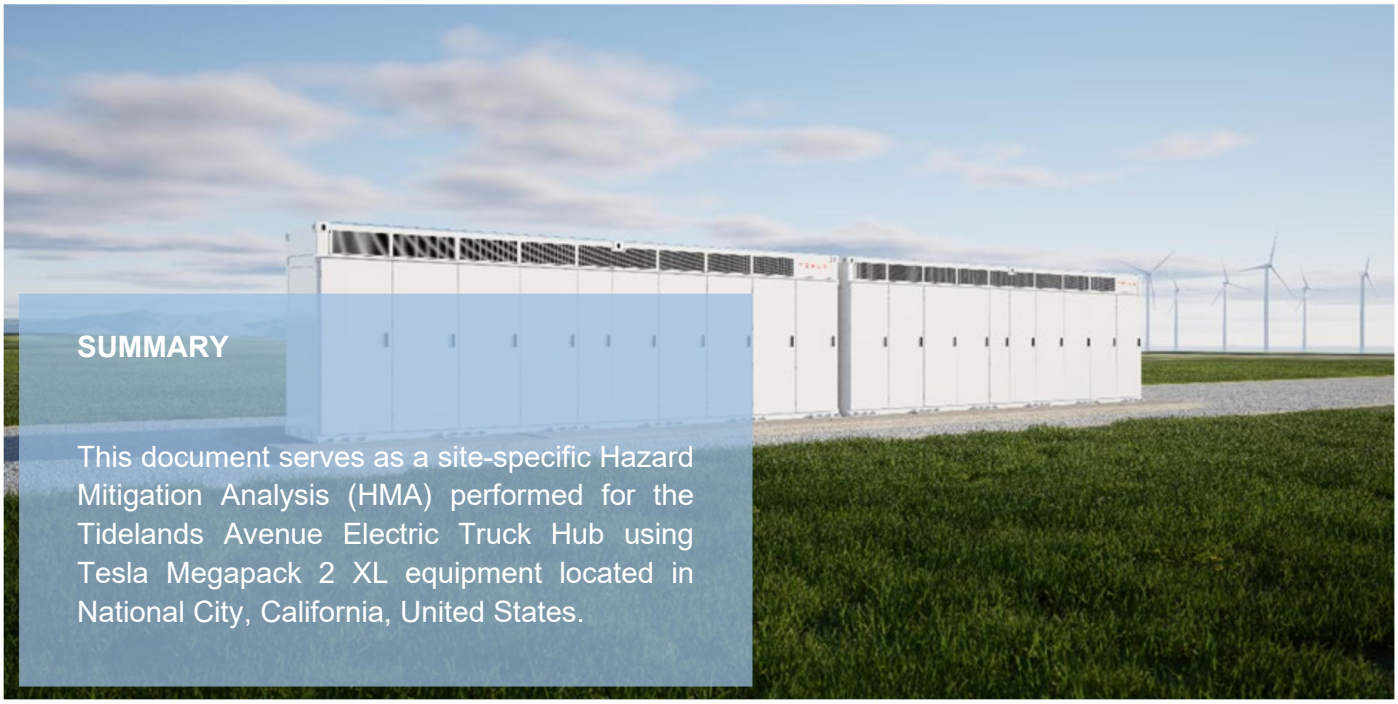
Public Utilities Code 761.3

Government Order 167

TIDELANDS AVENUE ELECTRIC TRUCK HUB

HAZARD MITIGATION ANALYSIS (HMA)

Rev 1.0 | September 2025



SUMMARY

This document serves as a site-specific Hazard Mitigation Analysis (HMA) performed for the Tidelands Avenue Electric Truck Hub using Tesla Megapack 2 XL equipment located in National City, California, United States.

Prepared For:

Skycharger
1616 16th Avenue
Nashville, TN 37212

Energy Safety Response Group
8350 US HWY 23 N
Delaware, OH 43015
www.energyresponsegroup.com
1-833-SAFE-ESS

© 2025 Energy Safety Response Group, LLC. All rights reserved.

This page left intentionally blank.

PROJECT DESCRIPTION

Project Name	**Tidelands Avenue Electric Truck Hub Hazard Mitigation Analysis**
ESRG Project No.	25-20282
Prepared For	**Skycharger** 1616 16th Avenue Nashville, TN 37212
Revision No.	Rev. 1.0
Date of Issue	09/15/2025

Prepared By:

Brian Scholl
Director of Emergency Response
brian.scholl@energyresponsegroup.com

Reviewed By:

Nick Petrakis
Director of Engineering
nick.petrakis@energyresponsegroup.com

Revision History

Revision No.	Date	Substance of Change	Prepared By	Reviewed By
1.0	9/15/2025	Edits based Customer Comments	B. Scholl	N/A

IMPORTANT NOTICE AND DISCLAIMER

This document conveys the results of research, investigations, intellectual property development, experience, and analysis to provide opinions, recommendations, explanations, service offerings, and quotations from Energy Safety Response Group LLC. This document is not meant to serve as professional and credentialed engineering, legal, technical, or emergency response judgment; it should not be used in place of consultation with such appropriate professionals, and you should seek the advice of such appropriate professionals regarding such issues as required.

Further, the contents of this document are in no way meant to address specific circumstances, and the contents are not meant to be exhaustive and do not address every potential scenario associated with the subject matter of the document. Site and circumstance-specific factors and real-time judgment and reason may significantly impact some of the subject matter conveyed in this document. Additional resources and actions, which may be beyond the scope of this document, may be required to address your specific issues.

Additionally, laws, ordinances, regulatory standards, and best practices related to the contents of this document are subject to change or modification from time to time. It is your responsibility to educate yourself as to any such change or modification.

This document is provided “as is”. Energy Safety Response Group LLC, to the fullest extent permitted by law, disclaims all warranties, either express or implied, statutory, or otherwise, including but not limited to the implied warranties of merchantability, non-infringement, and fitness for a particular purpose.

In no event shall Energy Safety Response Group LLC or its owners, officers, or employees be liable for any liability, loss, injury, or risk (including, without limitation, incidental and consequential damages, punitive damages, special damages, personal injury, wrongful death, lost profits, or other damages) which are incurred or suffered as a direct or indirect result of the use of any of the material, advice, guidance, or information contained in this document, whether based on warranty, contract, tort, or any other legal theory and whether or not Energy Safety Response Group LLC or any of its owners, officers, or employees are advised of the possibility of such damages.

TABLE OF CONTENTS

1 INTRODUCTION 8

1.1 Background 8

1.2 Applicable Codes and Standards 8

2022 California Fire Code 8

1.3 Summary of Findings 10

Table 1: Summary Findings of Failure Mode Consequences 11

Table 2: Summary Findings of AHJ HMA Approval Criteria 12

2 SITE DESCRIPTION 14

2.1 Site Overview 14

Table 3: Site Information 14

Figure 1: Aerial View 14

Figure 2: Layout 15

2.2 Nearby Exposures 16

2.3 Fire Department Access and Water Supply 16

3 ENERGY STORAGE SYSTEM DESCRIPTION 18

3.1 Megapack 2 XL Overview 18

Figure 3: Megapack 2 XL Internal Architecture 18

Figure 4: Megapack 2 XL Battery Module 19

Figure 5: Megapack 2 XL External View 19

Figure 6: Megapack 2 XL Internal View 20

3.2 Fire Safety Features 20

3.2.1 Deflagration Control System 20

3.2.2 Battery Management System (BMS) 21

3.2.3 Fire Detection 21

3.2.4 Site Controller and Monitoring 21

3.2.5 Fire Suppression Systems 22

3.2.6 Electrical Fault Protection Devices 22

4 HAZARD MITIGATION ANALYSIS 24

4.1 HMA Methodology 24

Figure 7: Example Bowtie Diagram 24
4.2 Relevant Supporting Information 25
4.2.1 UL 9540A Large-Scale Fire Testing 25
Figure 8: Cell Level Testing (Left) and Flexible Film Heater Installation (Right) 26
Figure 9: Tray Tested to UL 9540A Module Level Testing 27
4.2.2 Tesla Megapack 2 XL: Fire Protection Engineering Analysis 27
4.2.3 Tesla Megapack 2 XL: Internal Fire Testing and Modeling 29
Figure 10: Fire Progression During Unit Level Destructive Testing 31
Figure 11: Heat Flux Modelling Vs Time for Megapack Front and Back 32
Table 4: Heat Flux Examples 32
Table 5: Radiant Heat Flux Observations 33
4.2.4 Emergency Response Guide 34
4.3 Primary Consequences of ESS Failure and Mitigative Barriers 34
Figure 12: Primary Consequence Diagram 34
Table 6: Primary Consequence Barriers 35
4.4 Fault Condition Analysis 36
Table 7: Summary of Fault Condition Analysis 37
4.4.1 Thermal Runaway Condition 38
4.4.2 Failure of any Battery (Energy) Storage Management System 40
4.4.3 Failure of any Required Ventilation or Exhaust System 41
4.4.4 Failure of the Smoke/Fire/Gas Detection or Fire Suppression 41
4.4.5 Voltage Surges on the Primary Electric Supply 43
4.4.6 Short Circuits on the Load Side of the ESS 45
4.5 Analysis Approval 47
APPENDIX A – DETAILED HMA DIAGRAMS AND BARRIER DESCRIPTIONS 50
A.1 All Fault Conditions 50
A.2 Thermal Runaway Condition 50
A.3 Failure of an Energy Storage Management System 51
A.4 Failure of a Required Smoke/Fire/Gas Detection or Fire Suppression 51
A.5 Voltage Surges on the Primary Electric Supply 52
A.6 Short Circuits on the Load Side of the ESS 52
APPENDIX B – HMA METHODOLOGY 53
APPENDIX C – FLAME DETECTION SYSTEM 56

APPENDIX D – REFERENCED DOCUMENTATION 57

APPENDIX E – REFERENCED CODES AND STANDARDS 57

1 INTRODUCTION

1.1 Background

Energy Safety Response Group (ESRG) has been retained by Skycharger to perform a site-specific Hazard Mitigation Analysis (HMA). This HMA can be utilized to assess the anticipated overall effectiveness of protective barriers in place to mitigate the consequences of a battery-related failure. The analysis was performed based on the current documentation available at the time of the report.

The HMA for the Tidelands Avenue Electric Truck Hub is addressed according to the Fire Code regulatory requirements for National City, California. This report summarizes findings from a site-specific Hazard Mitigation Analysis (HMA) performed in compliance with the *2022 California Fire Code (CFC) Title 24, Part 6*, which is based off the *2021 International Fire Code (IFC)* and *NFPA 855, 2023 Edition* to assess the safety and overall effectiveness of barriers set in place to prevent and mitigate consequences of potential battery failure scenarios. The *2022 CFC* does not adopt *NFPA 855*, which is the National Fire Protection Association's Standard on Stationary Battery Energy Storage System, but this installation will still comply with this standard in addition to the *2022 CFC*.

1.2 Applicable Codes and Standards

2022 California Fire Code

The *2022 CFC §1207.1.2* requires that the design of each battery energy storage "unit" be submitted for review and approval by the local fire code official as part of the permitting process. The results of product-specific full-scale fire testing and the results of the HMA can be utilized by the local fire code official to determine acceptable terms and conditions for the installation of such systems throughout California. The *2022 CFC* prescribes the fault conditions or failure modes that shall be taken into account as part of the HMA.

Per the *2022 CFC §1207.1.4.1,* the analysis shall evaluate the consequences of a single failure :

1) Thermal runaway condition in a single module, array, or unit
2) Failure of any battery (energy) storage management system
3) Failure of a required ventilation or exhaust system
4) Voltage surges on the primary electric supply
5) Short circuits on the load side of the ESS
6) Failure of a required smoke detection, fire detection, fire suppression, or gas detection system
7) Required spill neutralization not being provided or failure of a required secondary containment system.

Per the *2022 CFC §1207.1.4.2,* the local fire code official shall be permitted to approve the hazardous mitigation analysis as documentation of the safety of the ESS installation, provided the consequences of the analysis demonstrate the following:

1) Fires will be contained within unoccupied ESS rooms or areas for the minimum duration of the fire-resistance-rated separations identified in *CFC §*1207.7.4.
2) Fires in occupied work centers will be detected in time to allow occupants within the room or area to safely evacuate.
3) Toxic and highly toxic gases released during fires will not reach concentrations in excess of the IDLH level in the building or adjacent means of egress routes during the time deemed necessary to evacuate occupants from any affected area.
4) Flammable gases released from ESS during charging, discharging, and normal operation will not exceed 25 percent of their lower flammability limit (LFL).
5) Flammable gases released from ESS during fire, overcharging, and other abnormal conditions will be controlled through the use of ventilation of the gases, preventing accumulation, or by deflagration venting.

The following codes, standards, and local requirements apply:

- *California Fire Code International Fire Code §1207 Electrical Energy Storage Systems*, 2022 Edition
- *California Electrical Code, 2022 Edition*
- *California Building Code, 2022 Edition*
- *UL 9540A Standard for Test Method for Evaluation of Thermal Runaway Fire Propagation in Battery Energy Storage Systems,* 4th Edition
- *UL 9540 Standard for Energy Storage Systems and Equipment,* 2nd Edition
- *NFPA 68 Standard on Explosion Protection by Deflagration Venting,* 2013 Edition
- *NFPA 72 National Fire Alarm and Signaling Code,* 2022 Edition
- *NFPA 76 Standard for the Fire Protection of Telecommunications Facilities,* 2016 Edition
- *NFPA 855 Standard for the Installation of Stationary Energy Storage Systems*, 2020 Edition

1.3 Summary of Findings

Based on a review of documentation provided by Skycharger and Tesla, ESRG finds that adequate protections are provided for the fault conditions listed per *2022 CFC §1207.1.4.1* and *2023 NFPA 855 §4.4*. Key findings include:

- The Tesla Megapack 2 or 2 XL is equipped with a number of protection systems (e.g., deflagration control system consisting of overpressure vents and sparker system, battery management system (BMS) control, an active liquid-cooling system for thermal management, electrical shutdowns and disconnects, etc.) that are anticipated to effectively manage all applicable fault conditions required per *2022 CFC §1207.1.4.1* and *NFPA 855 §4.4.2.1* (i.e., Table 1).
- The Tesla Megapack 2 or 2 XL is compliant with all applicable Analysis Approval requirements per *2022 CFC §1207.1.4.2* and *NFPA 855 §4.4.3* (i.e., Table 2).
- UL 9540A full-scale fire testing and performance of the Tesla Megapack 2 have shown that the system can be installed without the need for any additional passive or active fire protection features to prevent unit-to-unit propagation. Additionally, performance during UL 9540A testing indicates that nearby exposures will not be largely affected in the event of an ESS-related failure on-site.
- Additional voluntary destructive testing was conducted by Tesla on a representative Megapack 2 that utilized a more aggressive approach (than required by UL 9540A) to force the system into thermal runaway. The results of this testing showed that, due to the robustness of the system design, it was difficult to initiate and maintain any cascading thermal runaway within the unit.
- During the aforementioned testing, third-party analysis on products of combustion collected indicated no mercury (Hg) and trace levels of hydrofluoric acid (HF) far below National Institute for Occupational Safety and Health (NIOSH) Immediately Dangerous to Life or Health (IDLH) levels.
- Voluntary fire propagation modeling was conducted by Tesla to determine the anticipated impacts on representative target Megapack 2 XL units from an external heat flux generated by a failing unit. Even with worst-case wind scenarios taken into account, in the unlikely event of a Megapack 2 XL fire, the model shows that thermal runaway would not propagate to the adjacent units that are installed as per Tesla's site design requirements.
- A site-specific draft Emergency Response Plan (ERP) must be prepared for this project, detailing emergency response procedures to guide first responders in the event of a battery-related failure on-site, and will be reviewed with the local emergency response agency.

The BESS is immediately adjacent to a public roadway.

- The proposed BESS facility and location pose minimal risk to public or life safety and property by way of being on a secured site away from public spaces or roadways with limited public access to the site. Training will be provided to the First Responders to familiarize themselves with the site and hazards associated with lithium-ion ESS, based on safe operating procedures to address the unlikely event of an incident at this site.

These summary findings are further tabulated in *Table 1: Summary Findings of Failure Mode Consequences* and *Table 2: Summary Findings of AHJ HMA Approval Criteria*. These tables provide the direct response to each of the elements indicated.

Table 1: Summary Findings of Failure Mode Consequences

Failure Mode Consequences Evaluated by the HMA	
Thermal runaway condition in a single module, array, or unit	The system is provided with several passive and active measures to mitigate or contain a propagating thermal runaway condition. UL 9540A testing further shows that the effects of thermal runaway are contained within the module and Unit.
Failure of an Energy Storage Management System	Multiple levels of system monitoring provide redundant protection in the unlikely event of a failure of the energy storage management system.
Failure of a Required Ventilation or Exhaust System	Per the 2022 CFC 1207.4.7, Table 1207.6, and NFPA 855, the Megapack 2 XL is not required to have a ventilation or exhaust system. A proprietary deflagration control system is designed to mitigate the effects of flammable gases generated during an abnormal condition.
Voltage Surges on the Primary Electric Supply	Voltage surges on the primary electric supply are mitigated by BMS and inverter controls, voltage monitoring, and automatic disconnects.
Short Circuits on the Load Side of the ESS	Short circuits on the load side are mitigated by BMS controls and automatic safety actions.
Failure of a Required Smoke Detection, Fire Detection, Fire Suppression, or Gas Detection System	The project will utilize an external Infrared (IR) Fire Detection System. This system will be monitored in accordance with NFPA 72 and Chapter 9 of the CFC to include any failures or impairments to this system. A failure of the IR Detection Systems will be addressed in accordance with CFC section 901.7. Along with these safety actions, any BMS fault notifications will also be transmitted to Tesla's 24/7 Operations Center, alerting key stakeholders of any abnormal conditions.
Required spill neutralization is not being provided, or there is a failure of the secondary containment system.	Spill neutralization is only required for batteries that contain acids, such as lead-acid batteries.

Table 2: Summary Findings of AHJ HMA Approval Criteria

Authority Having Jurisdiction HMA Approval Criteria	
Fires or explosions will be contained within unoccupied battery storage rooms for the minimum duration of the fire-resistance-rated walls identified in Table 509.1 of the *International Building Code*.	Not Applicable – The Megapack 2 XL is intended for outdoor installations.
Fires and explosions in occupied work centers will be detected in time to allow occupants within the room to evacuate safely.	Not Applicable – The Megapack 2 XL is not intended for installation within occupied work centers.
Toxic and highly toxic gases released during fires will not reach concentrations in excess of the immediately dangerous to life or health (IDLH) level in the building or adjacent means of egress routes during the time deemed necessary to evacuate any affected area.	Internal Unit level testing conducted on the products of combustion from the Megapack 2 XL indicated that there was no Mercury (Hg) observed, and trace levels of HF far below NIOSH Immediately Dangerous to Life or Health (IDLH) levels.
Flammable gases released from batteries during charging, discharging, and normal operation shall not exceed 25 percent of their lower flammability limit (LFL).	Not Applicable – Lithium-ion batteries do not release flammable gases during charging, discharging, or normal operations.
Flammable gases released from batteries during fire, overcharging, and other abnormal conditions shall not create an explosion hazard that will injure occupants or emergency responders.	The Megapack 2 XL is provided with a proprietary explosion protection system. The effectiveness of the explosion protection system was validated during internal destructive fire testing.

This page left intentionally blank.

2 SITE DESCRIPTION

2.1 Site Overview

The Tidelands Avenue Electric Truck Hub is to be located on San Diego Port Authority property at 1640 Tidelands Avenue in National City, California. The site consists of two (2) Tesla Megapack 2 XL ESS units providing approximately 1.75 MW / 7 MWh of energy storage power and capacity, respectively.

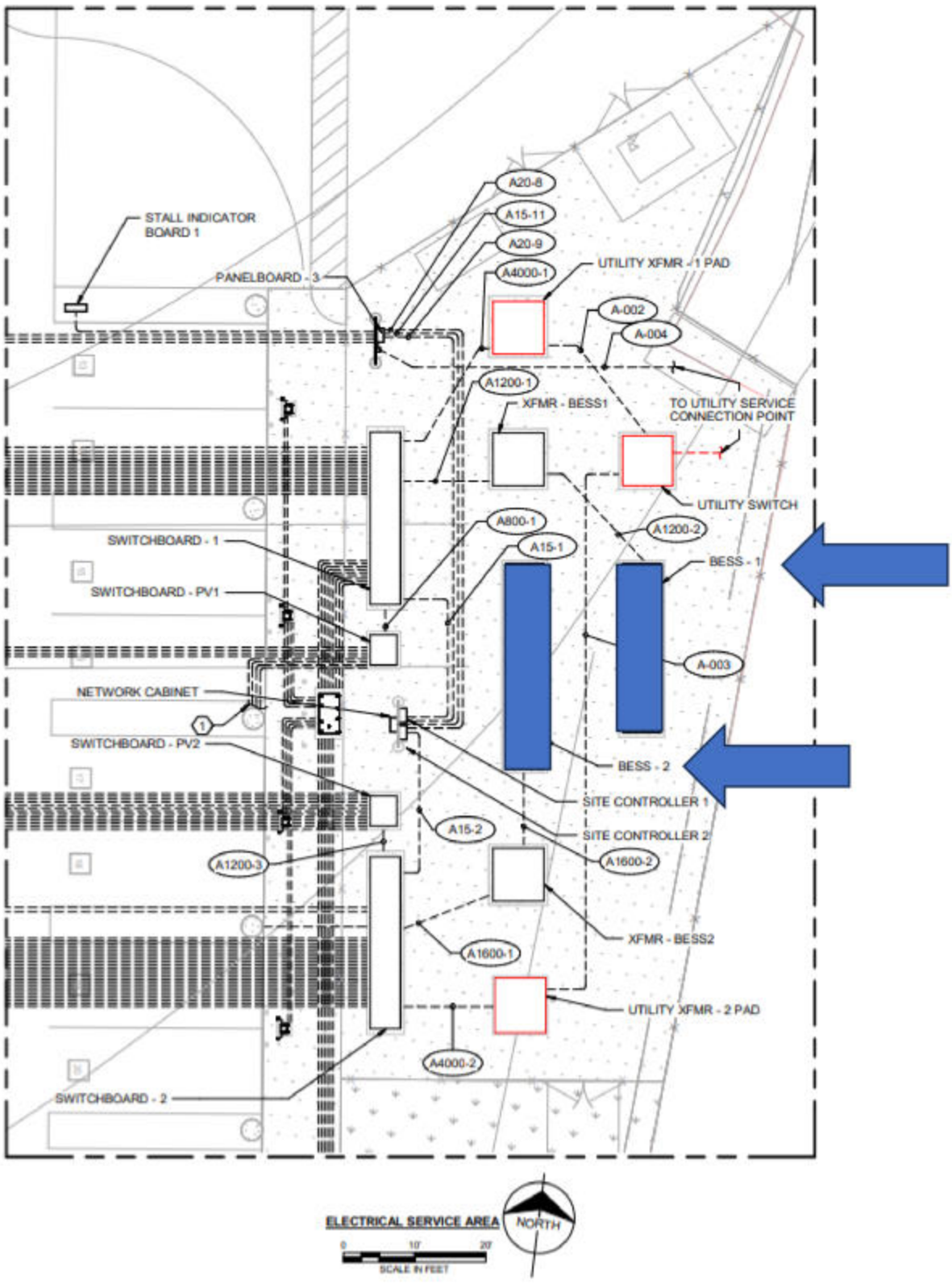
Table 3: Site Information

SITE INFORMATION	
Site Address:	1640 Tidelands Avenue National City, CA
GPS Coordinates:	32° 39' 56.15" N, 117° 06' 57.90" W

Figure 1: Aerial View



Figure 2: Layout



Add Glossary to include:
Units
Modules
Enclosures
Cabinets

2.2 Nearby Exposures

The Megapack 2 XLs will be sited outdoors in non-occupiable cabinets. The project will occupy approximately 4.8 acres.

Due to the location and nature of the site, potential site risks are anticipated to be minimal and negligible; however, the following nearby exposures are noted in the general area.

- **Unified Port of San Diego to North** – The Unified Port of San Diego building is located approximately 350 feet to the north of the BESS of the site
- **San Diego Port** – The San Diego Port is located on multiple sides of the site.

Be more specific as the port covers a large area and has many facilities

- **Harborside Gym** – The Harborside Gym is located approximately 325 feet to the west of the site.
- **Warehouses** – There are multiple warehouses and businesses located east of the site. The nearest warehouse is approximately 225 feet to the east.
- **Pacific Ocean** – The Pacific Ocean is located approximately 800 feet to the west of the site.

Clarify if this reference is in regards to the ocean, or San Diego Bay.

2.3 Fire Department Access and Water Supply

The National City Fire Department is the fire and emergency response agency for this jurisdiction. The nearest station, Fire Station 34, is located approximately 1.4 miles away (at 343 E 16th Street in National City, CA.) to the east. They are anticipated to arrive on-scene expeditiously after receiving notification of an emergency event.

Access to/from the site will be off Tidelands Avenue and provided with two access gates. There will be an access road throughout the site. Road width and spacing will be sized in accordance with fire code requirements and allow ample room for fire apparatus. There will be hydrants on-site, but engaging a battery fire directly with water is not recommended based on best industry practice. Firefighters can utilize this water supply to protect exposures, if necessary.

Provide Fire Department Access Plan that identifies the locations, details and code-compliance of the various features mentioned above.

This page left intentionally blank.

3 ENERGY STORAGE SYSTEM DESCRIPTION

3.1 Megapack 2 XL Overview

The Tesla Megapack 2 XL (a.k.a. MP2 XL) is a modular, fully integrated, AC-coupled battery energy storage system (BESS or ESS). The Megapack 2 XL is a design evolution of Megapack 2 and leverages the same core technology platform (cells, vents, sparker system, etc.). The Megapack 2 and 2 XL utilize lithium iron phosphate (LFP) battery cells provided by CATL, as opposed to the nickel manganese cobalt oxide (NMC) and nickel cobalt aluminum oxide (NCA) cells used in the Megapack 1. The Megapack 2 and 2 XL differ only in that the 2 XL has additional battery modules.

The Megapack 2 XL and constituent components are tested and certified to the latest editions of UL 9540, UL 1642, UL 1973, IEC 62619, and IEC 62933-5-2. UL 9540A (4th Edition) large-scale fire testing was performed at the Cell, Module, and Unit level (Note: Installation level testing was not required due to all Unit level performance criteria being met). The UL 9540A Unit level report was conducted by TUV Rheinland of North America, Inc. (TUV, a nationally recognized testing laboratory), and their conclusions state: “Based on the limited module propagation observed during MP2 testing (7 cells in runaway), the behavior would be the same with MP2 XL. With the increase in volume and sparker count, the deflagration risk is minimized. The testing performed on MP2 is considered harsher with higher gas concentrations, and fundamental engineering analysis for MP2 XL shows comparable behavior as the worst case”. (Note: the Sparker System and sparker count are explained in section 3.2.1.)

Figure 3: Megapack 2 XL Internal Architecture provides an illustration of the primary architecture of the battery units. *Figure 4: Megapack 2 XL Battery Module* illustrates the appearance of a single battery module.

Figure 3: Megapack 2 XL Internal Architecture

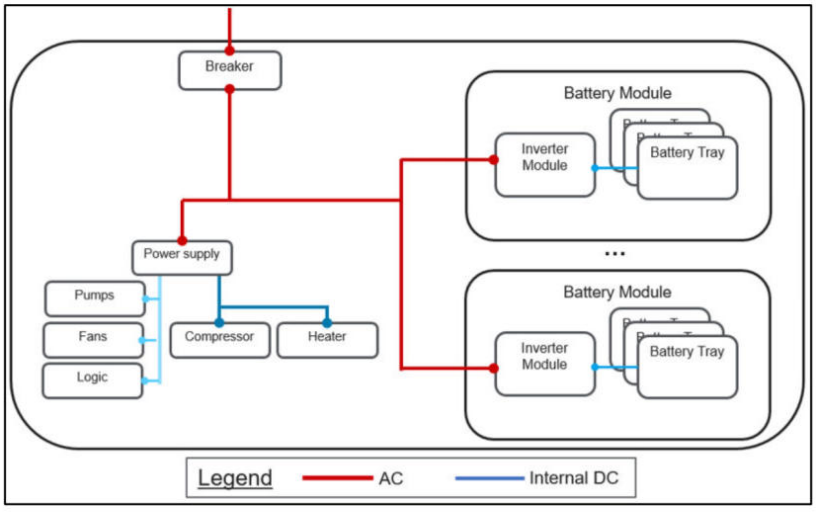


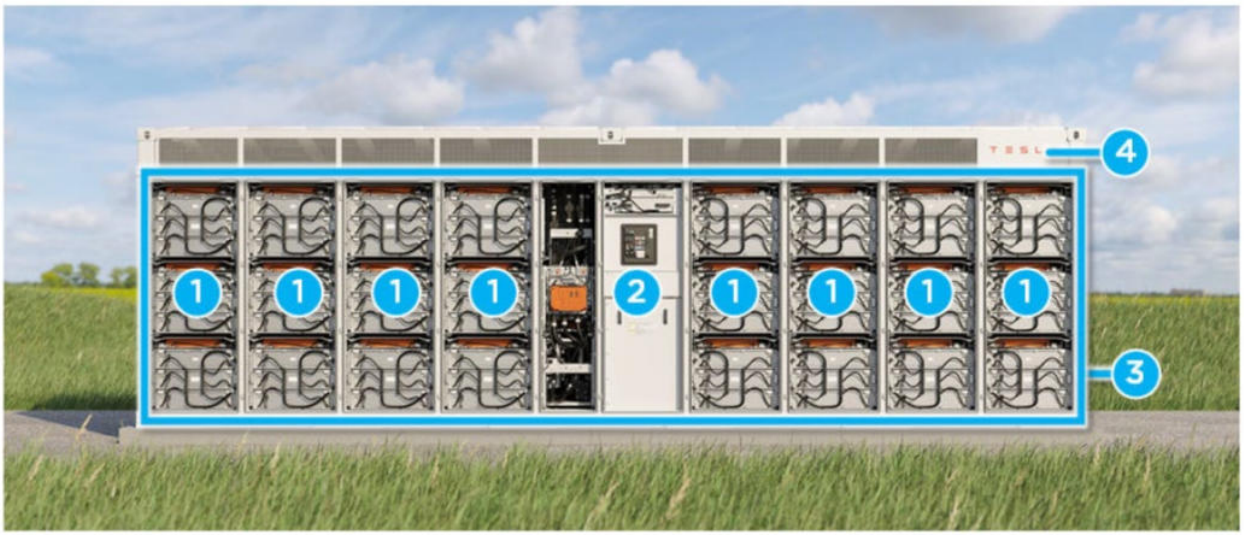
Figure 4: Megapack 2 XL Battery Module



Figure 5: Megapack 2 XL External View



Figure 6: Megapack 2 XL Internal View



1. Battery modules with active and passive fuses – externally serviceable
2. Touch-safe Customer Interface Bay
3. Non-walk-in IP66 enclosure and deflagration mitigation
4. Thermal roof with overpressure vents

3.2 Fire Safety Features

The Tesla Megapack 2 XL is equipped with a number of fire safety features designed to mitigate the propagation of a battery failure or prevent the failure from occurring altogether. These protections are aligned with the requirements of the 2022 CFC and the 2023 edition of NFPA 855.

3.2.1 Deflagration Control System

Each Megapack 2 XL is provided with an integral and proprietary deflagration prevention system (deflagration control). This deflagration prevention system is comprised of numerous pressure-sensitive (overpressure) vents located at the top of the Megapack and a sparker system, working in conjunction to ignite any flammable gases that could be generated within the unit during a failure event.

The Megapack 2 XL is provided with twelve (12) sparkers and twenty-six (26) overpressure vents. The sparkers are located throughout the Megapack at various heights and continuously operate to ensure that any flammable gas build-up is ignited early, limiting the concentration of flammable gas within the unit and activating the pressure-sensitive vents to create a natural ventilation pathway to the exterior. Any overpressures generated from the ignition of flammable gases within the unit will be relieved via the nearest pressure-sensitive vents and routed upwards, protecting the Megapack's structural integrity and preventing any hazardous pressure build-up within.

3.2.2 Battery Management System (BMS)

An integrated Battery Management System (BMS) monitors key datapoints such as voltage, current, and state of charge (SOC) of battery cells, in addition to providing control of corrective and protective actions in response to any abnormal conditions. Each battery module is equipped with a dedicated BMS, with a Megapack-level bus controller supervising output of all modules at the AC bus level. Critical BMS sensing parameters include battery module over/under voltage, cell string over/under voltage, battery module over temperature, temperature signal loss, and battery module over current. In the event of any abnormal conditions, the BMS will first raise an information warning alert, and then trigger a corresponding corrective action should certain levels be reached.

3.2.3 Fire Detection

The Megapack 2 XLs will be sited outdoors in non-occupiable cabinets, in a remote location as defined by the applicable codes (*2022 CFC* and *2023 NFPA 855)*. This project will utilize the Viking VSF 303 Multi-Spectrum external UV/IR flame detection system, which will be designed in accordance with CFC Chapter 9 and NFPA 72. The UV/IR flame detection system will be monitored by the Notifier 320SYS Fire Alarm Control Panel (FACP). Specification sheets for the fire detection system can be found in Appendix C. (The type of detector will be updated if it changes before commissioning)

As additional information, during UL 9540A unit-level testing for the Megapack 2 XL, the radiant energy sensing detectors used in the tests were not activated since no fire occurred. Subsequent supplemental full-scale (more aggressive) testing of Megapack systems showed that these external UV/IR detectors effectively detected failure conditions that initiated within the unit.

3.2.4 Site Controller and Monitoring

The Tesla Site Controller provides a single point of interface for the utility, network operator, or customer SCADA systems to control and monitor the entire energy storage site. It hosts the control algorithm that dictates the charge and discharge functions of the battery system units, aggregating real-time information and using the information to optimize the commands sent to each individual Megapack unit.

The Megapack 2 XL is supported by Tesla's 24/7 Operations Center, which is designed to support the global fleet of energy storage products. In conjunction with local operation centers, the Megapack 2 XL has 24/7 remote monitoring, diagnostics, and troubleshooting capabilities. In the event of an emergency, this information is communicated to the Fire Department to provide guidance to emergency response personnel.

The site controller and monitoring are significantly sophisticated in the levels, numbers, and types of issues it monitors, and further, this is monitored and processed 24/7. While this is a key feature for the ongoing maintenance of all units to assure optimal

performance, this detailed monitoring serves the additional purpose of effective fire alarm notification for all maintenance alerts that escalate beyond pre-defined thresholds.

3.2.5 Fire Suppression Systems

The Tesla Megapack 2 XL does not rely on any external or internal fire suppression systems to mitigate cascading thermal runaway, nor is this required in accordance with the applicable code requirements (e.g., CFC and NFPA 855). Additional full-scale testing and subsequent fire modeling have indicated that the Megapack's construction provides a robust thermal resistance from the impacts of an adjacent Megapack during a large-scale failure.

3.2.6 Electrical Fault Protection Devices

Multiple levels of passive and active electrical protection are provided for the Megapack 2 XL. At the battery module level, overcurrent protection is provided for each module in the form of single-use fusible links, providing interruption of overcurrent in the battery module in the case of an abnormal electrical event. Inverter modules, which are installed at each of the battery modules, are equipped with both DC protection via a high-speed pyrotechnic fuse for passive or active isolation of the battery module, as well as a dedicated AC contactor and AC fuses should an abnormal electrical event occur at the inverter module on the AC side of the circuit. Additionally, the Megapack 2 XL is equipped with a DC ground fault detection system and an AC circuit breaker with ground fault trip settings for distribution system protection.

Protection from direct lightning strike. Megapack enclosures have internal frames that act like a Faraday cage, diverting currents to flow around the internal components but not through them to ground. There is no expected significant impact to MegaPack functionality due to a direct lightning strike. Hence, air terminations or lightning masts are not required to protect MegaPack enclosures.

Protection from Indirect Lightning Strikes. MegaPacks are designed with adequate power electronic component sizing and creepage in addition to monitored surge protection on the load side of the MegaPack breaker. Tests, in accordance with Institute of Electrical and Electronics Engineers (IEEE) C62.45, demonstrate that internal circuits and components of MegaPack are protected from induced overvoltage from indirect lightning strikes. There is no expected impact on MegaPack functionality due to an indirect lightning strike.

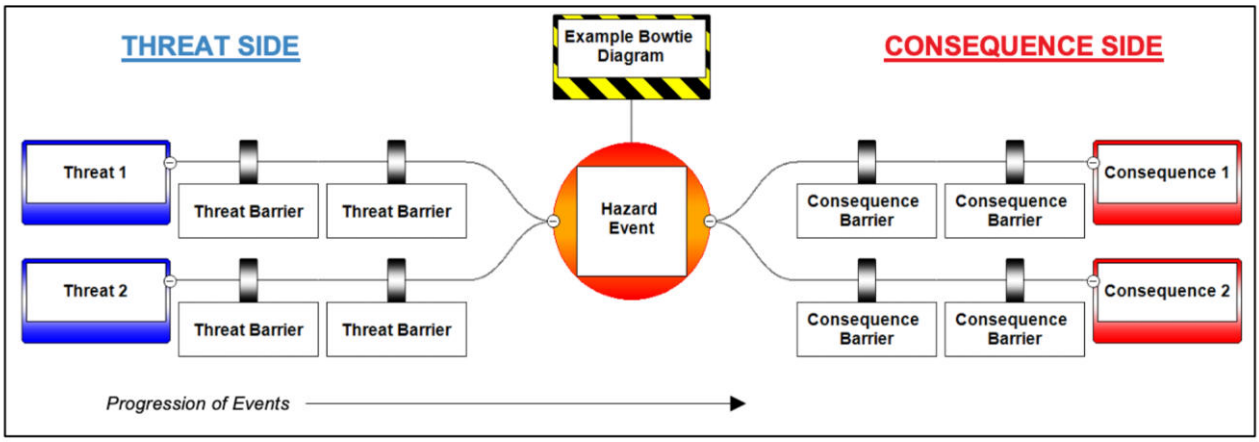
This page left intentionally blank.

4 HAZARD MITIGATION ANALYSIS

4.1 HMA Methodology

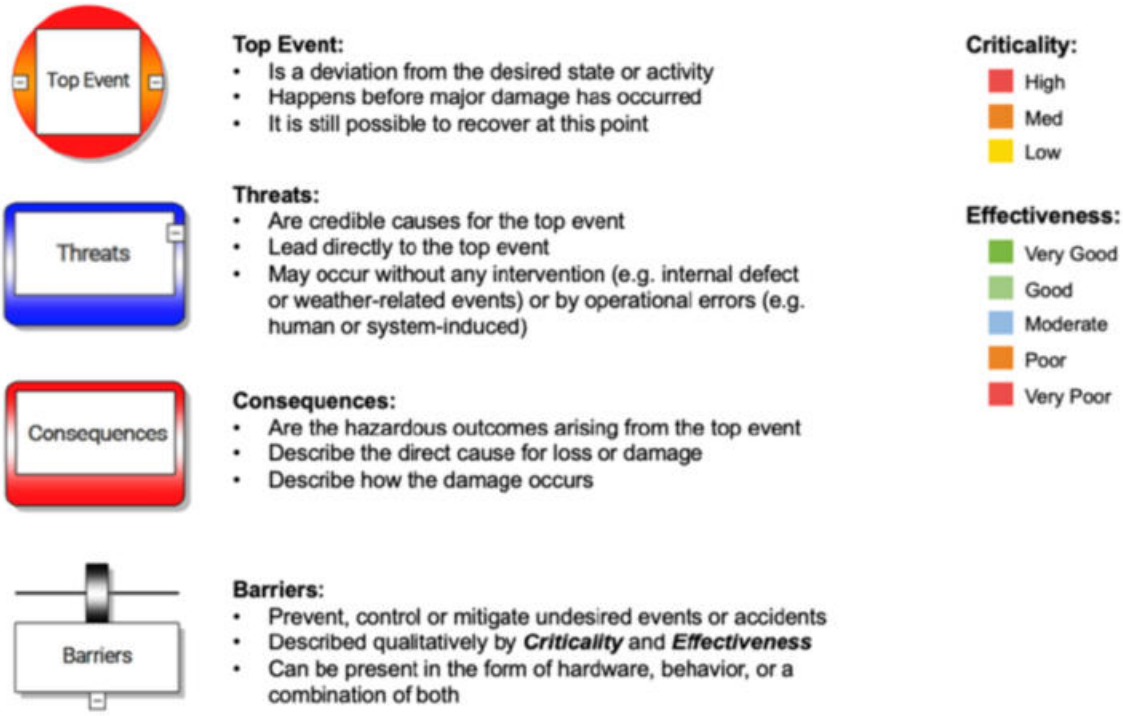
ESRG utilizes the bowtie methodology for hazard and risk assessments, as described in *ISO IEC 31010 §B.21*. This allows for in-depth analysis on individual mitigative **barriers** and serves as a strong tool for visualizing the chronological pathway of **threats** leading to critical hazard events, and ultimately to greater potential **consequences**, as depicted in Figure 13 below. This simple diagrammatic way of describing and analyzing the pathways of a risk from hazards to outcomes can be considered a combination of the logic of a fault tree analyzing the cause of an event, and an event tree analyzing the consequences.

Figure 7: Example Bowtie Diagram



Each fault condition per the 2022 CFC and the 2023 edition of *NFPA 855* assessed in Sections 4.4.1 – 4.4.6 below is accompanied by a corresponding bowtie diagram indicating critical *threat* and *consequence* pathways and the mitigative barriers between them. Since the most critical risk posed by lithium-ion battery cells involves the propagation of thermal runaway from a failing cell (or multiple cells) to surrounding cells, this serves as the primary critical hazard for the subsequent failure scenarios.

In addition to the main barriers for fault conditions on the *threat* side of the diagram, the *consequence* barriers on the right side of the diagram (e.g., explosion protection and emergency response plan) **also** contribute added layers of safety on top of the main threat barriers shown. It is important to note that the barriers on the left side, along a threat path, are intended to keep the threat from becoming a thermal runaway, while the barriers on the right side, along the consequence pathway, are intended to keep that single thermal runaway from evolving into one of the more severe consequences such as fire spread beyond containment. For more on the methodology and relevant terminology, see Appendix B of this report.



4.2 Relevant Supporting Information

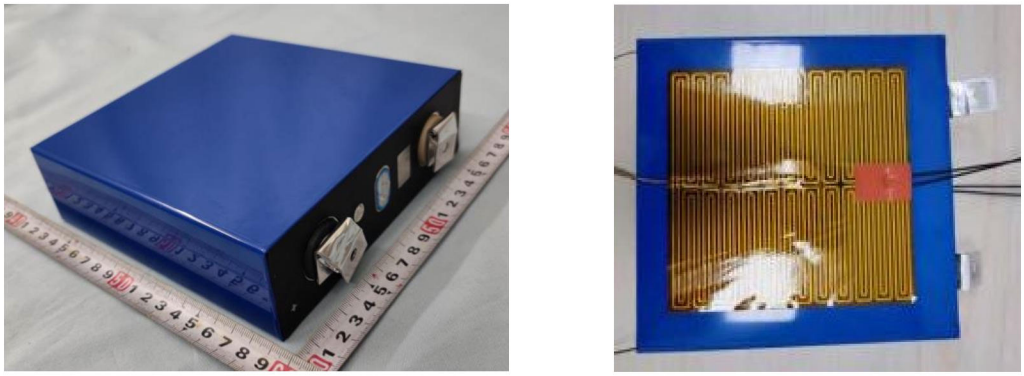
4.2.1 UL 9540A Large-Scale Fire Testing

UL 9540A (4th Edition) testing was performed for the constituent Cell, Module, and Unit levels of the Tesla Megapack 2 XL.

4.2.1.1 Cell Level and Module Level Test Report

UL 9540A (4th Edition) Cell level testing was performed on the Contemporary Amperex Technology Co., Ltd. (CATL) 3.22V, 157.2Ah lithium iron phosphate (LFP) battery cell at UL LLC (Changzhou) Quality Technical Service Co., LTD. (project number 4790205409 [1]). Thermal runaway was initiated via the film strip heater. Since the performance criteria per *UL 9540A Clause 7.7* were not met, module-level testing was required.

Figure 8: Cell Level Testing (Left) and Flexible Film Heater Installation (Right)



(Source: Fisher Engineering, Fire Protection Engineering Analysis, Megapack 2 XL, Jan 23, 2023)

4.2.1.2 Module Level Test Report

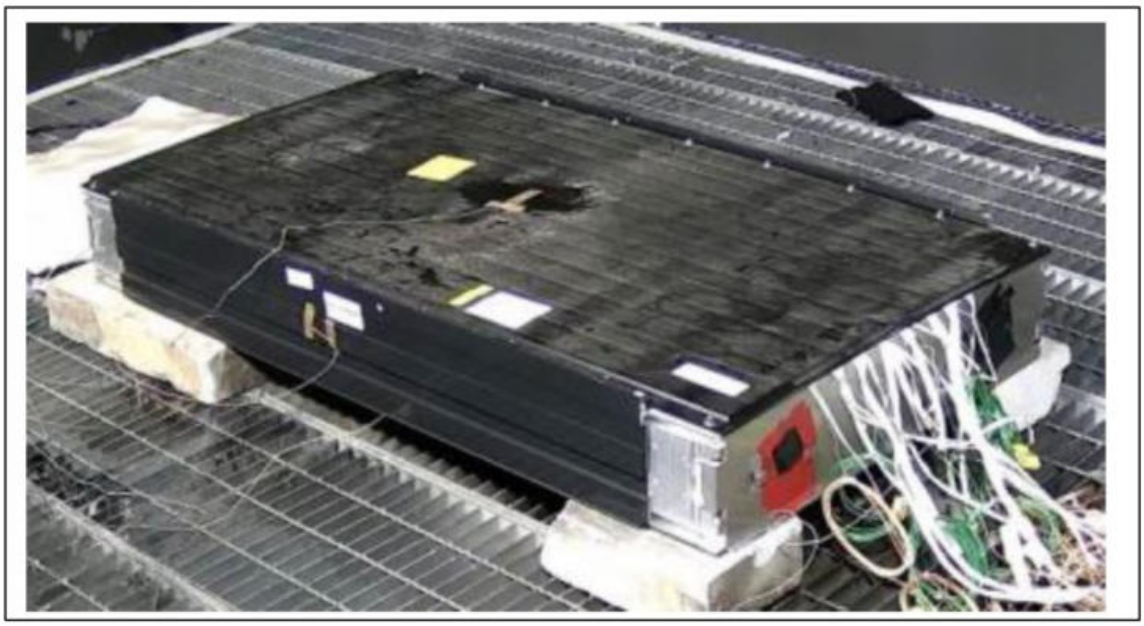
UL 9540A (4th Edition) Module level testing was performed on the Contemporary Amperex Technology Co., Ltd. (CATL) MP2 360.64Vdc, 157.2 Ah battery module at TÜV SÜD New Energy Testing (Guangdong) Co., Ltd. (Report number 64.280.22.60133.01 [2])

Thermal runaway was initiated via film strip heaters installed on both of the wide side surfaces of each cell, similar to the cell-level test. In the module-level test, however, two cells were heated simultaneously to force multiple cells into thermal runaway at the same time.

Thermal runaway propagated from the initiating cells to all cells within the MP2 tray (module). Sparks and flying debris were observed; however, there were no explosive discharges of gases. Gases generated from the cell were identified as flammable, but there was no detection of toxic gases that are sometimes associated with lithium-ion battery failure, such as HF, HCL, and HCN. Unit-level testing to the UL 9540A test method is required due to the gases generated being flammable.

Additional information regarding Cell and Module level testing can be found in the MP2 and MP2 XL FPE report by Fisher Engineering.

Figure 9: Tray Tested to UL 9540A Module Level Testing



4.2.1.3 Unit Level Test Report

UL 9540A (4th Edition) Unit level testing was performed for the Tesla Megapack 2 XL model 1748844-XX-Y at TUV Rheinland of North America, Inc. (Report number NN22GLCI.003 [3]).

Burn marks were observed on the initiating AC battery module, though no external damage was observed. No damage to target units or adjacent walls was observed. All performance criteria for outdoor ground-mounted non-residential use ESS were met; therefore, installation-level testing was not required.

A full review of unit-level testing was provided by Fisher Engineering, Inc., as is briefly summarized below.

4.2.2 Tesla Megapack 2 XL: Fire Protection Engineering Analysis

A fire protection engineering analysis was provided by Fisher Engineering, Inc. (FEI), which includes a review of the Megapack 2 and Megapack 2 XL construction, design, fire safety features, and large-scale fire test data [4]. A brief summary of key takeaways is provided below.

Key takeaways from the report include:

- The MP2 XL design is almost identical to the MP2, other than being greater in length to accommodate the additional battery modules. Given the limited module propagation observed during UL 9540A unit-level testing of the MP2 (seven cells went into runaway), the behavior is expected to be no different with the MP2 XL. As such, a stand-alone UL9540A unit-level fire test for the MP2 XL was not performed. The UL 9540A unit-level fire test results, described above for the MP2, can be applied to the MP2 XL.
    a. Similarly, after reviewing the MP2 unit-level fire test results and comparing the MP2 and MP2 XL to one another, TÜV determined the MP2 UL 9540A unit level fire test results can be applied to the MP2 XL and an additional UL 9540A unit-level fire test for the MP2 XL was not required for its listing.
- The largest variant of the Megapack 2 was tested at a worst-case scenario (i.e., 100% SOC with BMS and TMS disabled) to the UL 9540A unit-level fire test method in which six cells within a battery module of the initiating Megapack 2 unit were forced into thermal runaway. Thermal runaway propagated to a seventh cell but did not propagate any further. No propagation to adjacent battery modules or target Megapack units occurred.
- All unit-level performance criteria outlined in UL 9540A, Table 9.1 for outdoor, ground-mounted ESS were met; therefore, installation-level testing was not required. Specifically, these results included:
    a. No flaming was observed outside of the unit.
    b. Surface temperatures of battery modules within the target units did not exceed the temperature at which thermally initiated cell venting occurs. The maximum temperatures recorded at the battery modules of the adjacent cabinets were 13.8°C and 13.2°C, which are significantly below the temperature at which cell venting occurs (174°C).
    c. Surface temperatures of exposures 5 ft (1.52 m) to the side and 8 ft (2.44 m) in front of the initiating unit did not exceed 97°C (175°F) above ambient. The maximum external surface temperatures recorded at the instrumented wall 5 ft to the side were 25.9°C (78.6°F) with a temperature rise above ambient of 5.5°C (9.9°F). The maximum external surface temperatures recorded at the front target 8 ft directly in front of the initiating unit were 16.8°C with a temperature rise above ambient of 5.5°C. These temperatures are significantly below the maximum permitted temperature rise above ambient of 97°C (175°F).
    d. Explosion hazards, including, but not limited to, observations of deflagration, projectiles, flying debris, detonation, or other explosive discharge of gases, were not observed.
    e. Heat flux did not exceed 1.3 kW/m2. The maximum heat flux recorded was 0.0000016 W/m2, which was the sensor installed on the front target cabinet and was the ambient heat flux the sensor was exposed to throughout the test.

- A maximum surface temperature of 16.8°C was measured on the front target Megapack 2 unit installed 8 ft in front of the initiating Megapack 2 unit, and 13.8°C and 13.2°C at the battery modules of the adjacent unit. Based on cell venting and thermal runaway temperatures from the 9540A Cell level test report (174°C and 239°C, respectively), propagation to the battery modules within a unit at clearances of 8 ft is not possible.
- Smaller capacity MP2 cabinets, populated with less than nineteen battery modules, would be expected to perform similarly, given they are designed and constructed substantially similar (with the same cells, battery modules, fire safety features, etc.) than the larger capacity 3,100 kWh MP2 cabinet tested and described in the Fisher report.
- None of the fire detectors activated during the fire test (two multi-spectrum IR flame detectors and two thermal imagers), which is expected, as no flaming was observed outside of the cabinet during the test; however, previous testing on the Tesla Megapack 1 units demonstrated that multi-spectrum IR flame detectors can detect a fire should flames exit the cabinet through the roof.
- An internal fire suppression system or an external fire suppression system is not required to stop propagating thermal runaway from cell to cell, module to module, or MP2 cabinet to cabinet when near-simultaneous failure of up to six cells occurs within the same battery module.
- Manual fire suppression (hose lines) is not required to stop propagating thermal runaway and the spread of fire from an MP2 cabinet to adjacent MP2 cabinets installed 6 in (150 mm) behind and to the sides when a near-simultaneous failure of up to six cells occurs within the same battery module.

4.2.3 Tesla Megapack 2 XL: Internal Fire Testing and Modeling

4.2.3.1 Destructive Unit Level Testing

Voluntary destructive unit-level testing was conducted by Tesla on a representative and fully populated Megapack 2 XL [4]. This destructive fire testing utilized a more aggressive approach than what is required by the UL 9540A test method in order to force the system into a more severe cascading thermal runaway event. This destructive test was conducted to demonstrate the Megapack 2 XL's ability to fail in a safe manner, even in the extreme event of a catastrophic failure within an entire battery module. Additionally, the destructive testing further validated the design of the Megapack 2 XL proprietary explosion mitigation system.

This testing was conducted at the Northern Nevada Research Center on May 19th, 2022. The test utilized film heaters to simultaneously heat forty-eight (48) cells within a module, creating a severe failure scenario that is well beyond what is contemplated by the UL 9540A test method. The goal of this testing was to assess the risk of a large-scale fire resulting from an initiating Megapack 2 XL during a thermal runaway event propagating to

an adjacent Megapack 2 XL. The results of this testing show some key takeaways, as detailed in the Fisher Engineering FPE report:

- Thermal runaway propagated from the initiating cells to all the cells in the initiating tray.
- A thermal event occurred, likely initiated by the ignition of flammable gases by the sparker system. An overpressure vent installed above the initiating battery module opened and was visually confirmed through video. The cabinet doors immediately adjacent to the initiating battery module remained closed. No hazardous pressure waves, debris, shrapnel, or pieces of the cabinet were ejected.
- After approximately 10 minutes of smoking, a sustained fire began within the initiating battery module. The fire spread to the adjacent battery bays until it reached the CIB and stopped. The fire only burned half of the cabinet.
- Fire spread from battery bay to battery bay was a slow-progressing event. In total, visible flames were observed for 6 hours and 40 minutes while the four battery bays (bays 7-10) burned, as shown in Figure 18 of the Fisher report.
- Maximum flame heights were observed to be 11.5 ft (3.5 m) from ground to the top of the flame, 2.5 ft (0.75 m) above the top of the cabinet, and had a base (a width) of 3.3 ft (1 m) during peak flame intensity. This peak flame intensity occurred approximately 60-90 minutes after initial flaming was observed.
- An analysis of the pressure profile inside the cabinet during the test demonstrated the operation of the explosion control system, as shown in Figure 19 of the Fisher report. Pressure inside the cabinet increased to nearly 11 kPa (1.60 psi) until the deflagration vent opened and the pressure diminished. The overpressure vents are designed to operate at approximately 12 kPa (1.74 psi), or 2.5 times below the cabinet's strength of 30 kPa (4.35 psi).

4.2.3.2 Fire Modeling – Propagation Model

Subsequent fire propagation modeling was conducted to assess the fire propagation risk to adjacent Megapack 2 XL units during a more severe event, such as what was observed during the internal destructive testing referenced in Section 3.2.3.1. This fire propagation model showed that due to the robustness of the system design, it is unlikely that a fire from an initiating Megapack 2 XL would propagate to the adjacent Megapack 2 XL, even during worst-case scenario wind conditions. The modeling assessed two scenarios – a non-flaming event and the impact of heat transfer on a target Megapack 2 XL, as well as a flaming event and the impact of radiative heat transfer on a target Megapack 2 XL installed per Tesla's recommendations.

Figure 10: Fire Progression During Unit Level Destructive Testing



(Source: Fisher Engineering, Fire Protection Engineering Analysis, Megapack 2 XL, Jan 23, 2023)

4.2.3.3 Product of Combustion - Unit Level Testing

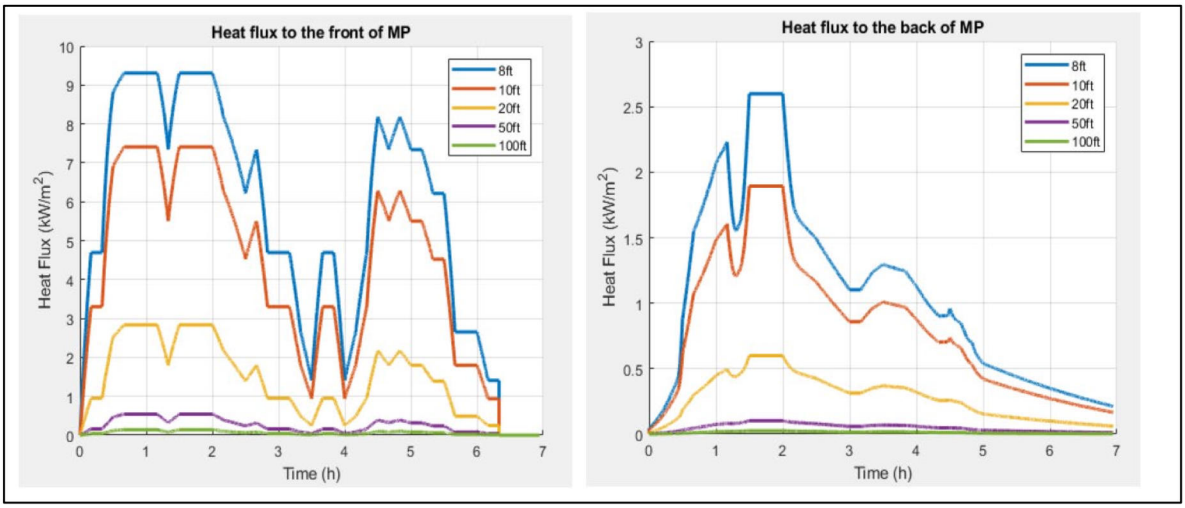
Tesla conducted additional internal unit-level testing to obtain and analyze the products of combustion from a failing Megapack Unit. The products of combustion were collected at locations 5 ft upwind and 20 ft downwind from the initiating unit to assess airborne contaminants that may be present during an incident. Subsequent third-party analysis concluded that no traces of Mercury were present over the entire 2.5-hour test duration. Hydrogen Fluoride (HF) was detected at values of 0.10 and 0.12 parts per million (ppm) in the two sampling locations over the course of the test, far below the accepted NIOSH Immediately Dangerous to Life or Health (IDLH) value of 30 ppm for HF. These results can be extrapolated to the Tesla Megapack 2 XL, as TUV indicated in the UL 9540A unit report that the testing performed on the Megapack 2 is considered “harsher with higher gas concentrations, and fundamental engineering analysis for the Megapack 2 XL shows comparable behavior as worst case”.

4.2.3.4 Tesla Megapack 2 XL: Heat Flux Analysis

The subsequent fire propagation modeling was conducted to assess the fire propagation risk to adjacent Megapack 2 XL units during a more severe event. As mentioned in the report, the heat flux model was also utilized to determine the estimated heat fluxes at distances further from the Megapack 2 XL cabinet. These values can be utilized to analyze the risk of flame spreading to exposures in proximity to the MP2 XL installation.

The peak heat flux values were utilized for this analysis, utilizing the higher values that are expected at the front of the Megapack 2 XL. For conservativeness, it is assumed that the higher heat flux values (front) are experienced at all orientations from the Megapack 2 XL.

Figure 11: Heat Flux Modelling Vs Time for Megapack Front and Back



(Source: Fisher Engineering, Fire Protection Engineering Analysis, Megapack 2 XL, Jan 23, 2023)

The heat flux values are estimated (and rounded up for conservativeness) from the peak values of the chart and are prescribed as the following discrete values:

- Approximately 9.5 kW/m2 at 8ft (radius) from the Megapack 2 XL
- Approximately 7.5 kW/m2 at 10ft (radius) from the Megapack 2 XL
- Approximately 3 kW/m2 at 20ft (radius) from the Megapack 2 XL
- Approximately 0.5 kW/m2 at 50ft (radius) from the Megapack 2 XL
- Approximately 0.1 kW/m2 at 100ft (radius) from the Megapack 2 XL

4.2.3.5 Failure Criteria and Thresholds

There are numerous sources of impacts from heat flux, depending on the data source. The information from NIST utilizes the following information:

Table 4: Heat Flux Examples

Heat Flux is the rate of heat energy transferred per surface unit area - kW/m^2.

Heat Flux (kW/m^2)	Example
1	Sunny day
2.5	Typical firefighter exposure
3-5	Pain to skin within seconds
20	Threshold flux to floor at flashover
84	Thermal Protective Performance Test (NFPA 1971)
60 - 200	Flames over surface

(Source: NIST Fire.Gov, Engineering Laboratory, Fire Research Division)

In a conservative manner, the minimum acceptable heat flux shall not exceed 2.5 kW/m2 where Emergency Responders are expected to stage for an extended duration of time.

Additionally, the SFPE Fire Protection Handbook references the maximum allowable heat flux to determine tenability for exposure of skin to radiant heat. That value is 2.5 kW/m2 as well. It is expected that exposure can be tolerated for at least several minutes at heat flux values below this level. This would allow time for people (without PPE) to egress to a safe location.

The City University of New York (CUNY) UL 9540A data utilization guidelines reference the SFPE handbook for radiant heat flux values and their observed effects (Table below). As indicated, a critical heat flux of 12.5 kW/m2 can be utilized as a failure threshold to assess the threshold for the potential ignition of combustibles.

Table 5: Radiant Heat Flux Observations

Approximate Radiant Heat Flux (kW/m^2)	Comment or Observed Effect
170	Maximum heat flux as currently measured in a postflashover fire compartment.
80	Heat flux for protective clothing Thermal Protective Performance (TPP) Test.[a]
52	Fiberboard ignites spontaneously after 5 seconds.[b]
29	Wood ignites spontaneously after prolonged exposure.[b]
20	Heat flux on a residential family room floor at the beginning of flashover.[c]
20	Human skin experiences pain with a 2-second exposure and blisters in 4 seconds with second-degree burn injury.[d]
15	Human skin experiences pain with a 3-second exposure and blisters in 6 seconds with second-degree burn injury.[d]
12.5	Wood volatiles ignite with extended exposure[e] and piloted ignition.
10	Human skin experiences pain with a 5-second exposure and blisters in 10 seconds with second-degree burn injury.[d]
5	Human skin experiences pain with a 13-second exposure and blisters in 29 seconds with second-degree burn injury.[d]
2.5	Human skin experiences pain with a 33-second exposure and blisters in 79 seconds with second-degree burn injury.[d]
2.5	Common thermal radiation exposure while fire fighting.[f] This energy level may cause burn injuries with prolonged exposure.
1.0	Nominal solar constant on a clear summer day.[g]

4.2.3.6 Heat Flux and Conclusions

Extrapolating the heat flux data, the 2.5 kW/m2 threshold is located at approximately 28 feet from the front of the nearest Megapack 2 XL unit. All exposures indicated in section 4.2.3.6 are expected to experience negligible heat flux in the rare event of a full Megapack failure and are all outside of the 28-foot boundary.

In addition, it is noted that the Megapack units themselves are well insulated and are not adversely impacted by a fully involved adjacent unit. This alleviates the concerns for

possible fire propagation from unit to unit in the rare event that a single unit becomes fully involved.

4.2.4 Emergency Response Guide

A product-level Emergency Response Guide (ERG) was provided by Tesla and provides an overview of the product materials, handling and use precautions, hazards, emergency response procedures, and storage and transportation instructions. Tesla's Emergency Response Guide is publicly available to all First Responders and can be found at: https://www.tesla.com/firstresponders

In addition to this product-level guide, a site-specific Emergency Response Plan (ERP) will provide an additional level of safety and familiarization for first responders who may be arriving on-scene to an incident at an installation utilizing the Megapack 2 XL system.

4.3 Primary Consequences of ESS Failure and Mitigative Barriers

The dynamics of lithium-ion ESS failures are extremely complex, and the pathway of failure events may vary widely based on system design, mitigative approaches utilized, and even small changes in environmental or situational conditions. However, the primary consequences stemming from a propagating lithium-ion battery failure largely fall into a number of specific hazard scenarios, as depicted in the diagram and associated table below (though other scenarios not listed may certainly also occur). These primary consequences serve as the basis for the consequence side of the majority of the fault condition diagrams in the following sections of this report.

While not explicitly detailed in the simplified diagram below, the criticality and effectiveness of the barriers may vary based on the associated threat or consequence pathway.

Figure 12: Primary Consequence Diagram

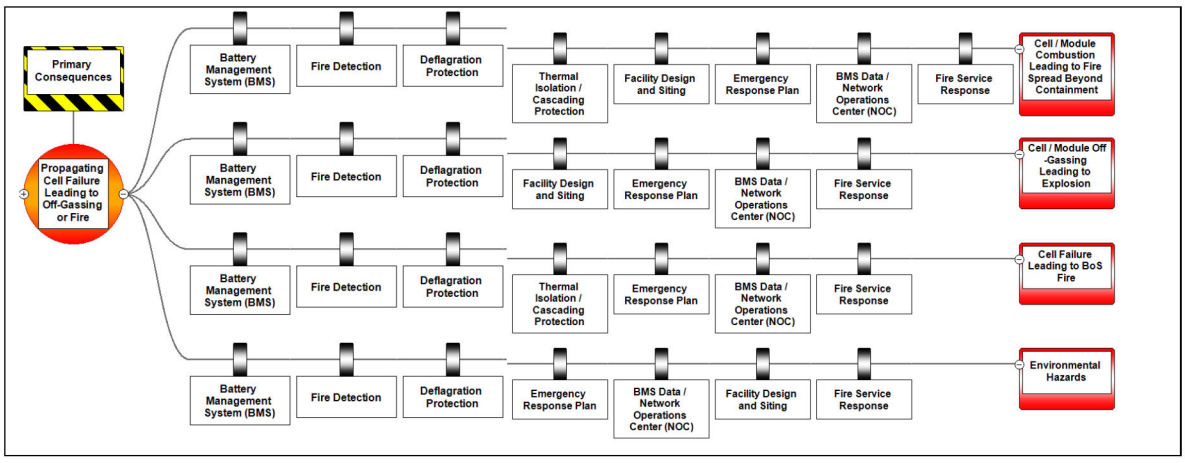


Table 6: Primary Consequence Barriers

PRIMARY CONSEQUENCE BARRIERS	
Battery Management System (BMS)	Critical BMS sensing parameters for the Megapack 2 XL include battery module over/under voltage, cell string over/under voltage, battery module over temperature, temperature signal loss, and battery module over current. In the event of any abnormal conditions, the BMS will generally first raise an information warning, and then trigger a corresponding corrective action should certain levels be reached.
Fire Detection	The Megapack 2 XL in outdoor cabinets are protected by an external IR fire detection system in accordance with the automatic fire detection requirements of the CFC and NFPA 855.
Water-Based Suppression System	The Megapack 2 XL does not rely on any external or internal water-based suppression system to prevent or mitigate hazards resulting from large-scale failure.
Deflagration Protection	The Megapack 2 XL is equipped with deflagration protection in the form of pressure-sensitive vents and a sparker system designed to ignite any flammable gases and release in a controlled manner before they are allowed to accumulate and create an explosive atmosphere within the enclosure.
Electrical Fault Protection Devices	The Megapack 2 XL is equipped with a number of electrical fault protections in the form of battery module overcurrent protection, inverter DC and AC protection, and ground fault protection.
Facility Design and Siting	The facility is sited with adequate separation distances from sensitive occupancies that may be affected. The BESS installation is provided with adequate separation distances from the nearest exposures. The BESS facility is bounded by a chain-link fence to prevent unauthorized access to the facility.
Emergency Response Plan / First Responders	A product-level Emergency Response Guide (ERG) is provided for the Tesla Megapack 2 XL, outlining key product information, safety hazards, and general emergency response procedures. A site-specific Emergency Response Plan (ERP) will provide an additional level of safety for the installation utilizing the Megapack 2 XL.
BMS Data Availability / Operations Center	Tesla Site Controller provides a point of interface for the utility, network operator, or customer SCADA systems to control and monitor the energy storage site. 24/7 remote monitoring by Tesla's Operations Center will be provided.

Fire Service Response	As recommended in Tesla's Emergency Response Guide (ERG); a defensive firefighting approach shall be utilized at the discretion of the first responders. Site-specific training and installation familiarization for local responding stations may further increase the strength of this barrier, and fire department equipment and capabilities will be strengthened with this familiarization.

4.4 Fault Condition Analysis

Per *2022 CFC§1207.2.3.1* (and Table 1 above), the analysis shall evaluate the consequences of the following failure modes and others deemed necessary by the AHJ:

1. *Thermal runaway condition in a single-battery storage rack, module, or array.*
2. *Failure of any energy management system.*
3. *Failure of any required ventilation system.*
4. *Voltage surges on the primary electric supply.*
5. *Short circuits on the load side of the ESS.*
6. *Failure of the smoke detection, fire detection, fire suppression, or gas detection system.*
7. *Required spill neutralization not being provided or failure of a required secondary containment system.*

For the purposes of this report, it is assumed that all construction, equipment, and systems that are required for the ESS are installed, tested, and maintained in accordance with local codes and the manufacturer's instructions. The assessment is based on the most recent information provided by Plus Power at the time of this report.

The following table provides a summary of findings from the hazard mitigation analysis performed in fulfillment of the *2022 CFC§1206.2.3.1,* with each fault condition described in greater detail, accompanied by simplified bowtie diagrams for visualization of mitigative barriers. Additionally, full bowtie diagrams with barrier descriptions are provided in Appendix A.

Table 7: Summary of Fault Condition Analysis

Compliance Requirement	Comments
1. Thermal runaway condition in a single-battery storage rack, module, or array.	A number of passive and active measures are implemented to reduce the potential of a thermal runaway event from occurring including BMS control and active cooling to internal components. Battery modules and cells have been listed to UL 1973 and UL 1642. Should a thermal runaway event occur, additional mitigative measures are provided to prevent further propagation of failure throughout the system (see Section 4.3 above for a list of all consequence barriers).
2. Failure of any battery (energy) storage management system	In the event of a failure of module-level BMS, the Megapack-level BMS (which may be considered "ESMS") shall isolate affected modules, mitigating against further propagation of failure across the system. Should a failure of the Megapack-level BMS occur, each module is equipped with a dedicated BMS to provide corrective actions in case of detection of abnormal operation outside of set parameters. To further isolate any failure stemming from a failure of the energy storage management system, passive and active electrical fault protections are provided at multiple levels, as described in Section 3.2.6 above.
3. Failure of any required ventilation or exhaust system	The Megapack 2 XL does not utilize a system to exhaust flammable gases, as lithium-ion batteries do not release flammable gases during normal operations. Flammable gases generated during abnormal operations are mitigated by the Megapack 2 XL's proprietary explosion mitigation system.
4. Voltage surges on the primary electric supply	Voltage surges on the primary electric side are anticipated to be mitigated by the provided BMS and inverter controls, voltage monitoring, and automatic disconnect provided by the BMS, in addition to a number of passive circuit protections briefly noted in Section 3.2.6 of this report.
5. Short circuits on the load side of the ESS	Short circuits on the load side of the ESS are anticipated to be mitigated by BMS control and subsequent safety actions, in addition to a number of passive circuit protections briefly noted in Section 3.2.6 of this report.

6. Failure of the smoke detection, fire detection, fire suppression, or gas detection system	The project will utilize an external Infrared (IR) Fire Detection System. This system will be monitored in accordance with NFPA 72 and Chapter 9 of the CFC to include any failures or impairments to this system. A failure of the IR Detection Systems will be addressed in accordance with CFC section 901.7. Along with these safety actions, any BMS fault notifications will also be transmitted to Tesla's 24/7 Operations Center, alerting key stakeholders of any abnormal conditions. Data from the BMS is expected to be communicated to the Subject Matter Expert to provide guidance to the fire department in case of emergency. The Megapack 2 XL does not rely on an integrated fire suppression system (such as an internal water-based or gas-phase suppression system) to mitigate the hazards associated with propagating thermal runaway. Destructive fire testing and subsequent fire modeling have shown that the robust passive thermal protection of the Megapack 2 XL design will prevent an unlikely fire from cascading to an adjacent Megapack from the initiating system. Furthermore, UL 9540A unit-level testing indicates that no flaming occurred and that no propagation of heat from the initiating unit to adjacent units/modules reached levels capable of initiating cell venting or thermal runaway. It is anticipated that sufficient water will be accessible for defensive operations by firefighters arriving on-site, due to the robust municipal water supply that is provided in proximity to the installation.

4.4.1 Thermal Runaway Condition

Thermal runaway is defined as the "self-heating of an electrochemical system in an uncontrollable fashion" (2023 edition of *NFPA 855 §3.3.26)*. The cause of a thermal runaway event can range from a manufacturer defect in the cell, external impact, exposure to dangerously high temperatures, or a multitude of controls and electrical failures. Furthermore, a thermal runaway event in a single cell can propagate to nearby cells, thus creating a cascading runaway event across battery modules and racks, leading to more heat generation, fire, off-gassing, and increased potential for a deflagration event.

The Tesla Megapack 2 XL is equipped with a number of passive and active mitigations, such as BMS Control and an active thermal management system for cooling of internal components to reduce the potential of a thermal runaway event from occurring, as is depicted on the *threat* side of the diagram below. Threat scenarios accounted for include single-cell thermal runaway, multi-cell thermal runaway, and internal defect or failure not

resulting in thermal runaway, leading to the primary hazard event (propagating cell failure leading to off-gassing or fire). Should thermal runaway occur within a battery module, a number of key barriers are provided to mitigate against the propagation of failure throughout the system, leading to more severe consequences, which are described in detail in Section 4.3 of this report above.

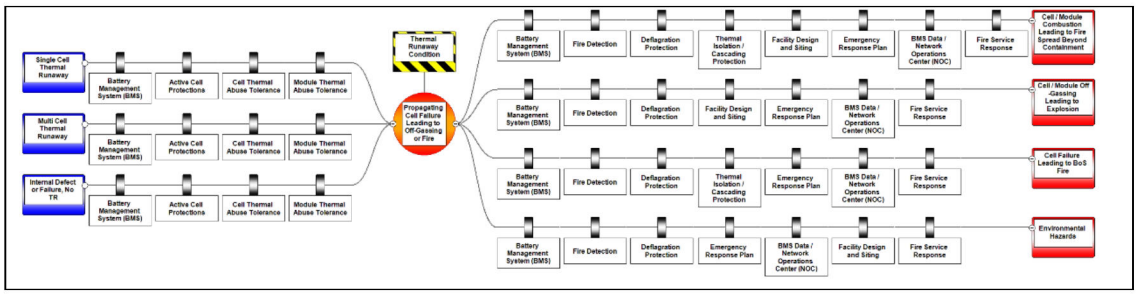


Figure 19: Thermal Runaway Condition Diagram

Table 10: Thermal Runaway Condition Barriers

Barrier	Barrier Description
THREAT BARRIERS	
Battery Management System (BMS)	BMS provides sensing and control of critical parameters and triggers protective or corrective actions if the system is operating outside normal parameters. Parameters include battery module over/under voltage, cell string over/under voltage, battery module over temperature, temperature signal loss, and battery module over current. In the event of any abnormal conditions, the BMS will first raise an information warning and then trigger a corresponding corrective action should certain levels be reached.
Thermal Management System	The active thermal management system provides liquid cooling to internal components within the Megapack 2 XL to limit heat diffusion.
Cell Thermal Abuse Tolerance	The cell has been tested and listed to UL 1973, in which thermal abuse tolerance was tested.
Module Thermal Abuse Tolerance	The module has been tested and listed to UL 1973, in which thermal abuse tolerance was tested.
CONSEQUENCE BARRIERS	
See Section 4.3 above for list of primary consequence barriers.	

4.4.2 Failure of any Battery (Energy) Storage Management System

The loss, failure, or abnormal operation of an energy storage control system (controllers, sensors, logic/software, actuators, and communications networks) may directly impact the proper function of the system. The Tesla Megapack 2 XL utilizes a tiered hierarchy of controls starting at the module level up to the site level.

In the event of a failure of module-level BMS, the Megapack-level BMS (which may be considered "ESMS") shall isolate affected modules, mitigating against further propagation of failure across the system. Should a failure of the Megapack-level BMS occur, each module is equipped with a dedicated BMS to provide corrective actions in case of detection of abnormal operation outside of set parameters. To further isolate any failure stemming from a failure of the energy storage management system, passive and active electrical fault protections are provided at multiple levels, as described in Section 3.2.6 above.

Finally, should a propagating thermal runaway occur, a number of key barriers are provided to mitigate against the propagation of failure throughout the system, leading to more severe consequences, which are described in detail in Section 4.3 of this report above.

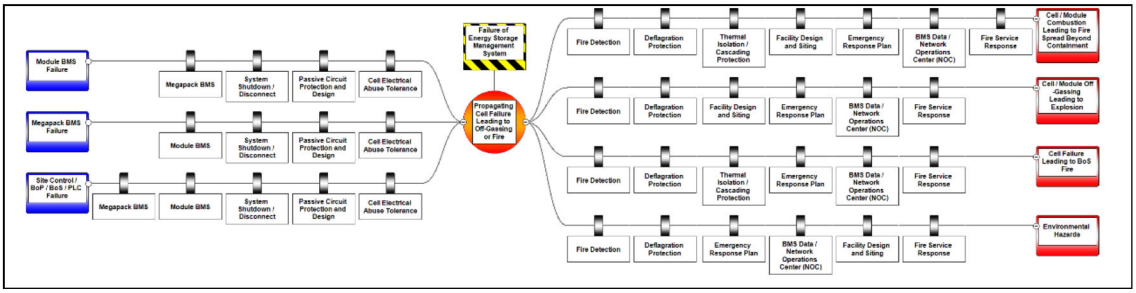


Figure 20: Failure of an Energy Storage Management System Diagram

Table 11: Failure of an Energy Storage Management System Barriers

Barrier	Barrier Description
THREAT BARRIERS	
Energy Storage Management System (ESMS)	Megapack-level Energy Storage Management System (ESMS) supervising output of all modules at the AC bus level to provide isolation / protective actions in case of module BMS failure.
Module BMS	Module-level BMS to provide isolation / protective actions in case of ESMS failure.
System Shutdown / Disconnect	Multiple levels of passive and active electrical protections are provided for the Megapack 2 XL, including module overcurrent protection via fusible links on the DC side of

	the modules, inverter DC and AC protections, and ground fault detection.
Passive Circuit Protection and Design	Fused disconnects and DC disconnect switches, in addition to ground fault detection/interruption and over-voltage protection provided.
Cell Electrical Abuse Tolerance	Cell tested and certified to UL 1642 Standard for Lithium Batteries.
CONSEQUENCE BARRIERS	
See Section 4.3 above for list of primary consequence barriers.	

4.4.3 Failure of any Required Ventilation or Exhaust System

The Megapack 2 XL does not utilize a system to exhaust flammable gases, as lithium-ion batteries do not release flammable gases during normal operations. Flammable gases generated during abnormal operations and explosion hazards are mitigated by the Megapack 2 XL's proprietary deflagration prevention system.

4.4.4 Failure of the Smoke/Fire/Gas Detection or Fire Suppression

The project will utilize an external Infrared (IR) Fire Detection System. This system will be monitored in accordance with NFPA 72 and Chapter 9 of the CFC to include any failures or impairments to this system. A failure of the IR Detection Systems will be addressed in accordance with CFC section 901.7. Along with these safety actions, any BMS fault notifications will also be transmitted to Tesla's 24/7 Operations Center, alerting key stakeholders of any abnormal conditions. Data from the BMS is expected to be communicated to the Subject Matter Expert to provide guidance to the fire department in case of emergency.

The Megapack 2 XL does not inherently rely on an integrated or external fire suppression system to mitigate a thermal runaway failure event. A fire is not expected to propagate through the system or to nearby exposures based on UL 9540A unit-level testing, indicating that no flaming occurred and that no propagation of heat from the initiating unit to adjacent units/modules reached levels capable of initiating cell venting or thermal runaway. Destructive fire testing and subsequent fire modeling have further assessed the robustness of the Megapack 2 XL system design and resistance to propagating failures. Furthermore, the fire department's response is expected to be strong based on training, robust firefighting capabilities, and timely response.

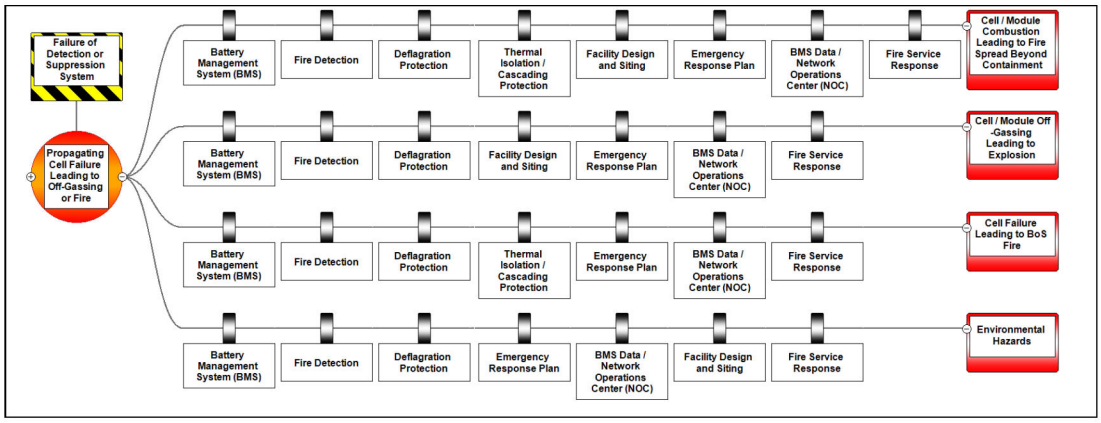


Figure 21: Failure of the Smoke/Fire/Gas Detection or Fire Suppression Diagram

Table 12: Failure of the Smoke/Fire/Gas Detection or Fire Suppression Barriers

Barrier	Barrier Description
CONSEQUENCE BARRIERS	
Battery Management System (BMS)	BMS provides sensing and control of critical parameters and triggers protective or corrective actions if the system is operating outside normal parameters. Parameters include battery module over/under voltage, cell string over/under voltage, battery module over temperature, temperature signal loss, and battery module over current. In the event of any abnormal conditions, the BMS will first raise an information warning and then trigger a corresponding corrective action should certain levels be reached.
Deflagration Protection	The Megapack 2 XL is equipped with deflagration protection in the form of pressure-sensitive vents and a sparker system designed to ignite any flammable gases and release in a controlled manner before they are allowed to accumulate and create a combustible atmosphere within the enclosure.
Thermal Isolation / Cascading Protection	Thermal isolation has been shown to be effective in limiting heat transfer between Megapacks in UL 9540A unit-level testing.

Facility Design and Siting	Facility design and siting are strong. The system is proposed to be installed in a secure area. The Megapack 2 XLs are provided with the minimum required separation distances from the adjacent exposures.
Emergency Response Plan / First Responders	Product-level Emergency Response Guide (ERG) provided by Tesla. An additional level of safety will be provided via site-specific Emergency Response Plans (ERP) in accordance with the requirements of the CFC.
BMS Data / Operations Center	Megapack data is accessible remotely via Tesla's 24/7 Operations Center.
Fire Service Response	Site-specific training and installation familiarization for local responding stations will increase the strength of this barrier, and fire department equipment and capabilities will be strengthened with this familiarization. Given the adequate water supply within the vicinity of the installation, water will be available for defensive firefighting tactics such as cooling of nearby enclosures or other high-risk exposures (if warranted).

4.4.5 Voltage Surges on the Primary Electric Supply

Voltage surges on the primary electric supply are expected to be largely mitigated by voltage monitoring and corrective actions taken by the BMS. Should corrective actions triggered by the BMS fail to prevent further propagation of failure, a number of electrical fault protections are provided for the Megapack 2 XL, as are briefly described in Section 3.2.6 of this report.

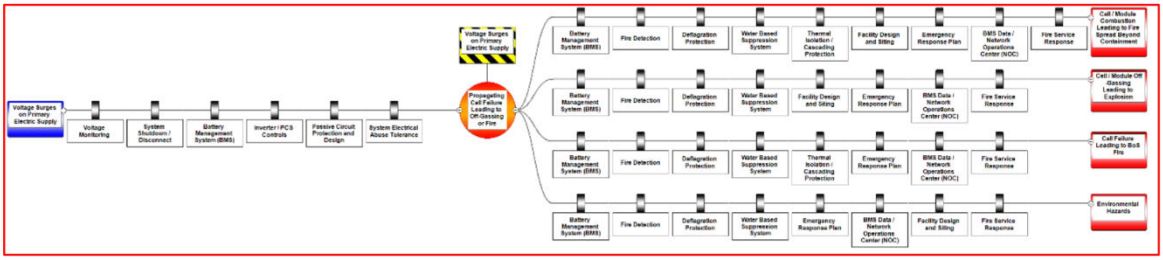


Figure 22: Voltage Surges on the Primary Electric Supply Diagram

Table 13: Voltage Surges on the Primary Electric Supply Barriers

Barrier	Barrier Description
THREAT BARRIERS	
Voltage Monitoring	Voltage is measured by the BMS, triggering fault and alarm monitor indicators, and potential system disconnect or other corrective actions if operating out of normal parameters.
System Shutdown / Disconnect	Multiple levels of passive and active electrical protections are provided for the Megapack 2 XL, including module overcurrent protection via fusible links on the DC side of the modules, inverter DC and AC protections, and ground fault detection.
Battery Management System (BMS)	BMS provides sensing and control of critical parameters and triggers protective or corrective actions if the system is operating outside normal parameters. Parameters include battery module over/under voltage, cell string over/under voltage, battery module over temperature, temperature signal loss, and battery module over current. In the event of any abnormal conditions, the BMS will first raise an information warning and then trigger a corresponding corrective action should certain levels be reached.
Inverter / PCS Controls	Inverter modules equipped with both DC protection via high-speed pyrotechnic fuse for passive or active isolation of the battery module, as well as dedicated AC contactor and AC fuses, should an abnormal electrical event occur at the inverter module on the AC side of the circuit.
Passive Circuit Protection / Design	Fused disconnects and DC disconnect switches, in addition to ground fault detection/interruption and over-voltage protection provided.
System Electrical Abuse Tolerance	System tested and listed to UL 9540.
CONSEQUENCE BARRIERS	
See Section 4.3 above for list of primary consequence barriers.	

4.4.6 Short Circuits on the Load Side of the ESS

Short circuits on the load side of the ESS are anticipated to be largely mitigated by BMS control and passive circuit protection and design (e.g., fused disconnects, ground fault detection/interruption, and overvoltage protection), as described in previous sections of this report. The Megapack 2 XL has been tested and listed to UL 9540A, demonstrating adequate system electrical abuse tolerance and compatibility of constituent components.

Finally, as is consistent across all previous fault conditions covered above, should propagating thermal runaway occur, a number of key barriers are provided to mitigate against the propagation of failure throughout the system, leading to more severe consequences, which are described in detail in Section 3.3 of this report above.

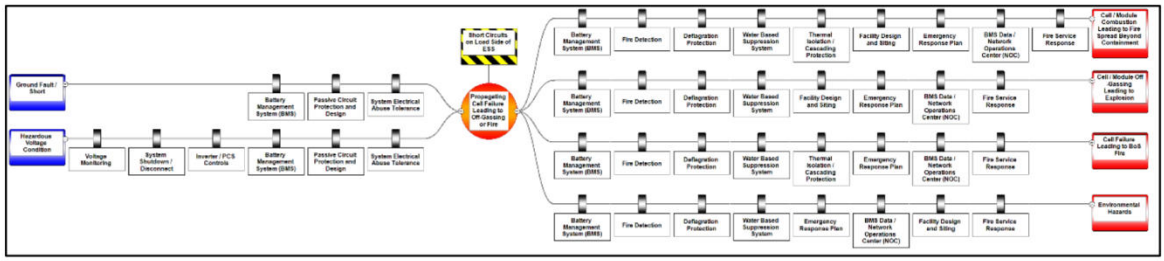


Figure 23: Short Circuits on the Load Side of the ESS Diagram

Table 14: Short Circuits on the Load Side of the ESS Barriers

Barrier	Barrier Description
THREAT BARRIERS	
Battery Management System (BMS)	BMS provides sensing and control of critical parameters and triggers protective or corrective actions if the system is operating outside normal parameters. Parameters include battery module over/under voltage, cell string over/under voltage, battery module over temperature, temperature signal loss, and battery module over current. In the event of any abnormal conditions, the BMS will first raise an information warning and then trigger a corresponding corrective action should certain levels be reached.
Voltage Monitoring	Voltage is measured by the BMS, triggering fault and alarm monitor indicators, and potential system disconnect or other corrective actions if operating out of normal parameters.

System Shutdown / Disconnect	Multiple levels of passive and active electrical protections are provided for the Megapack 2 XL, including module overcurrent protection via fusible links on the DC side of the modules, inverter DC and AC protections, and ground fault detection.
Passive Circuit Protection / Design	Fused disconnects and DC disconnect switches, in addition to ground fault detection/interruption and over-voltage protection provided.
System Electrical Abuse Tolerance	System tested and listed to UL 9540.
CONSEQUENCE BARRIERS	
See Section 4.3 above for list of primary consequence barriers.	

4.5 Analysis Approval

As per the 2022 CFC and 2023 edition of NFPA 855, the fire code official shall be permitted to approve the hazardous mitigation analysis as documentation of the safety of the ESS installation, provided the consequences of the analysis demonstrate the following:

1. *Fires or explosions will be contained within unoccupied ESS rooms for the minimum duration of the fire-resistance-rated separation identified in 1207.7.4.*
2. *Fires in occupied work centers will be detected in time to allow occupants within the room to evacuate safely.*
3. *Toxic and highly toxic gases released during fires will not reach concentrations in excess of the IDLH level in the building or adjacent means of egress routes during the time deemed necessary to evacuate occupants from any affected area.*
4. *Flammable gases released from ESS during charging, discharging, and normal operation will not exceed 25 percent of their lower flammability limit (LFL).*
5. *Flammable gases released from ESS during fire, overcharging, and other abnormal conditions will be controlled through the use of ventilation of the gases, preventing accumulation or by deflagration venting.*

Table 15: Summary of Analysis Approval

Compliance Requirement	Comments
1. Fires or explosions will be contained within unoccupied ESS rooms for the minimum duration of the fire-resistance-rated separation identified in 1207.7.4.	**Not applicable.** The Megapack 2 XL is intended for outdoor ground-mounted installations only and shall not be installed within any ESS rooms or structures.
2. Fires in occupied work centers will be detected in time to allow occupants within the room to evacuate safely.	**Not applicable.** The Megapack 2 XL is not intended to be installed in any occupied work centers.
3. Toxic and highly toxic gases released during fires and other fault conditions will not reach concentrations in excess of the immediately dangerous to life or health (IDLH) level in the building or adjacent means of egress routes during the time deemed necessary to evacuate from that area.	**Compliant.** Additional testing and third-party analysis performed on products of combustion from the Megapack 2 XL at locations 20 ft and 5 ft conclude no traces of Mercury or 27 different metals tested for. HF was detected at values of 0.10 and 0.12 ppm over the course of the test, far below the accepted NIOSH Immediately Dangerous to Life or Health (IDLH) value of 30 ppm for HF.

	The installation is proposed to be sited in an area with adequate separation distances.
4. Flammable gases released during charging, discharging, and normal operation will not exceed 25 percent of the LFL.	**Not applicable.** Lithium-ion batteries do not release flammable gases during charging, discharging, or normal operation. In the case of flammable off-gases being released due to a thermal runaway event, the Megapack 2 XL is equipped with pressure-sensitive vents and a sparker system designed to ignite any flammable gases and release in a controlled manner before they are allowed to accumulate and create an explosive atmosphere within the enclosure.
5. Flammable gases released from ESS during fire, overcharging, and other abnormal conditions will be controlled through the use of ventilation of the gases, preventing accumulation or by deflagration venting.	**Compliant.** The Megapack 2 XL is equipped with deflagration protection in the form of pressure-sensitive vents and a sparker system designed to ignite any flammable gases and release in a controlled manner before they are allowed to accumulate and create an explosive atmosphere within the enclosure.

This page left intentionally blank.

APPENDIX A – DETAILED HMA DIAGRAMS AND BARRIER DESCRIPTIONS

A.1 All Fault Conditions

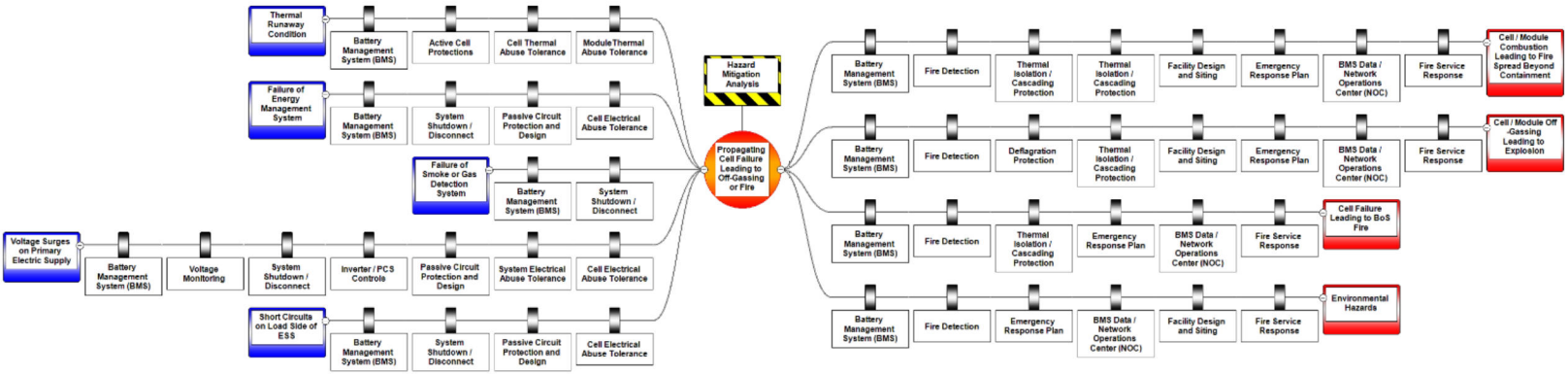


Figure A-1: All Fault Conditions

A.2 Thermal Runaway Condition

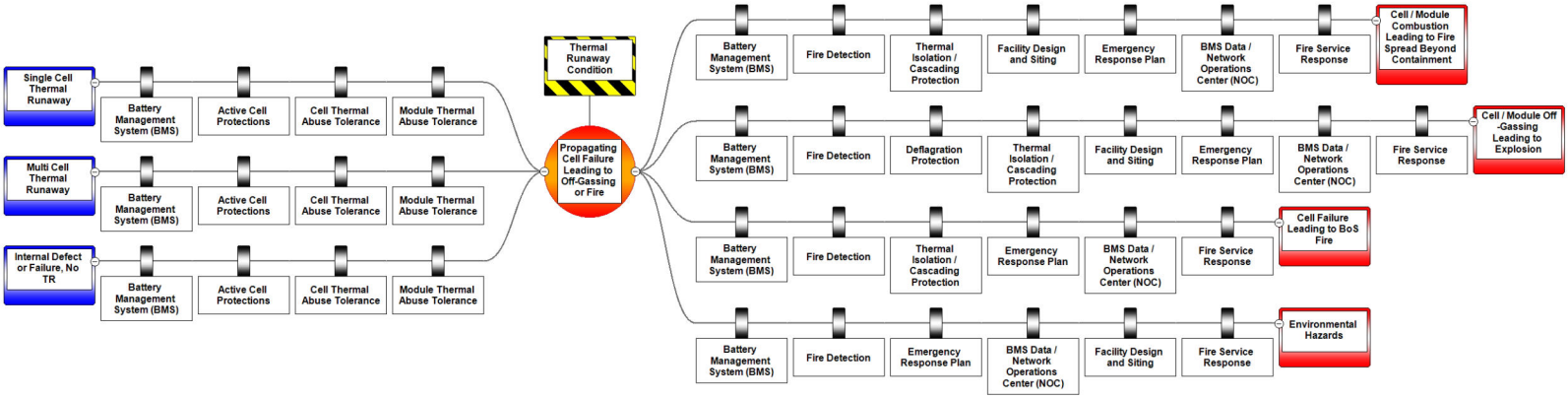


Figure A-2: Thermal Runaway Condition

A.3 Failure of an Energy Storage Management System

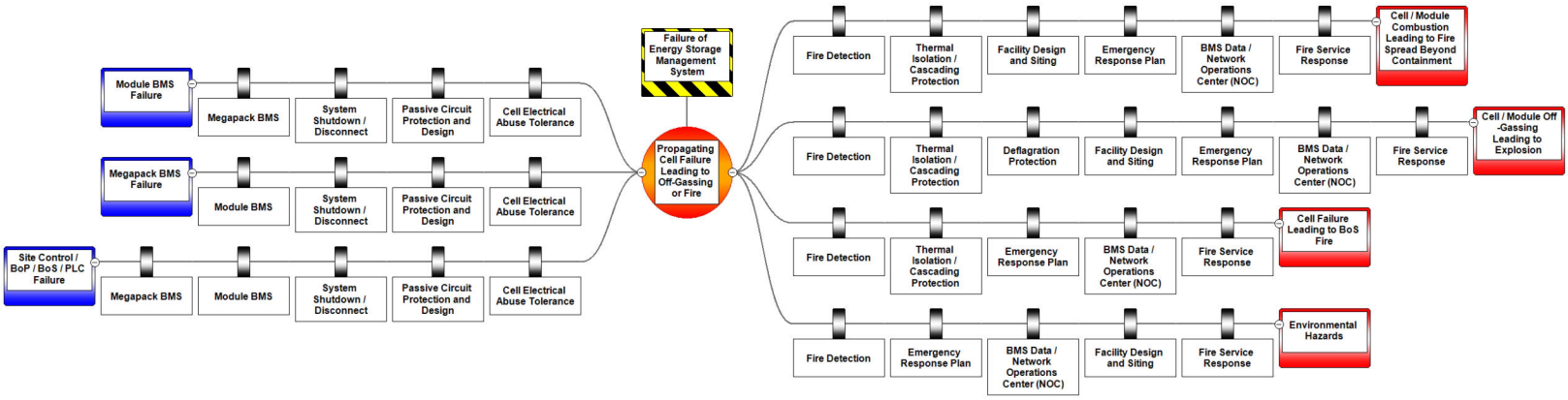


Figure A-3: Failure of an Energy Storage Management System

A.4 Failure of a Required Smoke/Fire/Gas Detection or Fire Suppression

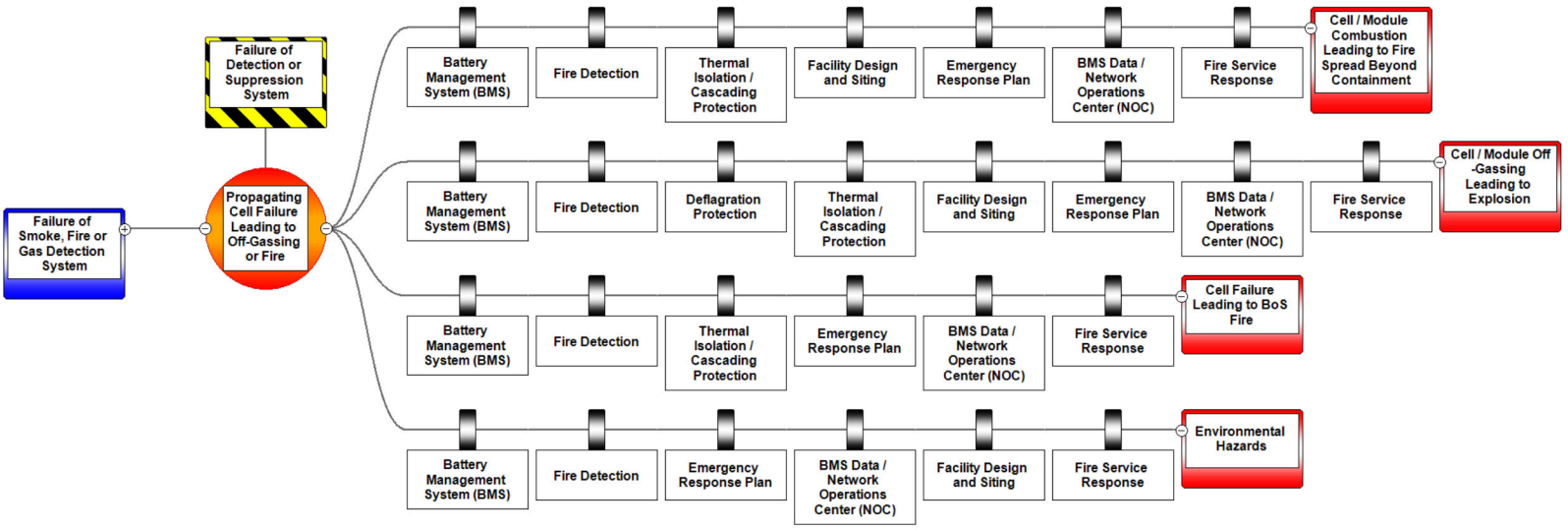


Figure A-4: Failure of a Required Smoke/Fire/Gas Detection or Fire Suppression

A.5 Voltage Surges on the Primary Electric Supply

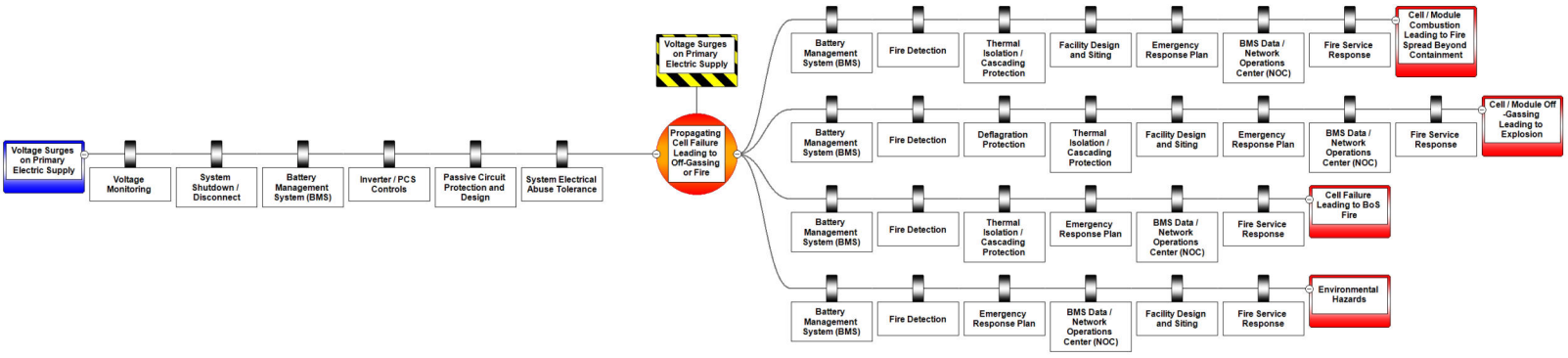


Figure A-5: Voltage Surges on the Primary Electric Supply

A.6 Short Circuits on the Load Side of the ESS

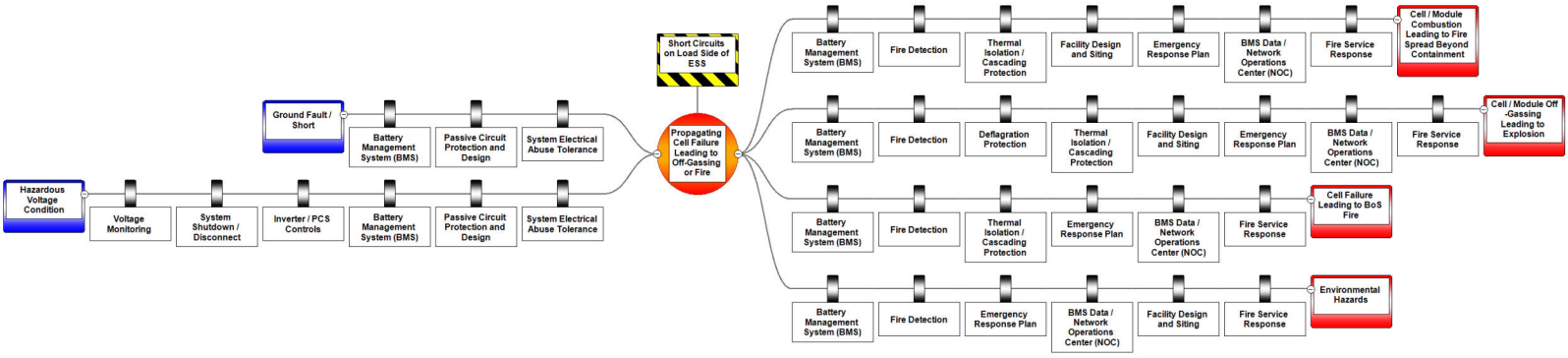


Figure A-6: Short Circuits on the Load Side of the ESS

APPENDIX B – HMA METHODOLOGY

This Appendix serves as a supplemental write up for the overall Hazard Mitigation Analysis (HMA) and provides additional context on the Bowtie methodology used, as well as key definitions and concepts.

ESRG utilizes the bowtie methodology for hazard and risk assessments, as is described in *ISO.IEC IEC 31010 §B.21*, as it allows for in-depth analysis on individual mitigative **barriers** and serves as a strong tool for visualizing the chronological pathway of **threats** leading to critical hazard events, and ultimately to greater potential **consequences**, as depicted in Figure B-1 below. This simple diagrammatic way of describing and analyzing the pathways of a risk from hazards to outcomes can be considered to be a combination of the logic of a fault tree analyzing the cause of an event and an event tree analyzing the consequences.

The strength of the bowtie approach comes from its visual nature, which forgoes complex, numerical tables for threat pathways which show a single risk or consequence and all the barriers in place to stop it. On the left side are the threats, which are failures, events, or other actions which all result in a single, common hazard event in the center. For our model, many of these threats are the requirements of the fire code such as an unexpected thermal runaway.

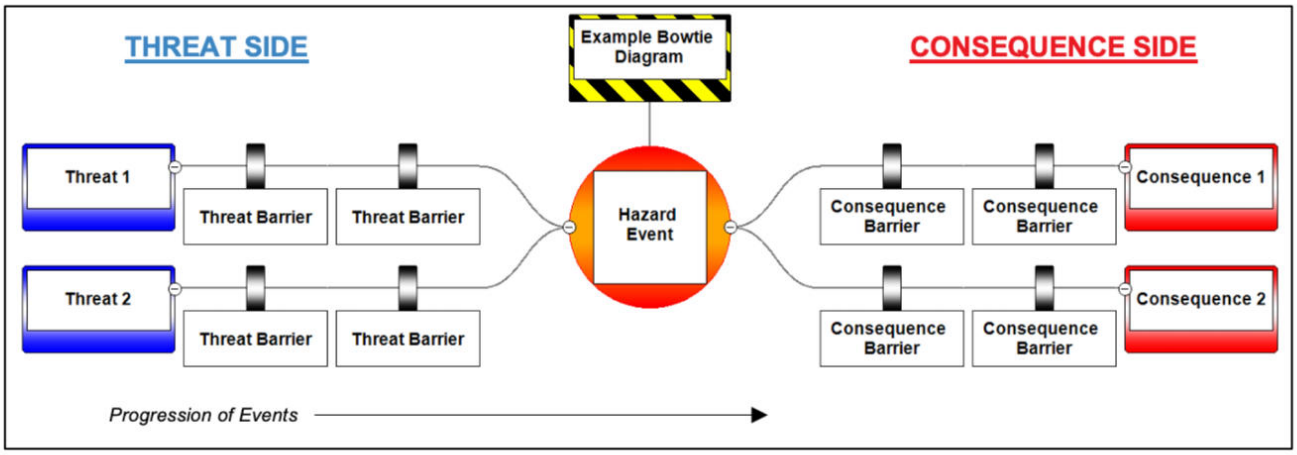


Figure B-1: Basic Bowtie Diagram

- **Hazard Event / Top Event**

  The hazard (or “top”) event – depicted as the center point in the middle of the bowtie diagram – represents a deviation from the desired state during normal operations (in this case, a thermal runaway or cell failure event), at which point control is lost over the hazard and more severe consequences ensue.

  This event happens before major damage has occurred, and it is still possible to prevent further damage.

- **Threats**

  There often may be several factors that cause a “top event”. In bowtie methodology, these are called threats. Each threat itself has the ability to cause the center event. Examples of threats are hazardous temperature conditions, BMS failure, and water damage from condensation, each leading to cell failure (the center event for many of the following bowtie diagrams for lithium-ion ESS failures).

  Threats may not necessarily address a fully involved system fire, but rather smaller, precursor events which could lead to these catastrophic consequences. Some threats occur without any intervention, such as defect propagation or weather-related events, while others represent operational errors (either human or system-induced). Often threats may also be consequences of even earlier-stage threats, spawning a new bowtie model that includes the threat at the center point or right side of the new bowtie. The diagrams that follow include careful selection and placement of each of the elements to best capture the perspective of system owners and operators responsible for ensuring safe operation.

- **Consequences**

  Consequences are the results of a threat pathway reaching and exceeding its center event. For the models described here, the center events were selected as the event in which proactive protections give way to reactive measures mostly related to fire protection systems and direct response. As the center event then is defined as either “cell failure” or propagating cell failure, the consequences in the models described assume a condition exists in which flammable gas is being released into the system or a fire is burning within the system.

  Consequence pathways include barriers that may help to manage or prevent the consequence event. Threat pathways are often consequence pathways from a separate hazard assessment, as is the case with thermal runaway. In other words, thermal runaway may result from many different threats at the end of a separate hazard pathway (if not properly mitigated) and may also be the threat that could result in several other consequences. The task force identified a set of common consequences representing areas of key concern to utilities, energy storage system operators, and first responders.

- **Barriers**

  In order to control risks, mitigative “barriers” are placed to prevent propagation of failure events across the system. A barrier can be any measure taken that acts against an undesirable force or intention, in order to maintain a desired state, and can be included as proactive threat barriers or reactive consequence barriers.

  Each barrier in these models is more indicative of a concept that may include a single approach or may consist of a complex series of combined measures. Similarly, the analysis may not include barriers required to prevent the threats at the far left of the diagram (which would be placed even further left) to ensure the models do not extend infinitely, though the incorporation of these variables into site-specific safety evaluations

may provide additional benefit. This list does not contain all possible solutions and in some designs, these barriers may not exist at all. Many of the same barriers apply to a number of threats.

Barriers may mitigate hazards or consequences in a variety of ways. For example, common barriers to thermal runaway include active electrical monitoring and controls, redundant failure detection, and even passive electrical safeties (such as over-current protection devices and inherent impedances). Should these systems fail to detect the threat, shutdown the system, or otherwise prevent thermal runaway from occurring, the hazard may persist.

APPENDIX C – FLAME DETECTION SYSTEM

1. INTENDED USE

Designed for hazardous industries where fast fire detection is critical and nuisance alarms are not an option. The Viking VSF303 UVIR is an explosion proof ultraviolet-infrared flame detector. The device delivers superior performance, responding to hydrocarbon liquid fuel and gas fires at long distances. The VSF303 UVIR has been independently tested to demonstrate it can detect a hydrocarbon fuel pan fire at over 128 feet in less than 5 seconds.

Typical applications include:

- On/Offshore Oil and Gas Processing Facilities
- Refineries
- Petrochemical Plants
- Chemical Facilities
- Pharmaceutical
- Aircraft Hangars
- Road Tunnels
- Power Generation
- Tank Farms
- Road & Rail Loading Racks
- LNG / LPG
- Warehouses/ Storage Areas
- Waste Recycling/ Biomass Plants
- Printing Industry



2. APPROVALS AND CERTIFICATIONS

FMus Approved
Class 1 Div 1 Groups B, C, D T4
Ambient
-58 °F to +185 °F
(-50 °C to +85 °C)

Class 1 Zone 1
AEx/Ex db IIC T4
Ambient
-58 °F to +185 °F
(-50 °C to +85 °C)

ATEX Ex II 2 G Ex db IIC T4
IECEx Ex db IIC T4
Ambient -76 °F to +185 °F
(-60 °C to +85 °C)

INMETRO Ex db IIC T4*
PESO Ex db IIC T4*
Ta=-76 °F to +185 °F (-60 °C to +85 °C)

Performance approvals
FM3260
EN 54-10

Ingress NEMA type 4X/ 4P IP66/67
IEC 61508 SIL 2 Capable*
Marine ABS Product Assessment*

*Designed to meet



The NFS-320SYS intelligent Fire Alarm Control Panel is part of the ONYX® Series of Fire Alarm Controls from NOTIFIER. The panel can be configured with just a few devices for small building applications, or networked with many devices to protect a large campus or a high-rise office block.

Features & Benefits:

- High-speed network for up to 200 nodes
- Standard network for up to 103 nodes
- Autoprogramming and Walk Test reports
- Multiple central station communication options
- Listings: Seismic Certified, Marine Approved

APPENDIX D – REFERENCED DOCUMENTATION

[1] *Megapack 2XL_-_ANSI-UL_9540A_Cell_Level_Report.pdf*

[2] *Megapack 2XL_-_ANSI-UL_9540A_Module_Level_Report-1.pdf*

[3] *Megapack_2_and_XL_-_ANSI-UL_9540A_Unit_Level_Report-1.pdf*

[4] *Tesla_Megapack_2_and_XL_FPE_Report_Final.-1pdf*

APPENDIX E – REFERENCED CODES AND STANDARDS

- *California Fire Code International Fire Code §1207 Electrical Energy Storage Systems*, 2022 Edition 2022 CFC, 2021 IFC
- *California Electrical Code, 2022 Edition*
- *California Building Code, 2022 Edition*
- *UL 9540A Standard for Test Method for Evaluation Thermal Runaway Fire Propagation in Battery Energy Storage Systems,* 4th Edition
- *UL 9540 Standard for Energy Storage Systems and Equipment,* 2nd Edition
- *NFPA 68 Standard on Explosion Protection by Deflagration Venting,* 2013 Edition
- *NFPA 72 National Fire Alarm and Signaling Code,* 2022 Edition
- *NFPA 76 Standard for the Fire Protection of Telecommunications Facilities,* 2016 Edition
- *NFPA 855 Standard for the Installation of Stationary Energy Storage Systems*, 2020 Edition

Tidelands Avenue Electric Truck Hub

EMERGENCY RESPONSE PLAN

Version 1.0 | September 15, 2025

Summary

This document serves as the Preliminary Emergency Response Plan (ERP) for the Tidelands Avenue Electric Truck Hub to be located at 1640 Tidelands Avenue, National City, CA. This Preliminary ERP will become the final ERP once final installation details are determined and input from the local fire department is received and added to the ERP.

This preliminary ERP provides information and instructions to guide first responders in preparing for, and safely responding to, an incident, fire, or other emergency associated with the energy storage facility.

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

The plan shall be updated when conditions that affect the response considerations and procedures change.

Prepared For:

Skycharger

1616 S 16th Avenue

Nashville, TN 37212

Energy Safety Response Group
8350 US HWY 23 N
Delaware, OH 43015

www.energyresponsegroup.com
1-833-SAFE-ESS

© 2025 Energy Safety Response Group, LLC. All rights reserved.

This page left intentionally blank.

EMERGENCY CONTACT INFORMATION

IN CASE OF EMERGENCY CALL 911

LOCAL FIRE DEPARTMENT

National City Fire Department Station 34

Phone: **(619) 336-4550**

Address: 343 E 16th Street
National City, CA 91950

LOCAL POLICE DEPARTMENT

National City Police Department

Phone: **(619) 336-4411**

Address: 1200 National City Blvd
National City, CA 91950

HOSPITAL EMERGENCY ROOM

Paradise Valley Hospital

Phone: **(619) 470-4321**

Address: 2400 E 4th Street
National City, CA 91950

LOCAL HEALTH FACILITY

Concentra Urgent Care

Phone: **(619) 474-9211**

Address: 102 Mile of Cars Way
National City, CA 91950

LOCAL BURN CENTER

Hillcrest Medical Center at UC San Diego Health

Phone: **(858) 657-7000**

Address: 200 W Arbor Drive
San Diego, CA 92103

SYSTEM OWNER / OPERATOR

Skychargers, LLC

Phone: **(408) 859-4421**

Address: 1616 16th Avenue
Nashville, TN 372121

SUBJECT MATTER EXPERT (SME)

Johannes Copeland
COO – Skychargers, LLC
Phone: (408) 859-1121

TESLA 24/7 OPERATIONS CENTER

Tesla Hotline (for Emergency Use)

Phone: +1 (650) 681-6060

Address: 13101 Tesla Rd
Austin, TX 78725

ENERGY STORAGE SYSTEM INFORMATION

Site Location: 1640 Tidelands Avenue
National City, CA 91950
Parcel ID Number: #7600445100

Make / Model: Tesla Megapack 2 XL

Total MW / MWh: ≈ 1.75 MW / 7 MWh

kW / kWh per Unit: ≈ #1 979 kW / 3916 kWh
#2 775 kW / 3100 kWh

Units: ≈ 2

OVERPRESSURE PROTECTION
Internal sparker system and pressure-relief vents automatically combust flammable gases released during a thermal runaway event and direct pressure upwards and safely from the enclosure.

WATER SUPPLY
There will be approved fire hydrants on-site, even though engaging a battery fire directly with water is not best industry practice.

PROJECT INFORMATION

Project Name	***Tidelands Avenue Electric Truck Hub***
Project No.	25-20282
Prepared For	**Skycharger** 1616 16th Avenue Nashville, TN 37212
Revision No.	Version 1.0
Document No.	TBD
Date of Issue	Draft

REVISION HISTORY

Revision Number	Date Provided	Type	Substance of Change
1.0	9/15/2025	Customers comments	Edits based on customer comments

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

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

Note 3: *Highlighted items are to be finalized prior to construction and are subject to change.*

IMPORTANT NOTICE AND DISCLAIMER

Energy Safety Response Group LLC (ESRG) is providing an interim preliminary version of this document based on an "*as-designed*" system. This document should not be provided externally until agreed by all responsible parties.

Upon acceptance of this "as designed" interim preliminary version, which may be made public as an "*as designed release*," ESRG shall treat this document as ready for release but shall not mark the document as "*as-built final*" until ESRG can confirm, via personnel on site, that the system, "*as-built*" aligns with the reviewed and reported design.

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

This document conveys the results of research, investigations, intellectual property development, experience, and analysis to provide opinions, recommendations, explanations, service offerings, and quotations from ESRG. This document is not meant to serve as professional and credentialed engineering, legal, technical, or emergency response judgment, and should not be used in place of consultation with such appropriate professionals. Appropriate professional advice should be obtained regarding such issues as required.

The contents of this document are in no way meant to address specific circumstances, and the contents are not meant to be exhaustive and do not address every potential scenario associated with the subject matter of the document. Site and circumstance-specific factors and real-time judgment and reason may significantly impact some of the subject matter conveyed in this document. Additional resources and actions, which may be beyond the scope of this document, may be required to address specific issues. Additionally, laws, ordinances, regulatory standards, and best practices related to the contents of this document are subject to change or modification.

This document is provided "*as is*". ESRG, to the fullest extent permitted by law, disclaims all warranties, either express or implied, statutory, or otherwise, including but not limited to the implied warranties of merchantability, non-infringement, and fitness for a particular purpose.

In no event shall ESRG or its owners, officers, or employees be liable for any liability, loss, injury, or risk (including, without limitation, incidental and consequential damages, punitive damages, special damages, personal injury, wrongful death, lost profits, or other damages) which are incurred or suffered as a direct or indirect result of the use of any of the material, advice, guidance, or information contained in this document, whether based on warranty, contract, tort, or any other legal theory and whether or not Energy Safety Response Group LLC or any of its owners, officers, or employees are advised of the possibility of such damages.

ACRONYMS

AHJ	Authority Having Jurisdiction
AR	Arc-Rated
BMS	Battery Management System
E-Stop / EPO	Emergency Stop / Emergency Power Off
ERP	Emergency Response Plan
EMS / ESMS	Emergency Management System / Energy Storage Management System
ERG	Emergency Response Guide (generic, product-level emergency response guide)
ESRG	Energy Safety Response Group
ESS / BESS	Energy Storage System / Battery Energy Storage Management System
FACP	Fire Alarm Control Panel
IC	Incident Commander
ICS	Incident Command System
kW	Kilowatt(s)
kWh	Kilowatt-hour(s)
LFL / LEL	Lower Flammability Limit / Lower Explosive Limit
LFP	Lithium Iron Phosphate
MW	Megawatt(s)
MWh	Megawatt-hour(s)
O&M	Operations and Maintenance
PCS	Power Conversion System
PPE	Personal Protective Equipment
SCBA	Self-Contained Breathing Apparatus
SDS	Safety Data Sheets
SME	Subject Matter Expert
SOC	State of Charge
TSC	Tesla Site Controller
UICS	Unified Incident Command System
UFL / UEL	Upper Flammability Limit / Upper Explosive Limit

Table of Contents

1.0 INTRODUCTION 11
1.1 Scope and Purpose 11
1.2 Activation 11
1.3 Incident Command System (ICS) 11
1.4 Operations and Maintenance (O&M) 11
1.5 ERP Update Process 12
1.5.1 Issuance and Revisions 12
1.5.2 Annual Review 12
1.5.3 Plan Retirement 12
1.6 Fire Department Training 12
2 SITE OVERVIEW 13
2.1 Site Location 13
Figure 1 – Google Map View 13
Figure 2 – Map View 14
Figure 3-Aerial View 14
Figure 4- Preliminary Site Layout 15
2.2 Staging Area 16
2.3 First Responders Station 16
2.4 Site Access 16
2.5 Equipment Access 16
2.6 Water Supply 16
2.7 Nearby Infrastructure and Natural Features 17
2.8 Site Maintenance 17
3 ENERGY STORAGE SYSTEM OVERVIEW 18
Figure 5 – Typical Tesla Megapack 2 XL ESS Units 18
4 FIRE PROTECTION SYSTEMS 19
4.1 Overpressure Protection 19
4.2 Emergency Shutoffs 19
4.2.1 Automatic E-Stop 19
4.2.2 Enclosure-Level E-Stop 19
4.3 Battery Management System (BMS) 20
5 FIRE DETECTION, ALARMING, AND NOTIFICATION 21
5.1 Fire Detection 21
5.2 Remote Monitoring Facility 21

Table 1 – Tesla 24/7 Operations Center Information 21
6 GENERAL HAZARDS ASSOCIATED WITH BATTERY ESS 22
6.1 Thermal Runaway 22
6.2 Fire and Re-ignition 22
6.3 Overpressure Event 23
6.4 Electric Shock 23
6.5 Arc Flash 24
6.6 Lightning 24
6.7 Natural Disasters 24
6.8 Toxic Smoke and Gas Emission 24
6.9 Additional Hazards and Considerations 25
7 EMERGENCY RESPONSE CONSIDERATIONS 26
7.1 Emergency Contacts 26
7.2 Equipment and Personnel Protective Equipment (PPE) 26
7.3 APIE (Analyze, Plan, Implement, and Evaluate) Framework 26
7.4 General Emergency Response Recommendations 27
Table 2 - General Emergency Response Recommendations 27
7.5 Determine Fire Protection Approach 28
7.6 Incident Monitoring and Evaluation 28
8 POTENTIAL INCIDENT SCENARIOS AND PROCEDURES 29
8.1 Overpressure Incident 29
8.2 Fire Incident 29
8.3 Thermal Runaway or Off-Gassing Incident 30
8.4 Alarm Incident 31
8.5 External Fire / Thermal Exposure Incident 32
8.6 Charging Vehicle Incident 32
8.7 External Impact Incident 32
8.8 Natural Disaster Impact 32
8.9 Emergency Response During Construction, Commissioning, and Maintenance 32
9 POST-INCIDENT / HANDOFF PROCEDURES 33
9.1 Handoff Procedures 33
9.2 Activation of Decommissioning Plan 33
APPENDICES 34
APPENDIX A – Additional Site Photos and Maps 34
Appendix A.1 Site Map 34
Appendix A.2 Typical Dimensions 34

Appendix A.3 Tesla MegaPack 2 - Inside View 35
Appendix A.4 Nearest Fire Station **35**
APPENDIX B – Signage / Placarding / IO Matrix 36

1.0 INTRODUCTION

1.1 Scope and Purpose

This Emergency Response Plan (ERP) is provided for the Tidelands Avenue Electric Truck Hub located in National City, CA. The purpose of this document is to provide guidance and pertinent information regarding the roles, responsibilities, and chain of communication and command of the System Owner / Operator, Property Owner, and other required Subject Matter Experts (SMEs) for preparing for, and safely responding to, a fire, overpressure event, or other battery-related incident requiring a public safety response at the energy storage facility.

The Operations and Maintenance (O&M) Manager for the project is an employee of Tidelands Avenue Electric Truck Hub or their designee. “On-site personnel” include all individuals on the facility property who are direct employees of the Owner / Operator or affiliated contractors. The Owner / Operator and contractors are similarly responsible for establishing and maintaining contractor-specific Emergency Response Plans and reporting procedures that will work in conjunction with the overall energy storage facility plan.

Life safety shall be the highest priority during any type of event.

1.2 Activation

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

1.3 Incident Command System (ICS)

The System Owner / Operator, Subject Matter Experts, Remote Monitoring Facility staff, and all energy storage system-related personnel shall comply with the orders of the Incident Commander (IC) and the command staff.

1.4 Operations and Maintenance (O&M)

Operations and maintenance procedures for the energy storage facility and associated equipment are outside the scope of this document.

Please refer to the manufacturer's Operations and Maintenance manuals for all associated equipment related to the site prior to beginning any work on this installation.

1.5 ERP Update Process

1.5.1 Issuance and Revisions

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

During project development and the AHJ review process, the design changes or other updates to pertinent information shall be reflected and shared with the AHJ.

Updates to this ERP based on any major material changes to the installation are the responsibility of the System Owner / Operator and other relevant entities required.

1.5.2 Annual Review

During the operating life span of this installation, it is expected that this document shall be reviewed annually, with all pertinent information updated as required and shared with the AHJ.

1.5.3 Plan Retirement

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

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

1.6 Fire Department Training

Initial and recurring training shall be provided to local first responders and emergency response personnel. Training may also include a site visit to the facility, where a walk-through of the site shall take place. A log of all training shall be maintained by Tidelands Avenue Electric Truck Hub and provided to the AHJ when requested.

2 SITE OVERVIEW

2.1 Site Location

The Tidelands Avenue Electric Truck Hub is to be located on San Diego Port Authority property at 1640 Tidelands Avenue in National City, California. The site consists of two (2) Tesla Megapack 2 XL ESS units providing approximately 1.75 MW / 7 MWh of energy storage power and capacity, respectively.

SITE INFORMATION	
Site Address:	**1640 Tidelands Avenue** National City, CA 91950 Parcel ID: 7600445100
GPS Coordinates: 32° 39' 56.15" N, 117° 06' 57.90" W	

Figure 1 – Google Map View

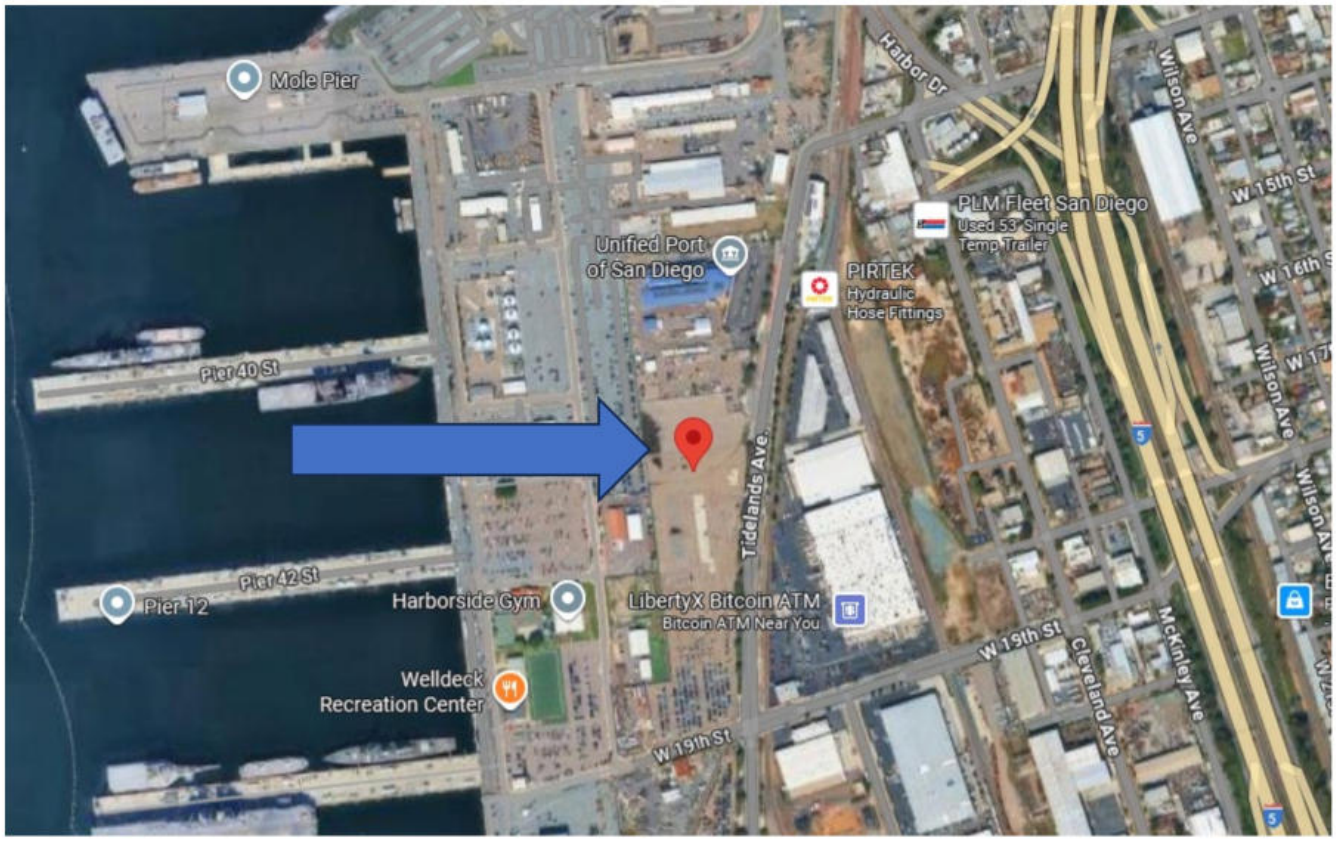


Figure 2 – Map View

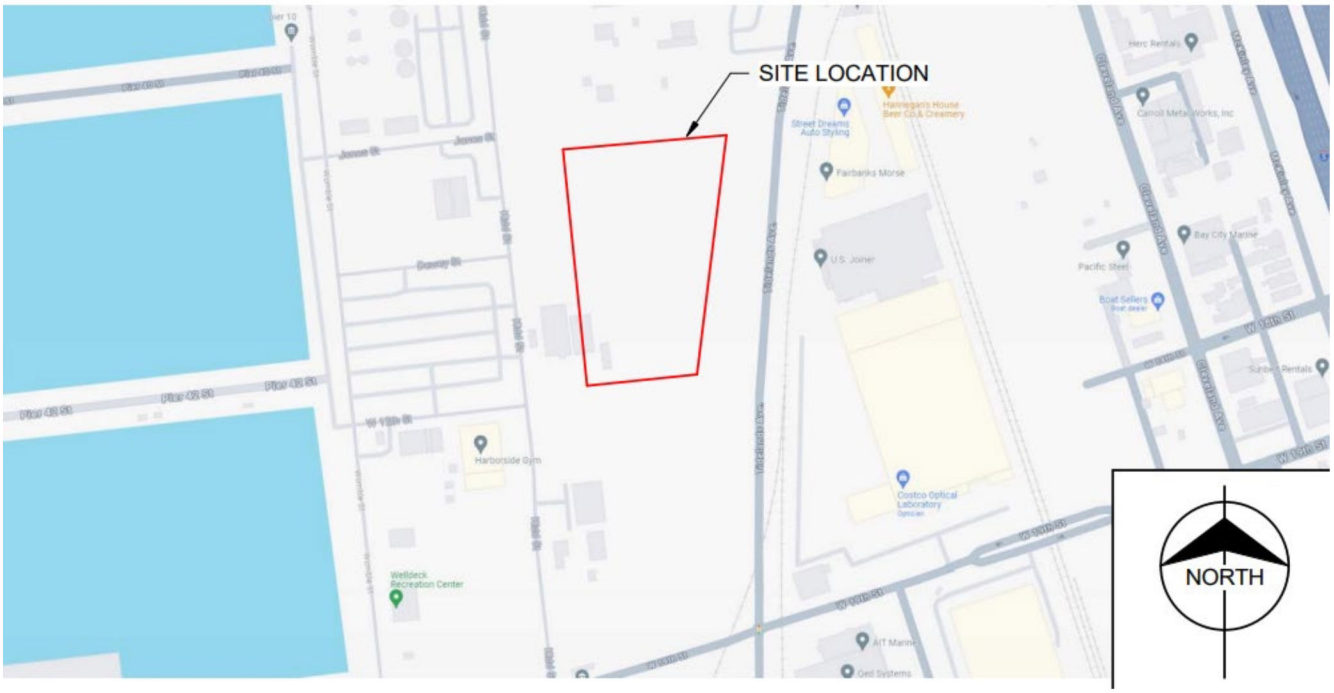
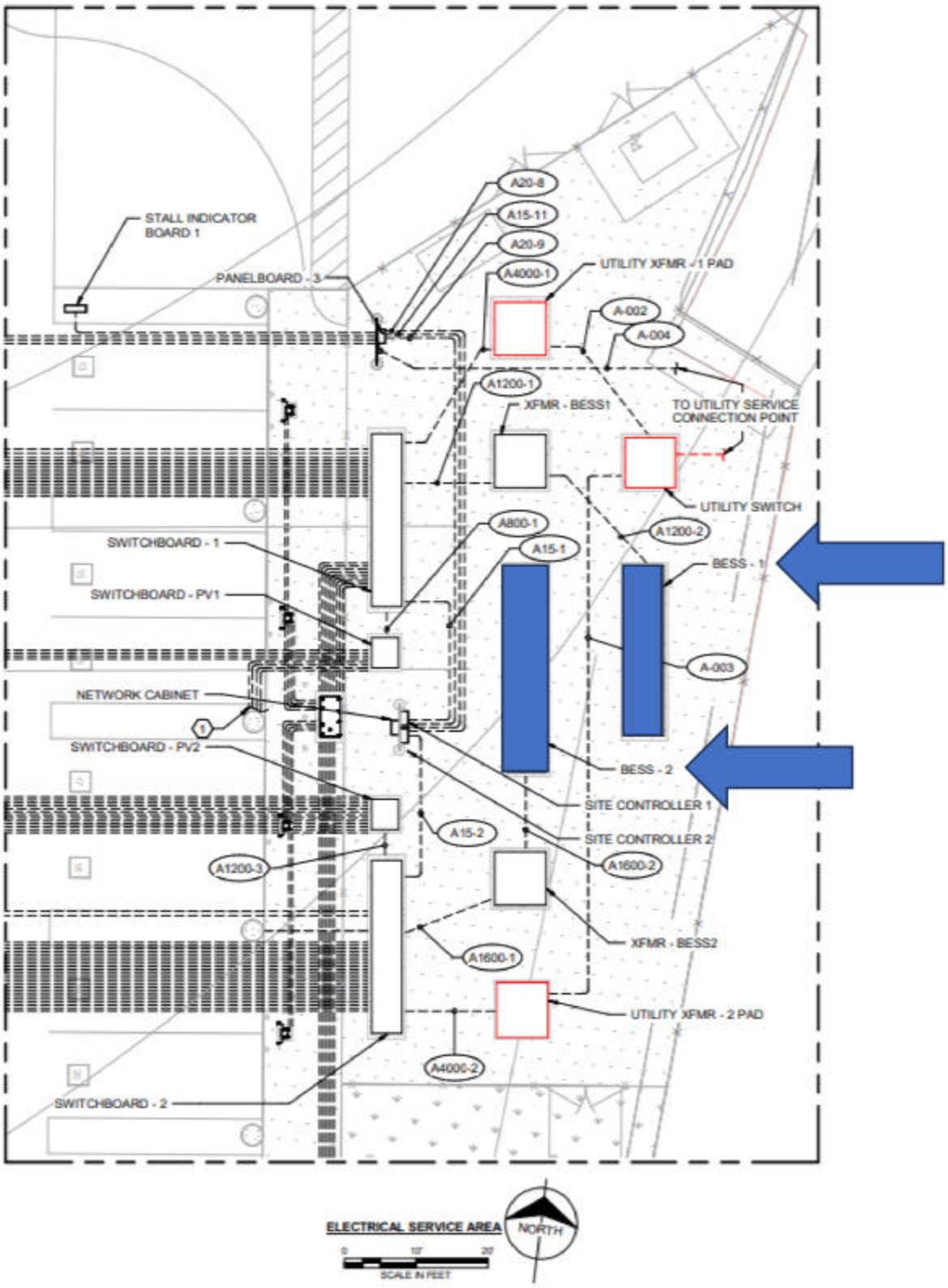


Figure 3 - Aerial View



Figure 4 - Preliminary Site Layout



2.2 Staging Area

Provide Fire Department Access Plan that identifies the locations of the staging and safety assembly areas.

Fire Department Level 2 staging and safety assembly area for any onsite personnel is located along 19th Street, east of Tidelands Avenue, or along Civic Center Drive, east of Tidelands Avenue. Both staging locations are located outside the BESS perimeter fence line, but will be dependent on wind conditions and wind direction.

It is recommended that the Fire Department staging is established at angles relative to the sides of the ESS enclosures to reduce potential impact from flying projectiles or debris from a possible overpressure event.

Provide example on the FDAP.

The Fire Department should not attempt to enter the BESS fence line prior to incident size-up and coordination with the facility's designated subject matter expert (SME), or as otherwise determined at the ultimate discretion of the Incident Commander.

2.3 First Responders Station

A First Responder's Station housing with a physical copy of the Emergency Response Plan (ERP), operational permits, O&M logs, and product manuals

Where is the station? Not shown on the site plan.

2.4 Site Access

A site access gate will be provided for fire department access. As noted above, the Fire Department should not attempt to enter the site fence line unless there is a clear threat to life safety.

Need to clarify between the facility site access and BESS site access and fence lines.

2.5 Equipment Access

The Tesla Megapack enclosures are only accessible for maintenance purposes via cabinet-style enclosure doors and cannot be physically entered by personnel at any time.

The Fire Department should not attempt to open the enclosure doors at any time.

Is unit the same as enclosure?

2.6 Water Supply

Proposed hydrant spacing or locations? Facility site or BESS site?

Water Source On-Site: There will be approved hydrants on the site, even though engaging a battery fire directly with water is not recommended based on best industry practice.

Tesla MP2 BESS units have demonstrated in full-scale fire tests that the fire will not spread between units, minimizing the need for water application to exposures. It is not anticipated, nor advised, that special extinguishing agents such as foam should be used throughout the incident.

A defensive approach is instead best practice, i.e., allowing all battery cells to be fully consumed/dissipate all energy and the fire to self-extinguish (while monitoring conditions of adjacent BESS units and the surrounding area for additional defensive actions, if needed).

More information regarding response approach, hazards, and best practices is detailed in Section 6 to the end of this document.

2.7 Nearby Infrastructure and Natural Features

The following do not present an immediate concern, though they are notable features of the area surrounding the site. This project poses minimal risk to these features.

- **Unified Port of San Diego to North** – The Unified Port of San Diego building is located approximately 350 feet to the north of the BESS of the site
- **San Diego Port** – The San Diego Port is located on multiple sides of the site.

  Be more specific as the port covers a large area and has many facilities
- **Harborside Gym** – The Harborside Gym is located approximately 325 feet to the west of the site.
- **Warehouses** – There are multiple warehouses and businesses located east of the site. The nearest warehouse is approximately 225 feet to the east.
- **Pacific Ocean** – The Pacific Ocean is located approximately 800 feet to the west of the site.

  Clarify if this reference is in regards to the ocean, or San Diego Bay.

2.8 Site Maintenance

The facility's interior access roads shall be maintained to guarantee accessibility to the site by emergency personnel, especially during inclement weather. Tidelands Avenue Electric Truck Hub shall ensure landscaping and other ongoing upkeep activities are in place prior to construction.

Need to address BESS site also.

3 ENERGY STORAGE SYSTEM OVERVIEW

The Tidelands Avenue Electric Truck Hub utilizes 2 Tesla Megapack 2 XL ESS units (which shall also be referred to as “Megapack” units throughout this report), providing a total of approximately 1.75 MW / 7 MWh of energy storage power and capacity to the electrical grid. Each Megapack unit consists of up to 24 battery modules utilizing lithium iron phosphate (LFP) battery cells.

External infrared (IR) flame detectors are provided for heat detection in the event of a thermal event from the Megapack units. The IR Detection Zones are shown in Figure X.

Where is this figure?

Additional information on fire protection systems is provided in Section 4 below.

Figure 5 – Typical Tesla Megapack 2 XL ESS Units



4 FIRE PROTECTION SYSTEMS

4.1 Overpressure Protection

Each battery enclosure will be equipped with overpressure protection in accordance with NFPA 855 and the IFC.

WARNING: Risk of Deflagration	
	A deflagration / over-pressure event is a critical hazard, and any emergency on-site should always be addressed with full awareness of potential factors that may lead to such an event. **Out of an abundance of caution, any failure or alarm condition should be assumed to result in a deflagration risk.**

WARNING: Risk of Re-ignition	
	Do **NOT** assume the fire is out as the fire event unfolds. A lithium-ion battery fire, which has seemingly been extinguished, may flare up again if all cells within the enclosure have not been completely consumed.

4.2 Emergency Shutoffs

Emergency shutoff is provided at multiple levels, though the Fire Department should not engage with E-Stops, as ESS shutdown may adversely affect the electrical grid.

The Fire Department should not engage with E-Stops, as an ESS shutdown may adversely affect the electrical grid. Any interaction with E-Stops should only be initiated in coordination with the System Owner and other SMEs as is deemed necessary.

4.2.1 Automatic E-Stop

Automatic shutdown is provided at different levels for the Tesla Megapack battery modules, depending on the type of failure:

- For major faults within battery module(s) – such as overtemperature, overcharge, or ground fault – the faulted module(s) will be isolated by DC-DC converters, disconnects, and/or DC fuses, and an alarm will be generated. This may not result in a complete shutdown of the system.

- In the unlikely event that a large propagating thermal runaway occurs, the faulted Megapack is isolated by opening its AC contactors, and over-temperature loss faults will be sent to the service team.

4.2.2 Enclosure-Level E-Stop

Each Megapack unit is equipped with an A/C circuit breaker located within the Megapack Customer Interface Bay door and is to be used **only by authorized maintenance or operations personnel.**

In the event of a battery-related failure, the Fire Department should not approach any battery enclosures or engage with any enclosure E-Stops.

CAUTION: Risk of Stranded Energy	
	Shutting off power to the ESS unit(s) does not de-energize the battery, and a shock hazard may still be present. Always treat the batteries as Energetic Hazardous Materials, as they may maintain their State of Charge (SOC) long after the removal of power to the overall ESS.

WARNING: Risk of Fire and Deflagration	
	Risk of fire or deflagration may be present in the event of a battery failure. The Fire Department should not attempt to engage with any site or enclosure E-stops. Assistance in shutdown should be provided by the System Owner / Operator and any other required SMEs.

WARNING: Electrical Shock Hazard	
	In case of flooding, stay out of the water if any part of the ESS unit(s) or wiring is submerged.

4.3 Battery Management System (BMS)

An integrated Battery Management System (BMS) monitors key datapoints such as voltage, current, and state of charge (SOC) of battery cells, in addition to providing control of corrective and protective actions in response to any abnormal conditions. Each battery module is equipped with a dedicated BMS, with a Megapack-level bus controller supervising output of all modules at the AC bus level. In the event of any abnormal conditions, the BMS will generally first raise an information warning, and then trigger a corresponding corrective action should certain levels be reached. Critical BMS sensing parameters include:

- Over / under temperature limits
- Over / under voltage limits
- Over / under current limits
- Communications loss

5 FIRE DETECTION, ALARMING, AND NOTIFICATION

5.1 Fire Detection

The energy storage facility is equipped with multi-spectrum infrared (IR) flame detectors directed at the Megapack units. In the event of a battery-related fire or thermal event emanating from the Megapack units, the flame detectors shall report to the monitoring center.

5.2 Remote Monitoring Facility

Remote monitoring of external IR flame detectors and BMS operation is provided by the 24/7 Tesla Operations Center. In the event of flame detection, system alarm and trouble signals are sent to the Tesla Operations Center, notifying the facility subject matter expert (SME) to relay wit h the local Fire Department to coordinate dispatch of responding units.

In the event of a battery-related failure transmitted by the BMS, alarm notifications and other pertinent information on the state of the ESS shall be sent to the System Owner to inform potential emergency response procedures as needed.

Additionally, if more detailed information on the state of the Megapack units is required, the Tesla Network Operations Center should be contacted.

Table 1 – Tesla 24/7 Operations Center Information

Tesla 24/7 Operations Center (for Emergency Use)
24/7 Emergency Hotline: +1 (650) 681-6060
Email Support: IndustrialStorageSupport@tesla.com

6 GENERAL HAZARDS ASSOCIATED WITH BATTERY ESS

Several Lithium-ion battery failures are briefly described in the sections below. Specific response procedures for various incident scenarios are detailed in Section 8 of this document.

Note: While the following hazards generally apply to all lithium-ion batteries, Tesla MP2 XL units have demonstrated through full-scale fire testing that the protections integrated from battery to system-level sufficiently mitigate the possibility for a fault condition to propagate or cascade into a larger emergency or life-safety incident and are unlikely to occur overall.

6.1 Thermal Runaway

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

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

6.2 Fire and Re-ignition

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

Application of water directly to affected battery modules may potentially prolong the incident, and the decision to apply water should be made in coordination with the System Owner / Operator and any other required SMEs.

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

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

6.3 Overpressure Event

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

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

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

6.4 Electric Shock

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

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

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

6.5 Arc Flash

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

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

6.6 Lightning

Protection from direct lightning strikes. Tesla Megapack 2 XL enclosures have internal frames that act like a Faraday cage, diverting currents to flow around the internal components but not through them to ground. There are no expected significant impacts to MegaPack functionality due to direct lightning strikes. Hence, air terminations or lightning masts are not required to protect MegaPack enclosures.

Protection from Indirect Lightning Strikes. Tesla Mega Pack 2 XL is designed with adequate power electronic component sizing and creepage in addition to monitored surge protection on the load side of the MegaPack breaker. Tests, in accordance with IEEE C62.45, demonstrate that internal circuits and components of MegaPack are protected from induced overvoltage from indirect lightning strikes. There is no expected impact on MegaPack functionality due to an indirect lightning strike.

6.7 Natural Disasters

If a tornado or similar high-wind natural disaster impacts the Tesla MegaPack 2 XL, the remote monitoring of each battery cell will detect a change in the batteries and will be shut down remotely.

If a wildfire impacts the site, the fire detection system will detect the fire and immediately contact the fire department. If the fire impacts the batteries, the remote monitoring of each battery cell will detect a change in the battery's temperature and will be shut down remotely.

Fire department, or monitoring company?

An emergency response from the fire department to this site for any natural disaster will be based on input from the local first responders, and the County and/or State Emergency Managers.

6.8 Toxic Smoke and Gas Emission

Lithium-ion batteries may release large quantities of flammable and toxic gas when undergoing failure and pose an inhalation hazard. Chemicals consumed during a thermal runaway event will produce copious amounts of smoke.

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

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

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

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

6.9 Additional Hazards and Considerations

For additional hazards associated with leaked coolant, leaked refrigerant, leaked electrolyte, or emergency considerations during storage, operation, transportation, or first aid measures, and disposal procedures, please see the product-level Tesla Emergency Response Guide.

7 EMERGENCY RESPONSE CONSIDERATIONS

7.1 Emergency Contacts

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

7.2 Equipment and Personnel Protective Equipment (PPE)

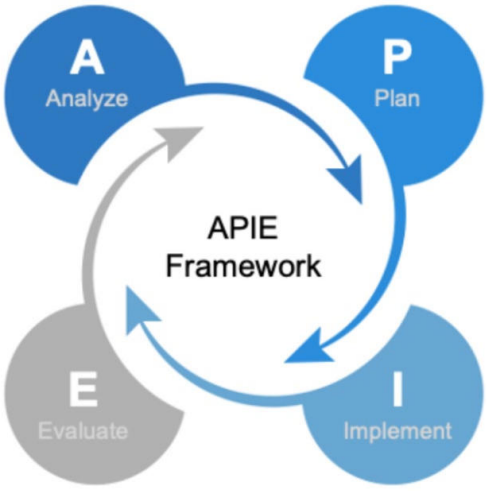
Full firefighter protective gear shall be worn in any response to a fire and/or deflagration event or if there is any indication a fire may be present or likely to be present at any time during the event.

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

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

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

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



Analyze: Provide signs and monitoring signals that indicate incident escalation (e.g., fire or deflagration) may take place, which first responders should be aware of

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

Implement: Once a plan is developed and proper resources and equipment are installed, implement respective safety actions as deemed necessary.

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

7.4 General Emergency Response Recommendations

Initiation of emergency response shall be activated per current protocol.

Table 2 - General Emergency Response Recommendations

General Emergency Response Recommendations

1. If there is any threat or potential threat to life or safety, 911 shall be called to immediately summon the aid of public safety responders.
2. An initial scene assessment shall be conducted from all sides (360-degree scene size-up) if possible, and a clear, concise assessment shall be given to incoming responders. Hazards and facility safety concerns, such as high voltage areas or other electrical concerns, shall be announced to all responders. The scene assessment shall include the following in plain language (no code or terms):
   - Where the incident is located
   - What has happened
   - What is occurring
   - Any injuries or unaccounted for individuals
   - What needs or other resources should be requested
3. An Incident Command System (ICS) shall be established immediately and shall include the designation of roles. The primary command post location shall be located at the Fire Department Staging Area at the front of the site. If Public Safety is summoned to the incident, the ICS shall be a Unified Incident Command System (UICS).
4. On-site staff (if applicable) shall immediately go to a designated muster point, which will be the command post location unless designated differently by the Incident Commander.
5. Incident Command shall designate the individual in charge of accountability. Accountability shall be reported as soon as possible. If available, another individual shall control any traffic and guide first responders to the scene.

Notes:

- At the same time as these activities are occurring, the System Owner / Operator or other designated SME shall immediately contact the Tesla 24/7 Operations Center to establish available data from the BMS and communicate this to the Incident Commander or other appropriate individual.
- It is recommended that a safe perimeter is set up and maintained around the site to keep any persons or personnel a safe distance from the incident. **A safe stand-off distance of at least 100 ft shall be maintained between individuals and the ESS enclosure(s) exhibiting fire conditions.**

Justification for 100 feet?

WARNING: Risk of Deflagration	
	A deflagration / over-pressure event is a critical hazard, and any emergency on-site should always be addressed with full awareness of potential factors that may lead to such an event.
WARNING: Toxic Gases	
	Large quantities of toxic smoke and gas may be emitted from the ESS during battery off-gassing or fire situations. **Proper PPE, including SCBA, should be worn by first responders.**

7.5 Determine Fire Protection Approach

The general approach for this application is to take a defensive posture. Unless there is an immediate threat to life safety or a similar threat, defensive fire management is normally preferred. Entering a fenced area, other than for life safety, is only to be considered after consultation with the SME. The SME should be contacted as soon as possible, and the situation monitored from outside the facility at a safe distance.

It is not recommended to apply water to the burning enclosure. Water is not anticipated to stop a thermal runaway event and may only delay the eventual combustion of the BESS unit. Exposure protection is the focus, and the IC and SME and/or Tesla should communicate on determining whether water application is at all necessary for adjacent exposures. The Incident Commander (IC) always maintains the discretion to apply water as deemed necessary. A fog pattern from a handline or monitor nozzle may potentially be utilized to control smoke and gases released from the affected enclosure and prevent them from migrating to unwanted areas.

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

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

7.6 Incident Monitoring and Evaluation

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

If available, real-time BMS data from the 24/7 Tesla Operations Center should be utilized (e.g., temperature, voltage, or other critical measurements) to monitor the spread of failure and assess the health of adjacent ESS units to help guide response procedures as the event

unfolds.

8 POTENTIAL INCIDENT SCENARIOS AND PROCEDURES

8.1 Overpressure Incident

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

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

The BESS is open on all sides and adjacent to Tidelands Avenue - no built environment is readily available. What is the next best option?

A safe stand-off distance of at least 100 ft shall be maintained between individuals and the ESS enclosure(s) exhibiting fire conditions. Staging of personnel and equipment shall be on the angles of the ESS enclosure to stay out of the potential blast radius of any enclosure doors or other possible projectiles.

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

8.2 Fire Incident

Upon detection of fire or excessive heat emanating from an affected ESS enclosure by the external IR detectors, an audible and visual alarm shall be signaled. Smoke and flames may be visible from the outside of the ESS enclosure. Fire growth may be slow, fast, or ultra-fast (e.g., during a deflagration event) in nature.

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

If there is no immediate threat to life safety:

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

Manage the fire incident utilizing the reach of the hose stream to protect exposures and control the off-gassing and smoke from the enclosure.

3. Remember that even after the ESS is isolated from the electric grid, there may still be considerable stranded energy in the batteries that poses a potential electric shock hazard to anyone in the nearby vicinity.

Additionally, chemicals released during a fire or deflagration event will be in a gaseous form and primarily pose an inhalation hazard. A fog pattern from a handline or monitor nozzle may provide an effective means of controlling an off-gassing event on the exterior of the battery enclosure from migrating to unwanted areas such as safety assembly areas, emergency responders, building intakes, etc.

Hose streams may also be applied to adjacent exposures for cooling purposes based on consultation with System Owner / Operator and other required SMEs. BMS data available via the 24/7 Tesla Operations Center should be closely monitored for the adjacent system(s) for any indicators of heat impact or water damage to any adjacent ESS units and relayed to the appropriate individual within the Incident Command System.

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

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

8.3 Thermal Runaway or Off-Gassing Incident

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

A thermal runaway event may result in large quantities of smoke and gas being released, which may or may not be visible outside of the ESS enclosure itself; therefore, it is critical that any failure or alarm condition result in the assumption of a deflagration or fire risk.

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

1. Evacuate the area to a safe location, a sufficient distance from the troubled enclosure

2. If the alarm system has not already signaled the Fire Department, immediately call 911
3. Call any required Subject Matter Experts designated for the site
4. Call the Tesla 24/7 Network Operations Center listed on Page 3
5. Establish a safety perimeter around all sides of the ESS and remain outside the fenced area. Do not allow personnel other than firefighters in proper PPE to enter the safety perimeter and stay upwind of any smoke or off-gassing. (Note: the safety perimeter may extend beyond the boundary of the fenced area.)
6. As the incident evolves, a fire or deflagration event may occur, and procedures outlined in Section 8.1 and Section 8.2 above should be followed based on the situation as it progresses.

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

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

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

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

8.4 Alarm Incident

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

1. Evacuate the area to a safe location, a sufficient distance from the troubled enclosure
2. If the alarm system has not already signaled the Fire Department, immediately call 911

3. Call any required Subject Matter Experts designated for the site
4. Call the Tesla 24/7 Network Operations Center listed on Page 3
5. Establish a safety perimeter around all sides of the ESS and remain outside the fenced area. Do not allow personnel other than firefighters in proper PPE to enter the safety perimeter and stay upwind of any smoke or off-gassing. (Note: the safety perimeter may extend beyond the boundary of the fenced area.)

8.5 External Fire / Thermal Exposure Incident

For any type of external heat source or fire impingement (i.e., not stemming from the battery system itself), the Incident Commander should be advised to look at the state of health information from the BMS data (e.g., increasing temperature in target ESS units) available from the 24/7 Tesla Operations Center to evaluate severity of the incident and treat as an ESS emergency. All precautions previously noted for fire and deflagration incidents should be observed.

8.6 Charging Vehicle Incident

In the event of a fire involving a vehicle that is connected to a charger, the fire department should protect exposures while also working to extinguish the vehicle fire. These operations shall be in accordance with the National City Fire Department's SOP on Electric Vehicle Fires.

8.7 External Impact Incident

In the event that an enclosure is severely impacted, causing crushing or puncturing of the outer shell of the enclosure, treat this as an emergency - notify 911 and other required parties.

8.8 Natural Disaster Impact

In the event that an enclosure is severely impacted by a natural disaster, treat this as an emergency - notify 911 and other required parties.

8.9 Emergency Response During Construction, Commissioning, and Maintenance

The Tesla battery enclosures are shipped with battery modules installed and partially charged. This is not uncommon throughout the industry, but poses some challenges to emergency response, which may not exist during normal operations. Once the batteries arrive, there will be a period of time until the fire protection system is commissioned.

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

to adjacent containers and assume direct fire impingement poses an enclosure-to-enclosure propagation risk.

Between delivery and commissioning of the fire protection system, the explosion prevention system may not be active. In cases where an adverse condition exists inside the system, it should be assumed that an explosive condition exists until proven otherwise.

9 POST-INCIDENT / HANDOFF PROCEDURES

9.1 Handoff Procedures

When an energy storage site is deemed safe, upon determination by the Incident Commander (IC), the Subject Matter Expert (SME) shall ensure that the site is safeguarded until the damaged system is removed, repaired, or replaced based on the approved Decommissioning Plan filed with this installation.

9.2 Activation of Decommissioning Plan

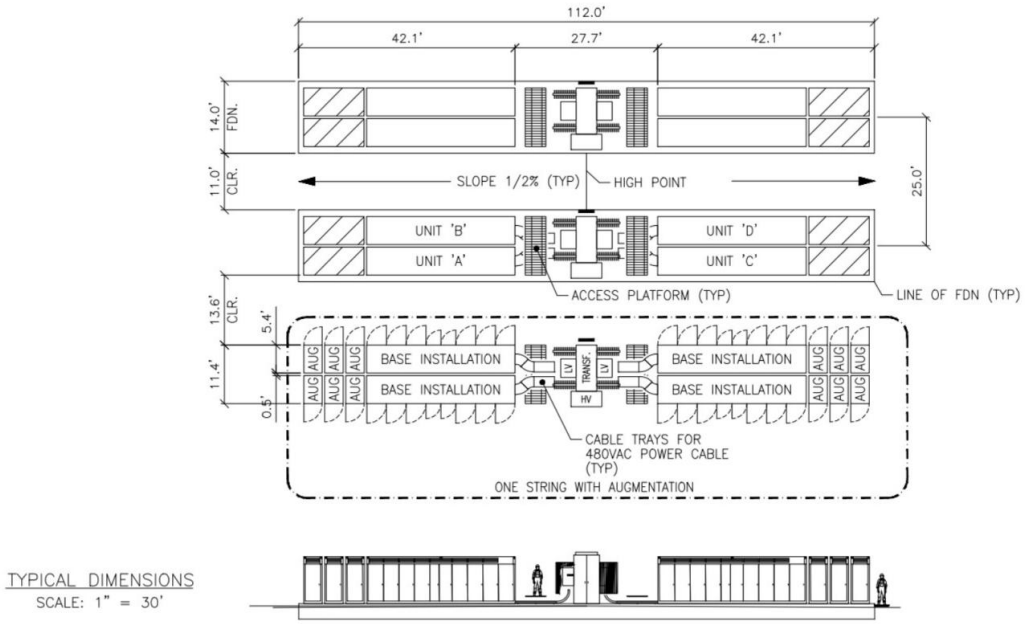
Decommissioning of the system shall take place in accordance with the approved Decommissioning Plan filed with this installation. Deactivation, de-energizing, dismantling, and removal of the system shall be conducted by trained and knowledgeable persons in accordance with the manufacturer's specifications.

APPENDICES

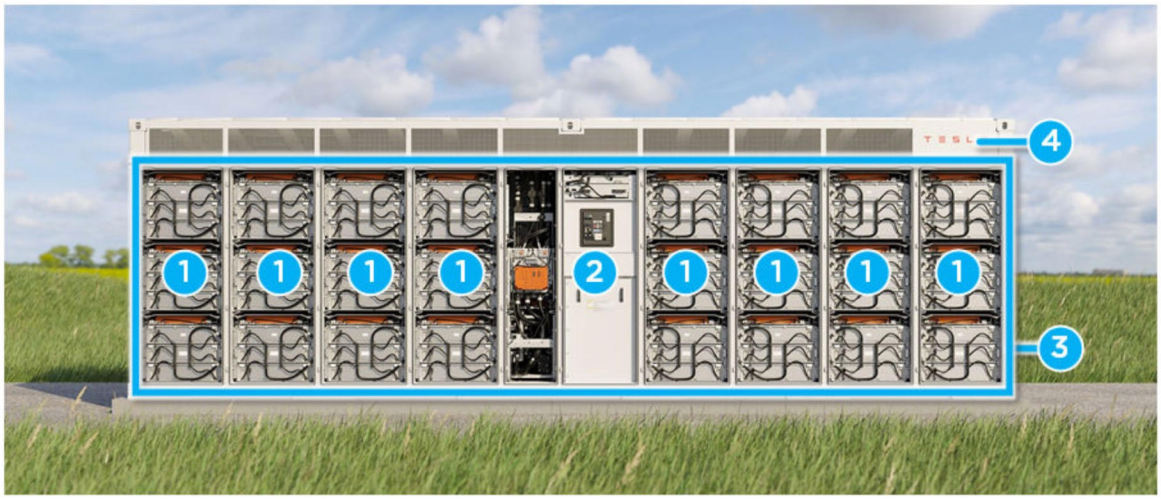
APPENDIX A – Additional Site Photos and Maps

Appendix A.1 Site Map

Appendix A.2 Typical Dimensions

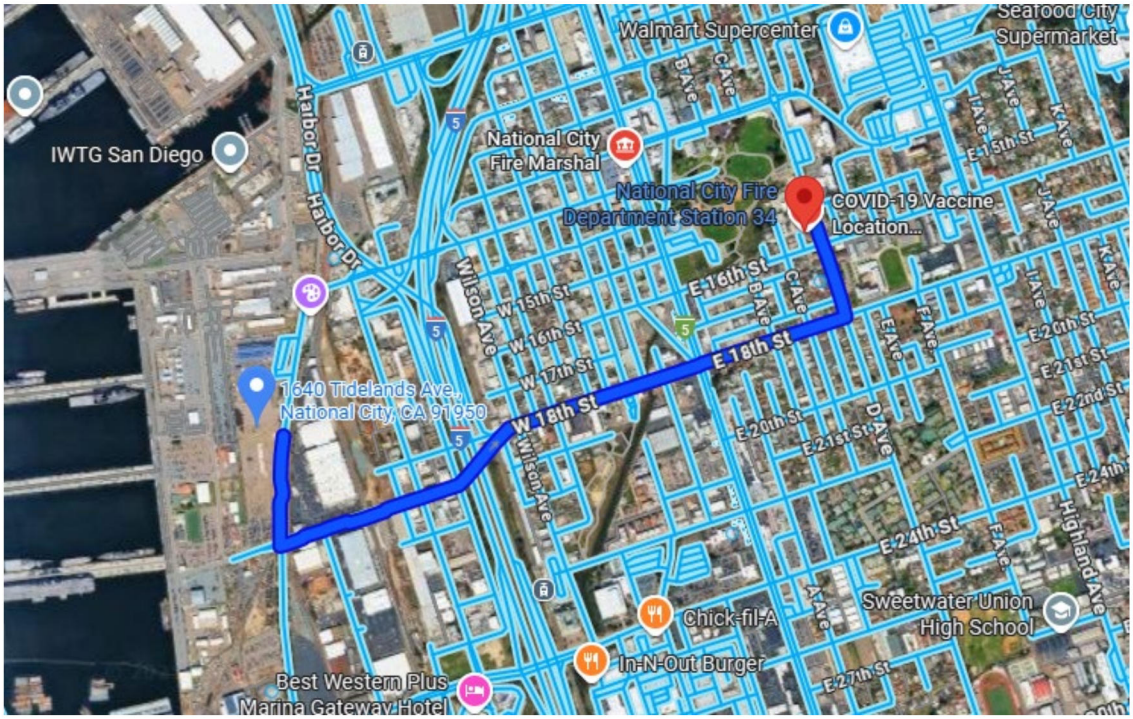


Appendix A.3 Tesla MegaPack 2 - Inside View



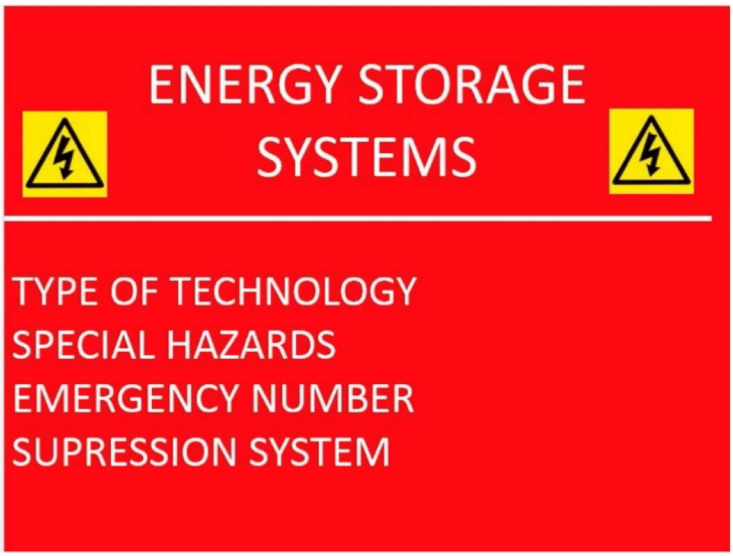
1. Battery modules with active and passive fuses – externally serviceable
2. Touch-safe Customer Interface Bay
3. Non-walk-in IP66 enclosure and deflagration mitigation
4. Thermal roof with overpressure vents

Appendix A.4 Nearest Fire Station

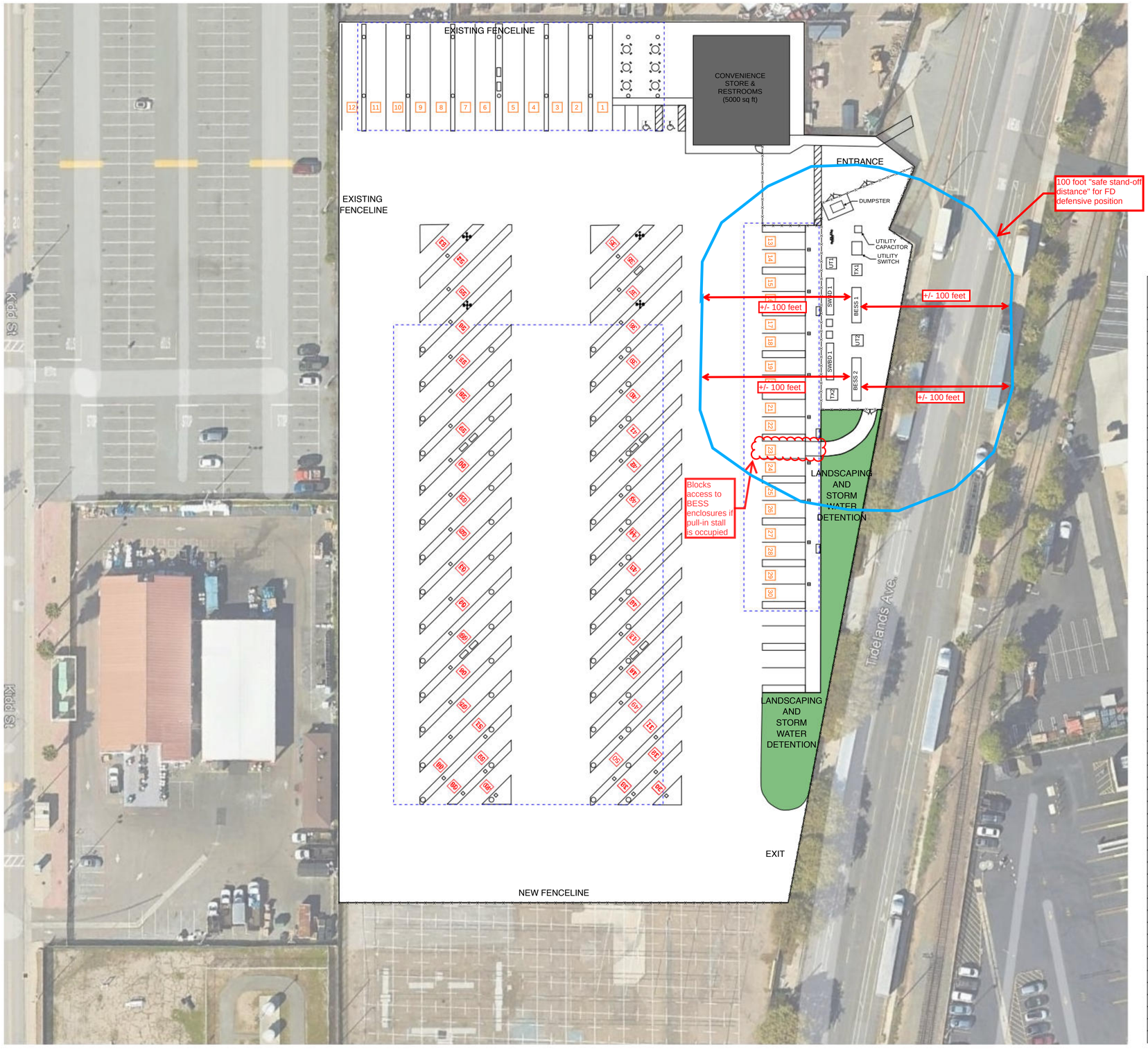


APPENDIX B – Signage / Placarding / IO Matrix

Where will placards be placed? Also include Apply No Water sign.







LEGEND:

- DUAL PORT SATELLITE DISPENSER
- SINGLE PORT SATELLITE DISPENSER
- POWER CABINET
- PICNIC TABLE
- SOLAR CANOPY OUTLINE
- LIGHT POLE
- FENCE
- # OVERNIGHT CHARGING STALL
- # OPPORTUNITY CHARGING STALL

EVSE #	STALL TYPE	VEHICLE TYPE	CAPACITY PER PORT	SATELLITE TYPE	POWER CABINET SUPPLIED BY	POWER CABINET INSTALLED CAPACITY
1	OVERNIGHT BACK-IN	TRUCK + TRAILER	240KW	OVERHEAD	PC-1	400KW
2	OVERNIGHT BACK-IN	TRUCK + TRAILER	240KW	OVERHEAD		
3	OVERNIGHT BACK-IN	TRUCK + TRAILER	240KW	OVERHEAD		
4	OVERNIGHT BACK-IN	TRUCK + TRAILER	240KW	OVERHEAD		
5	OVERNIGHT BACK-IN	TRUCK + TRAILER	240KW	OVERHEAD		
6	OVERNIGHT BACK-IN	TRUCK + TRAILER	240KW	OVERHEAD		
7	OVERNIGHT BACK-IN	TRUCK + TRAILER	240KW	OVERHEAD	PC-2	400KW
8	OVERNIGHT BACK-IN	TRUCK + TRAILER	240KW	OVERHEAD		
9	OVERNIGHT BACK-IN	TRUCK + TRAILER	240KW	OVERHEAD		
10	OVERNIGHT BACK-IN	TRUCK + TRAILER	240KW	OVERHEAD		
11	OVERNIGHT BACK-IN	TRUCK + TRAILER	240KW	OVERHEAD		
12	OVERNIGHT BACK-IN	TRUCK + TRAILER	240KW	OVERHEAD		
13 & 14	OVERNIGHT PULL-IN	TRUCK ONLY	160KW	DUAL PORT PEDESTAL	PC-3	500KW
15 & 16	OVERNIGHT PULL-IN	TRUCK ONLY	160KW	DUAL PORT PEDESTAL		
17 & 18	OVERNIGHT PULL-IN	TRUCK ONLY	160KW	DUAL PORT PEDESTAL		
19 & 20	OVERNIGHT PULL-IN	TRUCK ONLY	160KW	DUAL PORT PEDESTAL		
21 & 22	OVERNIGHT PULL-IN	TRUCK ONLY	160KW	DUAL PORT PEDESTAL	PC-4	500KW
23 & 24	OVERNIGHT PULL-IN	TRUCK ONLY	160KW	DUAL PORT PEDESTAL		
25 & 26	OVERNIGHT PULL-IN	TRUCK ONLY	160KW	DUAL PORT PEDESTAL		
27 & 28	OVERNIGHT PULL-IN	TRUCK ONLY	160KW	DUAL PORT PEDESTAL		
29 & 30	OVERNIGHT PULL-IN	TRUCK ONLY	160KW	DUAL PORT PEDESTAL		
31	OVERNIGHT PULL-THROUGH	TRUCK ONLY	240KW	SINGLE PORT PEDESTAL	PC-5	400KW
32	OVERNIGHT PULL-THROUGH	TRUCK ONLY	240KW	SINGLE PORT PEDESTAL		
33	OVERNIGHT PULL-THROUGH	TRUCK ONLY	240KW	SINGLE PORT PEDESTAL		
34	OVERNIGHT PULL-THROUGH	TRUCK ONLY	240KW	SINGLE PORT PEDESTAL		
35	OVERNIGHT PULL-THROUGH	TRUCK ONLY	240KW	SINGLE PORT PEDESTAL	PC-6	400KW
36	OVERNIGHT PULL-THROUGH	TRUCK ONLY	240KW	SINGLE PORT PEDESTAL		
37	OVERNIGHT PULL-THROUGH	TRUCK + TRAILER	240KW	SINGLE PORT PEDESTAL		
38	OPPORTUNITY PULL-THROUGH	TRUCK + TRAILER	400KW	LIQUID COOLED CABLE SINGLE PORT PEDESTAL	PC-8	500KW
39	OPPORTUNITY PULL-THROUGH	TRUCK + TRAILER	400KW	LIQUID COOLED CABLE SINGLE PORT PEDESTAL		
40	OPPORTUNITY PULL-THROUGH	TRUCK + TRAILER	400KW	LIQUID COOLED CABLE SINGLE PORT PEDESTAL		
41	OPPORTUNITY PULL-THROUGH	TRUCK + TRAILER	400KW	LIQUID COOLED CABLE SINGLE PORT PEDESTAL	PC-9	500KW
42	OPPORTUNITY PULL-THROUGH	TRUCK + TRAILER	400KW	LIQUID COOLED CABLE SINGLE PORT PEDESTAL		
43	OPPORTUNITY PULL-THROUGH	TRUCK + TRAILER	400KW	LIQUID COOLED CABLE SINGLE PORT PEDESTAL		
44	OPPORTUNITY PULL-THROUGH	TRUCK + TRAILER	400KW	LIQUID COOLED CABLE SINGLE PORT PEDESTAL	PC-10	500KW
45	OPPORTUNITY PULL-THROUGH	TRUCK + TRAILER	400KW	LIQUID COOLED CABLE SINGLE PORT PEDESTAL		
46	OPPORTUNITY PULL-THROUGH	TRUCK + TRAILER	400KW	LIQUID COOLED CABLE SINGLE PORT PEDESTAL		
47	OPPORTUNITY PULL-THROUGH	TRUCK + TRAILER	400KW	LIQUID COOLED CABLE SINGLE PORT PEDESTAL	PC-11	500KW
48	OPPORTUNITY PULL-THROUGH	TRUCK + TRAILER	400KW	LIQUID COOLED CABLE SINGLE PORT PEDESTAL		
49	OPPORTUNITY PULL-THROUGH	TRUCK + TRAILER	400KW	LIQUID COOLED CABLE SINGLE PORT PEDESTAL		
50	OVERNIGHT PULL-THROUGH	TRUCK ONLY	240KW	SINGLE PORT PEDESTAL	PC-7	400KW
51	OVERNIGHT PULL-THROUGH	TRUCK ONLY	240KW	SINGLE PORT PEDESTAL		
52	OVERNIGHT PULL-THROUGH	TRUCK ONLY	240KW	SINGLE PORT PEDESTAL		
53	OVERNIGHT PULL-THROUGH	TRUCK ONLY	240KW	SINGLE PORT PEDESTAL	PC-6	400KW
54	OVERNIGHT PULL-THROUGH	TRUCK ONLY	240KW	SINGLE PORT PEDESTAL		
55	OVERNIGHT PULL-THROUGH	TRUCK + TRAILER	240KW	SINGLE PORT PEDESTAL		
56	OPPORTUNITY PULL-THROUGH	TRUCK + TRAILER	400KW	LIQUID COOLED CABLE SINGLE PORT PEDESTAL	PC-12	500KW
57	OPPORTUNITY PULL-THROUGH	TRUCK + TRAILER	400KW	LIQUID COOLED CABLE SINGLE PORT PEDESTAL		
58	OPPORTUNITY PULL-THROUGH	TRUCK + TRAILER	400KW	LIQUID COOLED CABLE SINGLE PORT PEDESTAL		
59	OPPORTUNITY PULL-THROUGH	TRUCK + TRAILER	400KW	LIQUID COOLED CABLE SINGLE PORT PEDESTAL	PC-13	500KW
60	OPPORTUNITY PULL-THROUGH	TRUCK + TRAILER	400KW	LIQUID COOLED CABLE SINGLE PORT PEDESTAL		
61	OPPORTUNITY PULL-THROUGH	TRUCK + TRAILER	400KW	LIQUID COOLED CABLE SINGLE PORT PEDESTAL		
62	OPPORTUNITY PULL-THROUGH	TRUCK + TRAILER	400KW	LIQUID COOLED CABLE SINGLE PORT PEDESTAL	PC-14	500KW
63	OPPORTUNITY PULL-THROUGH	TRUCK + TRAILER	400KW	LIQUID COOLED CABLE SINGLE PORT PEDESTAL		
64	OPPORTUNITY PULL-THROUGH	TRUCK + TRAILER	400KW	LIQUID COOLED CABLE SINGLE PORT PEDESTAL		
65	OPPORTUNITY PULL-THROUGH	TRUCK + TRAILER	400KW	LIQUID COOLED CABLE SINGLE PORT PEDESTAL	PC-15	500KW
66	OPPORTUNITY PULL-THROUGH	TRUCK + TRAILER	400KW	LIQUID COOLED CABLE SINGLE PORT PEDESTAL		
67	OPPORTUNITY PULL-THROUGH	TRUCK + TRAILER	400KW	LIQUID COOLED CABLE SINGLE PORT PEDESTAL		
68	OVERNIGHT PULL-THROUGH	TRUCK ONLY	240KW	SINGLE PORT PEDESTAL	PC-7	400KW
69	OVERNIGHT PULL-THROUGH	TRUCK ONLY	240KW	SINGLE PORT PEDESTAL		
70	OVERNIGHT PULL-THROUGH	TRUCK ONLY	240KW	SINGLE PORT PEDESTAL		