Appendix O.5

Balance of Plant Preliminary Hazard Mitigation Analysis

Starlight Solar
Major Use Permit PDS2022-MUP-22-010 Balance of Plant Preliminary Hazard Mitigation Analysis

20250320-SLS-AW0764-BOP-PHMA-R1

Issued: 22 July 2025

AHJ Revision Note: This Balance of Plant (BOP) Hazard Mitigation Analysis (PHMA) is provided as a "Basis of Design" information only analysis to support the initial permitting of the Starlight Solar Energy Storage Project in San Diego County California. This NFPA 855 PHMA was created using the best available OEM information and addresses the majority of the liquid cooled GridSolv Quantum design failure modes that could result in fire, shock, explosion, or injury to personnel.

The information presented in this PHMA is provided only as a technical basis for a fire risk assessment for the development of the required Major Use Permit Hazard Mitigation Analysis. This BOP PHMA shall be updated upon determination of the actual energy storage technology for the Starlight Solar Project. This PHMA is intended to be considered as "information only" and shall not be used for final Building Permit Approval.

Prepared for:

Empire II, LLC
12302 Exposition Blvd.
Los Angeles, CA 90068

Issued by:

Hiller
2120 Capital Drive
Wilmington NC 28405

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2120 Capital Drive
Wilmington, North Carolina 28405
910-799-9191 | hillerfire.com

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Revision History

Revision	Date	Description
0	21 May 2025	Released to Client for Dissemination
1	22 July 2025	Redefinition of the intent of the document as preliminary at the client. Title page and appropriate verbiage changed as directed by client.

Executive Summary

This California Fire Code (CFC) Section 1207.1.4 Balance of Plant (BOP) Preliminary Hazard Mitigation Analysis (PHMA) identifies the intentional engineering and administrative controls to mitigate potential hazards associated with the Major Use Permit for Starlight Solar Project. This PHMA is theoretical and assumes the procurement and installation of Wartsila GridSolv Quantum technology. This PHMA is intended to address the Energy Storage System technical study requirements by a fire protection engineer detailing fire safety features is mandatory for all BESS facilities associated with PDS2022-MUP-22-010. Therefore, this PHMA and the cited supporting documents herein assume that the Wartsila GridSolv Quantum will be used for the Empire II LLC Starlight Project. The information presented in this PHMA is only for the initial Major Use Permit and is not intended to address all of the requirements of the California Fire Code. Additional analysis is required as part of the Building Permit that evaluates all known hazards and risks based on the final technology selected.

The Empire II LLC Starlight Project is an eight-parcel project located in San Diego County, southeast of Manzanita CA in proximity of 32.66016162785173, -116.28052568720432. The Project includes a 100 MW solar facility and a 217.5 MW battery energy storage system (BESS) that would be constructed in two phases. This PHMA was developed for Phase 1.

This PHMA addresses the requirement of the outlined in the California Fire Code (CFC) Section 1207.1.4 which states a “failure modes and effects analysis (FMEA) or other approved hazard mitigation analysis shall be provided” [1]. Additionally, as a result, this PHMA is intended to satisfy the requirements of 29CFR 1910, NFPA 855:2023[2, 3].

This PHMA is the culmination of numerous engineering analyses and presents the results in a multilayered, multivariable Bowtie Mitigation Analysis. This integrated solution is intended to provide relevant project stakeholders, such as the Authority Having Jurisdiction (AHJ), with the information necessary to make informed decisions regarding fire and explosion risk reduction and mitigation measures.

The analysis conducted from these sources indicates that the hazard mitigation systems and strategies implemented in the Starlight Solar Project selected for this project are based on well executed multi-layered engineering analyses demonstrating a design that exceeds the requisite safety standards. Sufficient documentation exists that indicates engineering due diligence has been exercised to address the following failure modes:

1. A thermal runaway condition in a single Energy Storage System (ESS) rack, module or unit.
2. Failure of any battery (energy) management system.
3. Failure of any 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 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 [1].

As required for permitting and compliance with the *California Fire Code (CFC)* Chapter 12, Section 1207.1.4 this PHMA is performed in which the consequences of several specific failure modes are analyzed, and the engineering and administrative controls are applied to mitigate the probability of occurrence and mitigation of the consequences, respectively [1].

Scope

This Preliminary Hazard Mitigation Analysis (PHMA) was developed for the Empire II containerized Battery Energy Storage System (ESS) Starlight Solar located in San Diego County, southeast of Manzanita CA in proximity of 32.66016162785173, -116.28052568720432. The Starlight Solar Project will contain multiple arrays of the UL9540 complaint Energy Storage enclosures as shown in Figure 1 and Figure 3. This PHMA evaluates the fire risk associated with the thermal runaway of the Wartsila GridSolv Quantum Lithium-Iron Phosphate (LFP) based energy storage system (ESS). The information presented in this PHMA assumes an unlikely failure event where all safety critical controls fail to operate upon demand to create the bounding fire event.

The Starlight Solar Energy Storage Project consists of numerous BESS's distributed throughout the eighty (8) areas for a combined capacity of 217.5MW/870 MWh D.C. The Wartsila GridSolv Quantum is based on the safe implementation of the $LiFePO_4$ (lithium-Iron-Phosphate, LFP) battery technology developed by a typical LFP cell manufacturer [4].

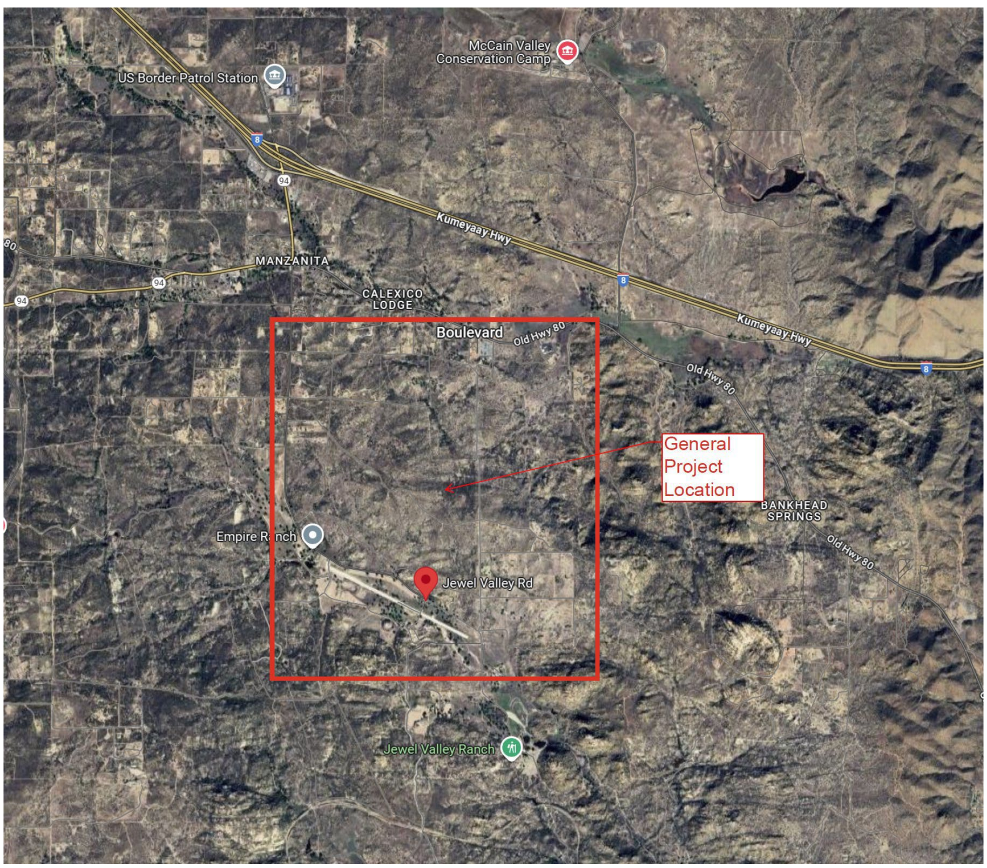


Figure 1: Starlight Solar Project Location

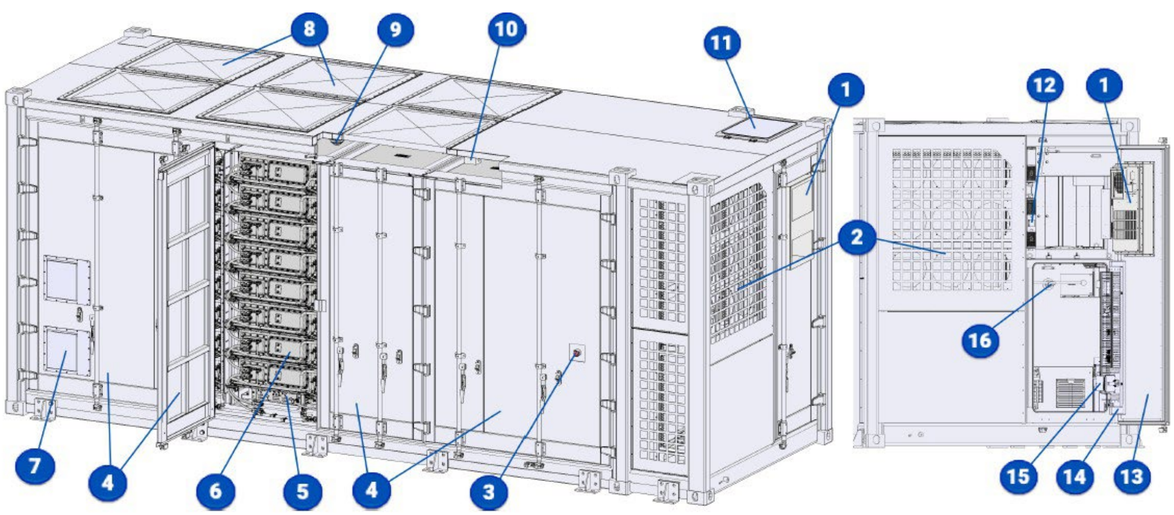
The Starlight Solar Wartsila GridSolv Quantum enclosures are divided into individually located BESS/PCS assemblies installed throughout the project site which feeds the nearby substation. The array of feeder structures is interconnected with an inverter which converts the direct current (DC) to supply power to 34.5kV three phase alternating current (AC) power source connected to the Bulk Electric System (BES).

The primary hazards associated with LFP batteries are overheating, generation of flammable gases during thermal or electrical abuse, and fire caused by thermal runaway. Thermal runaway is a temperature-triggered process that produces heat faster than the battery can cool, thus leading to temperature increases that can eventually lead to a fire. The release of flammable gases in the Starlight Solar battery packs is based on the UL9540A Module Level Test [4].

LFP batteries include a stable cathode chemistry that substantially reduces the possibility of thermal runaway and provides for a reduced reaction from any sort of abuse such as short-circuiting, overcharging, introduction of nails, or being crushed. In addition, the Starlight Solar battery storage system includes the following monitoring and safety components:

- Modular battery racks designed for monitoring and safety
- Integrated heat and fire detection and suppression system
- Explosive gas monitoring
- Exhaust/ventilation systems
- Integrated battery management system

The system in each BESS enclosure consists of flammable gas, smoke, and temperature detectors and one manual pull station as shown in Figure 3. The arrangement in each BESS enclosure is identical.



1. HVAC
2. Chiller Compartment
3. F-Stop
4. Enclosure Door
5. DCPM
6. Battery Module
7. Inlet Louver
8. Deflagration Panel x 6
9. Multi Detectors x 4
10. H2 Gas Detector x 2
11. Vent Panel
12. UPS
13. Enclosure Side Door
14. BCP Door
15. Enclosure Controller
16. DC Disconnect Switch

Figure 2: (typ.) Wartsila GridSolv Quantum BESS

The project would be served by the San Diego County Sheriff's Department. Fire support is assumed to be provided by the San Diego Fire Authority, Boulevard Fire Station #47, 39223 CA-94, Boulevard, CA 91905 to Starlight Project Site (~1.1 miles). Alternatively, the distance from CAL FIRE White Star Fire Station, 1684 Tierra Del Sol Rd, Boulevard, CA 91905 to the Starlight site (4 miles).

The project would be served by the San Diego County Sheriff's Department Jacumba Substation, phone +16197664585, or the 378 Sheridan Rd, Campo, CA 91906, phone +16194785378.

Primary site access via old Highway 80. The parcel falls under State Area Responsibility according to CALFIRE and is categorized as a “high fire hazard area”.

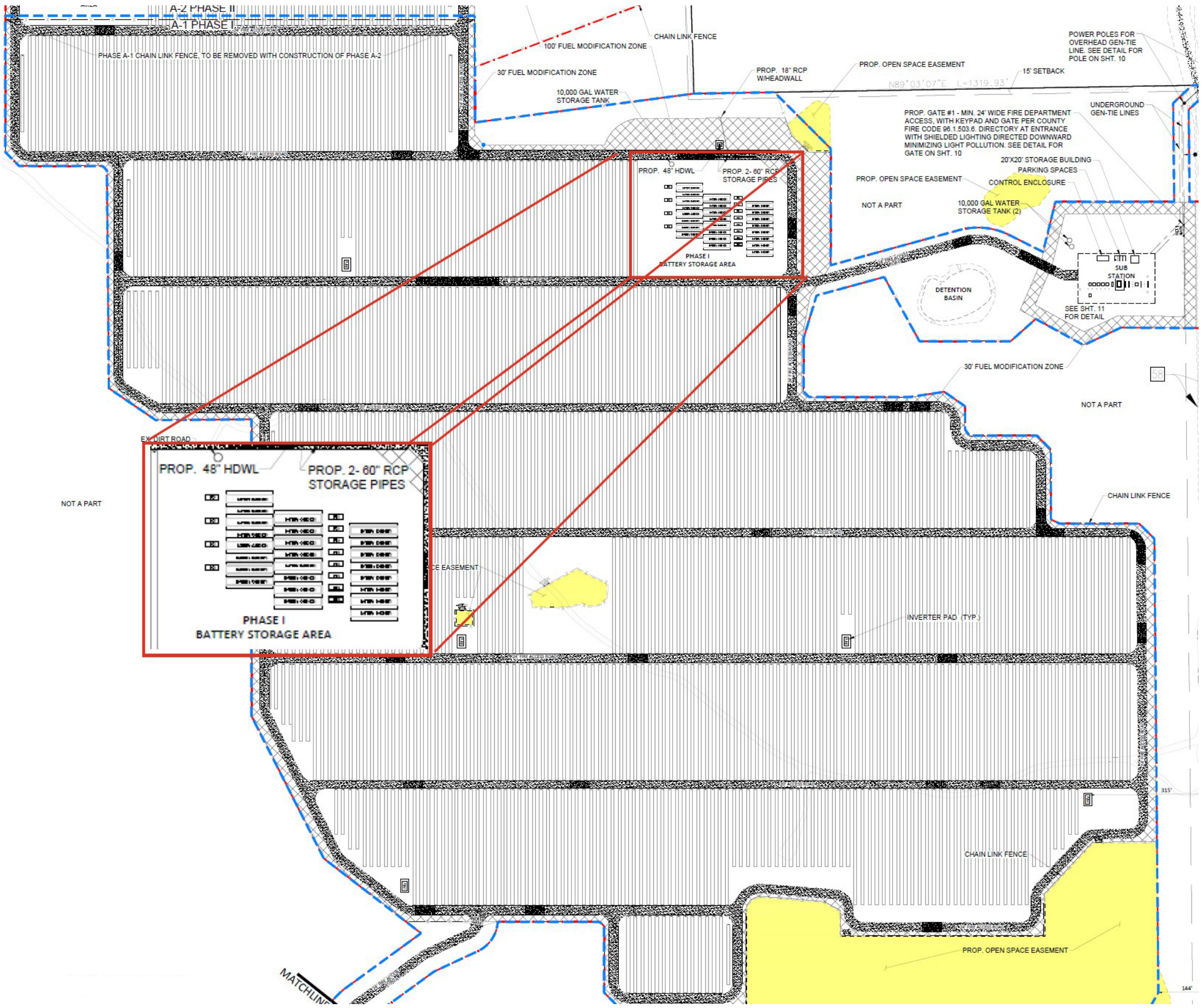


Figure 3: (typ.) Starlight Solar BESS Layout

Purpose and Objectives

This purpose of this report is to demonstrate how the Empire II Project Team have evaluated and conducted the numerous engineering analyses to demonstrate the proposed project satisfies the requirements of NFPA 855:2023, CFC and San Diego County requirements [1, 5, 6]. The design basis accident scenarios evaluated in this Preliminary Hazard Mitigation Analysis include:

1. A thermal runaway condition in a single ESS rack, module or unit.
2. Failure of any battery (energy) management system.
3. Failure of any 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 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 [1, 6].

Preliminary Hazard Mitigation Analysis Methodology

Safe operation of long-term Battery energy storage system safety depends on the range of identified engineering and administrative controls to address the complex hazards and the operational situations where intentional hazard mitigations result in decreased risk. Recent developments within the energy storage market sector emphasize the importance of the articulation of risks and the associated range of mitigation measures facilitating regulatory compliance and third-party certification. Hence, energy storage systems are required to be equipped with verified control mechanisms capable of reliably identifying and mitigating hazards in credited operational scenarios. To this end, available methods for the design and verification of active and passive controls have to be supported by models for risk hazard analysis and mitigation.

Central to Empire II's safety culture is the integration of risk-based decision making into the organization's governance, planning, management, reporting, policies, values and culture. Empire II relies upon an open and transparent, principles and standards-based system, enabling organizations to apply the principles of risk management throughout organizational context. Empire II's Risk Management Framework (RMF) is a structured process used to identify potential threats associated with the implementation of the Wartsila GridSolv Quantum containerized battery energy storage system, evaluates the engineered and administrative control and recovery barriers to preclude the threats, and to define the strategy for eliminating or minimizing the impact (consequences) of the risks. This risk-based and compensatory measures (mitigation) analysis will be performed as part of the Building Permit Approval process that presents the harmonized integration of numerous third-party engineering studies including NFPA 68 Explosion and Deflagration analyses, Failure Mode and Effects Analysis, Fire Risk Assessments, and others as depicted in Figure 4.

Hiller utilizes international consensus standards to establish technical rigor throughout the engineering process. For ease of understanding and the standardized presentation of the information, Hiller presents the results of this qualitative analysis in both a Bow-Tie form (Attachment 1: Bow-Tie Analysis Results).

The information presented throughout this PHMA is based on accepted industry Process Safety Management practices and uses a Bowtie Risk Analysis to correlate the proposed mitigation strategies (i.e., barriers and controls) decrease the probability of the event happening. This PHMA adopts a graded approach and leverages the analysis methodologies commonly used within the OSHA recognized High Hazard Process Safety Management (PSM), the Electric Power Research Institute (EPRI) and the Energy Storage Integration Council (ESIC) to present a comprehensive evaluation of the Starlight Solar BOP hazards. The results of this PHMA are presented in Attachment 1: Bow-Tie Analysis Results, follows the PSM and ESIC guidance for Bow-Tie Risk Analysis which relies upon significant HILLER industry market sector experience [7].

A summary of the numerous analyses and procedures required to complete the Starlight Solar PHMA is presented in Figure 4.

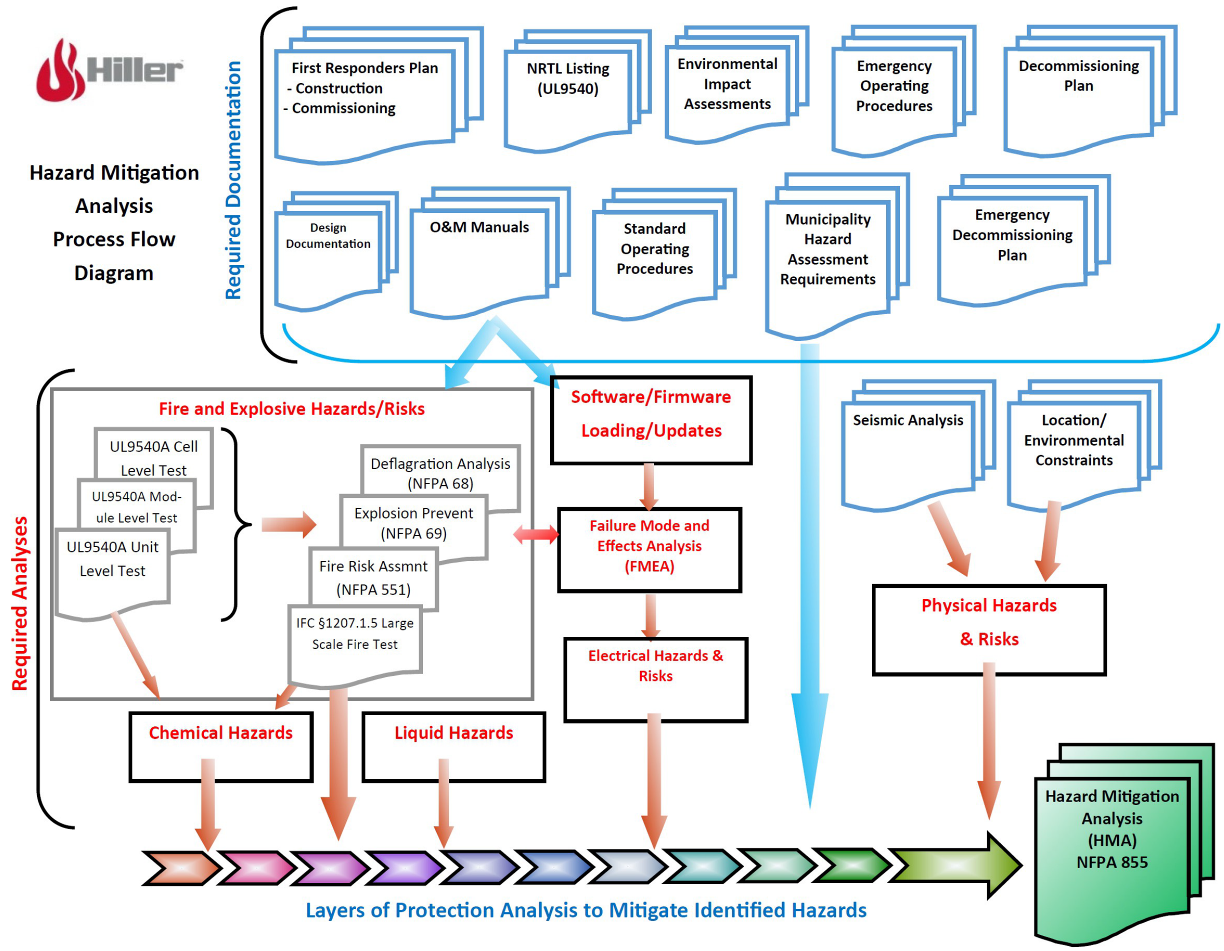


Figure 4: Hazard Mitigation Analysis Process

Neither the CFC nor the energy storage market sector designates any consensus standard to be used for either FMEA or HMA. Hiller, in support of the Starlight Solar project, has integrated international and third-party analyses techniques based on a consensus standards-based approach in accordance with the following standards and documents:

Risk Management and Analysis

- IEC 31000 – *Risk Management* [8]
- IEC 61511 - *Functional safety – Safety instrumented systems for the process industry sector – Part 3: Guidance for the determination of the required safety integrity levels* [9]

Failure Mode and Effects Analysis (FMEA)

- IEC 60812:2018 - Failure Modes And Effects Analysis (FMEA And FMECA) [10]

Fire Risk Assessment (FRA)

- NFPA 551, *Guide for the Evaluation of Fire Risk Assessments* [11]
- SFPE G.04:2006 – *Engineering Guide: Fire Risk Assessment*; [12]
- ISO 16732-1: 2012 – *Fire Safety Engineering – Fire Risk Assessment, Part 1: General*[13]
- ISO 16732-3: 2012 – *Fire Safety Engineering – Fire Risk Assessment, Part 3: Example of an Industrial Property* [14]

Short Circuit and Arc Flash Risk Assessments

- IEEE Std. 141-1993: *IEEE Recommended Practice for Electric Power Distribution for Industrial Plants* [15]
- IEEE Std. 242-2001: *IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (IEEE Buff Book)* [16]
- IEEE Std. 399-1997: *IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis (Brown Book)* [17]
- IEEE Std 1584:2018 - *IEEE Guide for Performing Arc Flash Hazard Calculations* [18]
- NFPA 70E:2018 - *Standard for Electrical Safety in the Workplace* [19].

Explosion and Deflagration Analysis:

- NFPA 68: 2019, *Standard on Explosion Protection by Deflagration Venting* [20]
- NFPA 69-2019, *Standard on Explosion Prevention Systems* [21]

Hiller strives to uniformly apply international consensus standards to all numerical and computational analysis when available. In instances where no applicable international consensus standard exists, recognized and generally accepted good engineering practices are applied that are either peer-reviewed and/or standards-based, where best available information is used to establish technically defendable analysis. In the absence of specific standards for Hazard Mitigation analysis, the fundamental principles of the Risk Management Framework outlined in ISO 31000, and the IEC 61511, Layers of Protection Analysis (LOPA) are applied to govern this Bowtie Risk Analysis [8, 9].

Although the IEC-61511 Layers of Protection Analysis (LOPA) techniques are typically applied to determine or allocate the Safety Integrity Level (SIL) of a Safety Instrumented Function (SIF) within a Safety Instrumented System (SIS). The graded approach to these analysis principles directly applies to determining the effectiveness of protection and mitigative measures for hazardous energy storage systems. The LOPA technique is based on the principle of Independent Protection Layers (i.e., barriers and controls) designed to prevent a threat or scenario, must fail for an event to occur. In order for the hazardous consequences of the scenario to manifest several Conditional Modifiers (an action or event that can reduce the probability of an undesirable event) might also have to coincide with the failure of all barriers and controls. This is the principle applied to calculate the demand rate on the credited system functions (before CMs) and the probability of occurrence (considering CMs).

Fundamentally, the Hiller PHMA process is the integration of the Starlight Solar Balance of Plant Failure Modes and Effects Analysis (FMEA) and numerous supporting third-party engineering studies that are integrated into this PHMA/Bow-Tie Analysis. The PHMA/Bow-Tie Analysis is intended to reveal potential gaps in the design where changes to engineering controls or administrative process are developed to address potential identified gaps in mitigation strategies. This process is depicted in Figure 5.

This analysis focuses on the requirements of the 2022 California Fire Code, NFPA 855:2023, and the San Diego County BESS Guide to objectively demonstrate how each of the required accident scenarios are mitigated. The results of this mitigation are presented in the following six bowtie models:

- Cell internal failure (Attachment Figure A-1)
- Controls (Attachment Figure A-2)
- Non-cell thermal issues (Ventilation) (Attachment Figure A-3)
- Electrical risks (Attachment Figure A-4)
- Complete System failure (Attachment Figure A-5)
- External and environmental risks (Attachment Figure A-6)

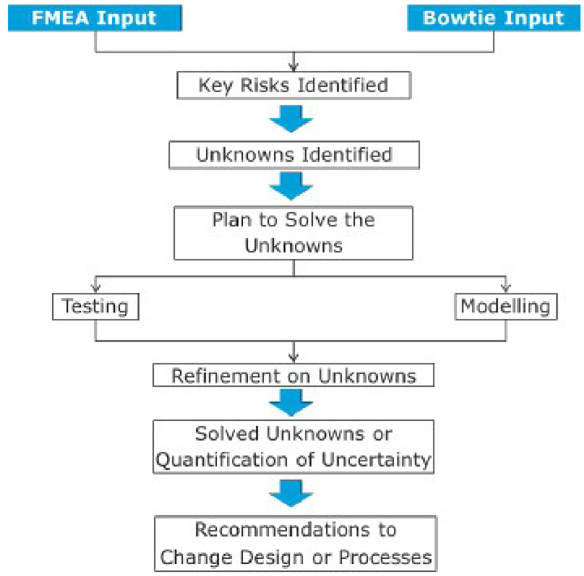


Figure 5: Risk Management Framework Integrating FMEA and Bowtie Risk Assessments

For the purpose of assessing ESS identified risks, four of the six mitigation analysis models focus on the propagation of external Balance of Plant hazards that could result in cell/module/stack/container failure that may result in very mild to very extreme consequences depending on the credited engineered or administrative controls (barriers) and subsequent compensatory measures (controls). The barriers are categorized and color-coded as Engineering Controls/Design Criteria, active hardware, continuous hardware, system property, and human factors.

Bowtie Risk Analysis Elements

Bowties are globally recognized as a useful tool to assist in the risk and hazard analysis of process and non-process industry risks. The general focus of bow ties in the process industry is towards the evaluation of Major Accident Events (MAE) where engineering or administrative controls or barriers are identified and credited to preclude occurrence. Bowtie Risk Analysis modeling is an emerging analysis tool within the energy storage market sector to assist in the delineation of energy storage hazards in traditionally difficult markets. The strength of the bowtie approach comes from its visual nature, which complements compliments complex tabular analysis.

Regarding the presentation of Bowtie information, the left side of the model 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 CFC and are assumed to result in an unexpected thermal runaway.

The construction of a bowtie model begins with the identification of a specific hazard event for which mitigation measures are desired. For the purposes of this BOP PHMA, the basis of the different analysis is rooted in the requirements of the California Fire Code (CFC) Chapter 12, Section 1207.1.4 for lithium-ion systems resulting in cell failure and potentially thermal runaway (Fault Condition). Once the hazard is determined the threats that can lead to the hazard and the consequences that can follow the hazard must be identified.

Credited Prevention/Mitigation Barriers are those engineering and administrative controls to preclude the realization of a consequence as depicted in Figure 6: Generic Bowtie Illustration.

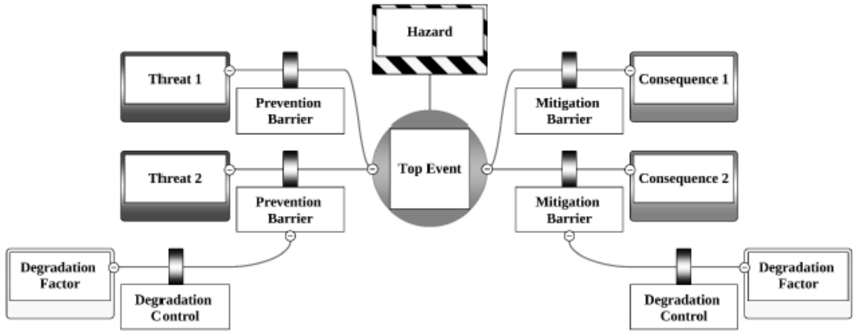


Figure 6: Generic Bowtie Illustration

A majority of failure conditions required by CFC are represented as threats on the left side of the bowtie model. These threat conditions, if uninhibited, may lead to thermal runaway, and then subsequently to the fire or deflagration events discussed as presented in Figure 7. To mitigate this progression of failures (Figure 8: Bowtie Illustration), barriers are put in place, displayed in approximate chronological order in which they may become relevant. Each barrier – many times present in the form of a physical protection system (such as a fire suppression system, smoke detector, or HVAC system) – is assessed in terms of its *Criticality* (a qualitative designation of how critical a barrier is to prevent further propagation of the threat resulting an analyzed consequence.

Threats

By definition, BESS threats may not necessarily address a fully involved system fire or severe explosion, but rather smaller, precursor events that could lead to these catastrophic consequences. It is generally understood some threats occur without any intervention, such as defect propagation or act-of-God weather-related events, while others represent operational errors (either human or system induced). The identified 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 information provided in Attachments 1 through 6 include diagrams that follow include careful selection and placement of each of the elements to best capture the perspective of system owners/operators responsible for safe construction and operation [22].

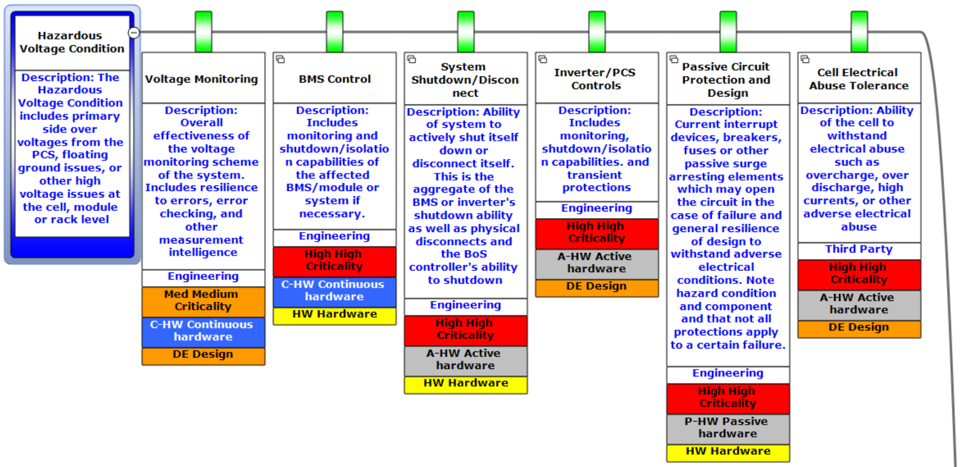


Figure 7: Threat Example

As it pertains to the Starlight Solar energy storage systems, many of these barriers include identified engineering controls that include active electrical monitoring and controls, passive electrical safety, and redundant failure detection if included in the design. In the unlikely event of the engineering controls detection and activation, system shutdown, or otherwise prevent thermal runaway from occurring, there are physical design elements which may prevent that fire from spreading. If the other associated protection measures fail the central risk hazard event (e.g., fire propagation) probability could increase unless additional mitigation barriers are initiated.

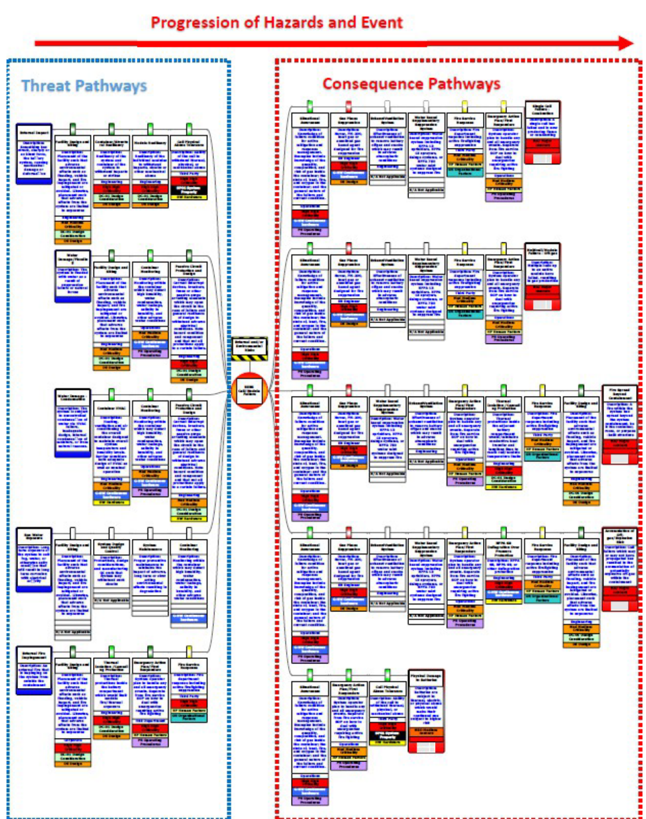


Figure 8: Bowtie Illustration

Barriers

As the California Fire Code chapter 1207 requires, only seven failure modes relative to the dozens of modes could be analyzed in more comprehensive analysis. The identified barriers that are intended to mitigate these failures are aggregated and explained quickly in a manageable document without the need for dozens of pages of documentation.

Each associated barrier in the Starlight Solar models is indicative of a concept that may include a single approach or consist of a complex series of combined layers of protection to mitigate the identified hazard. Similarly, the analysis may not include barriers required to prevent the threats at the far left of the diagram (which would be placed even farther left) to ensure that the models do not extend infinitely—though the incorporation of these variables into site-specific safety evaluations may provide additional benefits. This list does not contain all possible solutions; in some designs, these barriers may not exist at all. Many of the same barriers apply to several threats [22].

Barriers may offer benefits in a variety of ways. For example, common barriers to thermal runaway include active electrical monitoring and controls, interdependent system failure detection, and even passive electrical safety (such as over-current protection devices and inherent impedances). Should these systems fail to detect the threat, shut down the system, or otherwise prevent thermal runaway from occurring, the hazard may persist [22].

Consequences

Consequences are the events that are reasonably expected to occur once the central hazard event has occurred (thermal runway with cell-to-cell propagation). Consequence pathways include layers of protection as barriers that may help to manage or prevent the consequence of an 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 (ESS) operators, and first responders [22].

Consequence Risk Categorization

Establishing an understanding of the associated risks is a vital element of the Bow-Tie mitigation analysis to determine if the mitigation strategies presented reduce the significance or magnitude of the consequence. Using the information presented in Figure 9 and Figure 11 the following qualitative analysis can be used to assess the risk associated with People (Column 1), Assets (Column 2) and Environment (Column 3). Reputational Risk is presented in Column 4 and was not assessed as part of this PHMA. The following discussion and figures should be used when reading the Bow-Tie Analysis output.

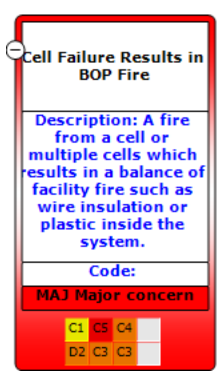


Figure 9: Risk Ranking Example

Given an example threat scenario where the identified barriers failed to stop a Thermal Management failure from creating the scenario resulting in BESS Cell/Module failure resulting in a BOP Fire, the risk to personnel was determined as class C1 where there is a “possible” chance of a “slight injury” to personnel responding to the event given the Empire II Emergency Response Procedures. If unmitigated there is residual chance the risk could degrade to where there is an increased hazard to personnel where “minor injury” is “likely” (Category D2).

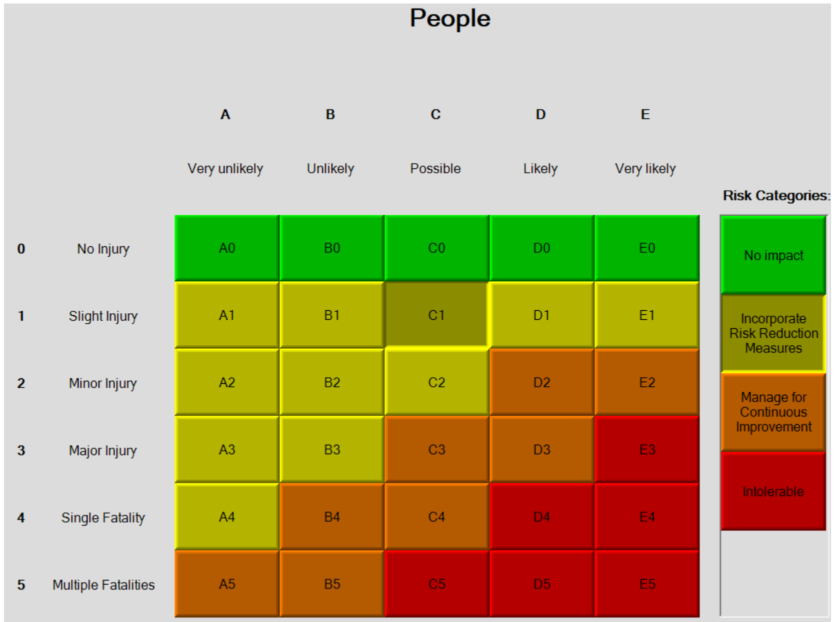


Figure 10: Bow-Tie Risk Categorization for Personnel

Asset Risk was classified is presented in Figure 11 as C5 where there is a possible risk of extensive damage to the BESS.

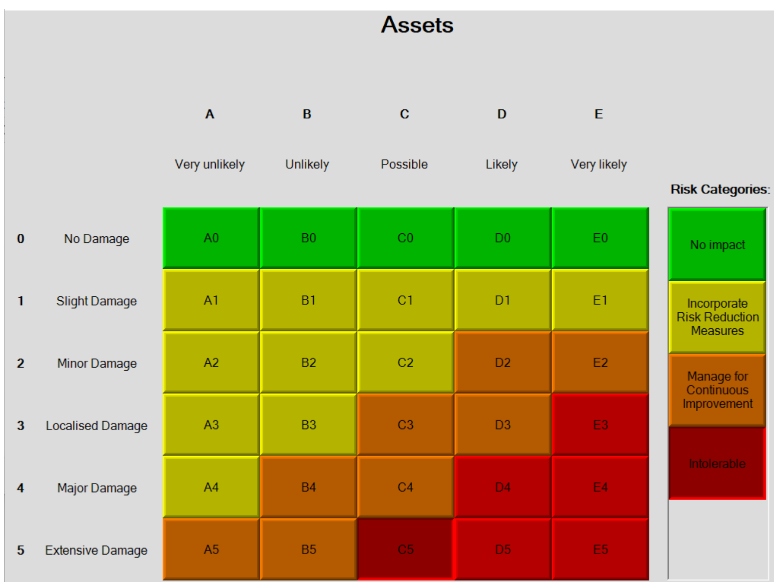


Figure 11: Bow-Tie Assets Risk Categorization Matrix

Environmental Risk was classified as “possible major effect” where the release of toxic plumes and entrained effluents could have an adverse impact on the environment as presented in Figure 12.

Figure 12: Bow-Tie Environmental Risk Categorization

1207.1.4 - Starlight Solar ESS Hazard Mitigation Analysis Results

Table 1 summarizes the requirements that must be met under *Section 1207.1.4* and provides justifications for compliance with each compliance requirement given under code.

Table 1: California Fire Code, Section 1207.1.4 Compliance Summary

CFC 1207.1.4.1 Requirement	Complies (Yes/No)?	Summary Observation/Explanation
Fault condition. The hazard mitigation analysis shall evaluate the consequences of the following failure modes. Only single failure modes shall be considered.	Yes*1	Hiller and third-party partners have performed a series of required analysis in accordance with the governing normative requirements as noted below and referenced herein.
A thermal runaway condition in a single ESS rack, module or unit.	Yes*1	UL 9540A Module Level test reports indicate that cell failure does propagate to adjacent battery cells within the module. Rack to rack propagation has been assumed and has been modeled to establish a bounding theoretical fire and heat flux event. The volume of flammable gas generated could be ignited as analyzed by Hiller reports 20250320-SLS-AW0764-BESS-FRA-R0A, 20250320-SLS-AW0764-BESS-FMEA-R0A, 20250320-SLS-AW0764-BOP-FRA-R0A, and 20250320-SLS-AW0764-BOP-FMEA-R0A demonstrating the potential that failure could result in a container fire [23-26]. Local 20k gal fire tanks are available to be used in the event of a fire for supplemental evaporative cooling of adjacent containers. Refer to Figure A-1: Cell Internal Failure Bowtie Analysis.
Failure of any battery (energy) management system.	Yes*1	The Wartsila GridSolv Quantum design includes a

		series of engineering controls to act as Preventive and Mitigative barriers such as ESMS control, UL9173 Certified BMS control, UL9540 Certified system shutdown / disconnect, and NFPA 70 and 855 requisite active and passive circuit protection and design are in place to prevent cell failure from being reached. 20250320-SLS-AW0764-BESS-FMEA-R0A, and 20250320-SLS-AW0764-BOP-FMEA-R0A documents several different credited failures (Common Cause and Common Mode) and evaluates the efficacy of the engineering and administrative controls. Additionally, should cell failure occur, numerous reference barriers are in place to prevent further failure leading to fire or deflagration events. Refer to Figure A-2: Energy Storage Management System (Controls) Bowtie Analysis Results.
Failure of any required ventilation or exhaust system.	Yes*1	The Wartsila GridSolv Quantum includes engineering controls that monitor and control the internal Thermal Management System to ensure safe operation within prescribed limits to preclude inadvertent thermal runaway events. Wartsila GridSolv Quantum's overall thermal management engineering topology utilizes multilayered protection, with overlapping zones. Sufficient controls/barriers are inherent in the BESS design to decrease the probability of the failure of the Thermal Management system resulting in a fire as documented in 20250320-SLS-AW0764-BESS-FMEA-R0A, and 20250320-SLS-AW0764-BOP-FMEA-R0A [24, 25]. Refer to Figure A-3: Thermal Management/Ventilation Bowtie Analysis Results.
Voltage surges on the primary electric supply.	Yes*1	Numerous overlapping and effective barriers exists in the form of both AC and DC voltage monitoring, PCS control, BMS control, passive circuit protection, and system shutdown / disconnect. Additionally, many barriers are in place to mitigate propagation of failure in the unlikely case that propagating thermal runaway is reached. Refer to the Empire II TOV analysis [27]. Strong electrical protections and subsequent barriers to prevent further propagation of failure due to load side short circuits. Refer to the Starlight Solar Arc Flash Risk Assessment. Engineering due-diligence has been demonstrated. Refer to Empire II calculations. Refer to Figure A-4: Electrical System Failure
Short circuits on the load side of the ESS.	Yes*1	

		Bowtie Analysis Results.
Failure of the smoke detection, fire detection, fire suppression, or gas detection system	Yes*1	The Wartsila GridSolv Quantum design is not inclusive of a fire suppression system. Flammable gas and smoke detectors are relied upon for detecting and exhausting the accumulation of flammable gases in the unlikely event Wartsila GridSolv Quantum Modules fails and enters TRA. 20250320-SLS-AW0764-BESS-FMEA-R0A, and 20250320-SLS-AW0764-BOP-FMEA-R0A documents several different credited failures including failure of the Wartsila GridSolv Quantum thermal management system. Reasonable protection provided by subsequent barriers including situational awareness, flammable gas detection and emergency ventilation capability, emergency response planning, etc. Refer to Figure A-5: Total System Failure Bowtie Analysis Results.
Required spill neutralization is not provided or failure of a required secondary containment system.	Yes*1	While the Starlight Solar BESS ESS is inclusive of a Air cooling system for maintaining cell/module/stack temperatures, the container level environmental The Air Cooling Thermal Management System relies on the coolant of the HVAC and for the Wartsila GridSolv Quantum thermal management system. The Air-Cooling system uses the Wartsila GridSolv Quantum Engine Ethylene Glycol Coolant. The credited BOP failures resulting inadvertent environmental impacts are presented Figure A-6: Environmental Controls Bowtie Analysis Results, and documented in 20250320-SLS-AW0764-BESS-FMEA-R0A, and 20250320-SLS-AW0764-BOP-FMEA-R0A. Refer to the Empire II Exhibit Environmental Reports. Refer to Empire II Spill Response Procedure. .

.*1 Conclusions of compliance are theoretically assumed as the CFC requires that all applicable Codes and Standards are objectively satisfied. These conclusions are only based on a selected BESS Technology as the Basis of Design.

The following discussion presents additional information about the PHMA leading to the requirement compliance determination.

Thermal Runaway Analysis in an ESS rack, module or unit

Complies? Yes ☒ No ☐

The exothermic and thermal runaway analysis is quantified in the Battery Energy Storage System (BESS, 20250320-SLS-AW0764-BESS-FRA-R0A, Balance of Plant Fire Risk Assessment (BOP FRA) (20250320-SLS-AW0764-BOP-FRA-R0A), and BESS Level Failure Mode and Effects Analysis (20250320-SLS-AW0764-BOP-

FMEA-R0A [23-26]. The BOP FRA provides the technical basis for the Fire Risk Assessment with the objective of identifying and quantifying the potential external fire hazards associated with containerized battery energy storage systems.

Exothermic reactions and subsequent thermal runaway present unique fire challenges associated with the bulk storage of Li-ion batteries. These challenges are exceptional given the presence of a flammable organic electrolyte within the Li-ion battery as compared to the aqueous electrolytes typically found in other widely used battery types. When exposed to an external fire, it is well documented that Li-ion batteries can experience thermal runaway reactions resulting in the combustion of the flammable organics and the potential rupture of the battery [28-39]. The Starlight Solar Project is assumed to implement the Wartsila GridSolv Quantum system which includes the LFP modules. The requisite UL9540A test have been performed and demonstrate how the lithium-ion battery technology responds to thermal abuse and was tested in compliance with the normative requirements [4, 40].

UL 9540A Cell/Module Level Tests objectively indicate that cell failure results in propagation to adjacent battery cells within the modules. However, since the Wartsila GridSolv Quantum thermal management system is not credited as a Safety Instrumented System (SIS), the system is assumed to fail resulting in the NFPA 855 bounded scenario of failure of a single rack/unit. It is conservatively assumed the volume of flammable gas generated could be ignited as analyzed by Hiller report 20250320-SLS-AW0764-BESS-FRA-R0A resulting in a container fire.

Refer to A- 1: Cell Internal Failure Bow-Tie Analysis Results.

Additional administrative controls are presented in the Empire II Standard Operating Procedure, Emergency Operating Procedure, Operations and Maintenance Manual and the Emergency Responders Plan.

Refer to the Empire II Procedures Index for the list of applicable procedures.

Energy Management (Controls) System Failure Complies? Yes ☒ No ☐

The Empire II Energy Storage Management System (ESMS), the Wartsila GridSolv Quantum Energy Management Control Unit (EMCU), and the Wartsila GridSolv Quantum Battery Management System (BMS) are the central functions for assuring safety within each battery module and within each Wartsila GridSolv Quantum. While no engineering documentation has been provided for the control of the BESS's, compliance is assumed.

To be compliant with Nationally Recognized Testing Laboratory Safety Standards, BESS's are required to utilize a UL 1973 certified battery management system (BMS) [41] to monitor and maintain safe, optimal operation of each battery pack and a system supervisory control (SSC) to monitor the full system. Lithium-ion batteries are inherently dynamic in nature, whereby they are constantly operating outside the equilibrium state during cycling. Additionally, this dynamic performance can worsen in certain cases where intercalation-based storage systems (e.g., Li chemistry) operate as a closed system with very few measurable state variables, making it difficult to properly monitor the states of the battery and maintain safe operation. Furthermore, even under normal operation the battery packs of a BESS will degrade during cycling [38, 42]. This degradation can be accelerated by extreme charging patterns, increased temperature (both ambient and operating), overcharging, or undercharging. Therefore, basic BMS utilizes engineered controls so the battery packs can satisfy the power demand without overall system performance degradation.

The Wartsila GridSolv Quantum is will be evaluated and listed to be fully compliant with UL9540 by [43].

The Wartsila GridSolv Quantum UL 1973 [41] compliant BMS collects data at the cell and module levels and communicates to external systems via Modbus protocol (RTU or TCP/IP) to the Empire II ESMS [44]. Properties monitored include temperature, voltage, current, state of charge (SOC), state of health (SOH), etc. If monitored system parameters exceed permissive setpoint, automatic shutdown is initiated.

Refer to the Empire II System Operations Document and the Wartsila GridSolv Quantum design details.

The characterization of the failure mechanisms of the ESMS and BMS utilized in the Wartsila GridSolv Quantum is documented in the BESS and BOP Failure Modes and Effects Analysis and the associated mitigation strategies are provided herein. Additional administrative controls are presented in the Empire II Standard Operating Procedure, Emergency Operating Procedure, Operations and Maintenance Manual and the Emergency Responders Plan.

Refer to the Empire II Procedures Index for the list of applicable procedures.

Attachment 1 provides the engineering and administrative carriers and controls to mitigate the cascading effects resulting from the failure of the BMS.

Failure of any Exhaust or Ventilation System

Complies? Yes ☒ No ☐

Wartsila GridSolv Quantum overall thermal management engineering topology utilizes multilayered protection, with overlapping zones. The Wartsila GridSolv Quantum will be UL 9540 compliant BESS safety features and a UL 1973 Certified Battery Management Systems [41] when integrated with the Empire II ESMS will work together to help protect against the cascading impacts of common industrial battery failure modes due to abuse, damage or other external factors. These protections are evaluated with a comprehensive Safety Risk Assessment for the equipment based on ISO 12100 (recommendations for Safety Risk Assessments) and ISO 13849 (Functional Safety) and designed to meet applicable UL, NEC, NFPA and IEC Standards.

The Wartsila GridSolv Quantum design uses other Wartsila divisions as part of the supply chain with products that have an international track record of utilizing technology and components that render the likelihood of a safety event low. Such an event could be isolated by the module enclosures, rack assemblies and steel shell of the storage unit.

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

Additional administrative controls are presented in the Empire II Standard Operating Procedure, Emergency Operating Procedure, Operations and Maintenance Manual and the Emergency Responders Plan. Refer to the Empire II Procedures Index for the list of applicable procedures.

The Wartsila GridSolv Quantum utilizes an integrated Air-Cooling and pressurized liquid Thermal Management System to maintain the operating temperatures within the Wartsila GridSolv Quantum

Modules. Hiller, in support of Empire II, has developed a detailed Starlight Solar BESS Failure Mode and Effects Analysis (FMEA) that supports this analysis conclusion. The Hiller Fire Risk Assessment establishes a maximum theoretical momentary heat flux calculation.

Figure A- 3: Thermal Management/Ventilation Bow-Tie Analysis Results contains the representation of the Ventilation System failure mechanisms and delineates the design measures considered to mitigate the consequences of the identified threats.

Refer to the Starlight Solar Project Emergency Response Plan.

Voltage Surges on Electric Supply and Short Circuit on the Load Side of the ESS	Complies?	Yes ☒	No ☐

The Starlight Solar Battery Energy Storage System utilizes the Wartsila GridSolv Quantum coupled with the power conversion system (PCS, Inverter) to form an IEEE 1547 and UL 9540 compliant grid connected energy storage system. The PCS complies with UL 1741 performance standards and IEEE 1547-2021 [45]. The three-phase output currents are sinusoidal with total harmonic distortion to meet or exceed IEEE 519 and IEEE 1547 requirements.

Although certified as being compliant with Nationally Recognized Testing Laboratory Safety Standards, there is the extremely unlikely possibility of cascading transient voltage surges that could result in challenging PCS performance. The PCS has internal protection measures (IGBTs) to clamp and shutdown in less than 100 ms to protect both the PCS and the interconnected ESS system.

Refer to Empire II Transient Overvoltage (TOV) Report and the DC Arc Flash Risk Assessment Reports that demonstrates adequate protection exists to minimize the likelihood of the event occurring [27].

Additional administrative controls are presented in the Empire II Standard Operating Procedure, Emergency Operating Procedure, Operations and Maintenance Manual and the Emergency Responders Plan. Refer to the Empire II Procedures Index for the list of applicable procedures.

BESS Short Circuit Analysis

Numerous engineering analyses have been performed by the Empire II engineering partners that demonstrate engineering due diligence has been performed to analyze the likelihood of short circuit currents. Refer to Empire II calculations [27].

Refer to A- 4: Electrical System Failure Bow-Tie Analysis Results and Attachment 2 for HMA results.

Failure of the smoke detection, fire detection, fire suppression, or gas detection system	Complies?	Yes ☒	No ☐

The Starlight Solar BESS relies upon the integrated Smoke Detection, Temperature (Heat) Monitoring, and Flammable Gas detection connected to a NFPA 72 Fire Alarm Control Panel (FACP).

The system was designed by Wartsila GridSolv Quantum and is documented in the Wartsila GridSolv Quantum drawing set. Orr designed the external site level alarm system will be shown in the Hiller AW0764FC-1-1 Drawing Set.

The Wartsila GridSolv Quantum ESS contains a series of interdependent Flammable Gas Detection and Temperature Monitoring subsystems to monitor if a thermal runaway event occurs (ref: Figure 3). The detection of potential thermal runaway events among the cells of the unit is achieved through a combination of electrical measurements and temperature readings. If thermal runaway occurs, containment of the failure is achieved primarily through passive design considerations and use of the cooling system. Should these measures fail and the runaway event progress into a module, rack, or full system fire, there exists the possibility of fire within the ESS as shown in Figure 14.

SEQUENCE OF OPERATIONS

		Enclosure			Core Support Enclosure								Fire Command Center								
	Sequence of Operation / Cause and Effect	Control Function			Control Panel				Notification	Control Function			Control Panel				Notification				Control Function
	System Input / output	Activate Relays for HVAC / Chiller Interface to shut down	Activate Relays for Opening in Air Vents	Activate Relays for Closing in Air Vents	Buzzer & LED Activate Control Panel **ALARM**	Buzzer & LED Activate Control Panel **SUPERVISORY**	Buzzer & LED Activate Control Panel **TROUBLE**	Activate Control Panel **STATUS** Buzzer and LED	VISUAL Devices (different sound for Activate Exterior AUDIBLE / VISUAL	Activate Relay for F-Stop Interface	Common Exterior audible Device Activate relay for Trouble Interface	(In the same Core) Block other Air Vents from openings (GSP)	Activate Control Panel **ALARM** Buzzer & LED	Activate Control Panel **SUPERVISORY** Buzzer & LED	Activate Control Panel **TROUBLE** Buzzer & LED	Activate Control Panel **STATUS** Buzzer and LED	Activate Exterior AUDIBLE / VISUAL Devices	(24th Attended Location) Transit **ALARM** signal to Central station via DAS	(24th Attended Location) Transit **SUPERVISORY** signal to Central station via DAS	(24th Attended Location) Transit **TROUBLE** signal to Central station via DAS	Activate Dialer module (2nd.+ Master via Relay) for Fire Brigade Interface
ENCLOSURE	Automatic Fire Detector (Multi sensor) at Fire orginating Enclosure	•	•		•				•	•			•				•	•			•
ENCLOSURE	Carbon Monoxide Detector (CO) in AUX Compartment anyone of the Enclosure in the same Core (GSP)	•	•			•			•	•				•			•		•		•
ENCLOSURE	Contact from the aerosol canister indicating that the agent has been released in one of the Enclosure in the same Core	•			•				•	•			•				•	•			•
ENCLOSURE	Limit Switch Air Vents (GSP)							•				•				•					
Core Support Enclosure	Automatic Fire Detector (Multi sensor)				•				•	•			•				•	•			•
Core Support Enclosure	FACP 240 VAC Power failure						•				•				•					•	
Core Support Enclosure	System Device wiring Trouble / Fault						•				•				•					•	
Core Support Enclosure	Open Circuit / Ground Fault						•				•				•					•	
Core Support Enclosure	Push Buttons Opening Air vents		•																		
Core Support Enclosure	Push Buttons Closing Air vents			•																	
Fire Command Center	Manual Fire Alarm - Pull Station												•				•	•			•
Fire Command Center	Automatic Fire Detector (Multi sensor)												•				•	•			•
Fire Command Center	FACP 240 VAC Power failure														•	•				•	
Fire Command Center	System Device wiring Trouble / Fault														•	•				•	
Fire Command Center	Open Circuit / Ground Fault														•	•				•	

Figure 13: (Assumed) Protection FD Sequence of Operation

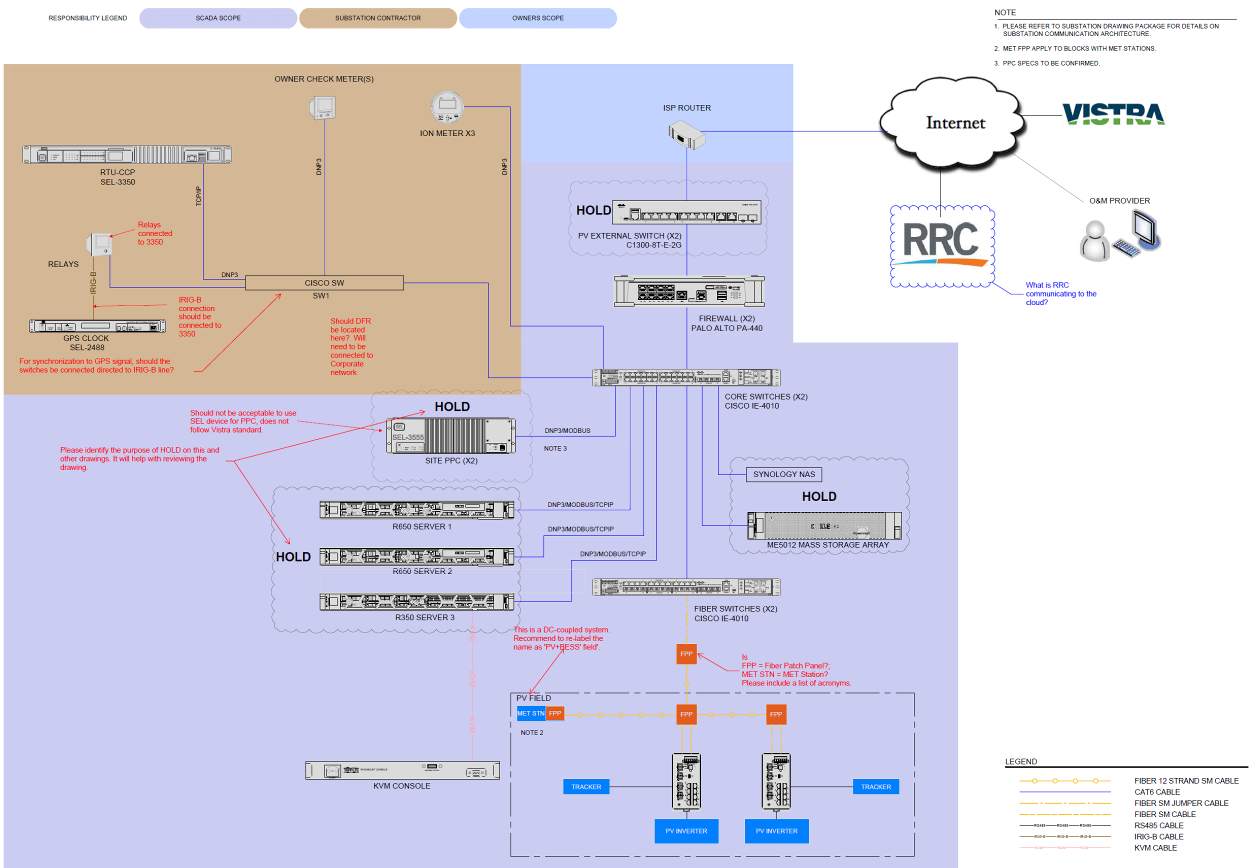


Figure 14: (Assumed) Empire II Communications Network

As stated, the Wartsila GridSolv Quantum design may include the option of a fire suppressant as an effective mitigation tool for electrical fires. A locally installed two 10k gallon fire water tank is included in the design and can be used for evaporative cooling of adjacent containers or structures.

Additional administrative controls are presented in the Empire II Standard Operating Procedure, Emergency Operating Procedure, Operations and Maintenance Manual and the Emergency Responders Plan. Refer to the Empire II Procedures Index for the list of applicable procedures.

Refer to Figure A-5: Total System Failure Bowtie Analysis Results.

Required spill neutralization not being provided or failure of a required secondary containment system	**Complies? Yes ☒ No ☐**

The Starlight Solar BESS Project contains a Wartsila GridSolv Quantum based pressurized process Air Cooling Thermal Management System. The Air-Cooling system uses the Wartsila GridSolv Quantum Engine Ethylene Glycol Coolant.

The credited BOP failures resulting inadvertent environmental impacts are presented Figure A-6: Environmental Controls Bowtie Analysis Results and documented in 20250320-SLS-AW0764-BESS-FMEA-R0A and 20250320-SLS-AW0764-BOP-FMEA-R0A [24, 25]

Refer to Empire II Spill Response Procedure

6. ACCIDENTAL RELEASE IN CASE OF SPILL OR OTHER RELEASE: In case of the release: Block the release or use a container to hold the antifreeze coolant and keep well-ventilated. Wear the respirator and personal protective clothes during the operation. The leaked antifreeze coolant can be treated with the inert absorbent such as covered with sand and soil. In order to prevent the pollution of surface water and groundwater, it is necessary to treat the contaminated area with detergent, water and a hard broom, and put the collected Air into a container.

Additional administrative controls are presented in the Empire II Standard Operating Procedure, Emergency Operating Procedure, Operations and Maintenance Manual and the Emergency Responders Plan. Refer to the Empire II Procedures Index for the list of applicable procedures.

References

[1] "California Code of Regulations, Title 24 " in *Part 9, 2024 California Fire Code*, ed. USA, 2024.
[2] *NFPA 855: Standard for the Installation of Stationary Energy Storage Systems*, NFPA, Quincy, MA, August 25 2023.
[3] OSHA. "1910.335 - Safeguards for personnel protection." United States Departmetn of Labor, Occupational Safety and Health Administration. https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.335 (accessed 29 November 2018, 2018).
[4] CSA, "Rechargeable Li ion battery cell, model CBFAD (UL 9540A Test Report)," Shanghai Huahui Testing Co., Ltd, Shanghai, China, 28 March 2023.
[5] KCFD, "Kern County Fire Department Energy Storage System Review Guide Sheet," ed. Kern County CA: Kern County Fire Department, 2021.
[6] *NFPA 855: Standard for the Installation of Stationary Energy Storage Systems*, NFPA, Quincy, MA, August 25, 2019 2020.
[7] DNV-GL, "Recommended practice — DNVGL-RP-0043. Safety, operation and performance of grid-connected energy storage systems," Rochester, NY, 2017. [Online]. Available: https://rules.dnvgl.com/docs/pdf/DNVGL/RP/2017-09/DNVGL-RP-0043.pdf?_ga=2.80787476.2095102769.1516371272-888917498.1516371272
[8] *ISO 31000 - Risk Management*, ISO, Geneva, Switzerland, May 2018 2018.
[9] *Functional safety – Safety instrumented systems for the process industry sector – Part 3: Guidance for the determination of the required safety integrity levels*, IEC, Geneva, Switzerland, 2018. [Online]. Available: www.iec.ch/searchpub
[10] *Failure Modes And Effects Analysis (FMEA And FMECA)* IEC, Brussels, Belgium, 2018. [Online]. Available: www.iec.ch/searchpub
[11] NFPA, "NFPA 551: guide for the evaluation of fire risk assessments," *National Fire Protection Association, Quincy, USA,* 2016.
[12] *Engineering Guide: Fire Risk Assessment*, SFPE, Gaithersburg, MD, 2006.
[13] *ISO 16732-1: Fire Safety Engineering - Fire RIsk Assessment, Part 1 - General*, ISO, Geneva, Switzerland, 15 February 2012 2012.
[14] *ISO 16732-1: Fire Safety Engineering - Fire RIsk Assessment, Part 3: Example of an Industrial Property*, ISO, Geneva, Switzerland, 15 February 2012 2012.
[15] "IEEE Recommended Practice for Electric Power Distribution for Industrial Plants," *IEEE Std 141-1993,* pp. 1–768, 1994, doi: 10.1109/IEEESTD.1994.121642.
[16] "IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (IEEE Buff Book)," *IEEE Std 242-2001 (Revision of IEEE Std 242-1986) [IEEE Buff Book],* pp. 1–710, 2001, doi: 10.1109/IEEESTD.2001.93369.
[17] "IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis (Brown Book)," *IEEE Std 399-1997,* pp. 1–488, 1998, doi: 10.1109/IEEESTD.1998.88568.
[18] *IEEE Std 1584-2018: IEEE Guide for Performing Arc Flash Hazard Calculations*, IEEE Std 1584-2018, IEEE, New York, NY, 27 September 2018 2018.
[19] *NFPA 70E: Standard for Electrical Safety in the Workplace*, NFPA, Quincy, MA, 2018.
[20] *NFPA 68: 2019 - Standard on Explosion Protection by Deflagration Venting*, NFPA, Quincy, MA USA, 30 November 2019.

[21] *NFPA 69: 2019 - Standard on Explosion Prevention Systems*, NFPA, Quincy, MA USA, 25 November 2019.

[22] E. Minear and M. Simpson, "Energy Storage Integration Council (ESIC) Energy Storage Reference Fire Hazard Mitigation Analysis," Palo Alto, California, 3002017136, October 2019 2019.

[23] R. Steele, "Starlight Solar Major Use Permit PDS2022-MUP-22-010 Battery Energy Storage System NFPA 551 Preliminary Fire Risk Assessment and Heat Flux Analysis," Hiller, Wilmington NC, 12 May 2025.

[24] R. Steele, "Empire Solar Major Use Permit PDS2022-MUP-22-010 Balance of Plant IEC 60812 Failure Mode and Effects Analysis," Hiller, Wilmington NC, 12 May 2025.

[25] R. Steele, "Starlight Solar Major Use Permit PDS2022-MUP-22-010 Battery Energy Storage System IEC 60812 Failure Mode and Effects Analysis," Hiller, Wilmington NC, 12 May 2025.

[26] R. Steele, "Starlight Solar Major Use Permit PDS2022-MUP-22-010 Balance of Plant Preliminary NFPA 551 Fire Risk Assessment," Hiller, Wilmington NC, 12 May 2025.

[27] EVS, "Caballero BESS Collector Substation Preliminary Transient Overvoltage Study," EVS, Inc., Eden Prairie, MN, 20 June 2023.

[28] R. T. L. Jr., J. A. Sutula, and M. J. Kahn, "Lithium Ion Batteries Hazard and Use Assessment Phase IIB, Flammability Characterization of Li-ion Batteries for Storage Protection," The Fire Protection Research Foundation, Quincy MA, April 29, 2013 2013.

[29] D. Belov and M.-H. Yang, "Failure mechanism of Li-ion battery at overcharge conditions," *Journal of Solid State Electrochemistry,* vol. 12, no. 7-8, pp. 885–894, 2008. [Online]. Available: https://www.researchgate.net/profile/Dmitry_Belov6/publication/226507209_Failure_mechanism_of_Li-ion_battery_at_overcharge_conditions/links/56fb42cb08ae8239f6dadb98.pdf.

[30] A. Blum and R. Long Jr, "Hazard assessment of lithium ion battery energy storage systems," in "Fire Protection Research Foundation," Fire Protection Research Foundation, Bowie, MD, February 2016 2016.

[31] A. Blum and R. Long Jr, "Lithiu m Ion Batteries Hazard and Use Assessment - Phase III," in "Fire Protection Research Foundation," Fire Protection Research Foundation, Quincy, MA, November 2016 2016.

[32] A. F. Blum and R. T. Long Jr, *Fire Hazard Assessment of Lithium Ion Battery Energy Storage Systems*. Springer Nature, 2016.

[33] Celina Mikolajczak, Michael Kahn, Kevin White, and Richard Thomas Long, "Lithium-Ion Batteries Hazard and Use Assessment - Final Report," The Fire Protection Research Foundation, Quincy MA, July 2011 2011.

[34] DNV-GL, "Testing of Aerosol Fire Extinguishing Agent for Li-ion Battery Fires," vol. 10030271 – HOU – R -01, ed. Rochester, NY: Det Norske Veritas (DNV) GL - Energy Advisory Americas, 2017.

[35] C. Edison, "Considerations for ESS Fire Safety," DET NORSKE VERITAS (U.S.A.),, Dublin, OH, OAPUS301WIKO(PP151894), Rev. 3, January 18th, 2017 2017. [Online]. Available: https://nysolarmap.com/media/1718/dg-hubbess-con-edison-nyserda-final-report-11817.pdf

[36] S. Koch, K. Birke, and R. Kuhn, "Fast thermal runaway detection for lithium-ion cells in large scale traction batteries," *Batteries,* vol. 4, no. 2, p. 16, 27 March 2018 2018. [Online]. Available: www.mdpi.com/journal/batteries.

[37] L. Kong, C. Li, J. Jiang, and M. Pecht, "Li-ion battery fire hazards and safety strategies," *Energies,* vol. 11, no. 9, p. 2191, 2018.

[38] N. Ponchaut, K. Marr, F. Colella, V. Somandepalli, and Q. Horn, "Thermal runaway and safety of large lithium-ion battery systems," *Proceedings of the The Battcon,* pp. 17.1–17.10, 2015.

[39] Q. Wang, P. Ping, X. Zhao, G. Chu, J. Sun, and C. Chen, "Thermal runaway caused fire and explosion of lithium ion battery," *Journal of power sources,* vol. 208, pp. 210–224, 2012.

[40] CSA, "Li-ion battery system for stationary application, model MC-B536-U-R4M01 (UL 9540A Test Report)," Shanghai Huahui Testing Co.,Ltd, Shanghai, China, 80146723, 19 April 2023.

[41] CSA, "CSA UL1973 Report (80146716 Test Report)," Shanghai Huahui Testing Co.， Ltd, Shanghai, China, 17 March 2023.

[42] NHTSA, "Lithium-ion Battery Safety Issues for Electric and Plug-in Hybrid Vehicles," US Department of Transportation, National Highway Traffic Safety Administration, Washington D.C., October 2017 2017. [Online]. Available: https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/12848-lithiumionsafetyhybrids_101217-v3-tag.pdf

[43] CSA, "Li-ion Battery Energy Storage System Subassembly, Model MC10C-B5365-U-R4M01 and MC8C-B4292-U-R4M01 (UL 9540 Certificate Report)," Shanghai Huahui Testing Co.,Ltd, Shanghai, China, 80146724, 13 July 2023.

[44] R. Lomazini, "Project Requirements Document for Origis Caballero," IHI Terrasun Solutions, Chicago, IL, July 2023.

[45] eurofins, "Certification Record," ed. Chicago, IL: Eurofins Electrical and Electronic Testing North America, Inc., 2023.