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Data Request Response #5

Corby Battery Energy Storage System Project (24-OPT-05)

March 2026

Prepared for

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Acronyms and Abbreviations

95% UCL	95% upper confidence limit
AEGL	Acute Exposure Guideline Level
Applicant	North Bay Interconnect, LLC and Corby Energy Storage, LLC
Application	Opt-in Application
ARB	Air Resources Board
BESS	battery energy storage system
Caltrans	California Department of Transportation
CEC	California Energy Commission
CLR	current limiting reactor
CO	carbon monoxide
COC	Condition of Certification
EPA	U.S. Environmental Protection Agency
ESMS	Energy Storage Management System
gen-tie	generation tie
g/Wh	grams per watt-hour
HARP	Hot Spots Analysis and Reporting Program
HCN	hydrogen cyanide
HF	hydrogen fluoride
HI	hazard index
HMA	Hazard Mitigation Analysis
HVDC	High Voltage Direct Current
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
KOP	key observation point
LFL	lower flammable limit
LiB	lithium-ion battery
$LiPF_6$	lithium hexafluorophosphate
LSFT	Large Scale Fire Test
mg	milligram
NFPA	National Fire Protection Association
NO_2	nitrogen dioxide

NO_x	nitric oxides
OCA	Offsite Consequence Analysis
OEHHA	Office of Environmental Health Hazard Assessment
PERP	Portable Equipment Registration Program
PG&E	Pacific Gas and Electric
PLC	Programmable Logic Controller
$PM_{2.5}$	fine particulate matter (less than 2.5 microns in diameter)
POCO	point of change of ownership
POI	point of interconnection
Project	Corby Battery Energy Storage System Project
REL	Reference Exposure Level
SDR	Supplemental Data Request
SID	Solano Irrigation District
SO_2	sulfur dioxide
SO_x	sulfur oxides
TAC	toxic air contaminant
UL	Underwriters Laboratories

1.0 INTRODUCTION

This Data Request Response #5 to North Bay Interconnect, LLC and Corby Energy Storage, LLC's (Applicant)[1] Opt-in Application (Application) for the Corby Battery Energy Storage System Project (Project) (24-OPT-05) responds to supplement data requests (SDR) that California Energy Commission (CEC) Staff have made as a result of their review of Project Description Update #2, including SDR AQ-1 through -4, SDR FP-1 through -4, SDR TR-1 through -6, SDR LAND-1, and SDR VIS-1 through -3. These SDRs were received via email on February 20, 2026, which is provided in Appendix 1-A.

Each data request is presented below in its entirety, followed by the Applicant's response to the information requested. All figures referenced in responses are provided following the set of responses for the technical discipline. If the response requires additional appended material, it is included in numbered appendices at the end of the document.

2.0 GENERATOR USE (AIR QUALITY)

Tables 5 and 6 of Air Quality and Greenhouse Gas Technical Report (TN 263284) indicate that portable generator sets and air compressors will be used during multiple construction phases, with several stages overlapping. The Yolo-Solano Air Quality Management District has raised concerns regarding the 12-month Portable Equipment Registration Program (PERP) limitation and portability requirements to determine whether District Authority to Construct/Permit to Operate permitting may be required, if not for the CEC's in lieu authority.

2.1 Data Request SDR AQ-1

SDR AQ-1. For all generator sets and air compressors identified in Table 6, please provide the engine make, model, horsepower and emission tiers.

Response: The construction generators and air compressors will be provided by the Project construction contractor; therefore, specific make and model information is not currently available. The horsepower and emission tier assumptions used in the air quality analysis are provided in Table 2-1.

2.2 Data Request SDR AQ-2

SDR AQ-2. Please clarify unit usage across stages, mobilization/demobilization dates, continuous onsite presence, and total cumulative duration for each unit.

Response: As noted in Section 2.4.2.1 of the Air Quality and Greenhouse Gas Technical Report (TN 263284), the overall construction schedule is 14 months in duration and would be extended to 15 months if groundwater well installation is required ahead of construction. The Commissioning phase will occur during months 13 through 15. The physical construction activities will occur over the span of approximately 11.5 months total duration. Table 2-1 provides clarification on the mobilization/demobilization dates, continuous onsite presence, and total cumulative duration for

[1] North Bay Interconnect, LLC and Corby Energy Storage, LLC are both wholly-owned subsidiaries of NextEra Energy Resources. North Bay Interconnect, LLC will own and operate the interconnection facilities for the Project; and Corby Energy Storage, LLC will own and operate the BESS components of the Project.

Table 2-1. Portable Generator and Air Compressor Usage

Construction Phase	Equipment Type	Quantity	Horsepower	Tier	Mobilization Date[1/]	Demobilization Date[1/]	Continuous Onsite Presence	Total Duration[3/]
Groundwater Well Drilling/Testing	Generator Sets	1	14	Average [2/]	2/1/2026	3/8/2026	Y	35 days
	Air Compressors	1	37	4				
Groundwater Well Equipment Installation	Generator Sets	1	14	Average[2/]	3/9/2026	3/31/2026		22 days
	Air Compressors	1	37	4				
Battery/ Container Installation	Air Compressors	2	37	4	5/1/2026	11/30/2026	Y	7 months
	Generator Sets	2	369	4				
Substation Installation	Air Compressors	1	37	4	7/1/2026	12/31/2026	Y	6 months
	Generator Sets	1	369	4				
Gen-tie Foundations, Tower Erection, and Underground Installation	Air Compressors	2	37	4	7/1/2026	12/31/2026	Y	6 months
Onsite Water Tank Installation	Generator Sets	2	14	Average[2/]	11/10/2026	2/16/2027	Y	3 months
Generator Only Phase-Construction	Generator Sets	2	369	4	3/1/2026	2/16/2027	Y	11.5 months

Notes:
1/ Equipment mobilization and demobilization dates presented are based on dates uses in the California Emission Estimator Model (CalEEMod) analysis included in the May 2025 Air Quality and Greenhouse Gas Technical Report (TN 263284) and are representative of the expected sequence and duration of activities. Actual dates will be based on license issuance and construction notice to proceed approval dates.
2/ For engines rated at less than 25 horsepower, CalEEMod does not provide tier emission factors, but instead uses statewide fleet average emission factors from the California Air Resources Board's OFFROAD2017-ORION v1.0.1 model.
3/ Total duration is based on start and end dates of each phase and therefore includes non-operational days when equipment is present on site.

each generator set and air compressor. As shown, the work phases generally overlap such that any specific piece of equipment will not be on site longer than 12 months regardless of whether it is used for multiple phases of work. Groundwater well drilling and installation, if required, will be performed by a separate contractor; the portable engines associated with those activities would not be used for subsequent Project construction.

2.3 Data Request SDR AQ-3

SDR AQ-3. For the 304-day Generator-Only Phase, please confirm whether the two generator sets are newly mobilized units or the same units used in earlier stages, and whether their total cumulative onsite duration (including prior stages) would exceed 12 months. Please confirm whether the applicant would accept a condition of certification restricting the total cumulative onsite duration of the generators to a maximum of 12 months.

Response: The "Generator-Only" phase refers to generators that will be used by the construction contractor to power onsite construction trailers until such time as power from local Pacific Gas and Electric (PG&E) distribution lines becomes available. These generators will be different units from the generators used in other phases and would be demobilized when the construction contractor demobilizes job site trailers at the beginning of the Commissioning phase, if not sooner. If these generators are on site for the full construction period beginning with the Site Preparation phase and ending at the completion of the Water Tank Installation phase, they would be on site for a maximum of 11.5 months. The Applicant will accept a condition of certification restricting the total cumulative onsite duration of the generators to a maximum of 12 months, consistent with Yolo-Solano Air Quality Management District and California Air Resources Board PERP requirements that would otherwise be applicable absent the CEC's in lieu authority.

2.4 Data Request SDR AQ-4

SDR AQ-4. Please confirm whether generators and air compressors will be relocated within the site, whether any unit will remain fixed in one location for extended periods, and how PERP portability requirements will be met.

Response: The portable generator and air compressor engines greater than 50 horsepower will be Tier 4 engines, as would otherwise be required under the PERP program. It is anticipated that some of the engines will be used at different locations throughout the site as needed to support construction activities across the site, whereas other engines (e.g., generators for job trailer power) will remain in one location for the duration of their use. No PERP-registered engines will be on site for longer than 12 months.

3.0 FIRE PROTECTION

3.1 Data Request SDR FP-1

The application references compliance with the 2023 Edition of NFPA 855, even though the 2026 Edition (adopted September 2025) is the applicable standard. It is unclear whether the project design, hazard mitigation measures, and operational protocols have been reviewed for consistency with the 2026 requirements. The application does not indicate that a gap analysis has been performed between the 2023 and 2026 editions. Clarification is needed to confirm that the project will meet the applicable fire and life safety requirements.

SDR FP-1. Please evaluate the differences between the 2023 and 2026 Editions of NFPA 855 as they apply to the proposed BESS and explain how the project would comply with the 2026 Edition. Please also provide similar evaluations for the 2026 Edition of NFPA 850 and UL 1741 (3rd Edition, including Supplement SB), and describe how the project would comply with those requirements.

Response: The Applicant understands that while the 2026 Edition of National Fire Protection Association (NFPA) 855: Standard for the Installation of Stationary Energy Storage Systems (published September 2025) is not expected to be adopted into the California Fire Code until July 1, 2027. CEC will require conformance to the extent practicable through a proposed Condition of Certification (COC).

The proposed battery energy storage system (BESS) has been evaluated against both the 2023 and 2026 Editions of NFPA 855: Standard for the Installation of Stationary Energy Storage Systems. The Project was designed and is being permitted during a period when the 2023 Edition is widely adopted; however, a review of the 2026 Edition indicates that the Project is already compliant with the majority of the updated requirements, as the core technical provisions applicable to utility-scale lithium-ion BESS installations have not materially changed between editions. Table 3-1 provides the requested gap analysis between the 2023 and 2026 Editions of NFPA 855 identifying the updates, potential applicability to the Project, and notes on Project conformance.

The 2026 Edition of NFPA 855 represents a refinement and expansion of prior requirements rather than a fundamental restructuring of the standard. Key areas of change include:

- Expanded coverage of battery chemistries and reorganization of threshold quantity tables to explicitly list emerging technologies; thresholds applicable to lithium-ion BESS remain unchanged.
- Clarification and expansion of fire and explosion testing provisions, including clearer linkage between Underwriters Laboratories (UL) 9540A data and large-scale fire testing concepts; these changes are primarily organizational and clarifying in nature.
- Enhanced emphasis on Hazard Mitigation Analysis (HMA), including clearer expectations for documenting fire, explosion, and gas hazards and associated mitigation measures.
- Updates to emergency response planning, training, and coordination, including alignment with updated detection technologies and emergency procedures consistent with NFPA 72 and evolving responder guidance.

These changes are largely procedural, documentation-focused, or clarifying and do not substantially alter the physical design or equipment requirements for a utility-scale outdoor BESS installation. A detailed review indicates that the proposed Project already meets or exceeds most of the 2026 Edition requirements due to the following:

- System layout, spacing, separation distances, fire access, and fire protection features were designed conservatively and are consistent with both the 2023 and 2026 Editions.

- Battery chemistry and capacity thresholds applicable to the Project remain unchanged between editions, and the Project falls squarely within the lithium-ion provisions that were already well established in the 2023 Edition.
- Fire detection, suppression, and explosion control concepts incorporated into the Project are consistent with the intent of the 2026 Edition and do not rely on provisions that were materially altered or newly introduced.
- UL 9540A fire and explosion testing data have already been developed and used to inform system design, consistent with the testing framework referenced in both editions.

Accordingly, no redesign or replacement of procured equipment is required to demonstrate compliance with the 2026 Edition. Where the Applicant has identified elements that are procedural, operational, or documentation-based and that were refined or expanded in the 2026 Edition, those items will be addressed through the CEC compliance review process and captured, as appropriate, through COCs. These include, but are not limited to:

- Updates to the HMA to explicitly reflect the organizational structure, terminology, and emphasis of the 2026 Edition, including confirmation of mitigation measures, emergency response actions, and coordination protocols
- Emergency response planning and coordination, including incorporation of 2026-specific guidance for responder actions, detection technologies, and notification procedures, in coordination with local fire authorities
- Training and operational protocols, including personnel training, drills, and documentation updates to reflect the most current NFPA 855 guidance; these items are typically finalized closer to commissioning and are well suited for COC-based verification
- Final compliance documentation, demonstrating alignment with the 2026 Edition during the post-certification compliance phase, consistent with standard CEC practice

These items do not represent deficiencies in Project safety or design, but rather reflect the normal progression of Project development from conceptual design through final compliance and commissioning. The differences between the 2023 and 2026 Editions of NFPA 855 do not materially affect the proposed BESS design or safety performance. The Project is already compliant with the majority of the 2026 Edition requirements, and any remaining administrative, analytical, or procedural updates will be addressed through future COCs and compliance filings. This approach is consistent with regulatory practice and ensures full alignment with the most current version of NFPA 855 prior to operation.

NFPA 850 is expressly limited in applicability to electric generating plants and high-voltage direct current (HVDC) converter stations, as stated in:

Section 1.1 (Scope), which identifies the standard as applicable to fire prevention and fire protection for electric generating plants and HVDC converter stations;

Section 1.2.1 (Purpose), which addresses fire protection requirements for the design, construction, installation, commissioning, operation, and maintenance of electric generating plants and HVDC converter stations.

Section 1.3.1 (Application), which also limits the standard's application to those specific facility types

The definition of an HVDC Converter Station as "a facility that functions as an electrical rectifier (ac-dc) or an inverter (dc-ac) to control and transmit power in a high-voltage network" in Section 3.3.17 of the standard further clarifies that the standard is intended for facilities that function as electrical rectifiers or inverters used to control and transmit power in high voltage networks involving HVDC valves with equipment that consist of oil filled converter transformers, wall bushings, capacitors, and specialized high voltage equipment that present unique fire risks.

The proposed BESS does not include an electric generating plant, an HVDC converter station, and mercury arc valves or solid state thyristor valve systems used for HVDC conversion. Accordingly, NFPA 850 does not directly apply to the Project.

Although NFPA 850 is not applicable, the substation has been designed utilizing the fire protection guidance specified in Institute of Electrical and Electronics Engineers(IEEE) 979-2012, *IEEE Guide For Substation Fire Protection*, which references applicable NFPA 850 relevant fire risk mitigation concepts commonly associated with substation and high voltage equipment design, including oil-filled transformer protection, spatial separation, exposure control, and fire protection elements required within enclosures.

Key examples include:

- Transformer Separation and Firewalls: NFPA 850 recommends firewalls or spatial separation to limit exposure from oil-filled transformer fires. For the proposed Project, firewalls are not required, as a minimum separation distance of 50 feet will be maintained between transformer elements containing oil and the nearest oil containment pits, providing adequate exposure mitigation through distance alone.
- Oil-Filled Equipment Setbacks: There are no enclosures or buildings located within 100 feet of equipment containing more than 500 gallons of oil, exceeding common separation distances discussed in NFPA 850 guidance and related industry best practices.
- Substation Layout and Exposure Control: The overall substation and electrical equipment layout has been designed to account for fire exposure, oil spill containment, drainage, and equipment spacing. While only one example is described above, additional design considerations include equipment orientation, material selection, property line setbacks, and coordination with applicable fire and building codes.

These measures demonstrate that, even though NFPA 850 is not applicable, the underlying fire protection principles identified in IEEE 979-2012 relevant to oil containing electrical equipment and fire detection and protection measures within the control enclosure have been thoughtfully incorporated into the substation project design.

With respect to UL 1741, the provided equipment meets the 3rd Edition and SB Supplement; the UL 1741 inverter certification is provided in Appendix 3-A.

3.2 Data Request SDR FP-2

The application relies on compliance with the 4th Edition of UL 9540A (published November 12, 2019), which the site-specific HMA identifies as the governing test standard. The 5th Edition of UL 9540A was published March 12, 2025, and includes revisions relevant to hazard characterization and mitigation measures. It is unclear whether the UL 9540A testing conducted in late 2024 is consistent with the 5th Edition requirements. Clarification is needed to ensure that the fire and explosion hazard evaluation reflects the current updated standard.

SDR FP -2. Please evaluate the differences between the 4th and 5th Editions of UL 9540A as they apply to the proposed BESS and the UL 9540A testing conducted in late 2024. Identify any substantive differences, and explain whether or not a supplemental analysis or additional testing will be conducted and provided to demonstrate compliance with the 5th Edition.

Response:

For the Project to comply with applicable codes and regulations, the testing for the BESS must be in accordance with the 4th Edition of UL 9540A. Based on the latest 2026 Edition of the NFPA 855 standard, the applicable testing method for BESS is the 4th Edition of UL9540A (see section 2.3.9 of the standard). It is our understanding that there is no regulation or rule that would require testing of equipment to the 5th Edition of UL9540A. It is not industry practice nor feasible to conduct such testing on already listed and procured equipment within the timeline of Project construction.

Changes to the 5th Edition of UL9540A primarily consist of the following:

- Clarification and refinement of definitions, terminology, and reporting structure;
- Minor updates to measurement methods, including data averaging and reporting consistency;
- Additional clarification of test setup parameters at the cell, module, unit, and installation levels; and
- Expanded guidance for interpretation of results for emerging battery chemistries and installation configurations.

The 5th Edition does not introduce fundamentally new hazard mechanisms, does not change the underlying purpose of UL 9540A testing, and does not convert the test method into a pass/fail compliance standard. UL 9540A remains a data generating test method, intended to inform installation design, separation distances, ventilation, and fire protection features.

The UL 9540A testing completed for the Project followed the 4th Edition, which was the current and required edition at the time of testing. It was conducted on representative, production-intent equipment that has since been procured for the Project. The testing generated fire, gas release, and thermal runaway propagation data required to support compliance with NFPA 855 (2026) and applicable fire code provisions. NFPA 855 (2026) does not require testing to the 5th Edition of UL 9540A nor has the 5th Edition been formally adopted by NFPA 855, the International Fire Code, or by

State or local fire codes applicable to the Project. As such, testing to the 4th Edition remains code-compliant and appropriate for permitting purposes.

No supplemental UL 9540A testing or retesting to the 5th Edition is proposed or warranted for the following reasons:

- Code Compliance: The 4th Edition satisfies the testing requirements explicitly referenced in NFPA 855 (2026). There is no regulatory mandate to retroactively apply the 5th Edition.
- Procured Equipment: The LG BESS equipment has already been manufactured, tested, and procured. Manufacturers do not retest or modify existing, listed equipment solely to align with a newer, unadopted test methodology.
- Nature of 5th Edition Changes: The 5th Edition changes are largely clarifications and refinements and do not invalidate or materially alter the relevance of data generated under the 4th Edition.
- Regulatory Practice: It is standard practice for projects and manufacturers to rely on the edition of a consensus standard that is in effect at the time of testing and procurement, particularly where newer editions have not been adopted by code.

The UL 9540A testing conducted in late 2024 to the 4th Edition remains valid, applicable, and compliant with NFPA 855 (2026) and current fire code requirements. The 5th Edition of UL 9540A has not been adopted by applicable codes, and its refinements do not necessitate additional testing or reevaluation of the already procured BESS equipment. No loss of safety or analytical rigor results from reliance on the 4th Edition data. Therefore, no supplemental testing is proposed.

In summary, because the proposed systems are fully compliant with NFPA 855 2026 and listed to UL 9540A 4th Edition, they satisfy the current regulatory safety mandates. The 5th edition of UL 9540A testing is not a retroactive requirement for systems already certified under the 4th Edition listing, provided the site-specific application adheres to the installation parameters defined in the 2026 NFPA 855 standard.

3.3 Data Request SDR FP-3

Inconsistent statements regarding the Energy Storage Management System (ESMS)/Programmable Logic Controller (PLC) certification status are found in Project Description Update #2, Part 2 [TN 268433]. Appendix 3.9-B1, §2.3, page 13 states that the ESMS/PLC is certified to IEC 61131-2 and IEC/UL 61010-2-201; however, a footnote indicates that certifications were not provided for review because an ESMS/PLC model has not yet been selected. Clarification is necessary to understand how compliance with referenced certification standards will be ensured if the equipment has not been identified. Staff is reviewing these supplemental submittals with the understanding that the model has already been selected.

SDR FP-3. Please inform staff of the exact model selected or clarify the status of and timeline for the ESMS/PLC selection and certification.

Response: The Applicant plans to use Schneider Electric Modicon M580 PLC (PLC/ESMS) units; the manufacturer product standards and certifications document provided in Appendix 3-B lists the standards that the unit is designed to comply with, including International Electrotechnical Commission (IEC) 61131-2 and IEC/UL 61010-2-201.

3.4 Data Request SDR FP-4

Staff seeks clarification regarding whether deflagration panels are included in the proposed design and, if so, to explain their role within the explosion protection strategy. The application references deflagration panels in several sections, including in discussions of NFPA 69 compliance; however, neither the Explosion Prevention System Design Report (TN 268433, Appendix 3.9-D) nor the Product HMA (TN268433, Appendix 3.9-B2) describes or evaluates deflagration panels as part of the system design. The Large Scale Fire Test (LSFT) also references deflagration panels, but photos of the systems tested do not appear to include them.

SDR FP-4. Please clarify whether deflagration panels are included in the proposed BESS design. If so, please include consistent figures and statements of their location, design basis, and how they are integrated into the NFPA 69 explosion protection approach, including any supporting calculations or evaluations.

Response: Each LG system utilizes an NFPA 69–compliant active deflagration prevention strategy consisting of six dedicated ventilation vents designed for combustible concentration reduction. In accordance with NFPA 69, these vents operate in conjunction with the gas detection system and exhaust fans to ensure the internal atmosphere is maintained below 25 percent of the lower flammable limit (LFL). Although not necessary to meet NFPA 69 compliance, the enclosure features six partial deflagration panels engineered to provide structural pressure relief (see pg. 6 of Appendix 3-C). These panels complement the NFPA 69 active prevention system by functioning as a secondary mitigation measure to protect the enclosure's integrity by providing a controlled path for pressure discharge in the event of an internal pressure rise, ensuring installation aligns with the mandatory hazard mitigation objectives of the 2026 NFPA 855.

Table 3-1. Changes in NFPA 855 (2023 to 2026)

Substantive Updates[1/]	Applicability to Project	Project Conformance[2/]
1.3 Application. This standard shall apply to ESS installations exceeding the values shown in Table 1.3 and the storage of lithium metal or lithium-ion batteries.	Applicable Additional battery technologies were added.	The standard was already applicable to Project and Project compliance has been evaluated through HMA and design.
1.3.5 Where approved, alternate safety measures shall be permitted to be applied for research, development, or testing.	Not Applicable Alternate safety measures not taken.	Not Applicable
2.3 Other Publications. Not all inclusive list of updates, but the following are some of the newly introduced standards: NFPA 3, *Standard for Commissioning of Fire Protection and Life Safety Systems*, 2024 edition. NFPA 4, *Standard for Integrated Fire Protection and Life Safety System Testing*, 2024 edition. NFPA 110, *Standard for Emergency and Standby Power Systems*, 2025 edition. NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*, 2025 edition. NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*, 2022 edition. NFPA 1660, *Standard for Emergency, Continuity, and Crisis Management: Preparedness, Response, and Recovery*, 2024 edition. UL 1564, *Standard for Industrial Battery Chargers*, 2024. UL 62109-1, *Power Converters for use in Photovoltaic Power Systems - Part 1: General Requirements*, 2014.	Applicable Additional publications added or editions updated, including the applicability of the updated 2023 edition of UL1741	Compliance with the 2023 Edition of UL 9540 and 2024 Edition of NFPA 69 was already provided as documented in the HMA and Explosion Prevention System Design Report (Appendix 3.9-B1, 3.9-B2, and 3.9-D). The proposed equipment already complies with UL 1741 3rd Edition and Supplement SB. See Appendix 3-A. Integrated testing will be performed and is already part of the UL 9540 commissioning plan.
3.1 General. 3.1.1 The definitions contained in this chapter shall apply to the terms used in this standard. 3.1.2 Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. 3.1.3 Merriam-Webster's Collegiate Dictionary, 11th edition, shall be the source for the ordinarily accepted meaning. 3.3.2 Appropriate Test Standard. A document which specifies the safety requirements for specific equipment or class of equipment and satisfies the requirements of 29 CFR 1910.7(C). 3.3.3 Battery. One or more cells connected together electrically in series, parallel, or both, to provide the required operating voltage and current levels. 3.3.3.1 Aqueous Metal-Air Battery.	Applicable	Several new definitions added and updated which help clarify language and align with other standards and best hazard mitigation practices. Does not alter Project compliance with the standard.

Substantive Updates[1/]	Applicability to Project	Project Conformance[2/]
A battery cell type with metal electrodes based on a reversible oxidation reaction that occurs in a mildly acidic or alkaline water-based solution. 3.3.3.2 Aqueous Nickel-Based Battery. A battery cell type which facilitates ion transport between anodes and cathodes in an alkaline solution of primarily water, and where one of the electrodes is nickel oxyhydroxide. 3.3.3.3 Flow Battery. A type of storage battery that includes one or more electrolyte solutions or suspensions in at least one storage tank, one or more energy converters where chemical energy is converted into electrical energy in a reversible process, and a circulation system that causes electrolyte to flow between the tank(s) and converter(s). 3.3.6 Combustible Concentration Reduction. The technique of maintaining the concentration of combustible material in a closed space below the lower flammable limit. [69, 2024] 3.3.7 Deflagration. Propagation of a combustion zone at a velocity that is less than the speed of sound in the unreacted medium. [68, 2023] 3.3.8 Developed Fire. A fire that has progressed beyond its ignition stage, reaching a point where it is self-sustaining and spreading within the unit of origin. 3.3.12 Emergency Power Supply (EPS). The source of electric power of the required capacity and quality for an emergency power supply system (EPSS). [110, 2022] 3.3.13 Emergency Power Supply System (EPSS). A complete functioning EPS system coupled to a system of conductors, disconnecting means and overcurrent protective devices, transfer switches, and all control, supervisory, and support devices up to and including the load terminals of the transfer equipment needed for the system to operate as a safe and reliable source of electric power. [110, 2022] 3.3.15 Energy Storage System Limited-Production Certification (LPC). A process that enables system integrators or original equipment manufacturers to field assemble, test, commission, and certify energy storage systems as satisfying the requirements of the appropriate test standard. 3.3.16.2 Critical Safety Component or System. A component or system designed to prevent loss of life, serious personal injury, or damage to the natural environment. 3.3.16.3 Electrochemical Energy Storage System. An energy storage system that converts and stores chemical energy to electrical energy and vice versa. 3.3.16.7 Mechanical Energy Storage System. An energy storage system that converts and stores mechanical energy to electrical energy and vice versa. 3.3.17 Fire and Explosion Testing. Testing of a representative energy storage system that evaluates the fire and explosion hazards produced by thermal runaway propagation. 3.3.20 Fire Risk Assessment (FRA).		

Substantive Updates[1/]	Applicability to Project	Project Conformance[2/]
A process to characterize the risk associated with fire that addresses the fire scenario or fire scenarios of concern, their probability, and their potential consequences. [551, 2022] .3.22 Gas. 3.3.22.1 Highly Toxic Gas. A chemical that has a median lethal concentration (LC50) in air of 200 ppm by volume or less of gas or vapor, or 2 mg/L or less of mist, fume, or dust, when administered by continuous inhalation for 1 hour (or less if death occurs within 1 hour) to albino rats weighing between 0.44 lb and 0.66 lb (200 g and 300 g) each. [55, 2023] 3.3.22.2 Toxic Gas. A gas with a median lethal concentration (LC50) in air of more than 200 ppm but not more than 2000 ppm by volume of gas or vapor, or more than 2 mg/L but not more than 20 mg/L of mist, fume, or dust, when administered by continuous inhalation for 1 hour (or less if death occurs within 1 hour) to albino rats weighing between 0.44 lb and 0.66 lb (200 g and 300 g) each. [55, 2023] 3.3.24 Highly Toxic Gas. See 3.3.22.1. 3.3.27 Occupiable Enclosure or Space. An area that has dimensions and physical characteristics such that it could be entered by a person for maintenance during normal operation. 3.3.31 Partial Volume Deflagration. An overpressure developed by the ignition of a flammable gas cloud that occupies only a part of the free air volume of a confined space. 3.3.32 Qualified Person. One who has skills, knowledge, and training related to the construction and operation of energy storage systems and electrical equipment and installations and has received safety training to recognize, avoid, and mitigate the hazards involved. 3.3.34 Registered Design Professional (RDP). An individual who is registered or licensed to practice his/her respective design profession as defined by the statutory requirements of the professional registration laws of the state or jurisdiction in which the project is to be constructed. [5000, 2024] 3.3.35 Reliability. The probability the system, structure, or component of interest will perform its specified function under given conditions upon demand or for a prescribed time. [806, 2020] 3.3.38 Stationary Standby Battery. A battery that spends the majority of the time on continuous float charge or in a high state of charge, in readiness for a discharge event. [70, 2023] 3.3.40 Stored Energy. The amount of energy stored in the ESS at a given point in time. 3.3.43 Thermal Runaway Propagation. The transfer of thermal energy released from one or more cells undergoing thermal runaway that induces thermal runaway of other cells without any additional initiating mechanism(s).		

Substantive Updates[1/]	Applicability to Project	Project Conformance[2/]
3.3.44 Thermal Runaway Propagation Protection (TRPP). An active means to mitigate thermal runaway propagation. 3.3.45 Toxic Gas. See 3.3.22.2.		
4.3.1 General. ESS emergency planning and training shall be provided by the owner of the ESS or their authorized representative. 4.3.2 Facility Staff Planning and Training. ESS emergency operations planning and associated training shall be established, maintained, and conducted. 4.3.2.1.4 The emergency operations plan shall include the following: (1)Roles and responsibilities (2)Procedures for safe shutdown, de-energizing, or isolation of equipment and systems under emergency conditions to reduce the risk of fire, electric shock, and personal injuries (3) Emergency procedures and notifications to be undertaken in the event of emergency alarms, fire, explosion, release of liquids or vapors, damage to critical moving parts, or other potentially dangerous conditions (4)Response considerations similar to a safety data sheet (SDS) that will address response safety concerns and extinguishment when an SDS is not required (5)Other procedures as determined necessary by the AHJ to provide for the safety of occupants and emergency responders	Applicable	Previously had to exceed threshold limits to be required. Project exceeded the 2023 limits so the requirements were already applicable under 2023 edition and emergency planning and training are included.
4.3.2.1.5 The emergency operations plan shall be reviewed annually.	Applicable	The emergency operations plan will be reviewed annually.
4.3.2.1.6 Lead-acid and nickel-cadmium battery systems that are used for dc power for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utility and located outdoors or in building spaces used exclusively for such installations shall not be required to comply with 4.3.2.1.	Not Applicable Project uses lithium-ion batteries	Not Applicable
4.3.2.2.2 Personnel responsible for the operation, maintenance, and repair of the ESS shall be trained in the procedures included in the emergency operations plan in 4.3.2.1 prior to the commissioning of the ESS.	Applicable	Personnel will be trained on emergency procedures prior to commissioning.
Pers4.3.3 Emergency Response Plan and Training. 4.3.3.1 General. ESS emergency response plan and associated training shall be established, maintained, and conducted. 4.3.3.2 Emergency Response Plan. 4.3.3.2.1 The emergency response plan shall be in accordance with Chapters 1 through 3, and Chapters 17 through 23 of NFPA 1660. 4.3.3.2.2 The emergency response plan shall, at a minimum, address the following: (1)Mitigation (2)Preparedness	Applicable	The emergency response plan will be coordinated with the Authority Having Jurisdiction (AHJ) and address all the elements indicated.

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(3)Response (4)Recovery 4.3.3.2.3 The emergency response plan shall be developed in coordination with the AHJ and submitted to the AHJ prior to the required training in 4.3.3.3. emergency response plan in 4.3.3 prior to the commissioning of the ESS.		
4.3.3.3 Training. 4.3.3.3.1 Personnel responsible for the installation of the ESS shall be trained in the procedures included in the emergency response plan in 4.3.3 prior to the ESS arriving onsite. 4.3.3.3.2 Personnel responsible for the operation, maintenance, repair, servicing, and emergency response for the ESS shall be trained in the procedures included in the emergency response plan prior to the commissioning of the ESS.	Applicable	Training will be provided accordingly.
4.3.3.4 Refresher Training. 4.3.3.4.1 Refresher training shall be conducted by ESS facility operations personnel at least annually. 4.3.3.4.2 Records of such training shall be retained in an approved manner. 4.3.3.5 Notification. Emergency responders shall be notified of the training dates and locations.	Applicable	Training will be provided at least annually; emergency responders will be notified.
4.4.1 A hazard mitigation analysis shall be provided to the AHJ for review and approval unless modified in Chapters 9 through 17.	Applicable	Hazard Mitigation Analysis (HMA) has already been prepared and provided in conformance with the applicable codes as required per the California Fire Code to ensure compliance. If requested, supplemental documentation will be provided to the AHJ (CEC) during the compliance process
4.4.2 Failure Modes. 4.4.2.1 The hazard mitigation analysis shall evaluate the consequences of the following: (1)A thermal runaway or mechanical failure condition in a single ESS unit (2)Failure of an energy storage management system or protection system that is not covered by the product listing failure modes and effects analysis (FMEA) (3)Failure of a required system including, but not limited to, HVAC, liquid cooling system, BMS, communication system, or other critical systems that might impact normal operations (4)Other failure modes required by the AHJ	Applicable AHJ can now require additional failure modes to be examined.	HMA has been provided which provides a thorough analysis of failure modes. It is not anticipated that additional failure modes be required to be examined. If requested, additional failure modes will be examined and supplemental documentation to the existing HMA can be provided when/if requested.
4.4.2.3 The HMA shall evaluate the reliability and survivability of the following critical safety components or systems, during a thermal runaway propagation or single failure event: (1)Exhaust ventilation	Applicable	All systems will be commissioned in accordance with applicable codes and

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(2)Smoke detection (3)Fire detection (4)Fire suppression (5)Combustible concentration reduction (CCR) system (6)Gas detection (7)Explosion control and prevention		standards and maintained accordingly. The HMA has been prepared in accordance with the applicable code, and design documentation includes considerations for each system as applicable to the Project. Furthermore, an explosion prevention system design report explains how reliability has been considered in the NFPA 69 design by considering abnormal condition scenarios.
4.6.1.1 Supplemental Information. A report documenting conditions of acceptability and any features or functions not evaluated by the UL 9540 listing shall be provided to the AHJ and owner.	Applicable Supplemental information required for features not evaluated by UL 9540 listing	Component listings such as the UL 1973 and UL 1741 listings cover the acceptability of components while UL 9540 covers the integration of components. Overall design documentation, training, and emergency response plan cover compliance with other codes and standards. As such, current design documentation covers this requirement.
4.6.5 Reused Equipment. 4.6.5.1 Materials, equipment, and devices shall not be reused or reinstalled unless such elements have been reconditioned, tested, and placed in good and proper working condition and approved. 4.6.5.2 Repurposed, remanufactured, and refurbished batteries shall also comply with 9.3.4.	Not Applicable All equipment is new	Not Applicable
4.7.1 Dedicated Location. When an ESS is installed in a structure, it shall be installed in a dedicated location readily accessible to first responders.	Not Applicable Project does not propose ESS within a structure	Not Applicable
4.7.2.1 Lead-acid and nickel-cadmium ESS installations consisting of standby power as part of communications equipment under the exclusive control of communications utilities located outdoors or in building spaces used exclusively for such installations shall not be required to comply with 4.7.2.	Not Applicable Project uses lithium-ion batteries	Not Applicable

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4.7.2.2 Lead-acid and nickel-cadmium ESS installations that are used for dc power for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utility and located outdoors or in building spaces used exclusively for such installations shall not be required to comply with 4.7.2. 4.7.2.3 Lead-acid and nickel-cadmium ESS installations that are part of installations of railways for generation, transformation, transmission, energy storage, or distribution of power used exclusively for operation of rolling stock or installations used exclusively for signaling and communications purposes shall not be required to comply with 4.7.2. 4.7.5.3.3 Lead-acid and nickel-cadmium energy storage systems operated as part of railways, secured from public access, and exempt from NFPA 70 shall not be required to comply with 4.7.5.3.		
4.7.5.7 ESS shall be provided with NFPA 704 placarding in accordance with the following: (1)As required by the HMA (2)As required by applicable codes and standards (3)As required by the AHJ	Applicable	Placarding will be provided in accordance with NFPA 704, HMA, and as required by AHJ.
4.7.8.3 Section 4.7.8 shall not apply to all types of lead-acid, aqueous nickel based, and aqueous metal-air batteries used in ESS in stationary standby service that complies with any of the following: (1)Comprised of vented cells (2)Comprised of cells or batteries listed to UL 1973 (3)Used for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utility and located outdoors or in building spaces used exclusively for such installations (4)Used for control of fixed guideway transit or passenger rail systems under the exclusive control of a transit authority and located outdoors or in building spaces used exclusively for such installations (5)Used in telecommunications facilities for installations of communications equipment under the exclusive control of communications utilities and located outdoors or in building spaces used exclusively for such installations (6)Used in uninterruptible power supplies listed to UL 1778	Not Applicable Project uses lithium-ion batteries	Not Applicable
4.7.11 Fire Command Centers. In buildings containing ESSs and equipped with a fire command center, the command center shall include signage or readily available documentation that describes the locations and types of ESSs, operating voltages, and locations of electrical disconnects where provided.	Not Applicable ESS not in building	Not Applicable
4.9.4.1 Automatic fire control and suppression systems shall comply with the following standards, or their equivalent, unless modified in Chapters 9 through 17: (1)NFPA 13 (2)NFPA 12 (3)NFPA 15 (4)NFPA 750 (5)NFPA 770 (6)NFPA 2001	Not Applicable New standards included adding alternative fire suppression systems. which are not applicable to unoccupied units as explained in the HMA.	HMA addresses considerations.

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(7)NFPA 2010		
4.9.4.3 Fire control and suppression systems used as a component of thermal runaway propagation protection (TRPP) systems shall meet the requirements of 9.7.6.6.	Not Applicable Clarification that TRPP systems do not replace room or area protection for ESS installations.	Not applicable
4.9.5.4 Fire hydrants installed on private fire service mains shall be installed in accordance with NFPA 24.	Not Applicable Clarifies that NFPA 24 is to be met even when not adopted by local jurisdictions (fire hydrants not proposed).	Not applicable
4.10 Emergency Power Supply Systems (EPSS). Critical safety systems that rely on power shall be provided with reliable EPSS or SEPSS power in accordance with NFPA 110 or NFPA 111. 4.10.1 If EPSS or SEPSS is provided, they shall be Class X, Type 10, Level 2. 4.10.2 ESS Design. 4.10.2.1 A registered design professional with an EPSS design background shall both evaluate the duration and total load requirements as well as define the specific loads to be served for the power systems. 4.10.2.2 The design for the EPSS shall be made available to the fire protection engineer (FPE) of record and the AHJ for review and approval. 4.10.3 EPSS or SEPSS Type 10 requirements shall be permitted to be increased based on the HMA evaluation and a safe critical infrastructure load transfer. 4.10.4 EPSS shall be installed per Section 7.2 of NFPA 110, providing separation and protection such that a failure event doesn't compromise the operation of the system. 4.10.5 Emergency power shall not be required on mechanical ventilation systems for all types of lead-acid, aqueous nickel-based, and aqueous metal-air batteries used in ESS in stationary standby service that complies with any of the following: (1)Comprised of vented cells in systems 600 V dc or less (2)Comprised of cells or batteries listed to UL 1973 in systems 600 V dc or less (3)Used for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utility and located outdoors or in building spaces used exclusively for such installations (4)Used for control of fixed guideway transit or passenger rail systems under the exclusive control of a transit authority and located outdoors or in building spaces used exclusively for such installations (5)Are less than 60 V dc in telecommunications facilities for installations of communications equipment under the exclusive control of communications utilities and located outdoors or in building spaces used exclusively for such installations (6)Utilized in uninterruptible power supplies listed to UL 1778, which occupy no more than 10 percent of the floor area on the floor on which they are located	Applicable Requirements for emergency power systems consolidated.	Critical safety systems are compliant with these standards as applicable.
4.11 Critical Safety System Control and Power. Where multiple ESS enclosures are tied to a single inverter or control container, the impact of an event in a single ESS enclosure shall not impair the operation of critical systems or communication capabilities of the other enclosures.	Applicable Requirements for Critical Safety Systems added	Critical safety systems are compliant with this requirement.

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4.12 Electric Vehicle Charging Systems. 4.12.1 Electric vehicle charging systems that utilize integral ESSs in excess of the limits in Table 1.3 shall comply with this standard. 4.12.2 Equipment shall comply with all applicable requirements for the ESS technology it utilizes. 4.12.3 Equipment shall be listed and labeled. 4.12.4 Vehicle impact protection for the ESS portion shall be provided in accordance with 4.7.5.2. 4.12.5 Electrical disconnects shall comply with NFPA 70.	Not Applicable	Not applicable
6.1.1.1 All types of lead-acid, aqueous nickel-based, and aqueous metal-air battery systems that are in telecommunications facilities for installations of communications equipment under the exclusive control of communications utilities and located outdoors or in building spaces or enclosures used exclusively for such installations shall be permitted to have a commissioning plan complying with recognized industry practices in lieu of complying with 6.1.5.2.	Not Applicable Project does not include telecommunication facilities.	Not Applicable
6.1.1.3 All types of lead-acid, aqueous nickel-based, and aqueous metal-air battery systems that are used for control of fixed guideway transit or passenger rail systems under the exclusive control of a transit authority and located in building spaces or enclosures used exclusively for such installations shall be permitted to have a commissioning plan in accordance with applicable governmental laws and regulations in lieu of developing a commissioning plan in accordance with 6.1.5.2.	Not Applicable Project does not include rail systems.	Not Applicable
6.1.4.2 System testing shall demonstrate that the installation and operation of the system and associated components, controls, and safety-related systems are in accordance with approved plans and specifications and confirm the operation, function, and maintenance serviceability of the ESSs.	Applicable Clarification on testing requirements.	Project will include UL 9540 commissioning and be constructed in accordance with plans, specification, and maintenance protocols documented.
6.3.1 Documentation. 6.3.1.1 Operations and maintenance documentation shall be provided to the ESS owner and operator at time of installation. 6.3.1.2 Owner and operator shall ensure that all operations and maintenance documentation is maintained for the entire length of system operation.	Applicable Clarification.	Documentation will be maintained accordingly.
7.1.1.2 Electric utilities, communications utilities, and rail transport authorities shall be permitted to follow industry-specific requirements and practices for all types of lead-acid, aqueous nickel-based, and aqueous metal-air battery systems in stationary standby service or control applications in lieu of manufacturer's instructions and operation and maintenance documentation.	Not Applicable	Not Applicable
7.2.5 Training shall be provided to all those responsible for system operation and maintenance. 7.2.5.1 Training on system operation and maintenance shall be provided by the system owner or their designated agent. 7.2.5.2 After recommissioning the ESS, training on any changes to the procedures and documentation related to the operation and maintenance of the system shall be provided to the owner and operators.	Applicable Requirements for after recommissioning added	Training will be provided as necessary.
7.2.5.3 Updated information shall be transmitted to the AHJ if the recommissioned system presents a change in the hazard.	Not Applicable (possible)	No changes in hazard anticipated. Maintenance plan will include information to

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	Update AHJ if there are changes to hazard.	ensure steps are taken for compliance as needed if need arises.
8.1.1 All types of lead-acid, aqueous nickel-based, and aqueous metal-air battery systems that are in telecommunications facilities for installations of communications equipment under the exclusive control of communications utilities and located outdoors or in building spaces or enclosures used exclusively for such installations shall be permitted to have a decommissioning plan in compliance with recognized industry practices in lieu of complying with 8.1.4.	Not Applicable No telecommunication facilities	Not Applicable
8.1.3 All types of lead-acid, aqueous nickel-based, and aqueous metal-air battery systems that are used for control of fixed guideway transit or passenger rail systems under the exclusive control of a transit authority and located in building spaces or enclosures used exclusively for such installations shall be permitted to have a decommissioning plan in accordance with applicable governmental laws and regulations in lieu of developing a decommissioning plan in accordance with 8.1.4.	Not Applicable Not for transit	Not Applicable
8.1.4 The decommissioning plan shall be provided to the AHJ and include the following information: (1) An overview of the decommissioning process developed specifically for the ESS that is to be decommissioned (2) Roles and responsibilities for all those involved in the decommissioning of the ESS and their removal from the site (3) The version of the decommissioning plan submitted during the permitting process (4) Plans and specifications necessary to understand the ESS and all associated operational controls and safety systems, as built, operated, and maintained (5)A detailed description of each activity to be conducted during the decommissioning process and who will perform that activity and at what point in time (6)Procedures to be used in documenting the ESS and all associated operational controls and safety systems that have been decommissioned (7)Guidelines and format for a decommissioning checklist and relevant operational testing forms and necessary decommissioning logs and progress reports (8)A description of how any changes to the surrounding areas and other systems adjacent to the ESS, including, but not limited to, structural elements, building penetrations, means of egress, and required fire detection and suppression systems, will be protected during decommissioning and confirmed as being acceptable after the system is removed	Applicable	Slight clarification on item 3 but no change to overall scope. Decommissioning plan will be provided when required.
9.2.1 Testing. Where required elsewhere in this standard, fire testing in accordance with Section 9.2 shall be conducted on a representative ESS in accordance with UL 9540A and large-scale fire testing to collect data for gas production at a cell level, thermal runaway propagation potential at a module level, and thermal runaway propagation potential between ESSs. 9.2.1.1 All types of lead-acid, aqueous nickel-based, and aqueous metal-air batteries comprised of vented cells, or cells or batteries listed to UL 1973, and used in stationary standby service shall not require UL 9540A and large-scale fire testing if they comply with one of the following: (1)They are installed with a charging system that is listed to UL 1012, UL 1564, UL 60950-1, UL 62109-1, or UL 62368-1. (2)They are installed with an inverter that is listed to UL 1741. (3)They are part of a UPS that is listed to UL 1778. (4)They are used for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utility and located outdoors or in building spaces used exclusively for such installations.	Applicable Testing now requires large-scale testing to collect data for gas production at a cell level, thermal runaway propagation potential at a module level, and thermal runaway propagation potential between ESSs.	In addition to UL 9540A cell and module testing, large-scale fire testing has been performed to evaluate propagation between containers as identified in the HMA.

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(5)They are used for control of fixed guideway transit or passenger rail systems under the exclusive control of a transit authority and located outdoors or in building spaces used exclusively for such installations. (6)They are used in telecommunications facilities for installations of communications equipment under the exclusive control of communications utilities and located outdoors or in building spaces used exclusively for such installations. 9.2.1.2 Where cell thermal runaway results in the release of flammable gases during a cell- or module-level test, an additional unit-level test shall be conducted involving intentional ignition of the vent gases to assess the fire propagation hazard.		
9.2.1.2.1 The large-scale fire testing in accordance with 9.2.1.2 shall be conducted or witnessed and reported by an approved testing laboratory to characterize the composition of the gases generated and show that a fire involving one ESS unit will not propagate to an adjacent unit.	Applicable The large-scale testing must be conducted or witnessed by an approved testing laboratory.	Project already complies; large-scale fire testing has been performed.
9.2.1.2.2 Proposed spacing between enclosures for outdoor ESS installations consisting of multiple enclosures shall comply with all of the following: (1)Be analyzed using anticipated wind conditions (2)Be validated using large-scale fire testing in accordance with Section 9.1 (3)Be reviewed by a registered design professional to verify that complete combustion of one enclosure shall not result in propagation to adjacent enclosures	Applicable Requirements to prevent fires spreading from one outdoor unit to another added.	Project already complies; large-scale fire testing has been performed to address this as explained in the HMA.
9.2.1.3.1 Use of stacked enclosures shall be permitted based on a large-scale fire test that the fire will not propagate beyond the stacked enclosure.	Not Applicable No stacked enclosures on the Project.	Not Applicable
9.3.2.3 An HMA shall not be required for all types of lead-acid and aqueous nickel-based battery ESSs.	Not Applicable Project uses lithium-ion batteries.	Not Applicable
9.3.3.1 Where required by the equipment listing in accordance with 4.6.1 or the hazard mitigation analysis in accordance with Section 4.4, an approved ESMS or BMS shall be provided for monitoring operating conditions and maintaining voltages, currents, and temperatures within the manufacturer's specifications. 9.3.3.2 The ESMS or BMS shall electrically isolate the ESS or affected components of the ESS if potentially hazardous conditions are detected.	Applicable	Minor clarifications to language but requirement stay the same. Already addressed by HMA.
9.3.4 Repurposed, Remanufactured, and Refurbished Batteries. 9.3.4.1 This section shall apply to batteries that have been repurposed, remanufactured, or refurbished. 9.3.4.2 ESSs containing repurposed, remanufactured, or refurbished batteries shall comply with all applicable requirements in this standard for an ESS containing new batteries.	Not Applicable All batteries are new on Project.	Not applicable

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9.3.4.3 Batteries that have been repurposed, remanufactured, or refurbished shall meet the applicable technology-specific requirements in Table 9.7.6. 9.3.4.4 Refurbished batteries that are used in an application that differs from the original use, or have internal parts replaced or repaired, shall comply with both of the following: (1)Subsection 9.3.4 for remanufactured batteries (2)Subparagraphs 9.3.4.5 and 9.3.4.6 9.3.4.5 Repurposed batteries, remanufactured batteries, and the refurbished batteries shall not be permitted unless the battery is repurposed by a company that is listed in accordance with UL 1974 and the system using the repurposed, remanufactured, or refurbished batteries complies with 4.6.1. 9.3.4.6 The repurposed or remanufactured batteries, modules, and cells shall be provided with a nameplate marking that includes the electrical ratings, chemistry, model number, and manufacturer's identification.		
9.4.1.2 Individual outdoor ESS cabinets that exceed 53 ft × 8.5 ft × 9.5 ft (16.2 m × 2.6 m × 2.9 m) in size, not including HVAC and other equipment affixed to the unit, shall be treated as indoor installations. 9.4.1.3 ESS enclosures that are occupiable shall be treated as indoor installations.	Not applicable ESS cabinets are smaller on Project and not occupied.	Not applicable
9.6.1 Indoor Installations. 9.6.1.1 ESS Dedicated-Use Buildings. 9.6.1.1.1 Where approved by the AHJ, the fire control and suppression systems, the size and separation requirements, and the water supply shall be permitted to be omitted in ESS dedicated-use buildings located more than 100 ft (30.5 m) from buildings, lot lines that can be built upon, public ways, stored combustible materials, hazardous materials, high-piled stock, and other exposure hazards not associated with electrical grid infrastructure. 9.6.1.1.2 Where approved, alarm signals shall not be required to be transmitted to an approved location where local fire alarm annunciation is provided and trained personnel are always present. 9.6.1.1.3 Occupied work centers shall not be permitted in ESS dedicated-use buildings.	Not Applicable ESS is not indoor type on Project.	Not applicable
9.6.2 Outdoor Installations. 9.6.2.1 Vegetation Control. 9.6.2.1.1 Areas within 10 ft (3 m) on each side of outdoor ESSs shall be cleared of combustible vegetation and other combustible growth. 9.6.2.1.2 Single specimens of trees, shrubbery, or cultivated ground cover such as green grass, ivy, succulents, or similar plants used as ground covers shall be permitted to be exempt provided that they do not form a means of readily transmitting fire. 9.6.2.2 Walk-in Units. Spacing shall not be required between the ESS and the enclosure walls in outdoor walk-in unit installations.	Applicable Minor clarification in language but scope is the same.	Project design complies. BESS yard will be gravel-surfaced with no vegetation and containers are 10 feet or greater from fenceline.
9.6.2.3.2 Outdoor ESS enclosures that are occupiable shall be treated as indoor installations. 9.6.2.5 Size and Separation.	Not Applicable	Not applicable

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Section 9.5.1 shall not apply to outdoor remote ESS installations. 9.6.2.6 Occupied Work Centers. Occupied work centers shall not be permitted in outdoor ESS installations.	Project not using occupiable or work centers type applications.	
9.6.2.7.1.9 The EV being charged shall not be considered an exposure for the EV charging equipment with integral ESSs.	Not Applicable No electric vehicle (EV) charging.	Not applicable
9.6.3.1 Rooftop and Open Parking Garage Installations. 9.6.3.1.1 Rooftop Installations. 9.6.3.1.1.1 Installations shall be permitted on rooftops of buildings that do not obstruct fire department rooftop operations when approved. 9.6.3.1.1.2 ESSs comprised of units with a maximum stored energy greater than 20 kWh, and associated equipment, that are located on rooftops and not enclosed by building construction shall comply with the following: (1)The roofing materials under and within 5 ft (1.5 m) horizontally from an ESS or associated equipment shall comply with one of the following: (a)Be noncombustible (b)Have a Class A rating when tested in accordance with ASTM E108 or UL 790 (2)ESSs and associated equipment shall be located from the edge of the roof a distance equal to at least the height of the system, equipment, or component but not less than 5 ft (1.5 m). (3)Installations on rooftops over 75 ft (23 m) in height above grade shall be permitted where approved by the AHJ. (4)The ESS shall be a minimum of 10 ft (3 m) from the fire service access point on the rooftop. (5)Stairway access to the roof for emergency response and fire department personnel shall be provided either through a bulkhead from the interior of the building or a stairway on the exterior of the building. (6)Access, service space, guards, and handrails shall be provided where required by the local building and mechanical codes. (7)Service walkways at least 5 ft (1.5 m) in width shall be provided for service and emergency personnel from the point of access to the roof to the system. (8)A Class I standpipe outlet shall be installed at an approved location on the roof level of the building or in the stairway bulkhead at the top level. (9)A thermal image fire detection system or radiant-energy-sensing fire detection system complying with Section 4.8 shall be provided to protect the ESS. (10)Open rack installations shall not be permitted. (11)Occupied work centers shall not be permitted.	Not Applicable Not a rooftop or open parking garage application.	Not applicable

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9.6.3.2.6.4 Alarm Signal Transmission. Alarm signals shall not be required to be transmitted to an approved location for mobile ESSs deployed 30 days or less.	Not Applicable Not a mobile ESS application.	Not applicable
9.7.1 Smoke and Fire Detection. ESSs shall be provided with a smoke detection, thermal image fire detector, or radiant-energy-sensing system in accordance with NFPA 72, unless modified by this chapter.	Applicable Thermal image fire detector added as an additional option, but is not used in Project design.	Project already complies as noted by NFPA 72 compliant design.
9.7.1.2 Normally unoccupied, remote, stand-alone, fixed guideway transit or passenger rail system buildings and enclosures with a gross floor area of less than 1500 ft2 (139 m2) using all types of lead-acid, aqueous nickel-based, and aqueous metal-air batteries shall not be required to have the detection required in 4.8.1.	Not Applicable No transit	Not applicable
9.7.1.4 All required annunciation means shall be located as required by the authority having jurisdiction to facilitate an efficient response to the situation. [72:10.18.3.2]	Applicable	Addressed in HMA and NFPA 72 Compliance.
9.7.1.5 Multiple panels shall be aggregated to a master or annunciator panel at a fire command center or other approved location.	Applicable A master panel location is required. Project has a similar configuration as any alarm state communicated from a BESS container is seen at the full site network's energy storage management system/programmable logic controller (ESMS/PLC). Confirmation will be needed from AHJ this is acceptable and they do not require a dedicated fire alarm panel.	The Project will feature a Master Fire Alarm Control Panel located on-site to provide immediate local monitoring and emergency interface. In addition, we will have 24/7/365 oversight at our Renewable Operations Control Center (ROCC).
9.7.1.7 Alarm signals from detection systems shall be transmitted to a supervising station in accordance with NFPA 72.	Applicable	Any alarm state communicated from a BESS container is seen at the full site network's energy storage management system/programmable logic controller (ESMS/PLC). The ESMS/PLC is certified to IEC 61131-2 [4] and IEC/UL

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		61010-2-201 [5] 1. The ESMS/PLC then transmits signals and alarms to NextEra Energy ROCC, which qualifies as a proprietary supervising station. The ROCC is staffed 24/7/365 and located in a building designed to withstand a Category 5 hurricane with a backup power supply.
9.7.4 Testing and Commissioning of Integrated Critical Safety Systems. 9.7.4.1 Basic Testing. Where installations involving two or more integrated critical safety systems are present, the systems shall be tested to verify the operation and function of such systems in accordance with 9.7.4.1.1 and 9.7.4.1.2. 9.7.4.1.1 When a critical safety system is tested, the response of the critical safety systems shall be verified. 9.7.4.1.2 After repair or replacement of equipment, required retesting of integrated systems shall be limited to verifying the response of critical safety functions initiated by repaired or replaced equipment. 9.7.4.2 NFPA 4 Testing. 9.7.4.2.1 For new buildings, integrated testing in accordance with NFPA 4 shall be conducted prior to the issuance of a certificate of occupancy. 9.7.4.2.2 For existing buildings, integrated testing in accordance with NFPA 4 shall be conducted at intervals not exceeding 5 years unless otherwise specified by an integrated system test plan prepared in accordance with NFPA 4. 9.7.4.3 NFPA 3 Commissioning. The procedures, methods, and documentation for the commissioning of critical safety systems and their interconnections with other building systems shall be in accordance with NFPA 3.	Applicable Testing and commissioning of integrated critical safety systems are required.	Commissioning will ensure compliance and maintenance plan will ensure integrated testing upon repair or replacement.
9.7.6.1.4 Outdoor Enclosures. Natural exhaust ventilation for outdoor enclosures shall be designed to limit the concentration of flammable gas to 25 percent of the lower flammable limit (LFL) of the free air volume during the worst-case conditions, including simultaneous "boost" charging of all the batteries.	Not Applicable	Not Applicable HMA and NFPA 69 compliance approach address how this is not applicable.

Substantive Updates[1/]	Applicability to Project	Project Conformance[2/]
9.7.6.1.5 Mechanical Exhaust Ventilation. Exhaust ventilation shall be provided in accordance with the applicable mechanical code and one of the following: (1)Where hydrogen is the gas generated, an exhaust ventilation rate based on hydrogen generation estimates sufficient to limit the maximum concentration of hydrogen to 1.0 percent of the free air volume of the room or enclosure during the worst-case conditions, including simultaneous "boost" charging of all the batteries, in accordance with nationally recognized standards (2)An exhaust ventilation rate based on the area of not less than 1 ft3/min/ft2 (5.1 L/sec/m2) of floor area of the ESS 9.7.6.1.5.1 Required mechanical exhaust ventilation systems shall be installed in accordance with the manufacturer's installation instructions and local building, mechanical, and fire codes. 9.7.6.1.5.2 Required mechanical exhaust ventilation systems shall either be supervised by an approved central, proprietary, or remote station service in accordance with NFPA 72 or initiate an audible and visual signal at an approved, constantly attended location. 9.7.6.1.5.3 The mechanical exhaust ventilation system and its components shall comply with the following: (1)Be either continuous or activated by a gas detection system in accordance with 9.6.6.1.5.4 (2)Remain on to ensure that flammable gas does not accumulate and exceed 25 percent of the LFL of the flammable gas mixture (3) Be considered a critical safety system and be in compliance with Section 4.10, unless the battery technology stops off-gassing on loss of charging power	Not Applicable Clarification to language but scope requirement remains the same	Not applicable HMA and NFPA 69 compliance approach address how this is not applicable.
9.7.6.1.5.4 Where gas detection is used to activate exhaust ventilation in accordance with 9.7.6.1.5.3, ESSs shall be protected by an approved continuous gas detection system that complies with the following: (1)The gas detection system shall be designed to activate the mechanical exhaust ventilation system when the level of flammable gas detected exceeds 25 percent of the LFL of the flammable gas mixture. (2) The gas detection system shall be considered a critical safety system and comply with Section 4.10, unless the battery technology stops off-gassing on loss of charging power. (3)Failure of the gas detection system shall annunciate a trouble signal at an approved central, proprietary, or remote station in accordance with NFPA 72 or at an approved, constantly attended location.	Not Applicable	Not Applicable HMA and NFPA 69 compliance approach address how this is not applicable.
9.7.6.5 Thermal Runaway Protection. Where required by Table 9.7.6, a listed device evaluated as part of the ESS or other approved method shall be provided to manage charging and discharging during normal operation of the ESS to maintain batteries and capacitors within their operating parameters and preclude thermal runaway.	Applicable	HMA illustrates compliance.
9.7.6.6 Thermal Runaway Propagation Prevention (TRPP) Protection Systems. 9.7.6.6.1 For fluid-based supplemental engineered and pre-engineered TRPP, the system piping and appurtenances shall be compliant with all applicable parts of ASME B31.1 or B31.3. 9.7.6.6.2 Compliance with ASME B31.1 or B31.3 shall be documented as part of the UL 9540 listing in accordance with 4.6.1. 9.7.6.6.3 The control system for the TRPP system shall be a fire alarm control unit specifically listed for releasing service. 9.7.6.6.4 The power requirements of the TRPP shall meet the requirements of Section 4.10. 9.7.6.6.5 The TRPP shall be commissioned and documented in accordance with 9.7.4.	Not Applicable	Not applicable

Substantive Updates[1/]	Applicability to Project	Project Conformance[2/]
9.7.6.6.6 The TRPP shall be inspected and tested at least annually. 9.7.6.6.7 The effectiveness of the system shall be documented in accordance with Section 9.2.		
9.7.6.7.1.1 Explosion control and prevention shall not be required if a deflagration hazard study, demonstrating that flammable gas concentrations cannot accumulate and exceed 25 percent of the LFL, on average, is submitted to the AHJ for review and approval. 9.7.6.7.1.2 Explosion control and prevention shall not be required for all types of lead-acid and aqueous nickel-based batteries. 9.7.6.7.2 Protection against the release of flammable gases during normal operation shall be in accordance with 9.7.6.1.	Not Applicable	Not applicable
9.7.6.7.3 All ESSs shall be provided with a reliable explosion control and prevention system designed, installed, operated, maintained, and tested in accordance with NFPA 69. 9.7.6.7.3.1 A partial volume deflagration evaluation shall be conducted in accordance with NFPA 68.	Applicable	Project conforms with NFPA 69 through the use of roof vents, fans, and gas detectors. Partial deflagration panels are included in Project design as a secondary measure, but are not necessary for NFPA 69 compliance; therefore, the NFPA 68 deflagration evaluation is not applicable. See SDR FP-4 for additional information.
9.7.6.7.3.2 Design of explosion control and prevention systems shall be based upon the gas composition and volume identified by testing conducted in accordance with Section 9.2.	Applicable Explosion control and prevention shall be based on large-scale testing.	Already complies based on large-scale fire test and explosion control analysis (documentation previously submitted).
9.7.6.7.3.3 Where approved, ESSs designed to ensure that no hazardous pressure waves, debris, shrapnel, or enclosure pieces are ejected, as validated by installation-level fire and explosion testing and an engineering evaluation performed by a registered design professional complying with Section 9.2 that includes the cabinet, shall be permitted in lieu of providing explosion control and prevention that complies with NFPA 69.	Not Applicable	NFPA 69 compliance is already provided.
9.7.6.7.3.4 Independent ESS enclosures installed in larger ESS configurations such as rooms, buildings, or containers shall be designed so explosive discharge of gases or projectiles are not ejected during testing complying with Section 9.2, including the ESS enclosure and the space they are installed in.	Applicable Clarification language.	Large-scale testing has been conducted.
9.7.6.7.3.6 Compartmentalization created by cold and hot aisle arrangements within the ESS enclosure shall be addressed in accordance with the following: (1)For NFPA 69 designs, the performance of ventilation systems shall be independently verified for a thermal runaway event in either aisle/sub compartment. (2)The gas detection system shall be designed to activate on detection of flammable gas in either aisle/sub compartment.	Not Applicable	Non-occupiable unit with no aisles.

Substantive Updates[1/]	Applicability to Project	Project Conformance[2/]
9.7.6.7.4 CCR Systems. The CCR system shall be suitable for its intended use and the temperatures to which it will be exposed to during a thermal runaway event. 9.7.6.7.4.1 CCR System Performance. (A) Where suppression systems other than water based are contained within an ESS, the detection, logic solvers, and sequence of events for discharge shall not impede the CCR system performance. (B) An analysis of no impact shall be provided to the AHJ along with performance data. 9.7.6.7.4.2 CCR Activation. (A) Where gas detection is used to activate a combustible concentration reduction system (CCR system) and based on an NFPA 69 deflagration study, enclosures containing ESSs shall be protected by a listed continuous gas detection system that complies with the following: (1)The gas detection system shall be designed to activate the CCR system on detection of flammable gases at no more than 10 percent of the LFL of the gas mixture. (2)The CCR system shall remain on to ensure the flammable gas does not accumulate and exceed 25 percent on average of the LFL of the gas mixture or of the individual flammable components. (3)The CCR system and its components shall be considered a critical safety system and shall comply with Section 4.10. (4)The gas detection system and CCR system shall annunciate at a supervising station. (B) Other technologies, besides gas detection, used for detection, notification, and initiation of the CCR system shall be evaluated by a registered design professional with experience in fire protection per the HMA. 9.7.6.7.4.3 CCR System Commissioning, Inspection, and Testing. In addition to NFPA 69 requirements, commissioning, inspection, and testing shall include the following: (1)Commissioning conducted and certified under the direction of a registered design professional (2)Airflow testing during commissioning to confirm that installed conditions meet the airflows in the NFPA 69 evaluation report (3)Inspection and testing to confirm the CCR systems are functioning as designed	Applicable Requirements for Combustible Concentration Reduction (CCR) system active explosion prevention method designed to stop flammable gases (like those released during a lithium-ion battery's thermal runaway) from reaching explosive levels inside an enclosure or room.	NFPA 69 compliance is already provided to meet this code section.
Chapter 10 - Reserved	Not Applicable Chapter is reserved for future use.	Not Applicable
Chapter 11 - Fuel Cell Energy Storage Systems	Not Applicable Project uses lithium-ion batteries.	Not Applicable
Chapter 12 - Superconducting Magnet Energy Storage (Reserved)	Not Applicable Chapter is reserved for future use.	Not Applicable

Substantive Updates[1/]	Applicability to Project	Project Conformance[2/]
Chapter 13 - Flywheel Energy Storage Systems (FESSs)	Not Applicable Project uses lithium-ion batteries.	Not Applicable
Chapter 14 - Storage of Lithium Metal or Lithium-ion Batteries	Not Applicable Per Section 14.1.1 (1) & 14.1.1 (7) exemption.	Not applicable
Chapter 15 - One- and Two-Family Dwellings and Townhouse Units	Not Applicable No one and two family dwellings on project	Not Applicable
Chapter 16 - Flow Batteries	Not Applicable Project uses lithium-ion batteries	Not Applicable
Chapter 17 - Energy Storage Systems on Barges and Vessels	Not Applicable Project uses lithium-ion batteries	Not Applicable

Notes:
1/ Changes or new code sections added to 2026 edition.
2/ Description of how Project conforms or will conform with applicable updates.

4.0 THERMAL RUNAWAY (AIR QUALITY, PUBLIC HEALTH, WORKER SAFETY)

4.1 Data Request SDR TR-1

Table 6 in Appendix 3.9-A Thermal Event Plume Analysis (TN 268433) presents the acute hazard quotients for individual pollutants based on Reference Exposure Level (REL) values. The Applicant indicates that the hazard index (HI) calculation is based on the Sensitive Receptor's (No. 986) result. Staff reviewed the AERMOD output files for Sensitive Receptor No. 986 and observed that the modeled 1-hour concentrations associated with source 11 (which appears to produce the highest impacts at this receptor) differ from the concentrations that can be back-calculated from Table 6 using the reported acute hazard quotients values and corresponding RELs.

SDR TR-1. Please provide the impacts calculation spreadsheet including the modeled worst-case 1-hour concentrations used for each pollutant at the maximally exposed individual receptor, along with identification of corresponding modeling scenarios from which concentration value was selected.

Response: No separate emission/concentration spreadsheets were created outside of the Hot Spots Analysis and Reporting Program (HARP) risk model. AERMOD output files, in .PLT format, were input into the HARP2 Risk Assessment model (Version 22118) from which the acute impacts were calculated. These files were supplied to the CEC. In particular, HARP generated the file "Corby11NCAcuteRiskSumByRec.csv." which displays that receptor 986 has a calculated HI of 0.260. The HARP generated file "Corby11NCAcuteRisk.csv" provides the individual concentrations by pollutant at each receptor. The modeled impacts of nitrogen oxides (NO_x), sulfur oxides (SO_x), and carbon monoxide (CO) were taken directly from the AERMOD output file, which is based on a one (1) gram/second emission rate, and the results were prorated to reflect the actual emissions of those pollutants. As noted in response SDR TR-5, particulate matter was also included as a modeled pollutant.

For the modeled worst-case 1-hour concentrations used for each pollutant at the maximum impact location (receptor 968) from source 11, HARP generates the individual pollutant concentrations and its contribution to the HI (by target organ) in the file named "Corby11NCAcuteRisk.csv."

Source 11 has consistently produced the largest 1-hour results as the location is the closest source to a sensitive receptor.

Based on discussions with CEC staff, the acute modeling analyses were revised to reflect the use of the 95% upper confidence limit of the arithmetic mean (95% UCL) across all of the test data in the Ramboll Offsite Consequence Analysis (OCA) report (Ramboll 2024). This data set was also supplemented with additional data from INERIS (2022), Willstrand et al. (2020), Hynynen (2022), and Truchot et al. (2025). The 95% UCL replaces the use of the arithmetic mean. The U.S. Environmental Protection Agency (EPA) ProUCL (Version 5.2) program was used with the emissions data to calculate the 95% UCL for hydrogen fluoride as the sample size exceeded 10 observations. For hydrogen chloride, hydrogen cyanide ammonia, formaldehyde, fine particulate matter, and sulfur dioxide, where the sample sizes were not sufficient to quantify the 95% UCL, typically with less than 10 data points, the maximum values across all of the test data were used.

The acute modeling assessments were also updated to reflect the addition of formaldehyde and ammonia and fine particulate matter ($PM_{2.5}$) to the emissions inventory, as also noted in response to SDR TR-5. The revised HI modeling results are provided in Table 4-1. Figure 4-1[2] represents the maximum distance of the HI equaling or exceeding 1.0 from any of the 14 hypothetical locations of unexpected thermal runaways at the BESS under meteorological conditions that can produce the highest ground level concentrations at a sensitive receptor.

Based on the increased conservatism of the updated analysis, the calculated HI at receptor 986 is 0.823.

Table 4-1. Acute 1-Hour Risk Results1/

Pollutant	REL Concentration (µg/m³)	AEGL-1 Concentration (µg/m³)	Acute Hazard Quotient (HI)	Sensitive Receptor x,y (meters)
Hydrogen Chloride2/	122.35	-	0.0583	595420.0, 4250270.0
Hydrogen Fluoride2/	141.76	-	0.5907	595420.0, 4250270.0
Hydrogen Cyanide	23.95	-	0.0705	595420.0, 4250270.0
Formaldehyde	9.56	-	0.1738	595420.0, 4250270.0
Ammonia	0.382		1.19E-04	595420.0, 4250270.0
Benzene	5.678	-	0.2103	595420.0, 4250270.0
Toluene	0.744	-	1.49E-04	595420.0, 4250270.0
Propane	-	9.257	-	-
Butane	-	18.775	-	-
Hexane	-	27.055	-	-
Hazard Index2/			0.823	595420.0, 4250270.0

Notes:
1/ Previously provided as Table 6 in Appendix 3.9-A Thermal Event Plume Analysis (TN# 268433)
2/ The total HI is based on the target organ "eyes" and represents the sum of HI hazard quotients for hydrogen chloride, hydrogen fluoride, formaldehyde, ammonia and toluene.
Sensitive receptor number = 986
AEGL = Acute Exposure Guideline Level; µg/m³ = microgram per cubic meter; HI = hazard index

[2] Previously provided as Figure 5 in Appendix 3.9-A Thermal Event Plume Analysis (TN# 268433)

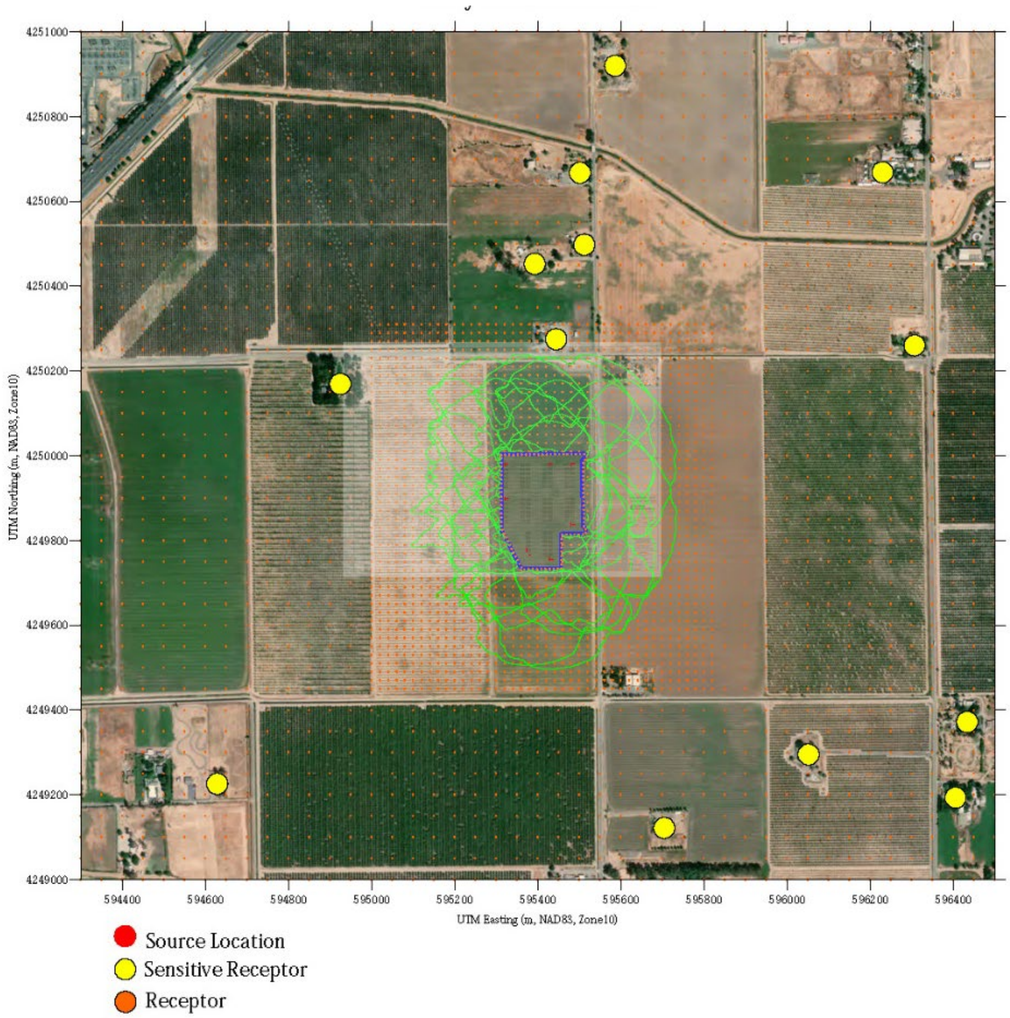


Figure 4-1. Corby BESS Acute HI > 1.0[3]

[3] Previously provided as Figure 5 in Appendix 3.9-A Thermal Event Plume Analysis (TN# 268433)

4.2 Data Request SDR TR-2

Table 1, Table 2 and Table 3 in Appendix 3.9-A Thermal Event Plume Analysis (TN 268433) do not provide emission factors or calculation steps for nitrogen dioxide (NO_2) or sulfur dioxide (SO_2). However, Table 7 presents modeled concentrations for these pollutants. In addition, the carbon monoxide (CO) concentration calculation is not clearly documented.

SDR TR-2. Please provide the impacts calculation spreadsheet, which includes the proposed emission factors, calculation steps, and supporting documentation used to derive the modeled SO_2, NO_2 and CO concentrations in Table 7.

Response: CO emissions were derived from the supplied gas composition analysis in the cell, module, and unit test reports supplied by LG. Table 2 in Appendix 3.9-A, Thermal Event Plume Analysis (TN# 268433) calculates the CO emissions using the same methodology for all the constituents on the table. CO emissions were estimated at 22.01 pounds/hour over the test duration of 7.52 hours. These emissions were used in the modeling analysis. The emission spreadsheet was updated to reflect the NO_x and SO_2 emissions as used in the modeling analysis and will be provided to the CEC under separate cover.

4.3 Data Request SDR TR-3

Table 3 in Appendix 3.9-A Thermal Event Plume Analysis (TN 268433) presents the emission factor of Hydrogen Cyanide (HCN) as 658.5 mg/kg, which is stated as the average computed from the RAMBOLL OCA report. Staff reviewed the two references cited in the RAMBOLL OCA report for HCN and observed that reference 11 characterizes emissions from stand-alone $LiPF_6$ and LiFSI-based carbonate electrolytes, with no actual battery testing conducted. The HCN emission factor from reference 11 is 64 mg/kg, which is much lower than the emission factor of 1,253 mg/kg from the other reference (#10).

SDR TR-3. Please provide additional justification demonstrating how emission factors derived from electrolytes experiments are applicable to lithium-ion battery fire scenarios.

Response: The assumptions in the Ramboll (2024) OCA report and the references given clearly indicate that the electrolytes represent a major portion of the material consumed (combusted) during a thermal runaway event. From the Ramboll OCA, the dominant volatile fuels and toxic emissions in lithium-ion batteries (LiBs) originate from electrolyte solvents and salt decomposition, not from other cell components. The referenced electrolyte-only studies (e.g., heating or burning carbonate solvents with lithium hexafluorophosphate [$LiPF_6$]) identify the same key species (CO, CO_2, hydrocarbons, hydrogen fluoride (HF), and other compounds) that are measured in full battery thermal runaway and fire tests. The studies cited in the OCA focus on the consensus that the typical dynamics of thermal runaway and emissions associated with it are electrolyte based. As noted, the early stage of battery failure is often associated with the accumulation of gases, which is the direct product of the heating and volatilization of the liquid electrolyte.

The NFPA report (Truchot et al. 2025) identifies extensive analysis of gas emissions from various scientific literature where electrolyte vaporization produces a significant portion of emissions of CO, carbon dioxide, styrene, benzene, toluene, and HF. The non-aqueous liquid electrolyte typically combines organic carbonate-based solvents and lithium salt and can decompose during a fire to produce hydrogen, hydrocarbons, and unreacted solvents. The electrolyte also contains salts, which can react with other components to produce HF. The report emphasizes that the composition of the gaseous mixture can evolve depending on many factors including battery chemistry, state of charge, and thermal runaway progression, but that the electrolyte vaporization appears to produce a majority of the recorded toxic emissions as noted from the various literate cited in the study.

In summary, the underlying decomposition chemistry in LiBs is the same, mass normalized emission factors from electrolyte experiments which represent the inherent production of these species per kilogram of "primary fuel" (electrolyte) in a real battery fire. Based on the above, we conclude that the electrolyte burn experiments represent a reasonable avenue for the derivation of emissions factors applicable to LiBs of differing types and sizes.

4.4 Data Request SDR TR-4

Using the applicant's assumed 22.5% battery mass loss for estimating emission factors, the implied mass loss is approximately 1.26 g/Wh. Staff finds that literature (Franqueville 2023) reports the mean mass loss is approximately 2.3 g/Wh.

SDR TR-4. Please clarify which value is considered more representative of the proposed battery fire scenario and provide supporting justifications.

Response: Converting the mass-based emissions approach to a stored energy approach in grams per watt-hour (g/Wh) for comparison purposes does not produce scalable results. This is especially true at the enclosure scale. It is rare for 100 percent of the battery energy to be involved, and modules/enclosures not reached by fire or shut down by protection systems have near-zero emissions. A linear Wh model implicitly assumes all energy in the fire scenario participates in the emissions. The more defensible approach is to base emission estimates on measured mass (and composition) of material actually released in fires, rather than simply based on stored energy.

Assuming emissions are simply proportional to energy storage can be attractive for high-level simple screening, but it ignores several important variables that can affect the modeling of upset events:

- Chemistry and formulation (nickel, manganese, and cobalt [NMC] vs lithium-ferro phosphate [LFP], electrolyte type, binder, flame retardants, pack materials).
- State of charge, which significantly affects heat release and HF peak rates and totals.
- Fire scenario (external fire vs internal thermal runaway, ventilation, suppression, incomplete combustion).
- Mechanical design (module/cabinet enclosures, vent paths) that change what fraction of mass actually burns or escapes.
- Propagation and segmentation: UL 9540A and NFPA 855–type designs intentionally limit fire spread to a unit or enclosure. That means emissions tend to scale more with "number of enclosures involved" than with total site megawatt-hours.
- Ventilation and dispersion nonlinearity: A 10 times increase in source strength does not produce a 10 times increase in ground-level toxic concentration, because plume rise,

buoyancy, and atmospheric dispersion all change with heat release and geometry. A simple Wh scaling ignores this.

- Suppression and burnout dynamics: At larger scales there is often staged suppression, fire service intervention, and partial burnout; total burned Wh can be a small fraction of installed Wh, and the timing of emissions changes.

Thus, much of the physics are ignored by utilizing the Wh approach to emissions estimation.

Because of these reasons, two systems with the same Wh can have quite different gas species, yields, and toxic emissions, so a purely energy-based proportionality can under- or over-predict specific hazards like HF or particulates by large factors.

Mass-loss–based approaches measure how much of the battery mass is lost (and sometimes how much of each material is volatilized or burned) during representative tests. Truchot et al. (2025) identifies that a mass approach is the preferred methodology for emissions estimates because no emission factor can be quantified without the total mass loss. This approach has the following advantages:

- It ties emissions to the actual fraction of combustible/reactive material involved, which can differ from total installed capacity if the fire is partially suppressed or compartmentalized.
- When coupled with gas/particle speciation (e.g., milligrams [mg] of HF, CO, or $PM_{2.5}$ per kilogram of mass lost), it better captures effects of design, chemistry, and ventilation than a simple mg/Wh factor.

The Ramboll OCA states:

> Page 46, 1st Paragraph - Although some studies (beyond these reviewed) have suggested that the gaseous emissions from thermal runaway events may be proportional to the battery energy capacity,[111] this is not observed when comparing data from within this highly heterogeneous dataset (Study #1 through Study #13). The large variance in emissions factors from the studies shown in Table 3-2 suggests that emissions are not simply proportional to the battery energy capacity.[112] This can also be seen in a meta-analysis[113] that included a comprehensive summary of all reviewed data.[114] Although the emissions factors were derived using two different bases (per battery mass or energy capacity) exhibit a similar degree of variation, emissions factors per unit mass were selected since there is a more fundamental link between the battery mass lost and the combustion products.[115]

In summary, when assessing the hazard impact from a BESS fire, the more physically realistic method is one anchored in measured emission factors tied to both mass loss and chemistry, then scaled up using the system's energy and configuration. A pure "total Wh" proportional model is a simplification used for rough estimates and early-stage risk screening, but it should not be treated as best-available science for detailed consequence analysis of large BESS fires.

Therefore, the use of emission factors based on mass loss and battery chemistry, as summarized in the Ramboll OCA, is expected to be the more representative approach to quantifying mass emissions.

4.5 Data Request SDR TR-5

Appendix 3.9-A Thermal Event Plume Analysis (TN 268433) only modeled hydrogen chloride, hydrogen fluoride, hydrogen cyanide, benzene, toluene, sulfur dioxide, nitrogen dioxide and carbon monoxide impacts. However, a review of the literature indicates that other toxic air contaminants (TACs), such as particulate matter, acrolein, formaldehyde, ultrafine particulates, phosphoryl fluoride, and carbonyl fluoride would also be released, even though they are not available from the UL 9540A test report. Staff needs additional analysis of the worst-case impacts during a potential BESS thermal runaway/fire event.

SDR TR-5. Please provide a revised impact analysis of all the potential criteria air pollutants and TACs mentioned above using available representative data from the literature review or measured from any BESS test and confirm that the data reflects the specific battery chemistry proposed.

Response: Much of the reviewed literature on lithium-ion battery fires and emissions characterization does not provide data in a format that can be converted into mass emissions. For example, much of the literature review identifies toxic species but in terms of concentration per unit volume rather than as a mass per unit time or mass per unit mass. The modeling method the CEC has requested requires the input of mass emissions; however, without additional data, such as the measured flow rate of the emissions sample, there is no way to quantify the measured toxic concentrations into a mass emission rate.

Where direct measurements of various species were not provided directly from the battery manufacturer, in the form of a UL 9540A test, literature was reviewed to identify additional toxic species as well as criteria pollutants. The LG-provided emissions data were presented in Table 2 in Appendix 3.9-A, Thermal Event Plume Analysis (TN# 268433). Table 4-2,[4] BESS Fire Emissions Conversions and Calculations, contains the emissions of toxics and criteria pollutants based on the literature review.

[4] Previously provided as Table 3 in Appendix 3.9-A Thermal Event Plume Analysis (TN# 268433)

Table 4-2. BESS Fire Emissions Conversions and Calculations[1/]

Conversion[2/]	Hydrogen Fluoride 7,415 mg/kg	Hydrogen Chloride 6,400 mg/kg	Hydrogen Cyanide 1,253 mg/kg	Hydrogen Bromide 500 mg/kg	Formaldehyde 500 mg/kg	Ammonia 20 mg/kg	NO_x 1426 mg/kg	SO_x 3600 mg/kg	THC 9800 mg/kg	PAH 43 mg/kg	PM 4.7 mg/kg
mg/lb =	3,363.39	2,902.99	568.35	226.80	226.80	9.07	646.82	1,632.93	4,445.20	19.50	2.13
lb/lb =	0.00742	0.00640	0.00125	0.00050	0.00050	0.00002	0.00143	0.00360	0.00980	0.00004	0.00000
Total Emissions, lbs	**103.7800**	**89.5741**	**17.5369**	**6.9980**	**6.9980**	**0.2799**	**19.9582**	**50.3854**	**137.1603**	**0.6018**	**0.0658**
Total Emissions, lbs/hr	**13.8067**	**11.9167**	**2.3331**	**0.9310**	**0.9310**	**0.0372**	**2.6552**	**6.7032**	**18.2475**	**0.0801**	**0.0088**
Modeling, g/sec	**1.74116**	**1.50282**	**0.29422**	**0.11741**	**0.11741**	**0.00470**	**0.33485**	**0.84534**	**2.30119**	**0.01010**	**0.00110**

Notes:
1/ Previously provided as Table 3 in Appendix 3.9-A Thermal Event Plume Analysis (TN# 268433)
2/ Conversion factors:
- 1 mg = 0.000002205 lb
- 1 kg = 2.204623 lb
- Cell Weight, lbs = 6.17
- Total # of Cells = 10080
- Total Battery Weight Consumed, lbs = 13994
- Total Sampling Period, min = 451
- Total Sampling Period, hrs = 7.52

Sources:
Ramboll (2024). (Mass loss rate based on p.38 data and references. Emissions factors represent the averages computed for typical LFP batteries from Tables 3-2 and 3-3.)
LG (2024a) (provided in Project Description Update #2, Part 1, Appendix 2-C [TN# 268369])
LG (2024b) (provided in Project Description Update #2, Part 1, Appendix 2-C [TN# 268369])
LG (2024c) (provided in Project Description Update #2, Part 1, Appendix 2-C [TN# 268369])
LG (2025) (provided in Project Description Update #2, Part 2, Appendix 3.9-C [TN# 268433]).
INERIS (2022), Willstrand (2020), Hynynen (2023); Truchot et al. (2025)

As noted in SDR TR-1, the assessment was updated to include the emissions of ammonia, formaldehyde, and fine particulate matter, the latter provided in the CEC staff–supplied “Environmental Impact of Lithium-Ion Battery Incidents Compared to Other Common Incidents” (Truchot et al. 2025), and was included in the revised analysis as the data were in a format that could be utilized in the CEC-requested dispersion model, AERMOD.

Based on discussions with CEC staff, the acute modeling analyses were revised to reflect the use of the 95% UCL across all applicable test data in the Ramboll (2024) OCA report. This data set was also supplemented with additional data from INERIS (2022), Willstrand et al. (2020), Hynynen et al. (2023) and Truchot et al. (2025). The 95% UCL replaces the use of the arithmetic mean. The EPA ProUCL (Version 5.2) program was used with emissions data to calculate the 95% UCL for hydrogen fluoride as the sample size exceeded 10 observations. For hydrogen chloride, hydrogen cyanide ammonia, formaldehyde, fine particulate matter, SO_2, and hydrogen bromide, the sample sizes were not sufficient to quantify the 95% UCL (typically with less than 10 data points) and the maximum value across all test data was used.

The revised emission factor data are presented in Table 4-2. The acute modeling assessments were updated based on these revised emissions and are presented in Table 4-1[5] (see response to DRR SDR TR-1). The inclusion of ultra-fine particulate matter (referenced as PM2.5) in the modeling analysis is presented in Table 4-3[6]. While the CEC did provide literature that identified acrolein emissions, the format of the data was as a concentration and not a mass emission rate, so acrolein was not included.

Additionally, some of the compounds referenced in SDR TR-5, including phosphoryl fluoride (POF_3) and carbonyl fluoride (COF_2), do not have associated California reference exposure levels.

Table 4-3. Modeled Concentrations and Ambient Air Quality Standards[1/]

Pollutant	Averaging Period	Maximum Concentration (µg/m³)	Background (µg/m³)	Total (µg/m³)	Ambient Air Quality Standards (µg/m³)
					CAAQS
NO_2	1-hour maximum	27.30	50.81	78.1	339
CO	1-hour maximum	121.50	13,225	13,346.5	23,000
	8-hour maximum	37.19	2,070	2,107.2	10,000
SO_2	1-hour maximum	45.39	296.32	341.71	655
$PM_{2.5}$	24-hour maximum	1.22	25.0	26.22	35

Note:
1/ Previously provided as Table 7 in Appendix 3.9-A Thermal Event Plume Analysis (TN# 268433)
µg/m³ = microgram per cubic meter; CAAQS = California Ambient Air Quality Standards

4.6 Data Request SDR TR-6

Appendix 3.9-A, Thermal Event Plume Analysis (TN 268433) only modeled hydrogen chloride, hydrogen fluoride, hydrogen cyanide, benzene, toluene, sulfur dioxide, nitrogen dioxide and carbon monoxide impacts. However, a review of the literature indicates that other toxic air contaminants (TACs), such as particulate matter, acrolein, formaldehyde, ultrafine particulates, phosphoryl fluoride,

[5] Previously provided as Table 6 in Appendix 3.9-A Thermal Event Plume Analysis (TN# 268433)
[6] Previously provided as Table 7 in Appendix 3.9-A Thermal Event Plume Analysis (TN# 268433)

and carbonyl fluoride would also be released, even though they are not available from the UL 9540A test report. Staff needs additional analysis of the worst-case impacts during a potential BESS thermal runaway/fire event.

SDR TR-6. If the modeling data originates from literature review, please provide a technical justification demonstrating that the data are representative and conservative for worker, responder, and public exposure conditions, and provide a copy of the referenced literature. If the modeling data comes from a BESS test, please also provide the specific analytical method(s) for determining the presence of off-gassing constituents in the test, including sample collection methods, laboratory preparation methods, analytical methods, the MDL (method detection limit) or PQL (practical quantitation limit) or RL (reporting limit) for all measured constituents, and all QA/QC (quality assurance/quality control) data including results of a spiked sample.

Response: An integral part of this analysis is the review of literature data as well as available thermal runaway testing data on cells, modules, and complete units as provided by LG. The provided source test data, utilizing the UL 9540A test methodology, were previously supplied to the CEC. As noted in the technical analysis and in these data responses, the Ramboll (2024) OCA was utilized for the additional compounds not tested in the UL 9540A test report.

Where the UL 9540A test data did not include compounds identified from literature review, the use of emission factors from the other studies was adjusted to reflect the upper bound 95% UCL in order to add a margin of conservatism in the analysis. Typically, uncontrolled fire events do not burn as a steady state process. Uncertainties in the fluctuations in temperature and mass burn rates can produce differences in plume rise and mass emissions. The available test data and literature review did contain information on a number of these variables, which were utilized in the dispersion and health risk models.

CEC staff requested that the analysis compare the potential concentrations of emitted toxic air contaminants (TACs) to the California Office of Environmental Health Hazard Assessment (OEHHA) and the Air Resources Board (ARB) one-hour (1-hr) RELs, which are used in facility health risk assessments conducted for the Assembly Bill 2588 Air Toxics “Hot Spots” Program. The data request also requested a comparison with the acute HI of TACs to determine if the significance threshold of 1.0 at sensitive receptors (residences) is exceeded.

A REL is the concentration level at or below which no adverse non-cancer health effects are anticipated for the specified exposure duration. RELs are based on the most sensitive, relevant, adverse health effects reported in medical and toxicological literature. RELs are designed to protect the most sensitive individuals in the population by the inclusion of factors that account for uncertainties as well as individual differences in human susceptibility to chemical exposures. The factors used in the calculation of RELs are meant to err on the side of public health protection in order to avoid underestimation of non-cancer hazards. Exceeding the REL does not automatically indicate an adverse health impact. Increasing concentrations above the REL value increases the likelihood that the health effect will occur, especially where exposure could occur repeatedly over time.

The REL threshold concentration(s) are always smaller than the corresponding EPA AEGL-1 and ERPG-2 thresholds, as are typically used in offsite consequence analyses, and would therefore be the most conservative concentration standard.

The modeled emissions and resultant concentrations in this assessment are based on estimates and assumptions from the data available at the time this report was generated. The AERMOD and HARP models are considered conservative in that they are designed to overpredict impacts. To aid in this overprediction, assumptions about the emissions (as referenced earlier) and the total mass consumed during an event were utilized:

- The HMA (previously provided as Appendix 3.9-B2, NextEra Product HMA [TN# 268433]) provides a summary of these safeguards in Section 3.2.1.2. There are numerous safeguards to prevent thermal runaway; as well as monitoring systems that detect possible causes and management systems that would address such causes to avoid the possibility of damage that can lead to thermal runaway. Thus, the probability that thermal runaway would occur even at just the cell level is very low.
- The cell-level UL9540A test involved the thermal runaway of a single cell. Gas composition data from the cell test were extrapolated to a module scenario and then to a unit scenario. The unit scenario assumed a thermal runaway event of all cells within the container comprising three (3) M-Link units, with two racks per unit, 14 modules per rack, and 120 cells per module, for a total of 10,080 cells.
- For the modeling assessment, it was assumed that all three M-LINK enclosures (all 10,080 battery cells) were consumed in the fire to conservatively overestimate the Project emissions and resulting modeled concentrations. The UL 9540A test results and the large-scale fire test demonstrate the low probability of a full container being consumed by fire in a thermal runaway event.
- The modeling assessment assumes the fire occurs in the one BESS container, out of the 341 total containers, that results in the highest predicted concentrations at sensitive receptor locations.
- The emissions of hazardous air pollutants were based on the 95% UCL or, in the cases of limited data, the maximum emission rate to add conservatism to the estimate.
- Worst-case meteorological conditions based on 5 years of hourly meteorological data (43,800 hourly meteorological combinations) were input to yield the maximum concentrations at receptor locations.

In summary, due to the inherent uncertainties in both the cell and large-scale burn tests, the modeling analysis accommodated these uncertainties by employing and utilizing conservative assumptions regarding emissions, meteorology, plume characteristics, and exposure methodology to conservatively calculate ground-based concentrations.

5.0 LAND USE

5.1 Data Request SDR LAND-1

SDR LAND-1. The application states Pacific Gas and Electric Company (PG&E) would design, construct, own, and operate the portion of the gen-tie line from the change of ownership (POCO) to the point of interconnection (POI) at the Vaca-Dixon Substation, including the final five structures and the I-80 crossing, and the New Corby Bay. Once operational, PG&E would transfer ownership of the POCO structure south of I-80 to the applicant. Per California Code of Regulations, Title 20, Appendix B (i) (3), please identify the steps PG&E has taken, including a schedule for obtaining easements, permits, or agreements outside the authority of the CEC, that would be necessary to complete interconnection of the project from the POCO to the POI. This should include, without limitation, the status of PG&E's ability to cross over the Solano Irrigation District (SID) canal, any Solano County Water Agency facility, creek, or drain, and coordination with Caltrans for the I-80 crossing.

Response: The agreements PG&E has identified as necessary to complete interconnection of the Project from the POCO to the point of interconnection (POI) are an encroachment permit from the California Department of Transportation (Caltrans) and a permanent easement from SID. PG&E has received the encroachment permit from Caltrans for the Interstate 80 crossing and is working with SID to obtain an Overhang Easement on SID property. PG&E made initial offer for the Overhang Easement to SID on February 24, 2026, and had been providing the necessary technical information to SID. Land acquisition typically takes 3 to 6 months, but the review schedule from SID is still pending.

6.0 VISUAL RESOURCES

6.1 Data Request SDR VIS-1

Project Description Update #2, Part 2 states that two (2) current limiting reactors (CLRs) would be visible from KOPs 2a, 3, 7a, and 7b. However, when comparing the new simulations for KOPs 2a, 3, 7a, and 7b with the previous simulations, the locations of the two CLRs are not clear.

SDR VIS-1. Please provide additional information/guidance as to where, precisely, the CLRs are located in simulations 2a, 3, 7a, and 7b.

Response: The text within Project Description Update #2 incorrectly stated the two CLRs would be visible from key observation points (KOPs) 2a, 3, 7a, and 7b. The CLRs are visible only in KOPs 2b, 3, and 7b. The CLRs are located outside of both KOP 2a and KOP 7a.

While evaluating the simulations provided under Project Description Update #2, it was noted that there was a minor discrepancy in the height of the CLRs. As a result, Figures 3.1-3, 3.1-4, 3.1-8, 3.1-11, and 3.1-12 have been updated to reflect the correct height of the CLRs. As shown in the updated figures, the CLRs continue to blend in with the substation equipment. At KOP 2b, the CLR is more visible than from the other KOPs as it is in the forefront of the substation equipment; however, when looking at the substation collectively, the CLR is of equivalent height and color as the surrounding equipment and the unit blends into the view. Further, although the CLR in KOP 2b is noticeable at the 1-year landscaping milestone (Figures 3.1-3 and 3.1-14), at 5 years (Figures 3.1-8 and 3.1-14) the landscaping effectively obscures most equipment including the CLRs, reducing visual impacts.

All other figures previously provided in the Project Description Update #2 require no changes. As requested, three additional figures (Figures 3.1-14 through 3.1-16) specifically identifying the location of the CLRs have been provided.

As a result, even with the updated modeling of the CLRs, the contrast ratings identified in the BLM Visual Contrast Rating Worksheets provided as Appendix 3.1A of the Project Description Update #2 and the conclusions provided in Project Description Update #2 remain the same.

6.2 Data Request SDR VIS-2

The Project Description Update #2, Part 2, Table 3.1-1 identifies the following dimensions for the CLRs: 25 feet in height and 10 feet in width.

SDR VIS-2. Please clarify if the 10-foot-wide dimension means 10 feet in diameter.

Response: The CLR is 10 feet wide and 10 feet in diameter.

6.3 Data Request SDR VIS-3

The Project Description Update #2, Part 2 states on Page 2 that "…The Project will continue to not include lighting." This statement contradicts the Application's previous description of lighting, which is: "Low-elevation (i.e., less than 14-foot), controlled security lighting will be installed at primary access gates and the onsite substation. The lighting will only switch on when personnel enter the area (through either motion sensor or manual activation [i.e., switch]). Lighting features will only be installed in areas where it is required for safety, security, or operations. All lighting will be directed onsite and will include shielding as necessary to direct light downward and minimize illumination of the night sky or potential impacts to surrounding viewers."

SDR VIS-3. Please clarify the apparent discrepancy in the description of lighting between the original application and the current update.

Response: The Project Description Update #2 inadvertently stated the Project would not include lighting. The Project will continue to include lighting consistent with what was identified in the Application. A lighting plan for the onsite substation was provided as Project Description Update #2, Part 1, Appendix 2-D (TN# 268369).

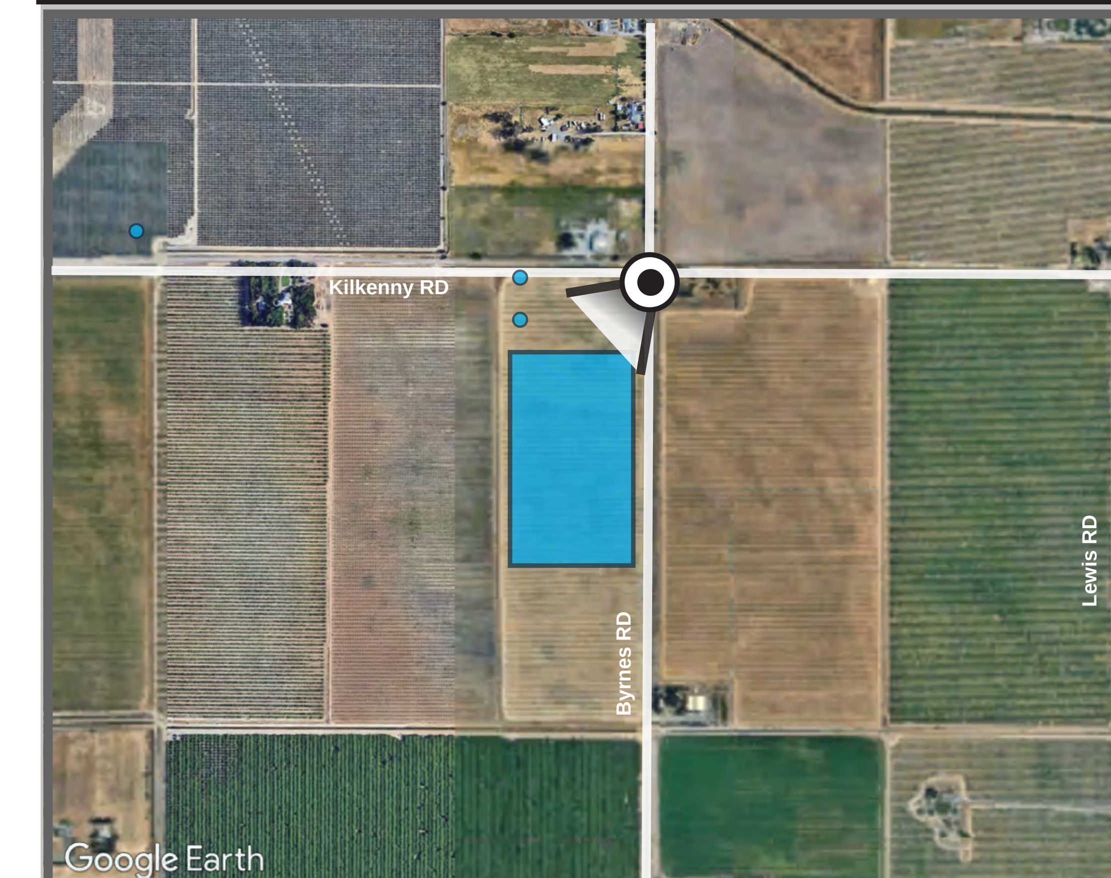
CORBY BATTERY ENERGY STORAGE SYSTEM PROJECT

Figure 3.1-3
KOP 2b

Simulation Conditions
With Landscaping After 1 Year

(Replaces Figure 4.1-9)

Intersection of Byrnes Road and Kilkenny Road



VICINITY MAP

LEGEND

SIMULATED EQUIPMENT

KOP LOCATION WITH SIMULATION

PHOTOGRAPH INFORMATION

TIME:	11:59 AM
DATE:	06/26/2024
WEATHER CONDITION:	SUNNY
VIEWING DIRECTION:	SOUTHWEST
LATITUDE:	38.39519349°
LONGITUDE:	-121.9058341°
DISTANCE TO BESS:	.12 MILES
CAMERA TYPE:	CANON EOS R5
LENS FOCAL LENGTH:	50MM

Preliminary Visualization

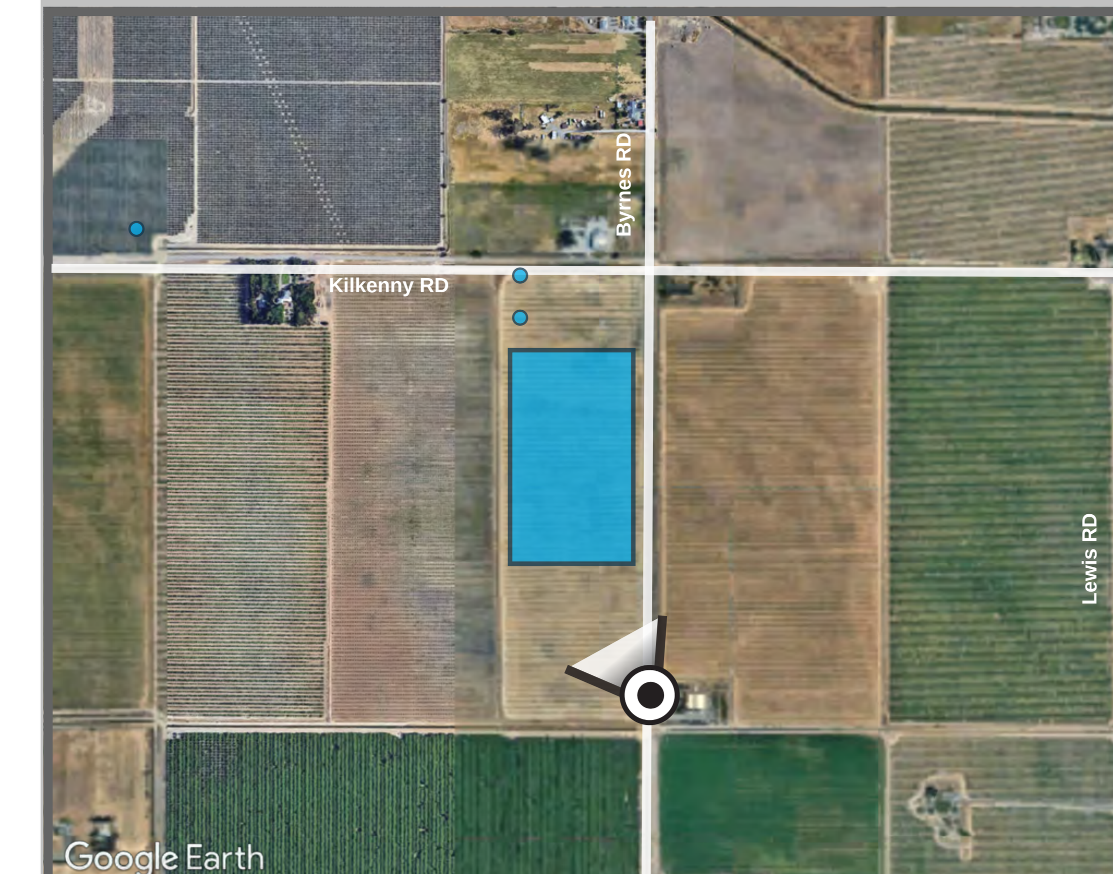
DISCLAIMER: PRELIMINARY VISUALIZATIONS ARE FOR REFERENCE ONLY; PROJECT LAYOUT IS IN DEVELOPMENT AND SUBJECT TO CHANGE.


EXISTING CONDITIONS


PROPOSED CONDITIONS

CORBY BATTERY ENERGY STORAGE SYSTEM PROJECT
Figure 3.1-4
KOP 3
Simulation Conditions
(Replaces Figure 4.1-10)

View North on Byrnes Road



VICINITY MAP

LEGEND

SIMULATED EQUIPMENT

KOP LOCATION WITH SIMULATION

PHOTOGRAPH INFORMATION

TIME:	12:06 PM
DATE:	06/26/2024
WEATHER CONDITION:	SUNNY
VIEWING DIRECTION:	NORTH
LATITUDE:	38.3879916°
LONGITUDE:	-121.905764°
DISTANCE TO BESS:	.24 MILES
CAMERA TYPE:	CANON EOS R5
LENS FOCAL LENGTH:	50MM

Preliminary Visualization

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CORBY BATTERY ENERGY STORAGE SYSTEM PROJECT

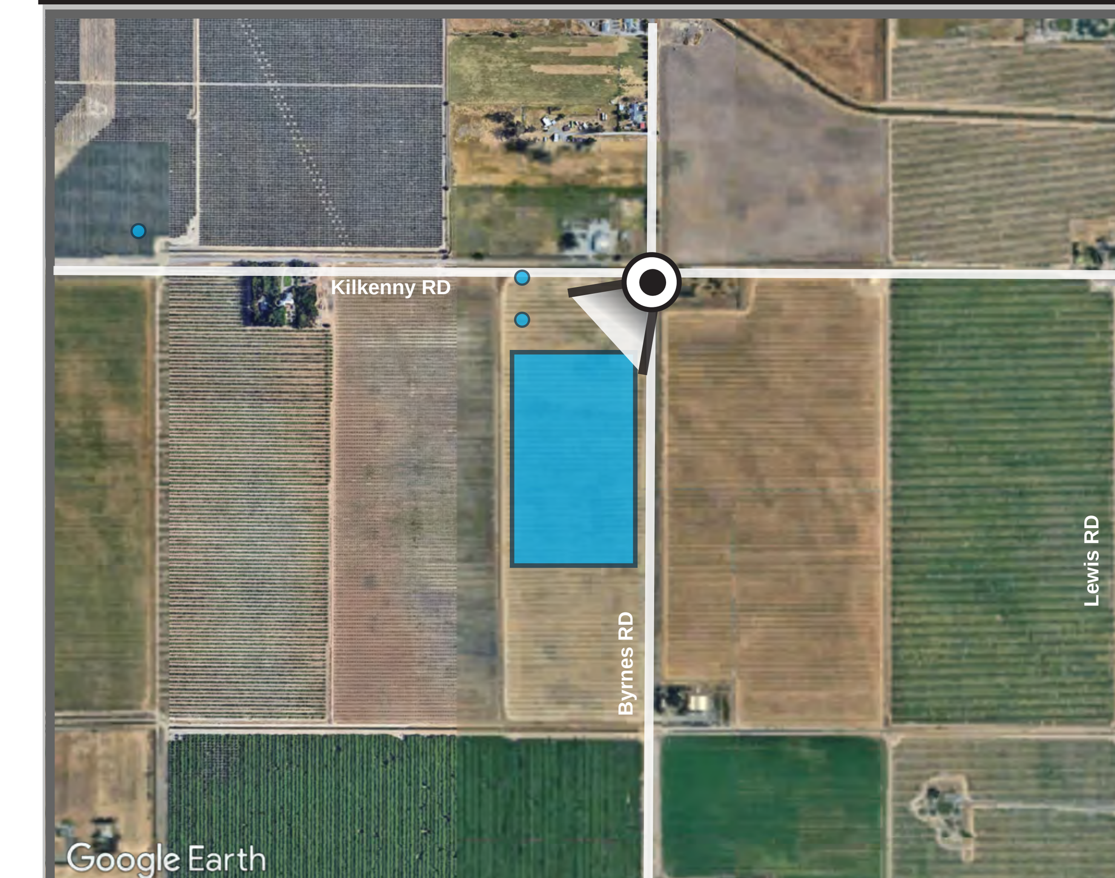
Figure 3.1-8

KOP 2b

Simulation Conditions With Landscaping After 5 Years

(Replaces Figure 4.1-13)

Intersection of Byrnes Road and Kilkenny Road



VICINITY MAP

LEGEND

SIMULATED EQUIPMENT

KOP LOCATION WITH SIMULATION

PHOTOGRAPH INFORMATION

TIME:	11:59 AM
DATE:	06/26/2024
WEATHER CONDITION:	SUNNY
VIEWING DIRECTION:	SOUTHWEST
LATITUDE:	38.39519349°
LONGITUDE:	-121.9058341°
DISTANCE TO BESS:	.12 MILES
CAMERA TYPE:	CANON EOS R5
LENS FOCAL LENGTH:	50MM

Preliminary Visualization

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CORBY BATTERY ENERGY STORAGE SYSTEM PROJECT

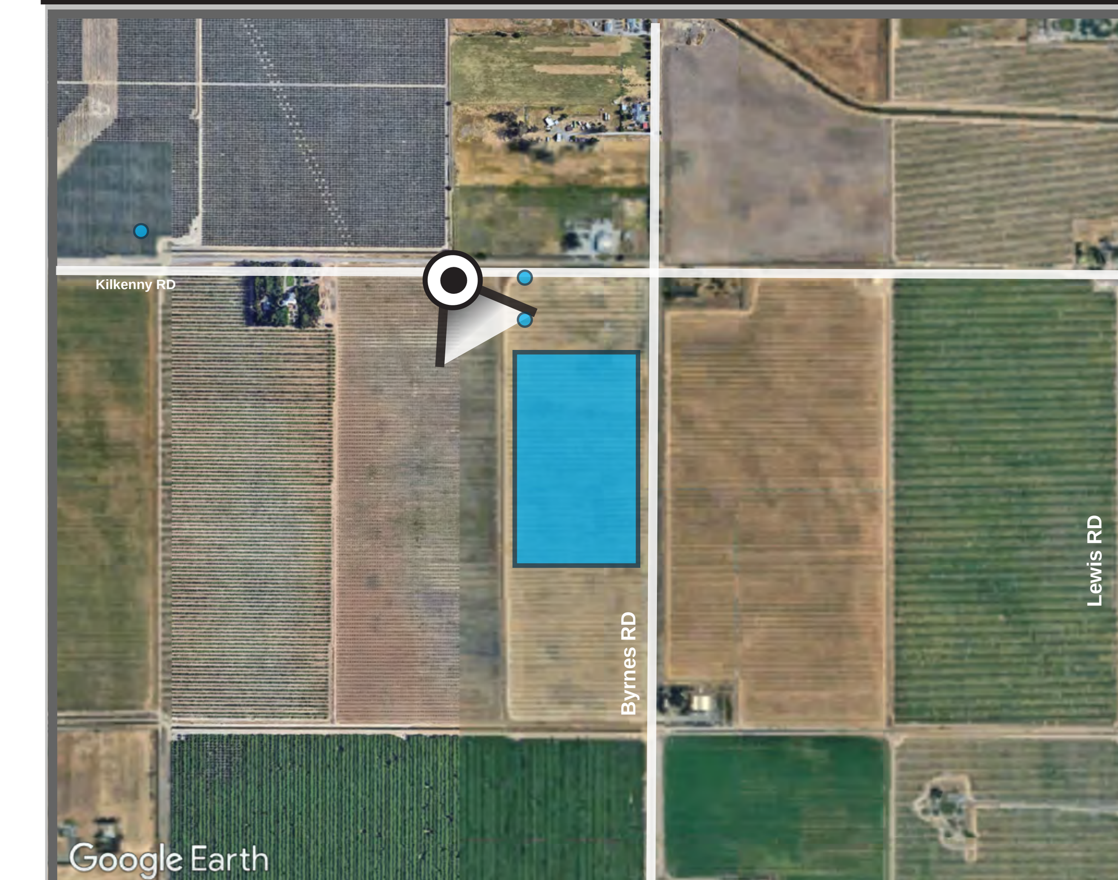
Figure 3.1-11

KOP 7b

Simulation Conditions

With Landscaping After 1 Year

Kilkenny Road



VICINITY MAP

LEGEND

SIMULATED EQUIPMENT

KOP LOCATION WITH SIMULATION

PHOTOGRAPH INFORMATION

TIME:	2:38 PM
DATE:	01/22/2025
WEATHER CONDITION:	SUNNY
VIEWING DIRECTION:	SOUTHEAST
LATITIUDE:	38.395317°
LONGITUDE:	-121.919325°
DISTANCE TO BESS:	.16 MILES
CAMERA TYPE:	CANON EOS R5
LENS FOCAL LENGTH:	50MM

Preliminary Visualization

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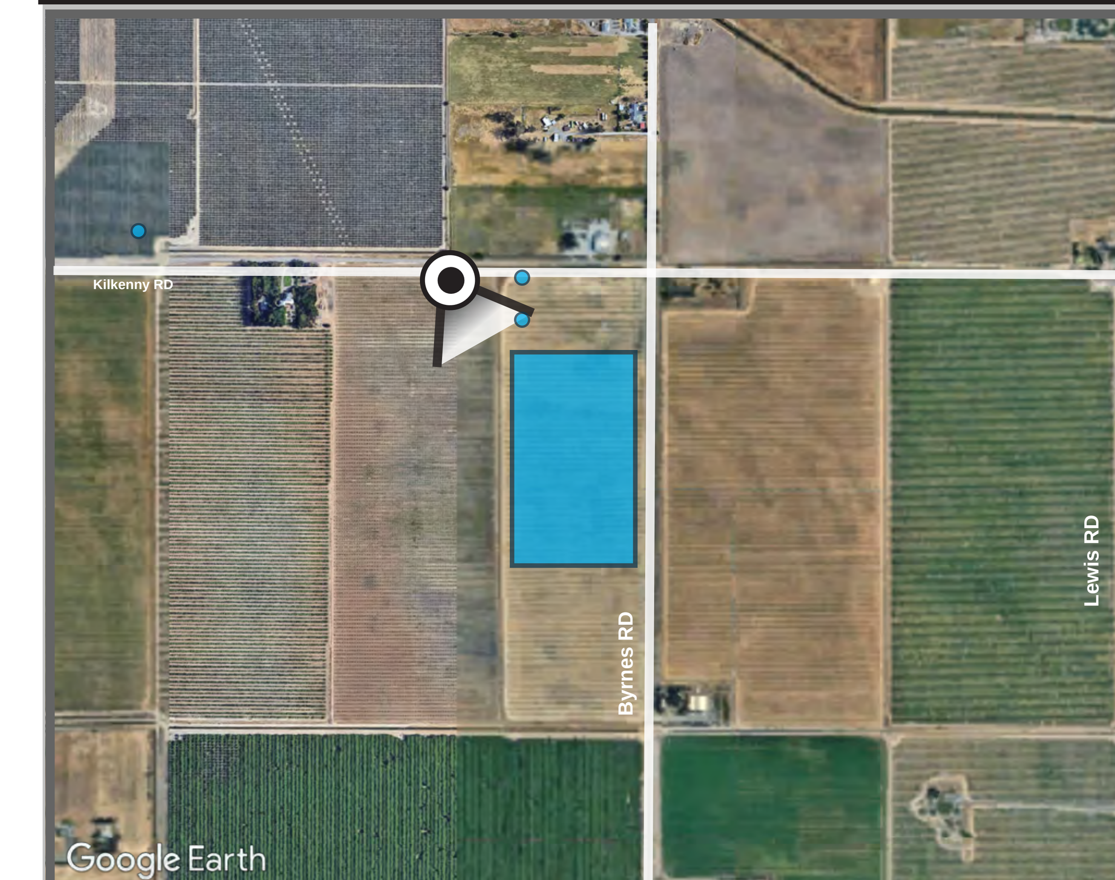
CORBY BATTERY ENERGY STORAGE SYSTEM PROJECT
Figure 3.1-12
KOP 7b
Simulation Conditions
With Landscaping After 5 Years

Kilkenny Road



VICINITY MAP

LEGEND

- SIMULATED EQUIPMENT
- KOP LOCATION WITH SIMULATION

PHOTOGRAPH INFORMATION

TIME:	2:38 PM
DATE:	01/22/2025
WEATHER CONDITION:	SUNNY
VIEWING DIRECTION:	SOUTHEAST
LATITIUDE:	38.395317°
LONGITUDE:	-121.919325°
DISTANCE TO BESS:	.16 MILES
CAMERA TYPE:	CANON EOS R5
LENS FOCAL LENGTH:	50MM

Preliminary Visualization

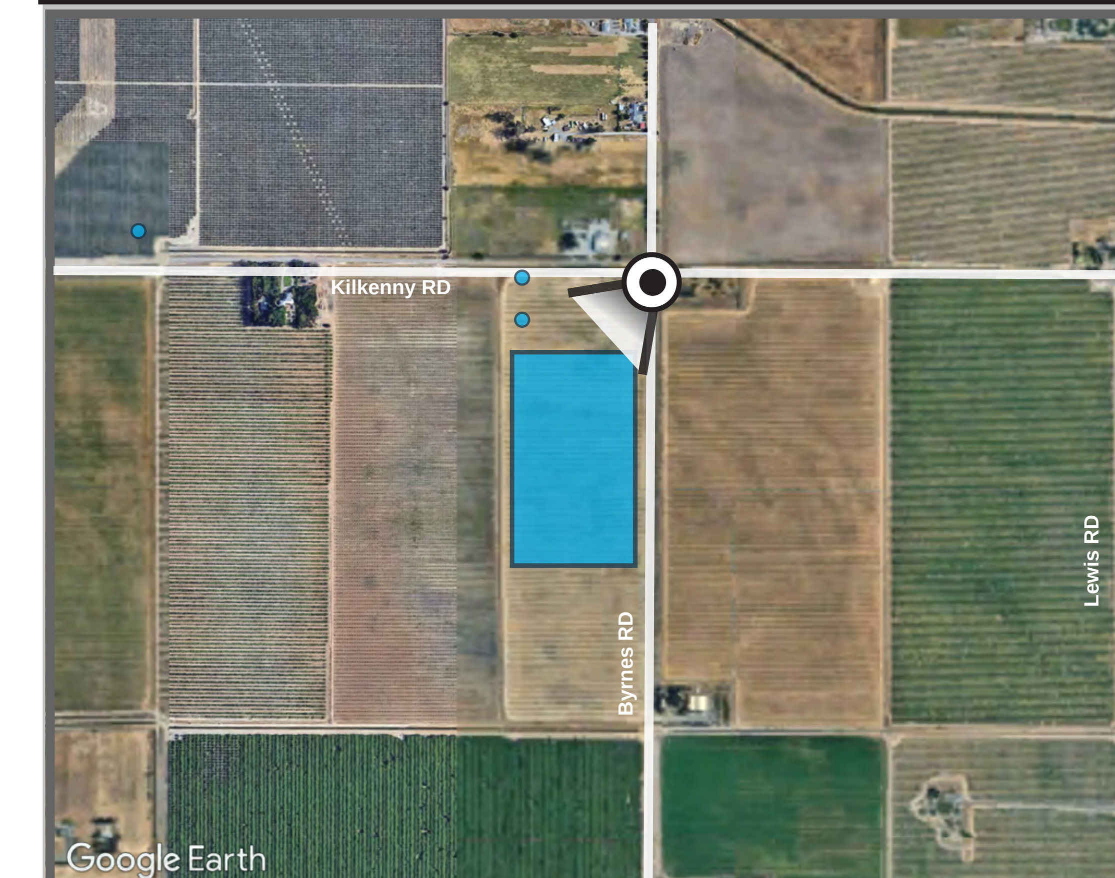
DISCLAIMER: PRELIMINARY VISUALIZATIONS ARE FOR REFERENCE ONLY; PROJECT LAYOUT IS IN DEVELOPMENT AND SUBJECT TO CHANGE.

CORBY BATTERY ENERGY STORAGE SYSTEM PROJECT

Figure 3.1-14
KOP 2b

Simulation Conditions With Indicators for CLRs

Intersection of Byrnes Road and Kilkenny Road



VICINITY MAP

LEGEND

SIMULATED EQUIPMENT

KOP LOCATION WITH SIMULATION

PHOTOGRAPH INFORMATION

TIME:	11:59 AM
DATE:	06/26/2024
WEATHER CONDITION:	SUNNY
VIEWING DIRECTION:	SOUTHWEST
LATITUDE:	38.39519349°
LONGITUDE:	-121.9058341°
DISTANCE TO BESS:	.12 MILES
CAMERA TYPE:	CANON EOS R5
LENS FOCAL LENGTH:	50MM

Preliminary Visualization

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CORBY BATTERY ENERGY STORAGE SYSTEM PROJECT
Figure 3.1-15
KOP 3
Simulation Conditions
With Indicators for CLRs

View North on Byrnes Road

VICINITY MAP

LEGEND

SIMULATED EQUIPMENT

KOP LOCATION WITH SIMULATION

PHOTOGRAPH INFORMATION

TIME:	12:06 PM
DATE:	06/26/2024
WEATHER CONDITION:	SUNNY
VIEWING DIRECTION:	NORTH
LATITUDE:	38.3879916°
LONGITUDE:	-121.905764°
DISTANCE TO BESS:	.24 MILES
CAMERA TYPE:	CANON EOS R5
LENS FOCAL LENGTH:	50MM

Preliminary Visualization

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CORBY BATTERY ENERGY STORAGE SYSTEM PROJECT

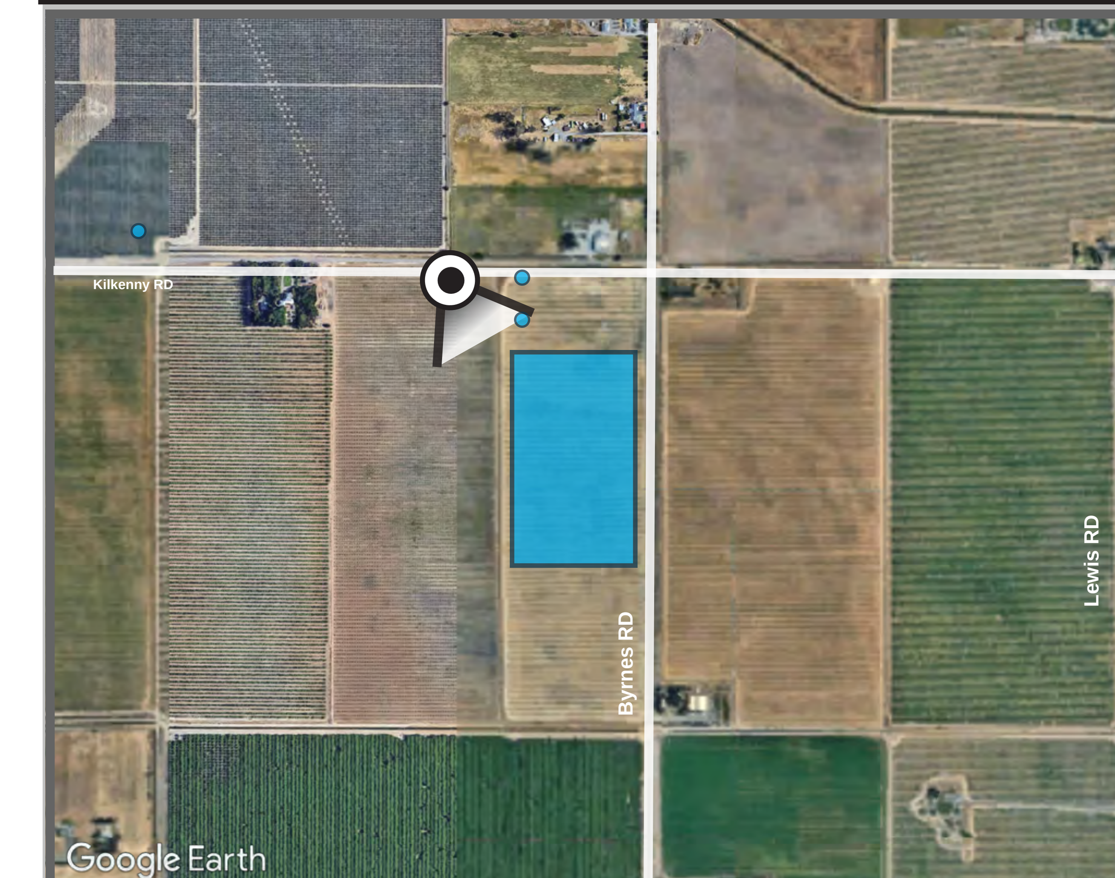
Figure 3.1-16

KOP 7b

Simulation Conditions

With Indicators for CLRs

Kilkenny Road



VICINITY MAP

LEGEND

SIMULATED EQUIPMENT

KOP LOCATION WITH SIMULATION

PHOTOGRAPH INFORMATION

TIME:	2:38 PM
DATE:	01/22/2025
WEATHER CONDITION:	SUNNY
VIEWING DIRECTION:	SOUTHEAST
LATITIUDE:	38.395317°
LONGITUDE:	-121.919325°
DISTANCE TO BESS:	.16 MILES
CAMERA TYPE:	CANON EOS R5
LENS FOCAL LENGTH:	50MM

Preliminary Visualization

DISCLAIMER: PRELIMINARY VISUALIZATIONS ARE FOR REFERENCE ONLY; PROJECT LAYOUT IS IN DEVELOPMENT AND SUBJECT TO CHANGE.

7.0 REFERENCES

INERIS. 2022. Comparison of the Fire Consequences of an Electric Vehicle and an Internal Combustion Engine Vehicle. Prepared by A. Lecocq, M. Bertana, B. Truchot, and G. Marlair. Verneuil-en-Halatte, France (data presented but not used).

Hynynen, J., O. Willstrand, P. Blomqvist, P. Anderson. 2023. Analysis of Combustion Gases from Large Scale Electric Vehicle Fire Tests. *Fire Safety Journal:* #103829.

LG (LG Energy Solution, LTD). 2024a. Cell Test Report #4791256609. October 9. (Provided in Project Description Update #2, Part 1, Appendix 2-C [TN# 268369])

LG. 2024b. Pack Test Report #4791519232. December 25. (Provided in Project Description Update #2, Part 1, Appendix 2-C [TN# 268369])

LG. 2024c. Unit Test Report #4791516927. December 26. (Provided in Project Description Update #2, Part 1, Appendix 2-C [TN# 268369])

LG. 2025. Large Scale Fire Test Report #80236098. February 25. (Provided in Project Description Update #2, Part 2, Appendix 3.9-C [TN# 268433]).

Ramboll. 2024. Offsite Consequence Analysis. Vistra Morro Bay Battery Energy Storage System (BESS) Project. Prepared by Shari Beth Libicki, Ph.D., Biljana Cosic, Ph.D., Shirley Lam, Ph.D., Volodymyr Shatokha, Ph.D.. and Farzan Oroumiyeh, Ph.D. March.

Truchot, B., C. Gaya, A. Bordes, J. Lamb, and L. Torres-Castro. 2025. *Environmental Impact of Lithium-Ion Battery Incidents Compared to Other Common Incidents.* NFPA Research Foundation. Quincy, MA. October.

Willstrand, O., R. Bisschop, P. Blomqvist, A. Temple, and J. Anderson. 2020. Toxic Gases from Vehicle Fires: RISE (Research Institute of Sweden-Div of Safety and Transport).

APPENDIX 1-A: CEC DATA REQUESTS

From:	Longman, Renee@Energy
To:	Syed, Qaim; Omercajic, Nadan
Cc:	Chang, Kaycee@Energy; Knight, Eric@Energy
Subject:	Corby BESS: Project Description Update #2 Supplemental Data Requests
Date:	Friday, February 20, 2026 6:33:34 PM
Attachments:	image001.png

Hi Qaim and Nadan,

Provided below are Corby BESS Project Description Update #2 Supplemental Data Requests. Responses should be filed to the project docket. Please let us know if you have any questions. Thank you!

Thermal Runaway Data Requests:

Table 6 in Appendix 3.9-A Thermal Event Plume Analysis (TN 268433) presents the acute hazard quotients for individual pollutants based on Reference Exposure Level (REL) values. The applicant indicates that the hazard index (HI) calculation is based on the Sensitive Receptor's (No. 986) result. Staff reviewed the AERMOD output files for Sensitive Receptor No. 986 and observed that the modeled 1-hour concentrations associated with source 11 (which appears to produce the highest impacts at this receptor) differ from the concentrations that can be back-calculated from Table 6 using the reported acute hazard quotients values and corresponding RELs.

> **SDR TR-1:** Please provide the impacts calculation spreadsheet including the modeled worst-case 1-hour concentrations used for each pollutant at the maximally exposed individual receptor, along with identification of corresponding modeling scenarios from which concentration value was selected.

Table 1, Table 2 and Table 3 in Appendix 3.9-A Thermal Event Plume Analysis (TN 268433) do not provide emission factors or calculation steps for nitrogen dioxide (NO_2) or sulfur dioxide (SO_2). However, Table 7 presents modeled concentrations for these pollutants. In addition, the carbon monoxide (CO) concentration calculation is not clearly documented.

> **SDR TR-2:** Please provide the impacts calculation spreadsheet, which includes the proposed emission factors, calculation steps, and supporting documentation used to derive the modeled SO_2, NO_2 and CO concentrations in Table 7.

Table 3 in Appendix 3.9-A Thermal Event Plume Analysis (TN 268433) presents the emission factor of Hydrogen Cyanide (HCN) as 658.5 mg/kg, which is stated as the average computed from the RAMBOLL OCA report. Staff reviewed the two references cited in the RAMBOLL OCA report for HCN and observed that reference 11 characterizes emissions from stand-alone $LiPF_6$ and LiFSI-based carbonate electrolytes, with no actual battery testing conducted. The HCN emission factor from reference 11 is 64 mg/kg, which is much lower than the emission factor of 1,253 mg/kg from the other reference (#10).

SDR TR-3: Please provide additional justification demonstrating how emission factors derived from electrolytes experiments are applicable to lithium-ion battery fire scenarios.

Using the applicant's assumed 22.5% battery mass loss for estimating emission factors, the implied mass loss is approximately 1.26 g/Wh. Staff finds that literature (Franqueville 2023) reports the mean mass loss is approximately 2.3 g/Wh.

SDR TR-4: Please clarify which value is considered more representative of the proposed battery fire scenario and provide supporting justifications.

Appendix 3.9-A Thermal Event Plume Analysis (TN 268433) only modeled hydrogen chloride, hydrogen fluoride, hydrogen cyanide, benzene, toluene, sulfur dioxide, nitrogen dioxide and carbon monoxide impacts. However, a review of the literature indicates that other toxic air contaminants (TACs), such as particulate matter, acrolein, formaldehyde, ultrafine particulates, phosphoryl fluoride, and carbonyl fluoride would also be released, even though they are not available from the UL 9540A test report. Staff needs additional analysis of the worst-case impacts during a potential BESS thermal runaway/fire event.

SDR TR-5: Please provide a revised impact analysis of all the potential criteria air pollutants and TACs mentioned above using available representative data from the literature review or measured from any BESS test and confirm that the data reflects the specific battery chemistry proposed.

SDR TR-6: If the modeling data originates from literature review, please provide a technical justification demonstrating that the data are representative and conservative for worker, responder, and public exposure conditions, and provide a copy of the referenced literature. If the modeling data comes from a BESS test, please also provide the specific analytical method(s) for determining the presence of off-gassing constituents in the test, including sample collection methods, laboratory preparation methods, analytical methods, the MDL (method detection limit) or PQL (practical quantitation limit) or RL (reporting limit) for all measured constituents, and all QA/QC (quality assurance/quality control) data including results of a spiked sample.

Generator Use Data Requests:

Tables 5 and 6 of Air Quality and Greenhouse Gas Technical Report (TN 263284) indicate that portable generator sets and air compressors will be used during multiple construction phases, with several stages overlapping. The Yolo-Solano Air Quality Management District has raised concerns regarding the 12-month Portable Equipment Registration Program (PERP) limitation and portability requirements in order to determine whether District Authority to Construct/Permit to Operate permitting may be required, if not for the CEC's in lieu authority.

SDR AQ-1: For all generator sets and air compressors identified in Table 6, please provide the engine make, model, horsepower and emission tiers.

SDR AQ-2: Please clarify unit usage across stages, mobilization/demobilization dates, continuous onsite presence, and total cumulative duration for each unit.

SDR AQ-3: For the 304-day Generator-Only Phase, please confirm whether the two generator sets are newly mobilized units or the same units used in earlier stages, and whether their total cumulative onsite duration (including prior stages) would exceed 12 months. Please confirm whether the applicant would accept a condition of certification restricting the total cumulative onsite duration of the generators to a maximum of 12 months.

SDR AQ-4: Please confirm whether generators and air compressors will be relocated within the site, whether any unit will remain fixed in one location for extended periods, and how PERP portability requirements will be met.

Land Use:

SDR LAND-1: The application states Pacific Gas and Electric Company (PG&E) would design, construct, own, and operate the portion of the gen-tie line from the change of ownership (POCO) to the point of interconnection (POI) at the Vaca-Dixon Substation, including the final five structures and the I-80 crossing, and the New Corby Bay. Once operational, PG&E would transfer ownership of the POCO structure south of I-80 to the applicant. Per California Code of Regulations, Title 20, Appendix B (i) (3), please identify the steps PG&E has taken, including a schedule for obtaining easements, permits, or agreements outside the authority of the CEC, that would be necessary to complete interconnection of the project from the POCO to the POI. This should include, without limitation, the status of PG&E's ability to cross over the Solano Irrigation District (SID) canal, any Solano County Water Agency facility, creek, or drain, and coordination with Caltrans for the I-80 crossing.

Visual Resources:

Project Description Update #2, Part 2 states that two (2) current limiting reactors (CLRs) would be visible from KOPs 2a, 3, 7a, and 7b. However, when comparing the new simulations for KOPs 2a, 3, 7a, and 7b with the previous simulations, the locations of the two CLRs are not clear.

SDR VIS-1: Please provide additional information/guidance as to where, precisely, the CLRs are located in simulations 2a, 3, 7a, and 7b.

The Project Description Update #2, Part 2, Table 3.1-1 identifies the following dimensions for the CLRs: 25 feet in height and 10 feet in width.

SDR VIS-2: Please clarify if the 10-foot-wide dimension means 10 feet in diameter.

The Project Description Update #2, Part 2 states on Page 2 that…*"The Project will continue to not include lighting."* This statement contradicts the Application's previous description of lighting, which is: "*Low-elevation (i.e., less than 14-foot), controlled security lighting will be installed at primary access gates and the onsite substation. The lighting will only switch on when personnel enter the area (through either motion sensor or manual activation [i.e., switch]). Lighting features will only be installed in areas where it is required for safety, security, or operations. All lighting will be directed onsite and will include shielding as necessary to direct light downward and minimize illumination of the night sky or potential impacts to surrounding viewers."*

SDR VIS-3: Please clarify the apparent discrepancy in the description of lighting between the original application and the current update.

Fire Protection:

The application references compliance with the 2023 Edition of NFPA 855, even though the 2026 Edition (adopted September 2025) is the applicable standard. It is unclear whether the project design, hazard mitigation measures, and operational protocols have been reviewed for consistency with the 2026 requirements. The application does not indicate that a gap analysis has been performed between the 2023 and 2026 editions. Clarification is needed to confirm that the project will meet the applicable fire and life safety requirements.

SDR FP-1: Please evaluate the differences between the 2023 and 2026 Editions of NFPA 855 as they apply to the proposed BESS and explain how the project would comply with the 2026 Edition. Please also provide similar evaluations for the 2026 Edition of NFPA 850 and UL 1741 (3rd Edition, including Supplement SB), and describe how the project would comply with those requirements.

The application relies on compliance with the 4th Edition of UL 9540A (published November 12, 2019), which the site-specific HMA identifies as the governing test standard. The 5th Edition of UL 9540A was published March 12, 2025, and includes revisions relevant to hazard characterization and mitigation measures. It is unclear whether the UL 9540A testing conducted in late 2024 is consistent with the 5th Edition requirements. Clarification is needed to ensure that the fire and explosion hazard evaluation reflects the current updated standard.

SDR FP-2: Please evaluate the differences between the 4th and 5th Editions of UL 9540A as they apply to the proposed BESS and the UL 9540A testing conducted in late 2024. Identify any substantive differences, and explain whether or not a supplemental analysis or additional testing will be conducted and provided to demonstrate compliance with the 5th Edition.

Inconsistent statements regarding the Energy Storage Management System (ESMS)/Programmable Logic Controller (PLC) certification status are found in Project Description Update #2, Part 2 [TN 268433]. Appendix 3.9-B1, §2.3, page 13 states that the ESMS/PLC is certified to IEC 61131-2 and IEC/UL 61010-2-201; however, a footnote indicates that certifications were not provided for review because an ESMS/PLC model has not yet been selected. Clarification is necessary to understand how compliance with referenced certification standards will be ensured if the equipment has not been identified. Staff is reviewing these supplemental submittals with the understanding that the model has already been selected.

SDR FP-3: Please inform staff of the exact model selected or clarify the status of and timeline for the ESMS/PLC selection and certification.

Staff seeks clarification regarding whether deflagration panels are included in the proposed design and, if so, to explain their role within the explosion protection strategy. The application references deflagration panels in several sections, including in discussions of NFPA 69 compliance; however, neither the Explosion Prevention System Design Report (TN 268433, Appendix 3.9-D) nor the Product HMA (TN268433, Appendix 3.9-B2) describes or evaluates deflagration panels as part of the system design. The Large Scale Fire Test (LSFT) also references deflagration panels, but photos of the systems tested do not appear to include them.

> **SDR FP-4:** Please clarify whether deflagration panels are included in the proposed BESS design. If so, please include consistent figures and statements of their location, design basis, and how they are integrated into the NFPA 69 explosion protection approach, including any supporting calculations or evaluations.

Renee Longman AICP, LEED AP BD+C
Project Manager
Siting and Environmental Branch
Siting, Transmission and Environmental Protection Division
1-916-937-3538

California Energy Commission
Website: www.energy.ca.gov

APPENDIX 3-A: POWER ELECTRONICS FREEMAQ PCSM GEN 3 INVERTER CERTIFICATION: GEN3 - UL 1741 – SAFETY

eurofins E&E

Certification Record

Listing#: E114528
Report #: 124390 c1 129727
Original Certification Date: September 21, 2022
Revised Certification Date: January 5, 2024

This Certification is issued to:
Power Electronics España SL
Polígono Pla de Carrases B. CV35 Salida 30
46160 Lliria, Valencia, España

Stating that the product(s):
Grid Support Interactive Medium Voltage Solar inverter,
Model HEM FSxxxxM
Grid Support Interactive Solar inverter,
Model HEMK FSxxxxK
Grid Support Interactive Medium Voltage Bidirectional Storage inverter,
Model FREEMAQ MULTI PCSM FPxxxxMy
Grid Support Interactive Bidirectional Storage inverter,
Model FREEMAQ MULTI PCSK FPxxxxKy
Grid Support Interactive Medium Voltage Bidirectional Storage inverter,
Model FREEMAQ PCSM FPxxxxM
Grid Support Interactive Bidirectional Storage inverter,
Model FREEMAQ PCSK FPxxxxK

Product Rating(s):

REFERENCE (inverters)		**FS4200M**	**FS4201M**
NUMBER OF MODULES		4	
AC	AC Output Power (kVA/kW) @40ºC	4200	
	AC Output Power (kVA/kW) @50ºC	3900	
	Operating Grid Voltage (VAC)	34,5kV ±10%	13,8kV ±10%
	Operating Grid Frequency (Hz)	60 Hz	
	Current Harmonic Distorsion	< 3% per IEEE 519	
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night	
DC	MPPt @full power (VDC)	934-1500V	
	Maximum DC Voltage	1500V	
	Voltage ripple	< 3%	
	Max. DC continuous current (A)	4590	
	Number of DC inputs	Up to 40	

REFERENCE (inverters)		**FS4105M**	**FS4106M**
NUMBER OF MODULES		4	
AC	AC Output Power (kVA/kW) @40ºC	4105	
	AC Output Power (kVA/kW) @50ºC	3810	
	Operating Grid Voltage (VAC)	34,5kV ±10%	13,8kV ±10%
	Operating Grid Frequency (Hz)	60 Hz	
	Current Harmonic Distorsion	< 3% per IEEE 519	
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night	
DC	MPPt @full power (VDC)	913-1500V	
	Maximum DC Voltage	1500V	
	Voltage ripple	< 3%	
	Max. DC continuous current (A)	4590	
	Number of DC inputs	Up to 40	

REFERENCE (inverters)		**FS4010M**	**FS4011M**
NUMBER OF MODULES		4	
AC	AC Output Power (kVA/kW) @40ºC	4010	
	AC Output Power (kVA/kW) @50ºC	3720	
	Operating Grid Voltage (VAC)	34,5kV ±10%	13,8kV ±10%
	Operating Grid Frequency (Hz)	60 Hz	
	Current Harmonic Distorsion	< 3% per IEEE 519	
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night	
DC	MPPt @full power (VDC)	891-1500V	
	Maximum DC Voltage	1500V	
	Voltage ripple	< 3%	
	Max. DC continuous current (A)	4590	
	Number of DC inputs	Up to 40	

REFERENCE (inverters)		**FS2195K**	**FS3290K**	**FS4390K**
NUMBER OF MODULES		2	3	4
AC	AC Output Power (kVA/kW) @40ºC	2195	3290	4390
	AC Output Power (kVA/kW) @50ºC	2035	3055	4075
	Operating Grid Voltage (VAC)	690V ±10%		
	Operating Grid Frequency (Hz)	60 Hz		
	Current Harmonic Distorsion	< 3% per IEEE 519		
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night		
DC	MPPt @full power (VDC)	976-1500V		
	Maximum DC Voltage	1500V		
	Voltage ripple	< 3%		
	Max. DC continuous current (A)	2295	3443	4590
	Number of DC inputs	Up to 20	Up to 30	Up to 40

REFERENCE (inverters)		FS2101K	FS3151K	FS4200K
NUMBER OF MODULES		2	3	4
AC	AC Output Power (kVA/kW) @40ºC	2100	3150	4200
	AC Output Power (kVA/kW) @50ºC	1950	2925	3900
	Operating Grid Voltage (VAC)	660V ±10%		
	Operating Grid Frequency (Hz)	60 Hz		
	Current Harmonic Distorsion	< 3% per IEEE 519		
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night		
DC	MPPt @full power (VDC)	934-1500V		
	Maximum DC Voltage	1500V		
	Voltage ripple	< 3%		
	Max. DC continuous current (A)	2295	3443	4590
	Number of DC inputs	Up to 20	Up to 30	Up to 40

REFERENCE (inverters)		FS2055K	FS3080K	FS4105K
NUMBER OF MODULES		2	3	4
AC	AC Output Power (kVA/kW) @40ºC	2055	3080	4105
	AC Output Power (kVA/kW) @50ºC	1905	2855	3810
	Operating Grid Voltage (VAC)	645V ±10%		
	Operating Grid Frequency (Hz)	60 Hz		
	Current Harmonic Distorsion	< 3% per IEEE 519		
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night		
DC	MPPt @full power (VDC)	913-1500V		
	Maximum DC Voltage	1500V		
	Voltage ripple	< 3%		
	Max. DC continuous current (A)	2295	3443	4590
	Number of DC inputs	Up to 20	Up to 30	Up to 40

REFERENCE (inverters)		FS2005K	FS3005K	FS4010K
NUMBER OF MODULES		2	3	4
AC	AC Output Power (kVA/kW) @40ºC	2005	3005	4010
	AC Output Power (kVA/kW) @50ºC	1860	2790	3720
	Operating Grid Voltage (VAC)	630V ±10%		
	Operating Grid Frequency (Hz)	60 Hz		
	Current Harmonic Distorsion	< 3% per IEEE 519		
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night		
DC	MPPt @full power (VDC)	891-1500V		
	Maximum DC Voltage	1500V		
	Voltage ripple	< 3%		
	Max. DC continuous current (A)	2295	3443	4590
	Number of DC inputs	Up to 20	Up to 30	Up to 40

REFERENCE (inverters)		FS1955K	FS2935K	FS3915K
NUMBER OF MODULES		2	3	4
AC	AC Output Power (kVA/kW) @40ºC	1955	2935	3915
	AC Output Power (kVA/kW) @50ºC	1815	2725	3635
	Operating Grid Voltage (VAC)	615V ±10%		
	Operating Grid Frequency (Hz)	60 Hz		
	Current Harmonic Distorsion	< 3% per IEEE 519		
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night		
DC	MPPt @full power (VDC)	870-1500V		
	Maximum DC Voltage	1500V		
	Voltage ripple	< 3%		
	Max. DC continuous current (A)	2295	3443	4590
	Number of DC inputs	Up to 20	Up to 30	Up to 40

REFERENCE (inverters)		FS1910K	FS2865K	FS3820K
NUMBER OF MODULES		2	3	4
AC	AC Output Power (kVA/kW) @40ºC	1910	2865	3820
	AC Output Power (kVA/kW) @50ºC	1775	2660	3545
	Operating Grid Voltage (VAC)	600V ±10%		
	Operating Grid Frequency (Hz)	60 Hz		
	Current Harmonic Distorsion	< 3% per IEEE 519		
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night		
DC	MPPt @full power (VDC)	849-1500V		
	Maximum DC Voltage	1500V		
	Voltage ripple	< 3%		
	Max. DC continuous current (A)	2295	3443	4590
	Number of DC inputs	Up to 20	Up to 30	Up to 40

REFERENCE (inverters)		FP4200M2	FP4201M2	FP4200M4	FP4201M4
AC	AC Output Power (kVA/kW) @40ºC	4200			
	AC Output Power (kVA/kW) @50ºC	3900			
	Operating Grid Voltage (VAC)	34,5kV ±10%	13,8kV ±10%	34,5kV ±10%	13,8kV ±10%
	Operating Grid Frequency (Hz)	60 Hz			
	Current Harmonic Distorsion	< 3% per IEEE 519			
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night			
DC	MPPt @full power (VDC)	934-1500V			
	Maximum DC Voltage	1500V			
	Voltage ripple	< 3%			
	Max. DC continuous current (A) per input	2295		1148	
	Number of DC inputs	2		4	

REFERENCE (inverters)		FP4105M2	FP4106M2	FP4105M4	FP4106M4
AC	AC Output Power (kVA/kW) @40ºC	4105			
	AC Output Power (kVA/kW) @50ºC	3810			
	Operating Grid Voltage (VAC)	34,5kV ±10%	13,8kV ±10%	34,5kV ±10%	13,8kV ±10%
	Operating Grid Frequency (Hz)	60 Hz			
	Current Harmonic Distorsion	< 3% per IEEE 519			
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night			
DC	MPPt @full power (VDC)	913-1500V			
	Maximum DC Voltage	1500V			
	Voltage ripple	< 3%			
	Max. DC continuous current (A) per input	2295		1148	
	Number of DC inputs	2		4	

REFERENCE (inverters)		FP4010M2	FP4011M2	FP4010M4	FP4011M4
AC	AC Output Power (kVA/kW) @40ºC	4010			
	AC Output Power (kVA/kW) @50ºC	3720			
	Operating Grid Voltage (VAC)	34,5kV ±10%	13,8kV ±10%	34,5kV ±10%	13,8kV ±10%
	Operating Grid Frequency (Hz)	60 Hz			
	Current Harmonic Distorsion	< 3% per IEEE 519			
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night			
DC	MPPt @full power (VDC)	891-1500V			
	Maximum DC Voltage	1500V			
	Voltage ripple	< 3%			
	Max. DC continuous current (A) per input	2295		1148	
	Number of DC inputs	2		4	

REFERENCE (inverters)		FP4200M2	FP4201M2	FP4200M4	FP4201M4
AC	AC Output Power (kVA/kW) @40ºC	4200			
	AC Output Power (kVA/kW) @50ºC	3900			
	Operating Grid Voltage (VAC)	34,5kV ±10%	13,8kV ±10%	34,5kV ±10%	13,8kV ±10%
	Operating Grid Frequency (Hz)	60 Hz			
	Current Harmonic Distorsion	< 3% per IEEE 519			
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night			
DC	MPPt @full power (VDC)	934-1500V			
	Maximum DC Voltage	1500V			
	Voltage ripple	< 3%			
	Max. DC continuous current (A) per input	2295		1148	

	Number of DC inputs	2	4

REFERENCE (inverters)		FP2195K2	FP3290K3	FP4390K2	FP4390K4
NUMBER OF MODULES		2	3	4	4
AC	AC Output Power (kVA/kW) @40ºC	2195	3290	4390	
	AC Output Power (kVA/kW) @50ºC	2035	3055	4075	
	Operating Grid Voltage (VAC)	690V ±10%			
	Operating Grid Frequency (Hz)	60 Hz			
	Current Harmonic Distorsion	< 3% per IEEE 519			
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night			
DC	MPPt @full power (VDC)	976-1500V			
	Maximum DC Voltage	1500V			
	Voltage ripple	< 3%			
	Max. DC continuous current (A) per input	1148	1148	2295	1148
	Number of DC inputs	2	3	2	4

REFERENCE (inverters)		FP2101K2	FP3151K3	FP4200K2	FP4200K4
NUMBER OF MODULES		2	3	**4**	4
AC	AC Output Power (kVA/kW) @40ºC	2100	3150	4200	
	AC Output Power (kVA/kW) @50ºC	1950	2925	3900	
	Operating Grid Voltage (VAC)	660V ±10%			
	Operating Grid Frequency (Hz)	60 Hz			
	Current Harmonic Distorsion	< 3% per IEEE 519			
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night			
DC	MPPt @full power (VDC)	934-1500V			
	Maximum DC Voltage	1500V			
	Voltage ripple	< 3%			
	Max. DC continuous current (A) per input	1148	1148	2295	1148
	Number of DC inputs	2	3	2	4

REFERENCE (inverters)		FP2055K2	FP3080K3	FP4105K2	FP4105K4
NUMBER OF MODULES		2	3	**4**	4
AC	AC Output Power (kVA/kW) @40ºC	2055	3080	4105	
	AC Output Power (kVA/kW) @50ºC	1905	2855	3810	
	Operating Grid Voltage (VAC)	645V ±10%			
	Operating Grid Frequency (Hz)	60 Hz			
	Current Harmonic Distorsion	< 3% per IEEE 519			
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night			
DC	MPPt @full power (VDC)	913-1500V			
	Maximum DC Voltage	1500V			
	Voltage ripple	< 3%			
	Max. DC continuous current (A) per input	1148	1148	2295	1148
	Number of DC inputs	2	3	2	4

REFERENCE (inverters)		FP2005K2	FP3005K3	FP4010K2	FP4010K4
NUMBER OF MODULES		2	3	**4**	4
AC	AC Output Power (kVA/kW) @40ºC	2005	3005	4010	
	AC Output Power (kVA/kW) @50ºC	1860	2790	3720	
	Operating Grid Voltage (VAC)	630V ±10%			
	Operating Grid Frequency (Hz)	60 Hz			
	Current Harmonic Distorsion	< 3% per IEEE 519			
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night			
DC	MPPt @full power (VDC)	891-1500V			
	Maximum DC Voltage	1500V			
	Voltage ripple	< 3%			
	Max. DC continuous current (A) per input	1148	1148	2295	1148
	Number of DC inputs	2	3	2	4

REFERENCE (inverters)		**FP1955K2**	**FP2935K3**	**FP3915K2**	**FP3915K4**
NUMBER OF MODULES		2	3	**4**	4
AC	AC Output Power (kVA/kW) @40ºC	1955	2935	3915	
	AC Output Power (kVA/kW) @50ºC	1815	2725	3635	
	Operating Grid Voltage (VAC)	615V ±10%			
	Operating Grid Frequency (Hz)	60 Hz			
	Current Harmonic Distorsion	< 3% per IEEE 519			
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night			
DC	MPPt @full power (VDC)	870-1500V			
	Maximum DC Voltage	1500V			
	Voltage ripple	< 3%			
	Max. DC continuous current (A) per input	1148	1148	2295	1148
	Number of DC inputs	2	3	2	4

REFERENCE (inverters)		**FP1910K2**	**FP2865K3**	**FP3820K2**	**FP3820K4**
NUMBER OF MODULES		2	3	**4**	4
AC	AC Output Power (kVA/kW) @40ºC	1910	2865	3820	
	AC Output Power (kVA/kW) @50ºC	1775	2660	3545	
	Operating Grid Voltage (VAC)	600V ±10%			
	Operating Grid Frequency (Hz)	60 Hz			
	Current Harmonic Distorsion	< 3% per IEEE 519			
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night			
DC	MPPt @full power (VDC)	849-1500V			
	Maximum DC Voltage	1500V			
	Voltage ripple	< 3%			
	Max. DC continuous current (A) per input	1148	1148	2295	1148
	Number of DC inputs	2	3	2	4

REFERENCE (inverters)		FP1685K2	FP2530K3	FP3370K2	FP3370K4
NUMBER OF MODULES		2	3	**4**	4
AC	AC Output Power (kVA/kW) @40ºC	1685	2530	3370	
	AC Output Power (kVA/kW) @50ºC	1565	2350	3130	
	Operating Grid Voltage (VAC)	530V ±10%			
	Operating Grid Frequency (Hz)	60 Hz			
	Current Harmonic Distorsion	< 3% per IEEE 519			
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night			
DC	MPPt @full power (VDC)	750-1300V			
	Maximum DC Voltage	1300V			
	Voltage ripple	< 3%			
	Max. DC continuous current (A) per input	1148	1148	2295	1148
	Number of DC inputs	2	3	2	4

REFERENCE (inverters)		FP1590K2	FP2385K3	FP3180K2	FP3180K4
NUMBER OF MODULES		2	3	**4**	4
AC	AC Output Power (kVA/kW) @40ºC	1590	2385	3180	
	AC Output Power (kVA/kW) @50ºC	1475	2215	2955	
	Operating Grid Voltage (VAC)	500V ±10%			
	Operating Grid Frequency (Hz)	60 Hz			
	Current Harmonic Distorsion	< 3% per IEEE 519			
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night			
DC	MPPt @full power (VDC)	708-1250V			
	Maximum DC Voltage	1250V			
	Voltage ripple	< 3%			
	Max. DC continuous current (A) per input	1148	1148	2295	1148
	Number of DC inputs	2	3	2	4

REFERENCE (inverters)		FP1525K2	FP2290K3	FP3055K2	FP3055K4
NUMBER OF MODULES		2	3	**4**	4
AC	AC Output Power (kVA/kW) @40ºC	1525	2290	3055	
	AC Output Power (kVA/kW) @50ºC	1415	2125	2840	
	Operating Grid Voltage (VAC)	480V ±10%			
	Operating Grid Frequency (Hz)	60 Hz			
	Current Harmonic Distorsion	< 3% per IEEE 519			
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night			
DC	MPPt @full power (VDC)	679-1200V			
	Maximum DC Voltage	1200V			
	Voltage ripple	< 3%			
	Max. DC continuous current (A) per input	1148	1148	2295	1148
	Number of DC inputs	2	3	2	4

REFERENCE (inverters)		FP4200M	FP4201M
NUMBER OF MODULES		4	
AC	AC Output Power (kVA/kW) @40ºC	4200	
	AC Output Power (kVA/kW) @50ºC	3900	
	Operating Grid Voltage (VAC)	34,5kV ±10%	13,8kV ±10%
	Operating Grid Frequency (Hz)	60 Hz	
	Current Harmonic Distorsion	< 3% per IEEE 519	
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night	
DC	MPPt @full power (VDC)	934-1500V	
	Maximum DC Voltage	1500V	
	Voltage ripple	< 3%	
	Max. DC continuous current (A)	4590	

REFERENCE (inverters)		FP4105M	FP4106M
NUMBER OF MODULES		4	
AC	AC Output Power (kVA/kW) @40ºC	4105	
	AC Output Power (kVA/kW) @50ºC	3810	
	Operating Grid Voltage (VAC)	34,5kV ±10%	13,8kV ±10%
	Operating Grid Frequency (Hz)	60 Hz	
	Current Harmonic Distorsion	< 3% per IEEE 519	
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night	
DC	MPPt @full power (VDC)	913-1500V	
	Maximum DC Voltage	1500V	
	Voltage ripple	< 3%	
	Max. DC continuous current (A)	4590	

REFERENCE (inverters)		**FP4010M**	**FP4011M**
NUMBER OF MODULES		4	
AC	AC Output Power (kVA/kW) @40ºC	4010	
	AC Output Power (kVA/kW) @50ºC	3720	
	Operating Grid Voltage (VAC)	34,5kV ±10%	13,8kV ±10%
	Operating Grid Frequency (Hz)	60 Hz	
	Current Harmonic Distorsion	< 3% per IEEE 519	
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night	
DC	MPPt @full power (VDC)	891-1500V	
	Maximum DC Voltage	1500V	
	Voltage ripple	< 3%	
	Max. DC continuous current (A)	4590	

REFERENCE (inverters)		**FP2195K**	**FP3290K**	**FP4390K**
NUMBER OF MODULES		2	3	4
AC	AC Output Power (kVA/kW) @40ºC	2195	3290	4390
	AC Output Power (kVA/kW) @50ºC	2035	3055	4075
	Operating Grid Voltage (VAC)	690V ±10%		
	Operating Grid Frequency (Hz)	60 Hz		
	Current Harmonic Distorsion	< 3% per IEEE 519		
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night		
DC	MPPt @full power (VDC)	976-1500V		
	Maximum DC Voltage	1500V		
	Voltage ripple	< 3%		
	Max. DC continuous current (A)	2295	3443	4590

REFERENCE (inverters)		**FP2101K**	**FP3151K**	**FP4200K**
NUMBER OF MODULES		2	3	4
AC	AC Output Power (kVA/kW) @40ºC	2100	3150	4200
	AC Output Power (kVA/kW) @50ºC	1950	2925	3900
	Operating Grid Voltage (VAC)	660V ±10%		
	Operating Grid Frequency (Hz)	60 Hz		
	Current Harmonic Distorsion	< 3% per IEEE 519		
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night		
DC	MPPt @full power (VDC)	934-1500V		
	Maximum DC Voltage	1500V		
	Voltage ripple	< 3%		
	Max. DC continuous current (A)	2295	3443	4590

REFERENCE (inverters)		FP2055K	FP3080K	FP4105K
NUMBER OF MODULES		2	3	4
AC	AC Output Power (kVA/kW) @40ºC	2055	3080	4105
	AC Output Power (kVA/kW) @50ºC	1905	2855	3810
	Operating Grid Voltage (VAC)	645V ±10%		
	Operating Grid Frequency (Hz)	60 Hz		
	Current Harmonic Distorsion	< 3% per IEEE 519		
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night		
DC	MPPt @full power (VDC)	913-1500V		
	Maximum DC Voltage	1500V		
	Voltage ripple	< 3%		
	Max. DC continuous current (A)	2295	3443	4590

REFERENCE (inverters)		FP2005K	FP3005K	FP4010K
NUMBER OF MODULES		2	3	4
AC	AC Output Power (kVA/kW) @40ºC	2005	3005	4010
	AC Output Power (kVA/kW) @50ºC	1860	2790	3720
	Operating Grid Voltage (VAC)	630V ±10%		
	Operating Grid Frequency (Hz)	60 Hz		
	Current Harmonic Distorsion	< 3% per IEEE 519		
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night		
DC	MPPt @full power (VDC)	891-1500V		
	Maximum DC Voltage	1500V		
	Voltage ripple	< 3%		
	Max. DC continuous current (A)	2295	3443	4590

REFERENCE (inverters)		FP1955K	FP2935K	FP3915K
NUMBER OF MODULES		2	3	4
AC	AC Output Power (kVA/kW) @40ºC	1955	2935	3915
	AC Output Power (kVA/kW) @50ºC	1815	2725	3635
	Operating Grid Voltage (VAC)	615V ±10%		
	Operating Grid Frequency (Hz)	60 Hz		
	Current Harmonic Distorsion	< 3% per IEEE 519		
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night		
DC	MPPt @full power (VDC)	870-1500V		
	Maximum DC Voltage	1500V		
	Voltage ripple	< 3%		
	Max. DC continuous current (A)	2295	3443	4590

REFERENCE (inverters)		FP1910K	FP2865K	FP3820K
NUMBER OF MODULES		2	3	4
AC	AC Output Power (kVA/kW) @40ºC	1910	2865	3820
	AC Output Power (kVA/kW) @50ºC	1775	2660	3545
	Operating Grid Voltage (VAC)	600V ±10%		
	Operating Grid Frequency (Hz)	60 Hz		
	Current Harmonic Distorsion	< 3% per IEEE 519		
	Power factor (cosine phi)	0.5 leading... 0.5 lagging / Reactive Power injection at night		
DC	MPPt @full power (VDC)	849-1500V		
	Maximum DC Voltage	1500V		
	Voltage ripple	< 3%		
	Max. DC continuous current (A)	2295	3443	4590

REFERENCE (inverters)		FP1685K	FP2530K	FP3370K
NUMBER OF MODULES		2	3	4
AC	AC Output Power (kVA/kW) @40ºC	1685	2530	3370
	AC Output Power (kVA/kW) @50ºC	1565	2350	3130
	Operating Grid Voltage (VAC)	530V ±10%		
	Operating Grid Frequency (Hz)	60 Hz		
	Current Harmonic Distorsion	< 3% per IEEE 519		
	Power factor (cosine phi)	0.5 leading... 0.5 lagging / Reactive Power injection at night		
DC	MPPt @full power (VDC)	750-1300V		
	Maximum DC Voltage	1300V		
	Voltage ripple	< 3%		
	Max. DC continuous current (A)	2295	3443	4590

REFERENCE (inverters)		FP1590K	FP2385K	FP3180K
NUMBER OF MODULES		2	3	4
AC	AC Output Power (kVA/kW) @40ºC	1590	2385	3180
	AC Output Power (kVA/kW) @50ºC	1475	2215	2955
	Operating Grid Voltage (VAC)	500V ±10%		
	Operating Grid Frequency (Hz)	60 Hz		
	Current Harmonic Distorsion	< 3% per IEEE 519		
	Power factor (cosine phi)	0.5 leading... 0.5 lagging / Reactive Power injection at night		
DC	MPPt @full power (VDC)	708-1250V		
	Maximum DC Voltage	1250V		
	Voltage ripple	< 3%		
	Max. DC continuous current (A)	2295	3443	4590

REFERENCE (inverters)		FP1525K	FP2290K	FP3055K
NUMBER OF MODULES		2	3	4
AC	AC Output Power (kVA/kW) @40ºC	1525	2290	3055
	AC Output Power (kVA/kW) @50ºC	1415	2125	2840
	Operating Grid Voltage (VAC)	480V ±10%		
	Operating Grid Frequency (Hz)	60 Hz		
	Current Harmonic Distorsion	< 3% per IEEE 519		
	Power factor (cosine phi)	0.5 leading… 0.5 lagging / Reactive Power injection at night		
DC	MPPt @full power (VDC)	679-1200V		
	Maximum DC Voltage	1200V		
	Voltage ripple	< 3%		
	Max. DC continuous current (A)	2295	3443	4590

Achieved Certification to the following standard(s):
UL1741 3nd edition: Inverters, Converters, Controllers and Interconnection System Equipment for Use With
Distributed Energy resource, Rev. September 28, 2021,
CSA/C22.2 No 107.1-16 – Power conversion equipment (reaffirmed 2021),
Compliance with UL1741 3 Edition includes applicable requirements of SA (SA8, SA9, SA10, SA11, SA12, SA13, SA14 and SA15 with SRD Electric Rule No 21, Hawaiian Rule 14H for Hawaii and PRC 024-2), SB (SB1, SB2, SB3, SB4.1, SB4.2, SB4.3.1, SB4.3.2, SB4.3.5, SB5, SB6, SB7) requirements and IIEEE 1547.1:2020 are required for full compliance for Support Utility Interactive Inverter requirements

Kenneth Kamer
Eurofins Electrical and Electronic Testing North America, Inc.

All changes proposed in the previously identified product that affects the above information must be submitted to Eurofins for evaluation prior to implementation to assure continued NRTL Certification status. The covered product(s) shall be subject to follow-up inspections to ensure that the Certified product(s) are identical to the product sample evaluated by Eurofins E&E NA and that all responsibilities are being fulfilled as specified in the Applicants' Responsibility section of the Certification Report. The Applicant named above has been authorized Eurofins E&E NA to represent the product(s) listed in this record as "MET Certified" and to mark this/these product(s) according to the terms and conditions of the Eurofins E&E NA Applicant Contract, Listing Reports, and the applicable agreements. Only the product(s) bearing the MET Mark and under a follow-up service are considered to be included in this Certification program. This certification has been granted under a System 3 program as defined in ISO/IEC 17067.

SCC Accredited
CB-P/S

Eurofins E&E North America, Inc. is accredited by OSHA and the Standards Council of Canada.

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APPENDIX 3-B: STANDARDS AND CERTIFICATIONS FOR THE MODICON M580, M340, AND X80 I/O PLATFORMS

Modicon M580, M340 and X80 I/O Platforms

Standards and Certifications

Original instructions

EIO0000002726.05
11/2023

Schneider Electric

www.se.com

Legal Information

Table of Contents

Safety Information

Important Information

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER
DANGER indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

WARNING
WARNING indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

CAUTION
CAUTION indicates a hazardous situation which, if not avoided, **could result** in minor or moderate injury.

NOTICE
NOTICE is used to address practices not related to physical injury.

Please Note

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

About the Book

Document Scope

This document presents the Standards and Certifications for the Modicon M580, M340, and X80 I/O ranges.

NOTE: The present document does not apply to the M580 safety-related range.

Validity Note

The characteristics that are described in the present document, as well as those described in the documents included in the Related Documents section below, can be found online. To access the information online, go to the Schneider Electric home page www.se.com/ww/en/download/

The characteristics that are described in the present document should be the same as those characteristics that appear online. In line with our policy of constant improvement, we may revise content over time to improve clarity and accuracy. If you see a difference between the document and online information, use the online information as your reference.

Related Documents

Title of documentation	Reference number
General Safety Instructions	EIO0000003905 (eng) EIO0000003906 (fre) EIO0000003907 (ger) EIO0000003908 (ita) EIO0000003909 (spa) EIO0000003910 (chs)
Electrical installation guide	EIGED306001EN (eng)

Platforms Conformity

The Modicon M580, M340, and X80 I/O platforms have been developed to comply with the principal national and international standards concerning electronic equipment for industrial automation systems.

Visit www.se.com for the latest Declarations of Conformity (DoC) and certifications.

Compliances for each product shall be verified in Declarations of Conformity (DoC) and certifications published on www.se.com.

The compliance and certification strategy of the Modicon M580, M340, and X80 I/O platforms is continuously adapted to the needs of the markets and domains listed below.

- Compliance with European Directives for CE marking
  - WEEE: *2012/19/EU*
  - Low Voltage: *2014/35/EU*
  - ElectroMagnetic Compatibility (EMC): *2014/30/EU*
  - ATEX: 2014/34/EU (for ATEX modules)
- Requirements specific to programmable controllers relative to controller standard
  - *IEC/EN 61131-2*
  - Electrical safety standards *IEC/EN/UL/CSA 61010-2-201*
- Country specific passport:
  - UKCA
  - RCM
  - EAC

- Specific market:
  - Power generation: IEC/EN 61000-6-5 for interfaces type 1 and 2, IEC 61850-3 for locations G
  - Merchant navy requirements of the major international agencies unified in organization *IACS E10* rules: BV, DNV, ABS, LR, RINA, KRS, CCS
  - Railway applications:
    - Rolling stock: EN 45545-2, IEC 60332–2–24; EN 50155, IEC 60571; EN 50121-3-2, IEC 62236-3-2
    - Fire protection on railway vehicles: EN 45545-2
    - Signaling and telecommunication apparatus: EN 50121-4, IEC 62236-4
    - Fixed power supply installations and apparatus: EN 50121-5, IEC 62236-5

    NOTE: To be compliant to railway market for rolling stock applications, a 24 Vdc process power supply compliant to EN 50155 has to be used.
    Controllers must be installed in a metallic enclosure and are suitable for installation with body mounted profiles (category 1, class B).
  - Hazardous areas:
    - For USA and Canada: Hazardous location for use in class I, division 2, groups A, B,C, and D
    - For European Union: ATEX for atmosphere Zone 2 (gas) and Zone 22 (dust)
    - For United Kingdom: UKEX for atmosphere Zone 2 (gas) and Zone 22 (dust)
    - For other countries: IECEx for atmosphere Zone 2 (gas) and/or Zone 22 (dust)

    NOTE: Refer to the supplied "ATEX IECEx instruction sheet" for important additional instructions concerning CE ATEX or IECEx equipment.

Certificates and Declarations

Product certificates and declarations are available for download on the Schneider Electric website.

NOTE: Depending on the country and language selected, the menu names and paths may differ.

Step	Action
1	Go to the www.se.com **global** website.
2	Click **PRODUCTS**, and then select your country.
3	Select **Industrial Automation and Control > PLC, PAC and Dedicated Controllers**.
4	Click the product range for which certificates or declarations are needed (for example, **Modicon M580 - ePac Controller**, or **Modicon X80 I/Os**).
5	Click the **Documents** tab. **Result:** A new page with a menu on the left side appears.
6	On the left-side menu, under **Document Category**, click **Conformity Assessments**. **Result:** The page content is refreshed and presents the available documents for the product range. **NOTE:** If the type of document is not visible in the left side menu, under **Document Category**, click **View more** to display more document types.
7	Click the name of the document you want to download.

Installation General Rules

M580, M340, and X80 I/O platforms are intended for use in a pollution degree 2 industrial environment, in over-voltage Category II applications (as defined in IEC 61010-2-201), at altitudes up to 2000 m (6562 ft) without derating, and in low-voltage installations where the main power branch is protected on both wires by devices such as fuses or circuit breakers limiting the current to 15 A for North America and 16 A for the rest of the world.

Modicon platforms are open-type equipment as defined in IEC 61010-2-201. Mount these modules in an enclosure that is appropriate for the specific environmental conditions.

NOTE: Install, wire, and maintain the devices in accordance with the instructions in the *Electrical installation guide*.

Operating and Storage Conditions

Characteristics

Characteristics		Standard module	Ruggedized module	
			Coated module	Hardened module
Ambient temperature[1]	Operation	0...60 °C (32...140 °F)	depending on the module reference: • 0...60 °C (32...140 °F) • -25...60 °C (-13...140 °F)	-25...70 °C (-13...158 °F)
	Storage	-40... 85 °C (-40...185 °F)	-40... 85 °C (-40...185 °F)	-40... 85 °C (-40...185 °F)
Relative humidity (without condensation)	Cyclical humidity	5...95% up to 55 °C (131 °F)	5...95% up to 55 °C (131 °F)	5...95% up to 55 °C (131 °F)
	Continuous humidity	5...93% up to 55 °C (131 °F)	5...93% up to 55 °C (131 °F)	5...93% up to 60 °C (140 °F)
Altitude	Operation	0…2000 m (0...6562 ft) For higher altitude, refer to section *Altitude*, page 11.		

(1) For non-vented equipment that is mounted in a cabinet and cooled by natural air convection, the ambient temperature is the air temperature at a point not more than 50 mm (1.97 in) and not less than 25 mm (0.98 in) away from the equipment, on a horizontal plane located at the vertical mid-point below the equipment.

Altitude

These modules are designed to operate with full characteristics (current, power) at altitudes up to 2000 m (6562 ft).

The Control Expert software defines the maximum number of modules that you can use with a single power supply at those altitudes. For more detailed information, refer to section *Power Consumption Breakdown* (see Modicon X80, Racks and Power Supplies, Hardware Reference Manual).

An additional derating applies to modules that operate above 2000 m (6562 ft) altitude:

- On the maximum ambient temperature or on the maximum power consumption
- On the dielectric strength

These deratings compensate for the reduced capacity of heat transfer that is due to the relatively lower air density, pressure, and temperature at higher altitudes.

Depending on the maximum operating ambient temperature of the equipment, you can either:

- Maintain the output capabilities of the modules and reduce the maximum ambient temperature, or
- Reduce the output capabilities of the modules that allow them to maintain the maximum ambient temperature

Conservation of Outputs Capabilities

The module characteristics, such as current and power, remain unchanged if the maximum ambient temperature does not exceed these values:

Altitude	**Maximum operating ambient temperature**		
	Standard module	**Ruggedized module**	
		Coated module	**Hardened module**
0...2000 m (0...6562 ft)	60 °C (140 °F)	60 °C (140 °F)	70 °C (158 °F)
> 2000 m (6562 ft)	54 °C (129.2 °F)	54 °C (129.2 °F)	63 °C (145.4 °F)
> 3000 m (9843 ft)	48 °C (118.4 °F)	48 °C (118.4 °F)	56 °C (132.8 °F)
> 4000 m (13123 ft) to maximum 5000 m (16404 ft)	42 °C (107.6 °F)	42 °C (107.6 °F)	49 °C (120.2 °F)
NOTE: Values for intermediate altitudes may be derived by linear interpolation.			

NOTE: This solution is suitable for power supplies and modules that have only internal dissipation such as controllers, communication modules, and so on.

Conservation of Maximum Ambient Temperature

The modules can be installed at maximum ambient temperature of 60 °C / 70 °C (140 °F / 158 °F) if the usable output power and current are reduced:

Altitude	**Usable output power**	**Usable output current**
0...2000 m (0...6562 ft)	$P_{2000\ m\ (6562\ ft)}$	$I_{2000\ m\ (6562\ ft)}$
> 2000 m (6562 ft)	$P_{2000\ m\ (6562\ ft)}$ x 0.9	$I_{2000\ m\ (6562\ ft)}$ x 0.95
> 3000 m (9843 ft)	$P_{2000\ m\ (6562\ ft)}$ x 0.8	$I_{2000\ m\ (6562\ ft)}$ x 0.89

Altitude	Usable output power	Usable output current
> 4000 m (13123 ft) to maximum 5000 m (16404 ft)	$P_{2000\ m\ (6562\ ft)}$ x 0.7	$I_{2000\ m\ (6562\ ft)}$ x 0.84
$P_{2000\ m\ (6562\ ft)}$: This is the maximum available power of a power supply on *3V3_BAC*, *24V_BAC*, or *24V_SENSORS* at 2000 m (6562 ft). **$I_{2000\ m\ (6562\ ft)}$:** This is the output current. **NOTE:** Values for intermediate altitudes may be derived by linear interpolation.		

After determining the maximum usable current delivered by the power supply with the above deratings, validate, in Control Expert, that the consumption of the modules into the rack is compatible with the new calculated values.

NOTE: For digital output modules, apply the calculated derating to the output current capabilities and adapt the corresponding loads.

Reduced Dielectric Strength

An increase in altitude reduces the dielectric strength characteristics. This table shows the degradation of isolation at specific altitudes:

Altitude	Dielectric strength loss
0...2000 m (0...6562 ft)	$Dielec_{2000\ m\ (6562\ ft)}$ = Values given in module characteristics
> 2000 m (6562 ft)	$Dielec_{2000\ m\ (6562\ ft)}$ - 150 V
> 3000 m (9843 ft)	$Dielec_{2000\ m\ (6562\ ft)}$ - 300 V
> 4000 m (13123 ft) to maximum 5000 m (16404 ft)	$Dielec_{2000\ m\ (6562\ ft)}$ - 450 V
NOTE: Values for intermediate altitudes may be derived by linear interpolation.	

Select the double-isolation BMXCPS4002 module as the main power supply 230 Vac.

Environment Test Compliance Levels

Overview

Standards and levels are provided for these tests:

- Immunity to low frequency interference, page 14
- Immunity to high frequency interference, page 16
- Electromagnetic emissions, page 21
- Immunity to climatic variations (Power ON), page 22
- Withstand to climatic variations (Power OFF), page 22
- Immunity to mechanical constraints (Power ON), page 23
- Withstand to mechanical constraints (Power ON), page 23
- Equipment and personnel safety, page 24

Immunity to Low Frequency Interference Tests

Name of test	Standards	Levels
Voltage and frequency variation	**Industry** IEC/EN 61131-2; IEC/EN 61000-6-2; IEC 61000-4-11	0.85...1.10 Un - 0.94...1.04 Fn; 4 steps t = 30 min
	Merchant Navy IACS E10	0.80 Un...0.90 Fn; 1.20 Un...1.10 Fn; t = 1.5 s / 5 s
Direct voltage variation	**Industry** IEC/EN 61131-2; IEC 61000-4-29	0.85...1.2 Un + ripple: 5% peak; 2 steps t = 30 min
	Merchant Navy IACS E10 (controller connected to DC supply)	0.85...1.2 Un + ripple: 5% peak; 2 steps t = 30 min
	Merchant Navy IACS E10 (controller not connected to charging battery)	0.75...1.2 Un + ripple: 0%; 2 steps t = 15 min
Third harmonics	**Industry** IEC/EN 61131-2	H3 (10% Un), 0° / 180°; 2 steps t = 5 min

Name of test	Standards	Levels
Immunity to conducted low frequency	**Merchant Navy** IACS E10	For AC: H2…H15 (10% Un), H15…H100 (10%...1% Un), H100…H200 (1% Un) For DC: H100…H200 (10% Un)
Voltage interruptions and dips	**Industry** IEC/EN 61131-2; IEC/EN 61000-6-2; IEC 61000-4-11; IEC 61000-4-29	Short interruptions: 10 ms for AC or DC PS2 , 85% Un 1 ms for DC PS1, 85% Un
	Railway EN 50155; IEC 60571	Un to 0.6*Un ; t = 100 ms Supply dips and change over Class C1 Un to 0: Interruption of supply Class S1, S2, S3 and Supply change over Class C2 Class S1; [normal operation] Class S2; t = 10 ms; Class S3; t = 20 ms; Class C2; t = 30 ms
	Industry IEC/EN 61131-2; IEC/EN 61000-6-2; IEC 61000-4-11; IEC 61000-4-29	Longer interruptions: Check operating mode (no erratic behavior) up to 5 s , 85% Un for IACS, 3 times 30 s in 5 min, 85% Un
	Merchant Navy IACS E10	Longer interruptions: Check operating mode (no erratic behavior) up to 5 s , 85% Un for IACS, 3 times 30 s in 5 min, 85% Un
	Industry IEC/EN 61131-2; IEC/EN 61000-6-2; IEC 61000-4-11	Dips: For AC PS2 only 0% Un, t0: 1/2 period 40% Un, cycle: 10/12 70% Un, cycle: 25/30 0% Un, cycle: 250/300
Voltage shut-down and start-up	**Industry** IEC/EN 61131-2	Un…0…Un; t = Un / 60 s Umin…0…Umin; t = Umin / 5 s Umin…0.9 Udl…Umin; t = Umin / 60 s

Name of test	Standards	Levels
Conducted common mode disturbances range 0 Hz…150 kHz	**Industry** IEC 61000-6-5; IEC 61850-3; IEC 61000-4-16	For remote systems: 50/60 Hz and DC, 300 V, t = 1 s 50/60 Hz and DC, 30 V, t = 1 min 5 Hz…150 kHz, sweep 3…30 V
Where: **PS1**: applies to controller supplied by battery **PS2**: applies to controller energized from AC or DC supplies **Un**: nominal voltage **Fn**: nominal frequency **Udl**: detection level when powered		

Immunity to High Frequency Interference Tests

Name of test	Standards	Levels
Electrostatic discharges	**Industry** IEC/EN 61131-2 (zone B and C); IEC/EN 61000-6-2; IEC 61000-4-2	4 kV contact; 8 kV air; 4 kV indirect contact
	Merchant Navy IACS E10	6 kV contact; 8 kV air; 6 kV indirect contact
	Power Station and Substation IEC 61000-6-5; IEC 61850-3; IEC 61000-4-2	6 kV contact; 8 kV air; 6 kV indirect contact
	Railway EN 50155; EN 50121-3-2; EN 50121-4; EN 50121-5 ; IEC 60571; IEC 62236-3-2; IEC 62236-4; IEC 62236-5	6 kV contact; 8 kV air; 6 kV indirect contact
Radio frequency electromagnetic field	**Industry** IEC/EN 61131-2 (zone B); IEC/EN 61000-6-2; IEC 61000-4-3	10 V/m, 80 MHz…1 GHz; 3 V/m, 1.4…6 GHz Sinus amplitude modulated 80%, 1 kHz + internal clock frequencies

Name of test	Standards	Levels
	Merchant Navy IACS E10	10 V/m, 80 MHz…6 GHz Sinus amplitude modulated 80%, 1 kHz + internal clock frequencies
	Power Station and Substation IEC 61000-6-5; IEC 61850-3; IEC 61000-4-2	10 V/m, 80 MHz…1 GHz; 3 V/m, 1…2.7 GHz; 1 V/m, 2.7…6 GHz Sinus amplitude modulated 80%, 1 kHz + internal clock frequencies
	Railway Rolling Stock EN 50155; EN 50121-3-2; IEC 60571; IEC 62236-3-2	20 V/m, 80 MHz…0.8 GHz; 20 V/m, 0.8…1 GHz; 10 V/m 1.4…2 GHz; 5 V/m, 2…2.7 GHz; 3 V/m, 5.1…6 GHz Sinus amplitude modulated 80%, 1 kHz
	Railway Stationary EN 50121-4; EN 50121-5; IEC 62236-3-2; IEC 62236-4; IEC 62236-5	10 V/m, 80 MHz…0.8 GHz; 20 V/m, 0.8…1 GHz; 10 V/m 1.4…2 GHz; 5 V/m, 2…2.7 GHz; 3 V/m, 5.1…6 GHz Sinus amplitude modulated 80%, 1 kHz
Electrical fast transient bursts	**Industry** IEC/EN 61131-2; IEC/EN 61000-6-2; IEC 61000-4-4	For AC and DC main supplies: 2 kV in common mode / 2 kV in differential mode For AC and DC auxiliary supplies, AC unshielded I/Os: 2 kV in common mode For unshielded analog and DC I/Os, communication and all shielded lines: 1 kV in common mode
	Merchant Navy IACS E10	For AC and DC main supplies: 2 kV in common mode / 2 kV in differential mode For AC and DC auxiliary supplies, AC unshielded I/Os: 2 kV in common mode For unshielded analog and DC I/Os, communication and all shielded lines: 1 kV in common mode
	Power Station and Substation IEC 61000-6-5; IEC 61850-3; IEC 61000-4-4	For AC and DC supplies: 2 kV in common mode / 2 kV in differential mode (type 2) 4 kV in common mode / 4 kV in differential mode (type 3) For unshielded/shielded AC, DC I/Os, communication:

Name of test	Standards	Levels
		1 kV in common mode (type 2) 2 kV in common mode (type 3)
	Railway Rolling Stock EN 50155; EN 50121-3-2; IEC 60571; IEC 62236-3-2	For I/Os and communication lines: 2 kV in common mode For AC and DC power supplies: 2 kV in common mode for power ports
	Railway Stationary (signaling and telecommunication) EN 50121-4; IEC 62236-4	For I/Os and communication lines: 2 kV in common mode For AC and DC power supplies: 2 kV in common mode for power ports 1 kV in common mode for earth ports
	Railway (fixed installation power supply) EN 50121-5; IEC 62236-5	For ports for process, measurement and control lines and long bus 2 kV in common mode For AC and DC power supplies: 4 kV in common mode for power ports 1 kV in common mode for earth ports
Surge	**Industry** IEC/EN 61131-2 (zone B); IEC/EN 61000-6-2; IEC 61000-4-5	For AC main and AC auxiliary supplies: 2 kV in common mode / 1 kV in differential mode For DC main and DC auxiliary supplies: 1 kV in common mode / 1 kV in differential mode For analog, digital unshielded I/Os: 1 kV in common mode (I/O < 48V) 2 kV in common mode / 1 kV in differential mode For communication and all shielded lines: 1 kV in common mode
	Merchant Navy IACS E10	For AC or DC main supplies 1 kV in common mode / 0.5 kV in differential mode
	Power Station and Substation IEC 61000-6-5; IEC 61850-3;	For AC or DC main and AC or DC auxiliary supplies 2 kV in common mode / 1 kV in differential mode

Name of test	Standards	Levels
	IEC 61000-4-5	For analog, digital unshielded I/Os: 1 kV (I/O < 48 V); 2 kV (I/O > 48 V) in common mode For communication and all shielded lines: 2 kV in common mode
	Railway EN 50155; EN 50121-3-2; EN 50121-4; IEC 60571; IEC 62236-3-2; IEC 62236-4	For I/Os and communication lines, DC and AC power supplies: 2 kV in common mode / 1 kV in differential mode
	Railway (fixed installation power supply) EN 50121-5; IEC 62236-5	For ports for process, measurement and control lines and long bus and DC power supplies 2 kV in common mode / 1 kV in differential mode For AC power supplies: 4 kV in common mode / 2 kV in differential mode
Conducted disturbances induced by radio-frequency electromagnetic fields	**Industry** IEC/EN 61131-2 (zone B and C); IEC/EN 61000-6-2; IEC 61000-4-6	10 V, 0.15…80 MHz Sinus amplitude modulated 80%, 1 kHz + spot frequencies
	Merchant Navy IACS E10	3 V, 0.15…80 MHz Sinus amplitude modulated 80%, 1 kHz + spot frequencies
	Power Station and Substation IEC 61000-6-5; IEC 61850-3; IEC 61000-4-6	10 V, 0.15…80 MHz Sinus amplitude modulated 80%, 1 kHz + spot frequencies
	Railway EN 50155; EN 50121-3-2; EN 50121-4; EN 50121-5; IEC 60571; IEC 62236-3-2; IEC 62236-4; IEC 62236-5	10 V, 0.15…80 MHz Sinus amplitude modulated 80%, 1 kHz + spot frequencies
Damped oscillatory wave	**Industry** IEC/EN 61131-2 (zone C); IEC 61000-4-18	For AC and DC main supplies and AC auxiliary supplies, AC unshielded I/Os: 2.5 kV in common mode / 1 kV in differential mode only at 1 MHz

Name of test	Standards	Levels
		For DC auxiliary supplies, analog, DC unshielded I/Os: 1 kV in common mode / 0.5 kV in differential mode For communication and all shielded lines: 0.5 kV in common mode For ports for process, measurement, control lines and long bus: 2.5 kV in common mode / 1 kV in differential mode
	Power Station and Substation IEC 61000-6-5; IEC 61850-3; IEC 61000-4-18	For AC and DC main supplies and AC auxiliary supplies, AC unshielded I/Os, communication and all shielded lines: 2.5 kV in common mode / 1 kV in differential mode only at 1 MHz
	Railway (fixed installation power supply) EN 50121-5; IEC 62236-5	For AC and DC main supplies and AC auxiliary supplies, AC unshielded I/Os, communication and all shielded lines: 2.5 kV in common mode / 1 kV in differential mode only at 1 MHz
Magnetic field	**Power Station and Substation** IEC 61000-6-5; IEC 61850-3; IEC 61000-4-6	Power frequency: 50/60 Hz, 100 A/m continuous | 1000 A/m; t = 3 s; 3 axes Oscillatory: 100 kHz | 1 MHz, 100 A/m; t = 9 s; 3 axes

Electromagnetic Emissions Tests

Name of test	Standards	Levels
Conducted emission	IEC/EN 61131-2; IEC/EN 61000-6-4; CISPR 11 and 22, Class A, Group 1	150…500 kHz: quasi-peak 79 dB (µV/m); average 66 dB (µV/m) 500 kHz…30 MHz: quasi-peak 73 dB (µV/m); average 60 dB (µV/m)
	IACS E10	For AC or DC power (general power distribution zone): 10…150 kHz: quasi-peak 120...69 dB (µV/m) 150…500 kHz: quasi-peak 79 dB (µV/m) 500 kHz…30 MHz: quasi-peak 73 dB (µV/m) For AC or DC power (bridge and deck zone for evaluation): 10…150 kHz: quasi-peak 96…50 dB (µV/m) 150 kHz…350 kHz: quasi-peak 60…50 dB (µV/m) 350 kHz…30 MHz: quasi-peak 50 dB (µV/m)
Radiated emission	IEC/EN 61131-2; IEC/EN 61000-6-4; CISPR 11 and 22, Class A, Group 1	30...230 MHz: quasi-peak 40 dB (µV/m) (at 10 m) 230 MHz...1 GHz: quasi-peak 47 dB (µV/m) (at 10 m) 1...3 GHz: quasi-peak 76 dB (µV/m) (at 3 m) 3...6 GHz: quasi-peak 80 dB (µV/m) (at 3 m)
	IACS E10	For general power distribution zone: 150 kHz…30 MHz: quasi-peak 80…50 dB (µV/m) (at 3 m) 30...100 MHz: quasi-peak 60…54 dB (µV/m) (at 3 m) 100 MHz...2 GHz: quasi-peak 54 dB (µV/m) (at 3 m) 156…165 MHz: quasi-peak 24 dB (µV/m) (at 3 m)

Immunity to Climatic Variations (Power ON) Tests

Name of test	Standards	Levels
Dry heat	IEC 60068-2-2 (Bb and Bd)	60 °C (140 °F), t = 16 hrs (for ruggedized range: 70 °C (158 °F), t = 16 hrs)[1]
	IACS E10	70 °C (158 °F), t = 16 hrs
Cold	IEC 60068-2-1 (Ab and Ad); IACS E10	-25...0 °C (-13...32 °F), t = 16 hrs + power on at 0 °C (32 °F) (for ruggedized range: power on at -25 °C (-13 °F))[1]
Damp heat, steady state (continuous humidity)	IEC 60068-2-78 (Cab); IACS E10	55 °C (131 °F), 93% relative humidity, t = 96 hrs (for ruggedized range: 60 °C (140 °F))[1]
Damp heat, cyclic (cyclical humidity)	IEC 60068-2-30 (Db); IACS E10	25…55 °C (77...131 °F), 93…95% relative humidity, 2 cycles t = 12 hrs +12 hrs
Change of temperature	IEC 60068-2-14 (Nb)	0 …60 °C (32...140 °F), 5 cycles t = 6 hrs + 6 hrs (for ruggedized range: -25…70 °C (-13...158 °F))[1]
(1) Refer also to the section *Installation in More Severe Environments*.		

Withstand to Climatic Variations (Power OFF) Tests

Name of test	Standards	Levels
Dry heat	IEC/EN 61131-2; IEC 60068-2-2 (Bb and Bd); IEC/EN 60945	85 °C (185 °F), t = 96 hrs
Cold	IEC/EN 61131-2; IEC 60068-2-1 (Ab and Ad); IACS E10	- 40°C (-40 °F), t = 96 hrs
Damp heat, cyclic (cyclical humidity)	IEC/EN 61131-2; IEC 60068-2-30 (Db)	25…55 °C (77...131 °F), 93…95% relative humidity, 2 cycles t = 12 hrs + 12 hrs
Change of temperature	IEC/EN 61131-2; IEC 60068-2-14 (Na)	-40...85 °C (-40...185 °F), 5 cycles t = 3 hrs + 3 hrs

Immunity to Mechanical Constraints (Power ON) Tests

Name of test	Standards	Levels
Sinusoidal vibrations	IEC/EN 61131-2; IEC 60068-2-6 (Fc)	Basic IEC/EN 61131-2: 5...150 Hz, ±3.5 mm amplitude (5…8.4 Hz), 1 g (8.4…150 Hz) Specific profile: 5...150 Hz, ±10.4 mm amplitude (5….8.4 Hz), 3 g (8.4….150 Hz) Endurance (basic and specific): 10 sweep cycles for each axis
	IEC 60870-2-2; IEC 60068-2-6 (Class Cm)	2...500 Hz, 7 mm amplitude (2…9 Hz), 2 g (9…200 Hz), 1.5 g (200…500 Hz) Endurance: 10 sweep cycles for each axis
	IACS E10	3...100 Hz, 1 mm amplitude (3…13.2 Hz), 0.7 g (13.2 …100 Hz) Endurance at each resonance frequency: 90 min for each axis, amplification coefficient < 10
	IEC 60068-2-6	Seismic analysis: 3...35 Hz, 22.5 mm amplitude (3…8.1 Hz), 6 g (8.1…35 Hz)
Shocks	IEC/EN 61131-2; IEC 60068-2-27 (Ea)	30 g, 11 ms; 3 shocks/direction/axis (1) 25 g, 6 ms; 100 bumps/direction/axis (bumps) (2)
Free fall during operation	IEC/EN 61131-2; IEC 60068-2-32 (Ed Method 1)	1 m (3.28 ft), 2 falls

(1) When using fast actuators (response time ≤ 5 ms) driven by relay outputs: 15 g, 11 ms; 3 shocks/direction/axis.

(2) When using fast actuators (response time ≤15 ms) driven by relay outputs: 15 g, 6 ms; 100 bumps/direction/axis.

Withstand to Mechanical Constraints (Power OFF) Tests

Name of test	Standards	Levels
Random free fall with packaging	IEC/EN 61131-2; IEC 60068-2-32 (Method 1)	1 m (3.28 ft), 5 falls
Flat free fall	IEC/EN 61131-2; IEC 60068-2-32 (Ed Method 1)	10 cm (0.33 ft), 2 falls

Name of test	Standards	Levels
Controlled free fall	IEC/EN 61131-2; IEC 60068-2-31 (Ec)	30° or 10 cm (0.33 ft), 2 falls
Plugging/Unplugging	IEC/EN 61131-2	Operations (for modules and connectors): 50 for permanent connections, 500 for non-permanent connections

Equipment and Personnel Safety Tests

Name of test	Standards	Levels
Dielectric strength and insulation resistance	IEC/EN 61131-2; IEC 61010-2-201; UL; CSA	Dielectric: 2 Un + 1000 V; t = 1 min Insulation: Un ≤50 V: 10 MΩ, 50 V ≤Un ≤250 V: 100 MΩ
Ground continuity	IEC/EN 61131-2; IEC 61010-2-201; UL; CSA	30 A, R ≤0.1 Ω; t = 2 min
Leakage current	IEC/EN 61131-2; IEC 61010-2-201; UL; CSA	<0.5 mA in normal condition <3.5 mA in single fault condition
Protection offered by enclosures	IEC/EN 61131-2; IEC61010-2-201;	IP20 and protection against standardized pins
Impact withstand	IEC/EN 61131-2; IEC 61010-2-201; UL; CSA	Sphere of 500 g, fall from 1.30 m (4.27 ft) (energy 6.8 J minimum)
Overload	IEC/EN 61131-2; IEC 61010-2-201; UL; CSA	50 cycles, Un, 1.5 In; t = 1 s ON + 9 s OFF
Endurance	IEC/EN 61131-2; IEC 61010-2-201; UL; CSA	In, Un; 6000 cycles, 1 s ON + 9 s OFF
Temperature rise	IEC/EN 61131-2; UL; CSA; ATEX; IECEx	Ambient temperature 60 °C (140 °F) (for ruggedized range: 70 °C (158 °F))

Specific Environment Tests

Name of test	Standards	Levels
Corrosion areas - gas, salt, dust	ISA S71.4	Flowing mixed gas; class Gx, 25 °C (77 °F), 75% relative humidity, t = 14 days
	IEC/EN 60721-3-3 IEC 60068-2-60	Flowing mixed gas; class 3C3, 25 °C (77 °F), 75% relative humidity, t = 14 days
	IEC/EN 60721-3-3 IEC 60068-2-60	Flowing mixed gas; class 3C4, 25 °C (77 °F), 75% relative humidity, t = 7 days
	IEC 60068-2-52	Salt spray: test Kb, severity 2
	IEC/EN 60721-3-3 IEC 60068-2-68	Dust and sand, Arizona dust, class 3S4, 20 cycles
	IEC/EN 60721-3-3 IEC 60068-2-10	Mold growth, fungal spore, class 3B2, t = 28 days

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As standards, specifications, and design change from time to time, please ask for confirmation of the information given in this publication.

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APPENDIX 3-C: FIRE ALARM SYSTEM DRAWING JF2 DC/AC LINK 5.1

Confidential

Fire Alarm System Drawing

JF2 DC/AC LINK 5.1

Document No : F2X4-5.1US-FS09

Revision : 5.0

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TRADEMARKS

Table of Contents

1. Introduction

This document describes the fire Alarm System of JF2 DC/AC LINK 5.1. The JF2 DC/AC LINK 5.1 consists of three M-LINKs and one E-Panel. The total capacity is 5.11MW and the voltage range is 1,134~1,499.4V. For detailed specifications, please refer to Table 1 and 2 below.

Item	Specification
Cell	JF2
Pack	4P30S
Rack	14Pack in series per Rack
Configuration	6Rack system per DC LINK
Voltage (Nominal)	1344Vdc
DC Voltage Range	1,134~1,499.4 Vdc
Energy Density	5.11 MWh
Communication	Modbus TCP/IP(Ethernet, Optical)
Auxiliary Power	AC480 3Phase 60Hz

Table 1. JF2 DC/AC LINK 5.1 Electrical Specification

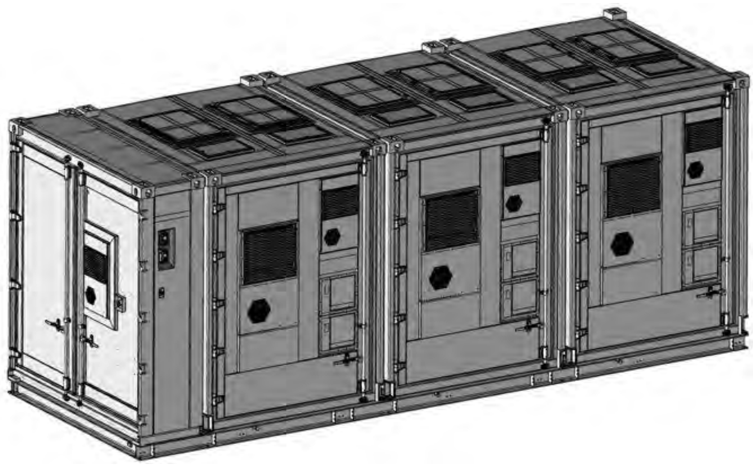
Item	Specification
Appearance	
Dimension (W×D×H,mm)	7,170 x 2,570 x 2,896mm
Weight	about. 48 ton
Ingress protection level	55
Cooling	Liquid Cooling
Seismic grade	ASCE(7-22) Sds1.2 (optional Sds 1.5)
Transportable	O (with pre-installation)
Explosion proof	O (Active Ventilation)
Certification	UL1642, UL1973, FCC, UL9540A, UL9540, UN38.3, UN3536, UL1741, NFPA 69,72,855

Table 2. JF2 DC/AC LINK 5.1 Mechanical Specification

1.1 Fire Safety Design Overview

The DC LINK 5.1 system complies with the standards NFPA 69, NFPA 72, UL 268, UL 2075, UL 864, UL 1973, and UL 9540A. The E-panel is equipped with an FACP (Fire Alarm Control Panel), a smoke detector and 2 horn & strobe devices ("for gas" and "for fire”). Each M-LINK is equipped with a smoke detector and a gas detector. The signals detected by the M-LINK are transmitted to the FACP located in the E-panel, and the FACP send the information to the FCC (Fire Command Center).

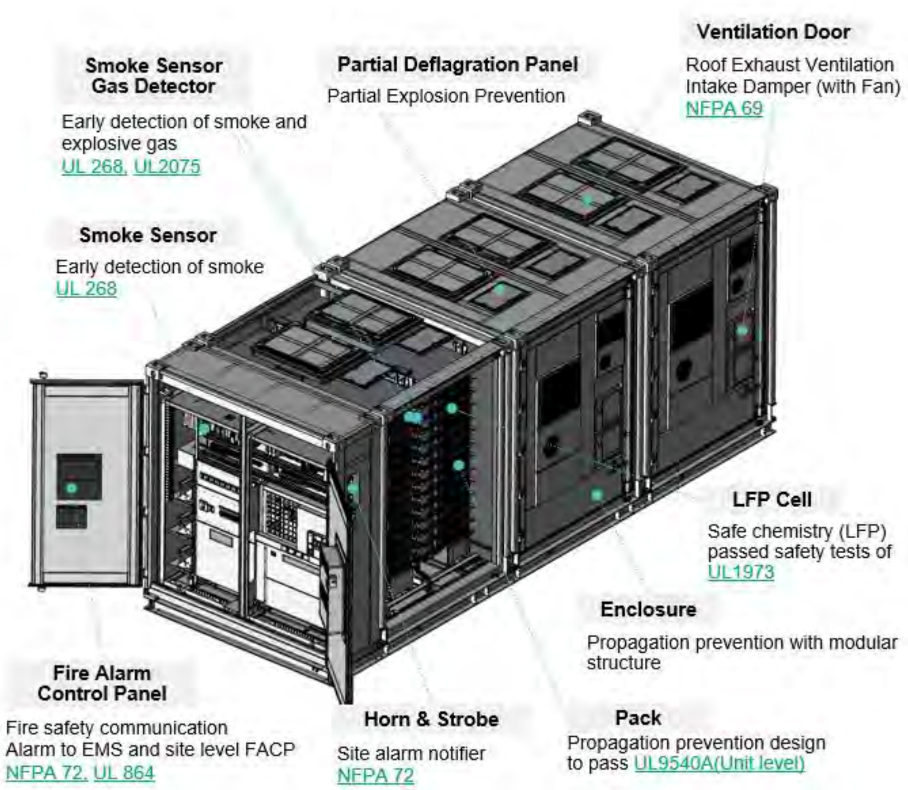


Figure 1. Fire Safety Design Overview

Item		Key components
Cell		LFP chemistry. Passed safety tests including short circuit, nail, and impact tests
Pack		Thermal insulation to prevent Sub-Pack to Sub-Pack thermal propagation
Enclosure		Modular structure to help preventing enclosure to enclosure propagation
Explosion Prevention		Ventilation Door on the roof / Partial Deflagration Panel / Intake Damper (with Fan)
FSS	Detection	Gas (H2) detector, Smoke sensor
	Alarm	Fire Alarm Control Panel & Horn & Strobe (2ea in E-Panel, Gas & Smoke)

Table 3. Fire Safety Design Overview

2. Component Specification

2.1 E-Panel Fire Safety Components

The table below lists the fire safety materials installed in the E-Panel.

2.1.1 Horn and Strobe (Smoke)

The brightness of Horn and Strobe (Smoke) is usually set as 75cd. Tone pattern for Horn and Strobe (Smoke) is usually temporal and the volume of sound is 85db which is pattern 1 of figure 2. Brightness and tone pattern can be changed depending on site's property. Those can be set by turning the dial of Horn and Strobe (Smoke). Refer to figure 2.

Wattage of Horn and Strobe (Smoke) is 2.088[W] when brightness is set as 75cd. It can vary by the brightness.

2.1.2 Horn and Strobe (Gas)

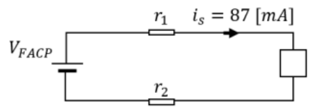
The brightness of Horn and Strobe (Gas) is usually set as 75cd. Tone pattern for Horn and Strobe (Gas) is usually non-temporal and the volume of sound is 85db or 77db which are pattern 3 or 4 of figure 2. Brightness and tone pattern can be changed depending on site's property. Those can be set by turning the dial of Horn and Strobe (Gas). Refer to figure 2.

Wattage of Horn and Strobe (Gas) is 2.088[W] when brightness is set as 75cd. It can vary by the brightness.

Figure 2. Dial of Horn and Strobe

2.1.3 Voltage Drop Calculation for Horn and Strobe

When Horn and Strobe brightness is set as 75cd. Maximum current is 87[mA]. Cable resistance is 0.021[Ω/m]. Cable length from FACP battery to Horn and Strobe is 8m. Calculation is as below.



$$r_1 = r_2 = 0.021(\Omega/\text{m})\text{x}8[\text{m}] = 0.168[\Omega]$$
$$V_{Drop} = i_s(r_1 + r_2) = 87[\text{mA}]\text{x}0.336[\Omega] = 0.02923[\text{V}]$$

Figure 3. Voltage Drop Calculation

Nominal Voltage of FACP battery is 24[V]. A conservative estimate applies 20.4[V], which is 85% of the nominal voltage. Voltage drop is 0.03[V]. Voltage on Horn and Strobe is 20.37[V] which is between operating range from 16[V] ~ 33[V].

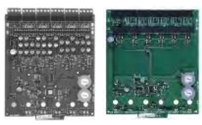
Appearance	Section	Item	Product Information					Certificate Information		
			Manufacturer	Model	Q'ty	Unit	UL Code	UL Category	File No	CSFM
	Fire Alarm Control Panel	FACP	Notifier	NFS-320	1	ea	UL 864	UOJZ	S635	7165-0028:0243
		Network Card	Notifier	HS-NCM-SF	1	ea	UL 864	SYZV	S635	7300-0028:0257
		Lead-Acid Battery	SEBANG	ES30-12	2	ea	UL 1989	BAZR2	MH15934	
	Smoke Detector	Smoke Detector	Notifier	FSP-951	1	ea	UL 268	UROX	S1115	7272-0028:0503
		Base	Notifier	B501-WHITE	1	ea	UL 268	UROX	S1115	7300-1653:0109
	Module	6 Relay Output Module	Notifier	XP6-R	1	ea	UL 864	UOXX	S635	7300-0028:0219
		10 Input Module	Notifier	XP10-M	1	ea	UL 864	UOXX	S635	7300-0028:0219
	Horn and Strobe (Smoke)	Horn and Strobe	Notifier	P2GRKLED	1	ea	UL 464	ULSZ UVAV	S4011	7135-1653:0534
	Horn and Strobe (Gas)	Horn and Strobe	Notifier	P2GWKLED-P	1	ea	UL 464	ULSZ UVAV	S4011	7135-1653:0534
		Amber Lens	Notifier	LENS-A3	1	ea	UL 1638	UVAV	S5512	
	FACP Aux Flexible Conduit Assy	DC Aux Flexible Conduit			16	M	UL listed		E305578	
		FACP SLC Cable	KWAMGIL		6	ea	UL1424	FPL	E472701	
		18 AWG Copper Cable Lug		A-SC1.5-4	6	ea				

Table 4. E-Panel Fire Safety Components

2.2 M-LINK Fire Safety Components

The table below lists the fire safety materials installed in each M-LINK.

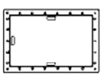
Appearance	Section	Item	Product Information				Certificate Information			
			Manufacturer	Model	Q'ty	Unit	UL Code	UL Category	File No	CSFM
	Smoke Detector	Smoke Detector	Notifier	FSP-951	1	ea	UL 268	UROX	S1115	7272-0028:0503
		Base	Notifier	B501-WHITE	1	ea	UL 268	UROX	S1115	7300-1653:0109
 	Module	6 Relay Output Module	Notifier	XP6-R	1	ea	UL 864	UOXX	S635	7300-0028:0219
		2 Input Module	Notifier	FDM-1	1	ea	UL 864	UOXX	S635	7300-0028:0219
	Gas Detector	Gas Detector	Honeywell	XCL	1	ea	UL 61010-1	NYOK	E486160	5278-2383:0001
	Ventilation	Roof Exhaust Vent	INTOR KHAN	-	2	ea				
		Linear Actuator	Timotion	MA2-K	2	ea	UL962	IYOX2	E343440	
		Intake Damper (with Fan)	Electroman	EF17-850-00210	2	ea	UL507	GPWV2	E89520	
	Partial Deflagration Panel	Partial Deflagration Panel	INTOR KHAN		2	ea				
	FACP Aux Flexible Conduit Assy	DC Aux Flexible Conduit			16	M	UL listed		E305578	
		FACP SLC Cable	KWAMGIL		6	ea	UL1424	FPL	E472701	
		Cable Lug								

Table 5. M-LINK Fire Safety Components

3. Fire Safety Logic

3.1 Fire Safety Logic

The E-Panel is configured with Fire Safety Logic through the FACP (Fire Alarm Control Panel), while the M-LINK manages the fire safety system using two methods: the FACP and a PLC (Programmable Logic Controller).

E-Panel

One smoke detector is installed in the E-Panel. When the smoke detector is activated, an alarm is triggered, and the information is shared with the PLC. Also, when it is activated, the fire horn/strobe is triggered, and simultaneously, the HVAC system installed inside the E-panel shuts down.

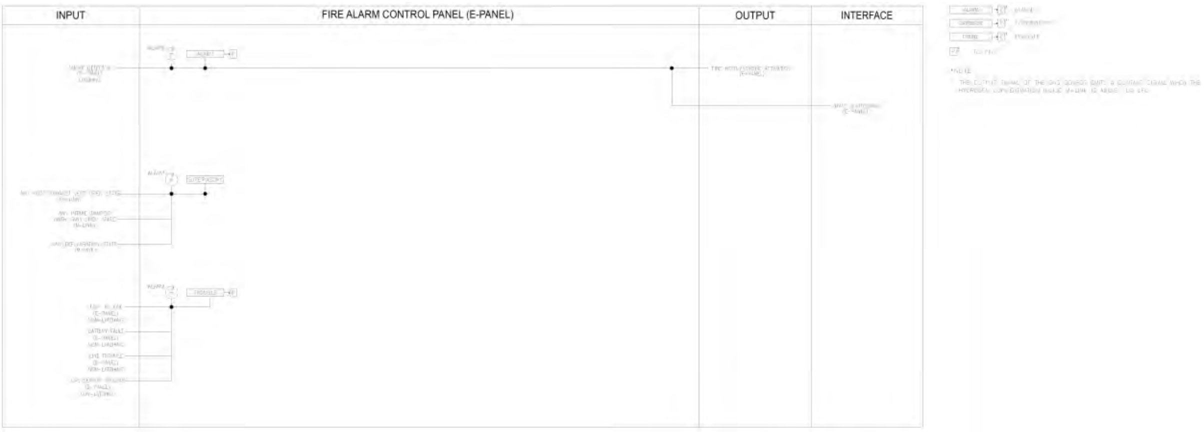


Figure 4. Fire Safety Logic (E-Panel)

(1) M-LINK

One smoke detector and one gas detector are installed in each M-LINK. When smoke detection is activated, the fire horn/strobe is triggered, and simultaneously, the HVAC system inside the M-LINK shuts down, and the ventilation system is activated. Gas detectors are set to detect combustible gas at 10% of the LFL (Lower Flammable Limit) in accordance with NFPA 69. (Detection condition can be set via S/W manner, it will be set before installing on site) When some combustible gas is detected, the ventilation system is activated, which ensures that the gas concentration inside each M-LINK remains below 25% of the LFL. The ventilation system consists of two door intake dampers (with fans), two roof exhaust vents. Even if only one door intake damper and one roof exhaust vent (with fan) are operational, the system still complies with NFPA 69 requirements (below 25% of the LFL). If gas detector or smoke detector is activated in any of three M-LINKs, the entire ventilation system of the JF2 DC/AC LINK 5.1 will be activated. As shown in the Figures below, each M-LINK detects fire and gas using two systems: the FACP (Fire Alarm Control Panel) and the PLC (Programmable Logic Controller). The deflagration panel is designed to ensure that the structure of M-LINK can Withstand and not collapse in the event of an explosion of flammable gas that occurs before the gas sensor is activated (LFL10%).

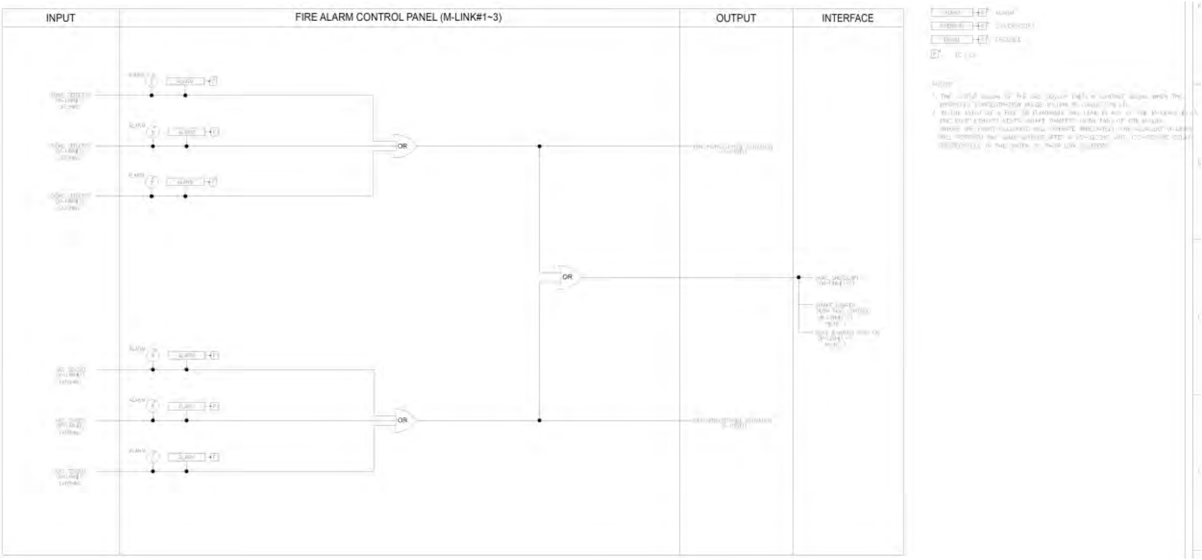


Figure 5. Fire Safety Logic of FACP (M-LINK)

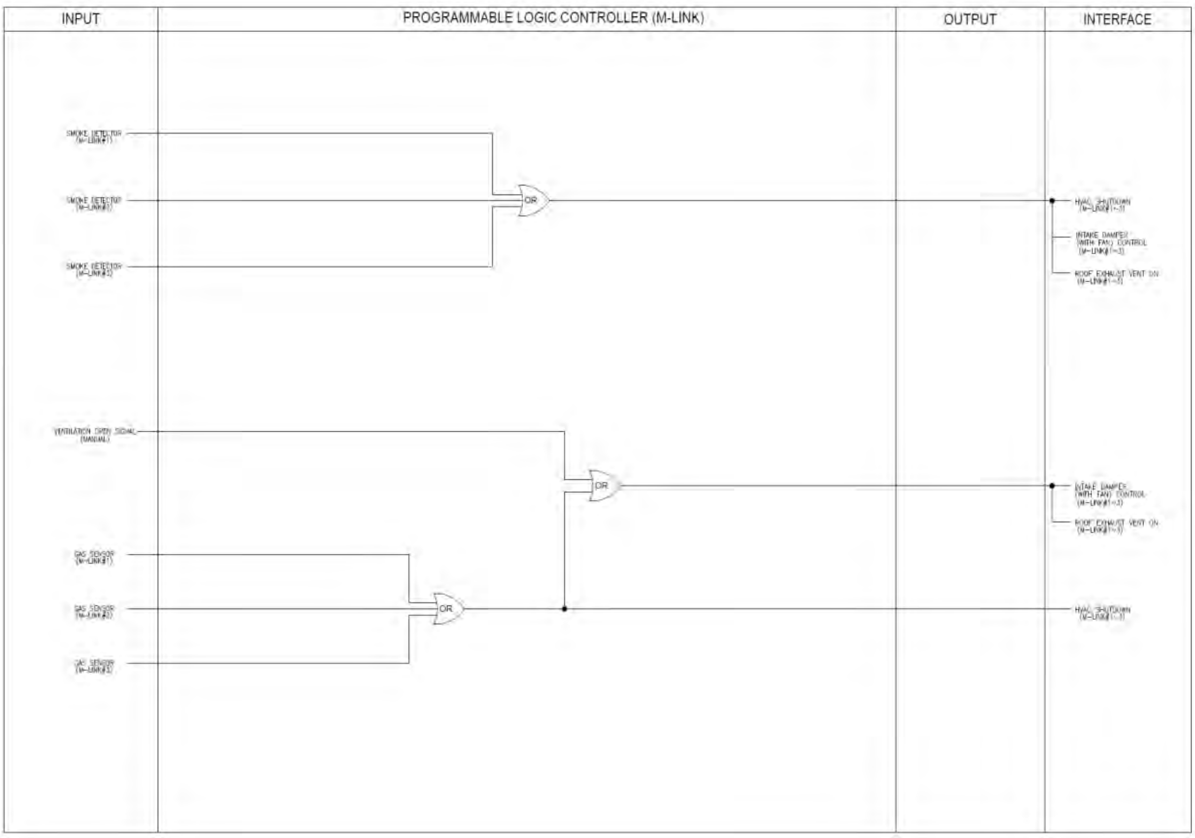


Figure 6. Fire Safety Logic of PLC (M-LINK)

3.2 Cause & Effect Chart

The figure below represents the Cause & Effect Chart of the JF2 DC/AC LINK 5.1. All fire safety information is transmitted to the FCC (Fire Command Center) installed on site.

CAUSE AND EFFECT

ABBREVIATIONS :
X = ACTION / ACTIVATE
X* = 60-SECOND DELAY
X** = 120-SECOND DELAY
NOTES :
1. THE OUTPUT SIGNAL OF THE COMBUSTIBLE GAS DETECTOR EMITS A CONTACT SIGNAL WHEN THE HYDROGEN CONCENTRATION INSIDE M-LINK IS ABOVE 10% LFL.

CAUSE			EFFECTS	FIRE CONTROL PANEL				E-PANEL								M-LINK-1			M-LINK-2			M-LINK-3		
			DESCRIPTION	DISPLAY ON LCD	ALARM LED / BUZZER	SUPERVISORY LED / BUZZER	TROUBLE LED / BUZZER	FIRE HORN/STROBE ACTIVATION	GAS SENSOR HORN/STROBE	FACP SYSTEM TROUBLE	SMOKE DETECTOR ALARM	HVAC SHUTDOWN	M-LINK#1 SMOKE DETECTOR ALARM	M-LINK#2 SMOKE DETECTOR ALARM	M-LINK#3 SMOKE DETECTOR ALARM	INTAKE DAMPER (WITH FAN) OPEN AND FAN CONTROL	ROOF EXHAUST VENT OPEN CONTROL	HVAC SHUTDOWN	INTAKE DAMPER (WITH FAN) OPEN AND FAN CONTROL	ROOF EXHAUST VENT OPEN CONTROL	HVAC SHUTDOWN	INTAKE DAMPER (WITH FAN) OPEN AND FAN CONTROL	ROOF EXHAUST VENT OPEN CONTROL	HVAC SHUTDOWN
			ADD. NO.	-	-	-	-	TB9-NAC#1	TB8-NAC#2	M100	M101	M102	M103	M104	M105	M25	M26	M28	M45	M46	M48	M65	M66	M68
NO.	ITEM	ADD. NO.	ACTION STATUS / NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
E-PANEL																								
1	SMOKE DETECTOR	D100	ALARM	X	X			X			X	X												
2	INTAKE DAMPER (WITH FAN) OPEN STATE (M-LINK#1)	M120	SUPER.	X		X																		
3	INTAKE DAMPER (WITH FAN) OPEN STATE (M-LINK#2)	M121	SUPER.	X		X																		
4	INTAKE DAMPER (WITH FAN) OPEN STATE (M-LINK#3)	M122	SUPER.	X		X																		
5	ROOF EXHAUST VENT OPEN STATE (M-LINK#1)	M123	SUPER.	X		X																		
6	ROOF EXHAUST VENT OPEN STATE (M-LINK#2)	M124	SUPER.	X		X																		
7	ROOF EXHAUST VENT OPEN STATE (M-LINK#3)	M125	SUPER.	X		X																		
8	FACP AC FAIL		TROUBLE	X			X			X														
9	BATTERY FAULT		TROUBLE	X			X			X														
10	LINE TROUBLE		TROUBLE	X			X			X														
M-LINK-1																								
1	SMOKE DETECTOR	D10	ALARM	X	X			X					X			X	X	X	X*	X*	X	X**	X**	X
2	GAS SENSOR ALARM	M35	ALARM	X	X				X							X	X	X	X*	X*	X	X**	X**	X
3	GAS SENSOR TROUBLE	M35	TROUBLE	X			X																	
4	DEFLAGRATION STATE	M36	SUPER.	X		X																		
M-LINK-2																								
1	SMOKE DETECTOR	D20	ALARM	X	X			X						X		X*	X*	X	X	X	X	X**	X**	X
2	GAS SENSOR ALARM	M55	ALARM	X	X				X							X*	X*	X	X	X	X	X**	X**	X
3	GAS SENSOR TROUBLE	M55	TROUBLE	X			X																	
4	DEFLAGRATION STATE	M56	SUPER.	X		X																		
M-LINK-3																								
1	SMOKE DETECTOR	D30	ALARM	X	X			X							X	X*	X*	X	X**	X**	X	X	X	X
2	GAS SENSOR ALARM	M75	ALARM	X	X				X							X*	X*	X	X**	X**	X	X	X	X
3	GAS SENSOR TROUBLE	M75	TROUBLE	X			X																	
4	DEFLAGRATION STATE	M76	SUPER.	X		X																		

Figure 7. Cause & Effect Chart

4. Fire Alarm System Plan

The figure below shows the cable connections for the JF2 DC/AC LINK 5.1 system.

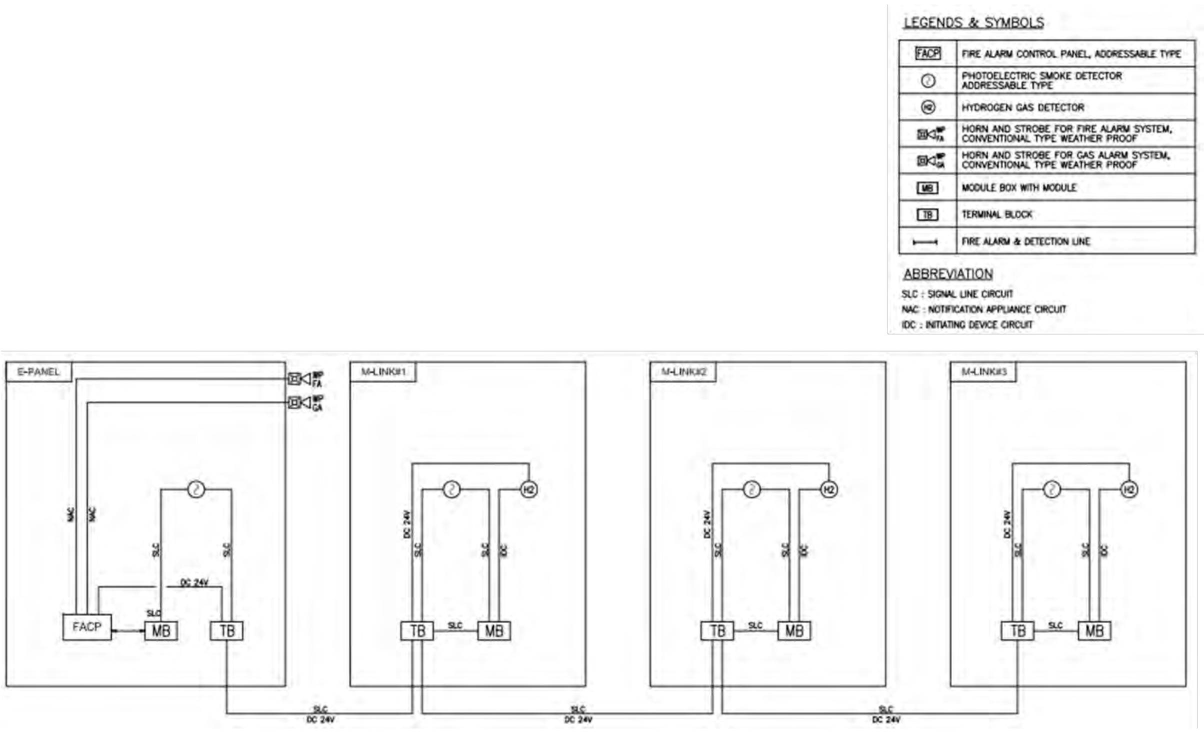


Figure 8. JF2 DC/AC LINK 5.1 Connection Diagram

4.1 System Designer

System Designer name is Hyunmin Lee. And his contact is esshyunmin@lgensol.com

4.2 Pathway Class

Pathway class designation of Fire Alarm System is Class B

4.3 Pathway Survivability Level

Pathway Survivability Level of Fire Alarm System is level 0. The Fire Alarm System cable is certified UL 1424. This cable has undergone Heat Shock Test(135℃, 1 hour)

4.4 E-Panel

(1) FACP

FACP (Fire Alarm Control Panel) has the capability to connect to a UPS power supply, auxiliary power, FCC communication lines, and internal communication lines. The Figure below shows the wiring connections for the FACP (Fire Alarm Control Panel). LG will add a lockout kit on top of the existing MCB for FACP to comply with NFPA 72 clause 10.6.5.2 and 10.6.5.4.

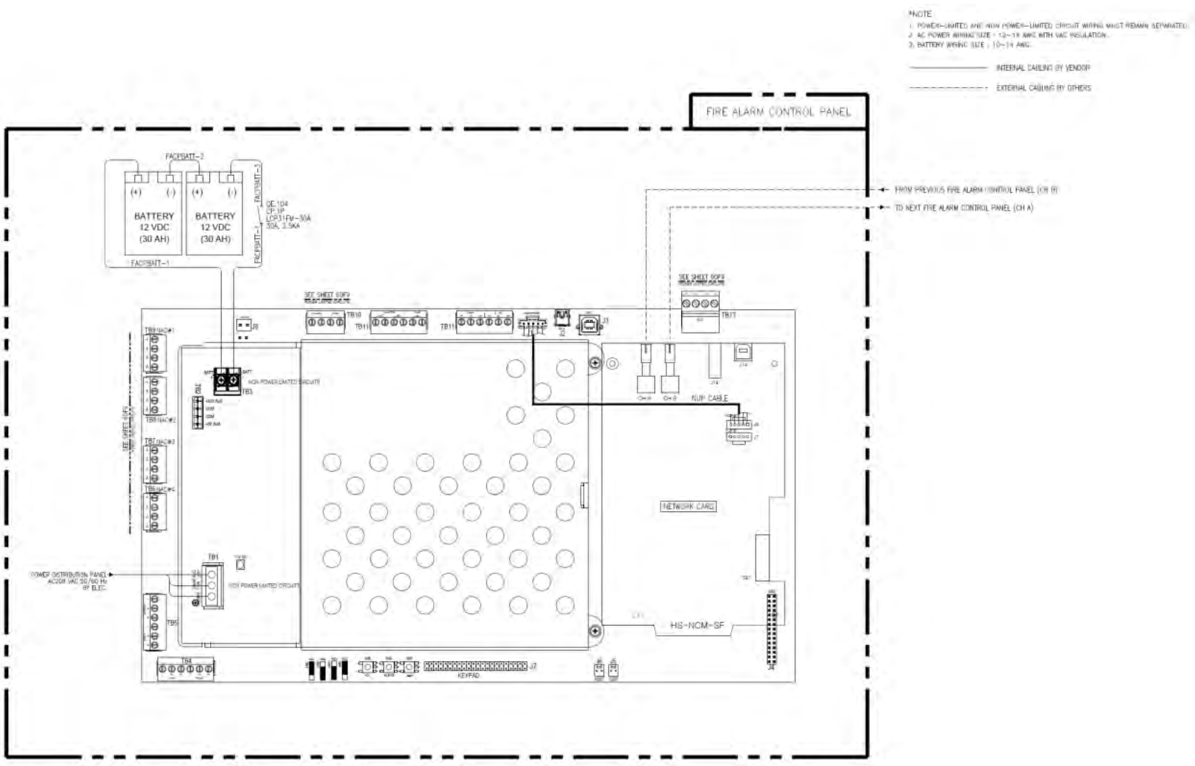


Figure 9. FACP Connection Diagram

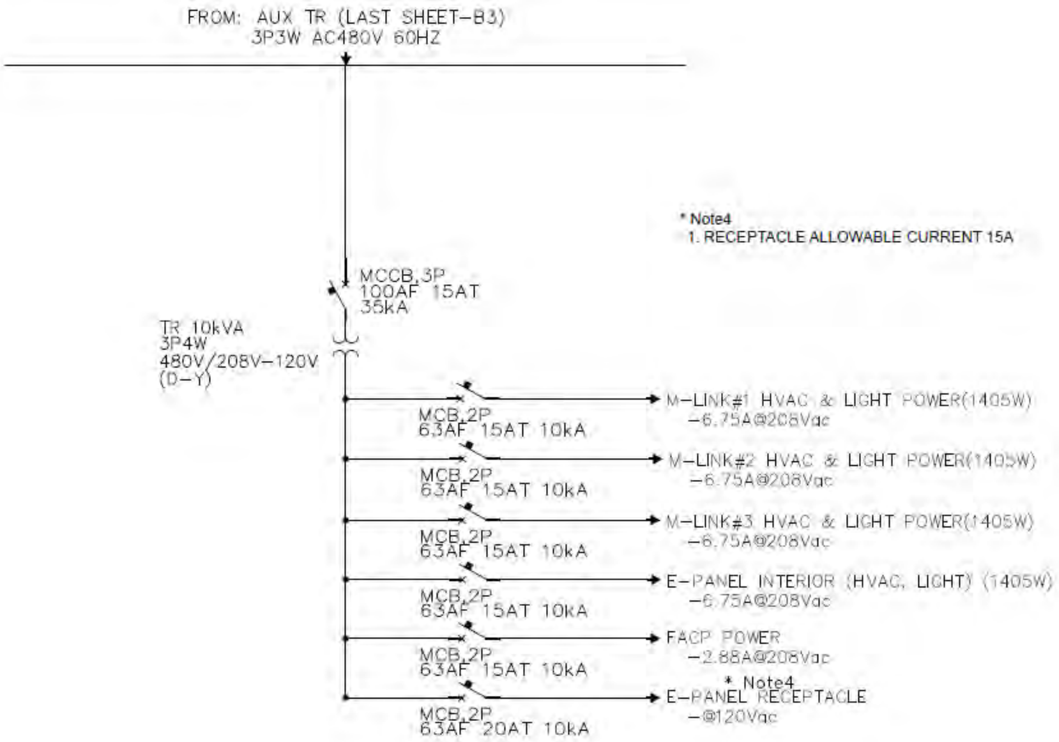


Figure 10. SLD (Breaker for FACP power)

Note: The capacity of each components of SLD may vary depending on the model.

(2) Fire Safety-related Connection in E-Panel

The figure below shows the cable connections for the fire system inside the E-Panel. The cables are connected from the E-Panel to M-LINK 1, then to M-LINK 2, and to M-LINK 3, and finally loop back from M-LINK 3 to the E-Panel. (back loop configuration)

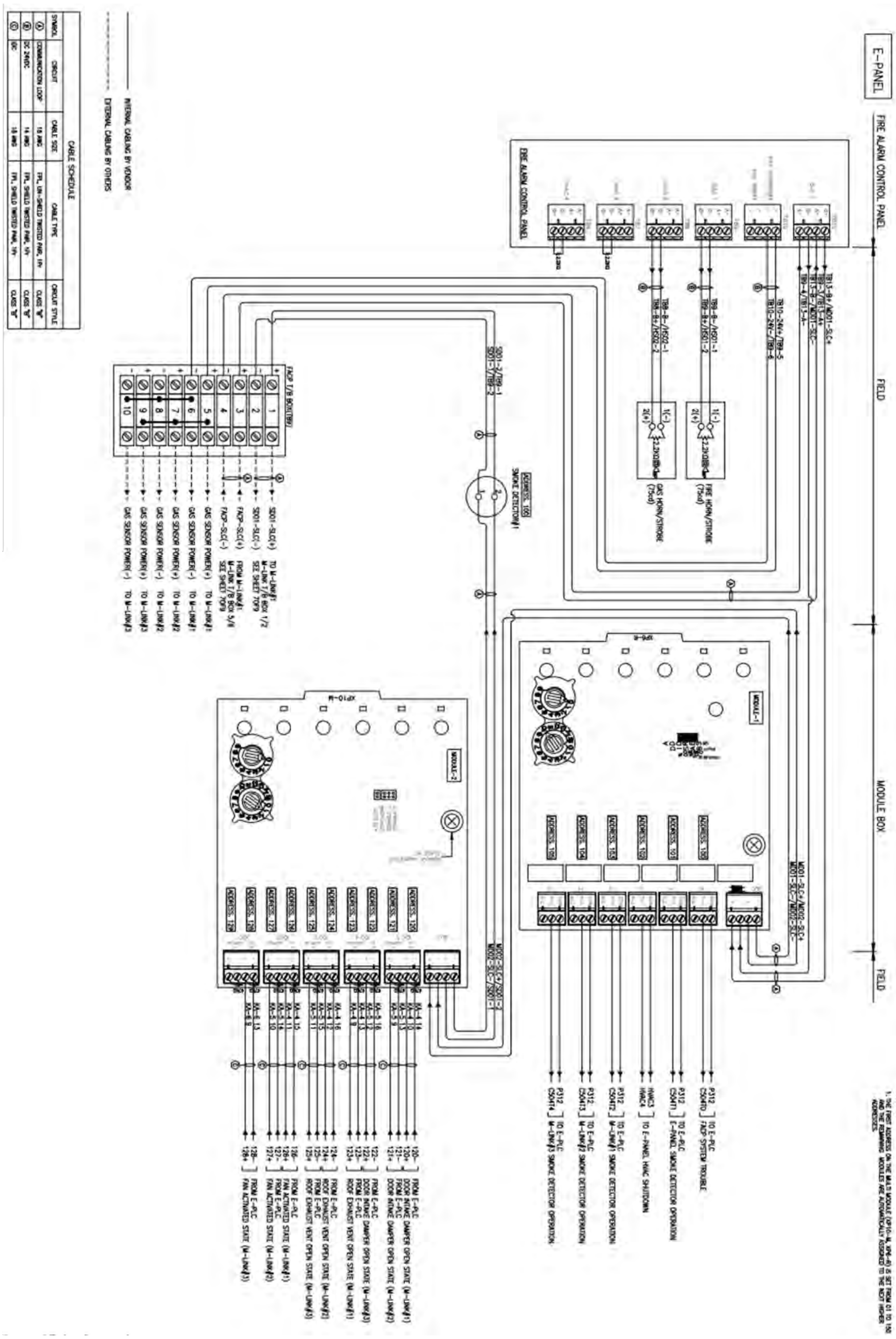


Figure 11. E-Panel Connection Diagram

4.5 M-LINK

The Figure below illustrates the cable connections inside the M-LINK. The smoke detectors are configured on the SLC (Signaling Line Circuit), the horn and strobe are on the NAC (Notification Appliance Circuit), and the gas detectors are on the IDC (Initiating Device Circuit). The fire communication is based on RS-485 communication.

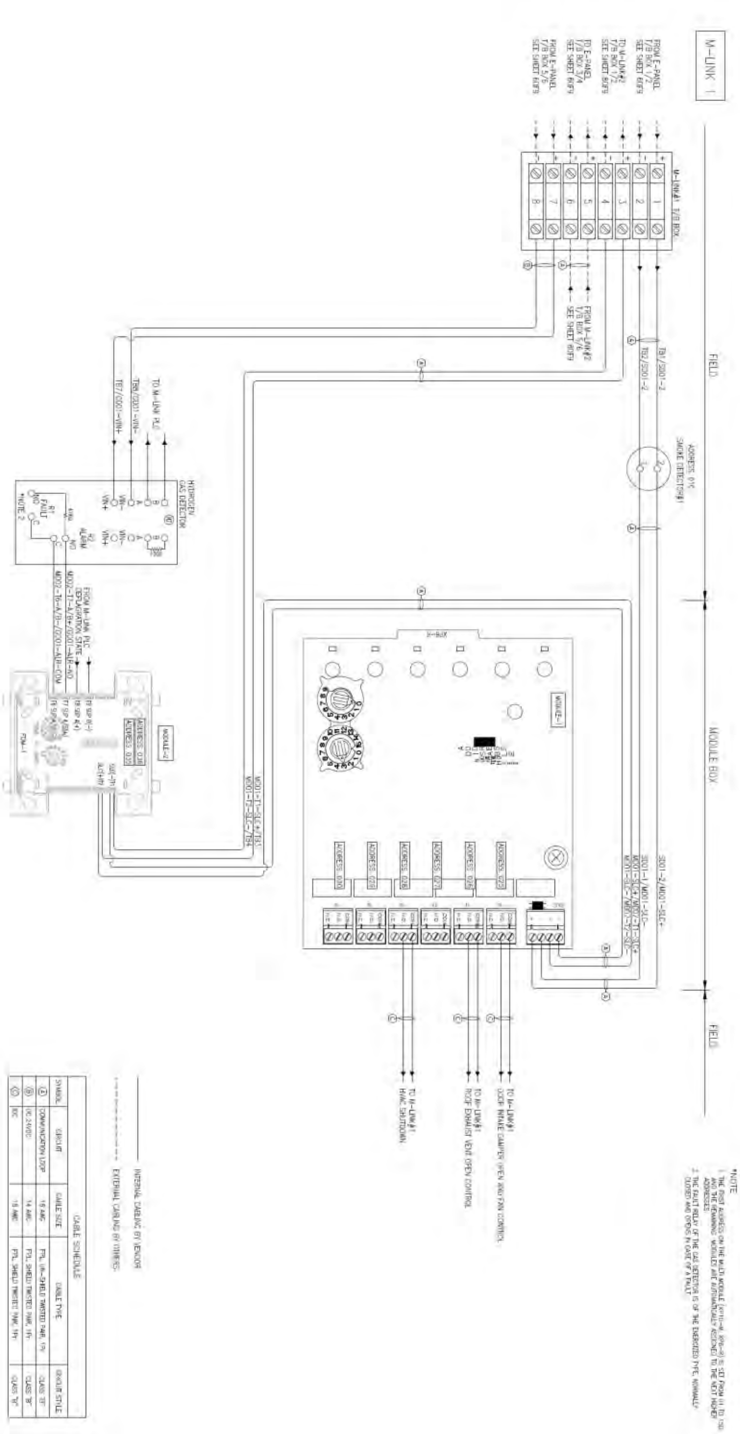


Figure 12. M-LINK 1 Connection Diagram

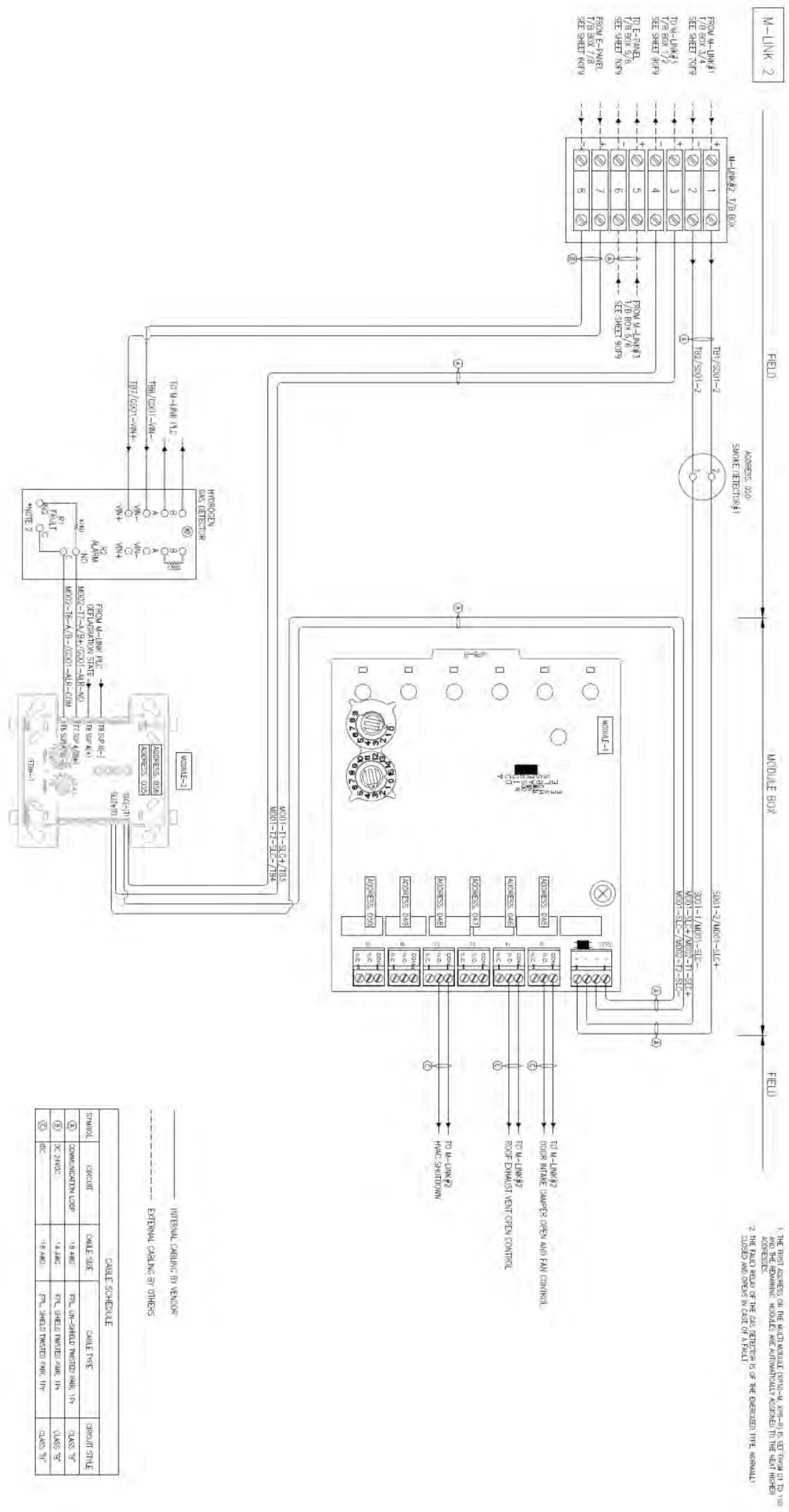


Figure 13. M-LINK 2 Connection Diagram

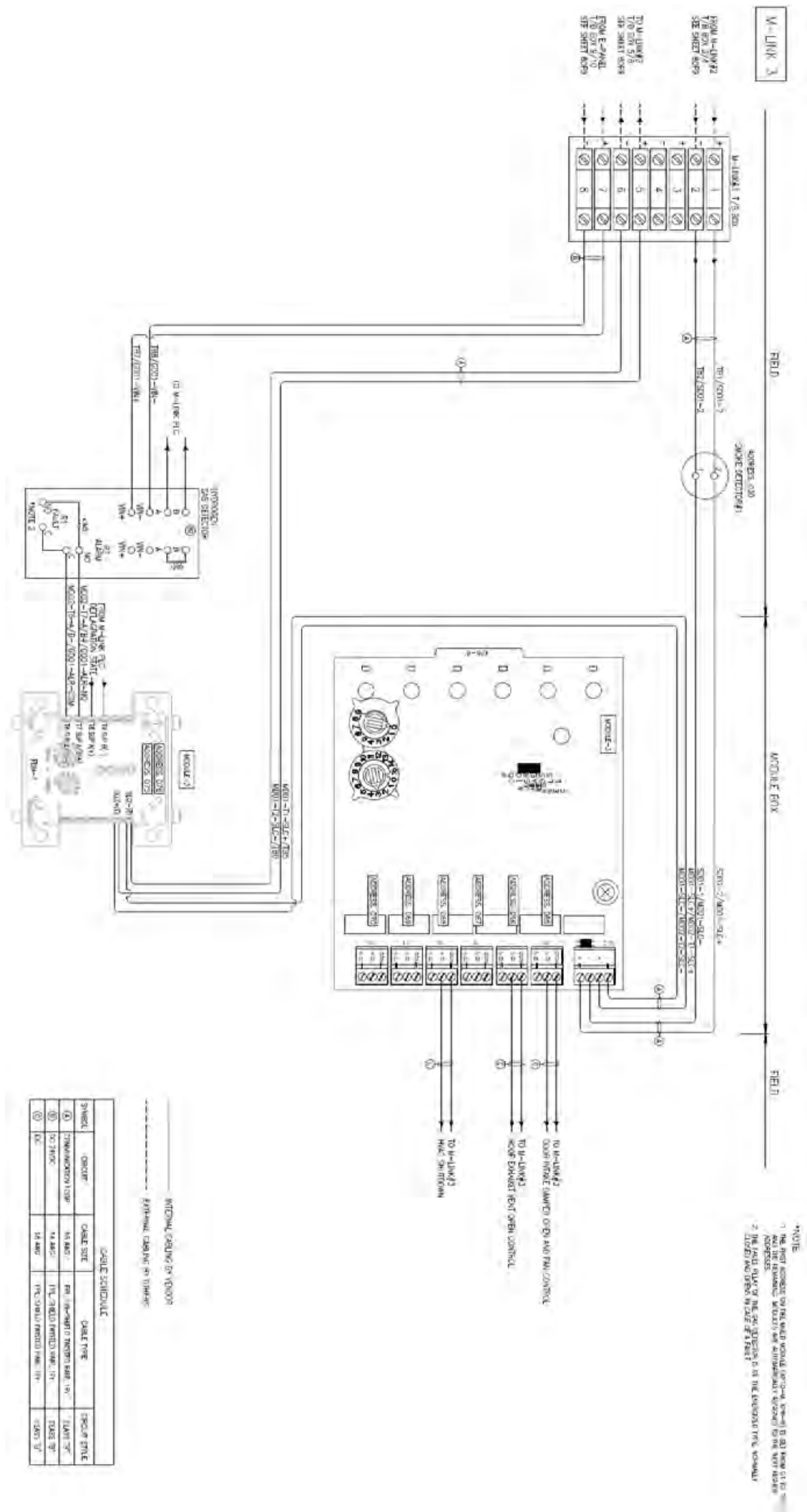
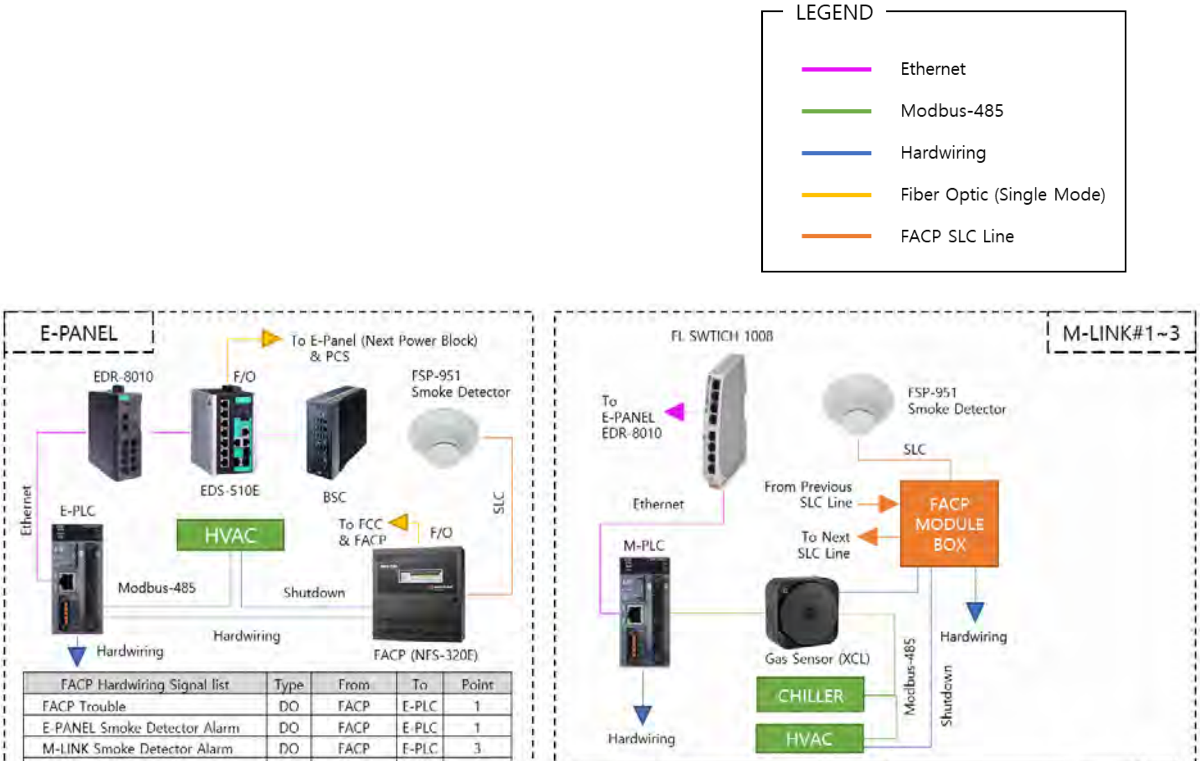


Figure 14. M-LINK 3 Connection Diagram

4.6 Communication

The figure below shows the communication architecture of the JF2 DC/AC LINK 5.1 fire system. The communication between FACP (Fire Alarm Control Panel) and PLC (Programmable Logic Controller) is established through hard-wired signals. The fire system communication via the PLC utilizes RS-485, hard-wired signals, and Modbus TCP.



FACP Hardwiring Signal list	Type	From	To	Point
FACP Trouble	DO	FACP	E-PLC	1
E-PANEL Smoke Detector Alarm	DO	FACP	E-PLC	1
M-LINK Smoke Detector Alarm	DO	FACP	E-PLC	3
E-PANEL HVAC Shutdown	DO	FACP	HVAC	1
Intake Damper State (M-LINK#1~3)	DI	E-PLC	FACP	3
Roof Vent State (M-LINK#1~3)	DI	E-PLC	FACP	3
Intake Fan State (M-LINK#1~3)	DI	E-PLC	FACP	3
E-PLC Hardwiring Signal list	**Type**	**From**	**To**	**Point**
DS State	DI	DS	E-PLC	1
DS Control	DO	E-PLC	DS	2
Fuse State	DI	Fuse	E-PLC	1
Door Limit Switch State	DI	Door S/W	E-PLC	1
DC SPD State	DI	DC SPD	E-PLC	1
AC SPD State	DI	AC SPD	E-PLC	1
Emergency Stop State	DI	E-STOP	E-PLC	1
DC UPS Error	DI	DC UPS	E-PLC	3
SMPS DC OK	DI	SMPS	E-PLC	6
Diesel Generator operation	DI	TB (E Panel)	E-PLC	1
Intake Damper State (M-LINK#1~3)	DO	E-PLC	FACP	3
Roof Vent State (M-LINK#1~3)	DO	E-PLC	FACP	3
Intake Fan State (M-LINK#1~3)	DO	E-PLC	FACP	3
E-PLC Modbus RTU Comm.	**Type**	**From**	**To**	**Point**
E-PANEL HVAC Shutdown	Com	E-PLC	HVAC	1

FACP Hardwiring Signal list	Type	From	To	Point
Gas Sensor Alarm/Trouble	DI	Gas Sensor	FACP	1
Deflagration State	DI	M-PLC	FACP	1
M-LINK HVAC Shutdown	DO	FACP	HVAC	1
Intake Damper with Fan Control (Open)	DO	FACP	Intake Damper with Fan	1
Roof Vent Control (Open)	DO	FACP	Roof Vent	1
M-PLC Hardwiring Signal list	**Type**	**From**	**To**	**Point**
Door Limit Switch State	DI	Door S/W	M-PLC	1
Intake Damper State	DI	Intake Damper	M-PLC	2
Intake Damper with Fan Control (Manual)	DO	M-PLC	Intake Damper with Fan	1
Roof Vent State	DI	Roof Vent	M-PLC	4
Roof Vent Control (Manual)	DO	M-PLC	Roof Vent	2
Intake Fan State	DI	Intake Fan	M-PLC	2
Intake Fan Fault	DI	Intake Fan	M-PLC	2
Deflagration State	DI	Deflag PNL	M-PLC	2
Deflagration State signal to FACP	DO	M-PLC	FACP	1
M-PLC Modbus RTU Comm.	**Type**	**From**	**To**	**Point**
M-LINK HVAC Shutdown	Com	M-PLC	HVAC	1
Gas Sensor State	Com	M-PLC	Gas Sensor	2

Figure 15. JF2 DC/AC LINK 5.1 Fire Safety Architecture (Communication)

5. Location of Components

Symbols are from NFPA170.

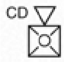
	Gas Detector
	Smoke Detector
FACP	Fire Alarm Control Panel
	Horn & Strobe

Figure 16. Symbols of Fire Alarm System Components

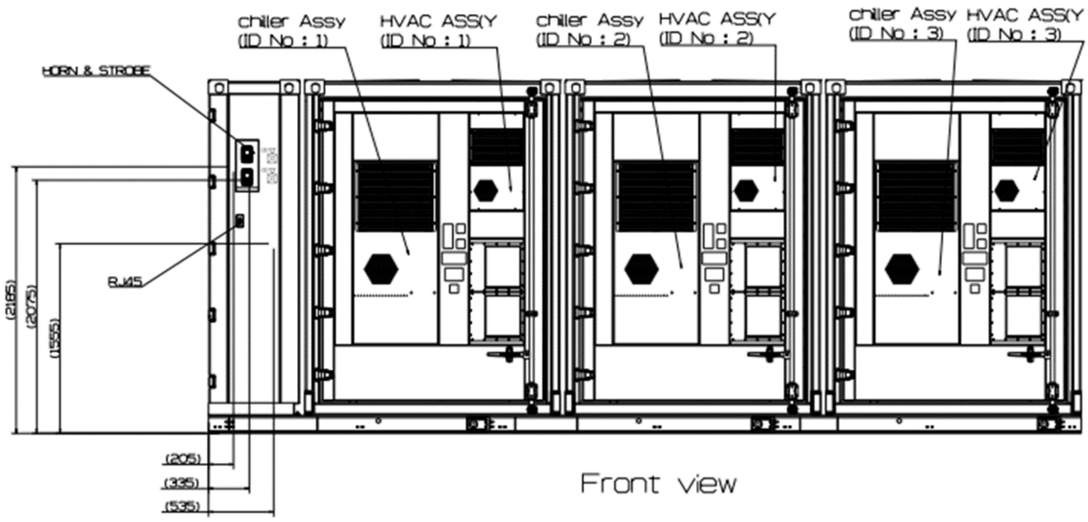


Figure 17. Front View of JF2 DC/AC LINK

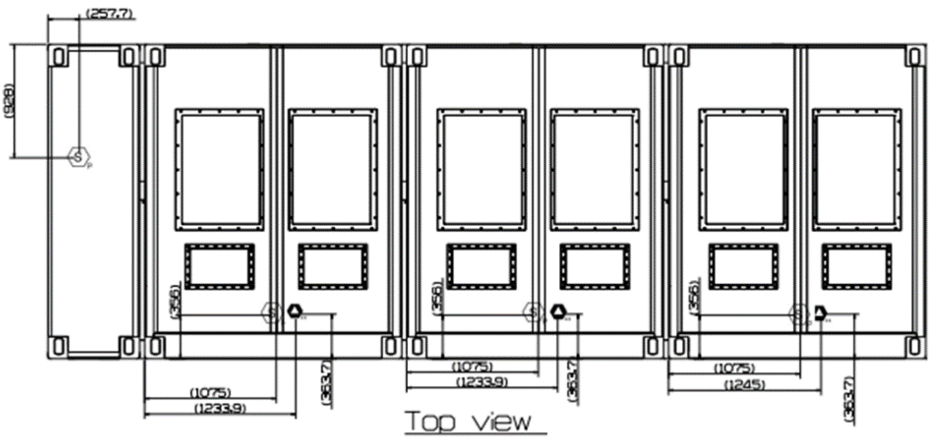


Figure 18. Top View of JF2 DC/AC LINK

5.1 Smoke Sensor (E-Panel)

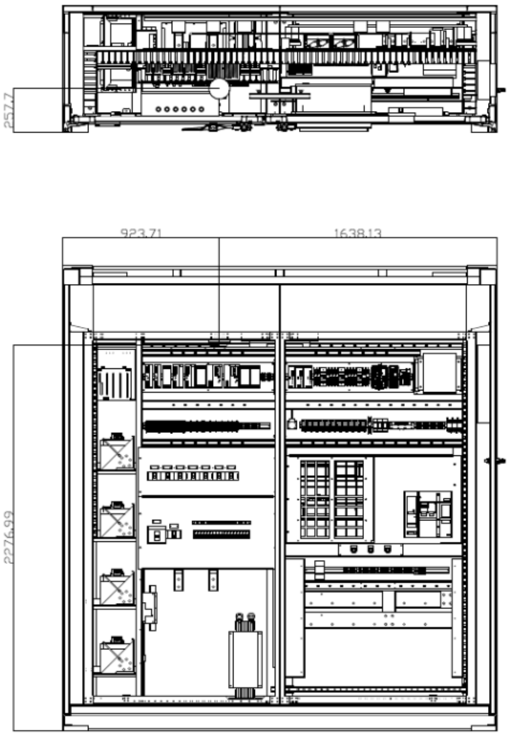


Figure 19. Location of Smoke Sensor (E-Panel)

5.2 Smoke sensor and Gas Detector (M-LINK)

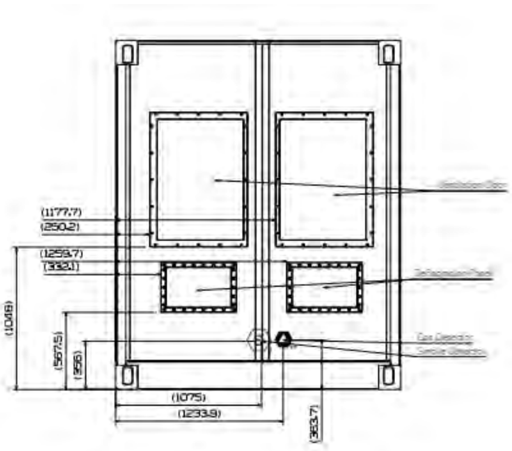


Figure 20. Location of Smoke Detector and Gas Detector (M-LINK, Top view)

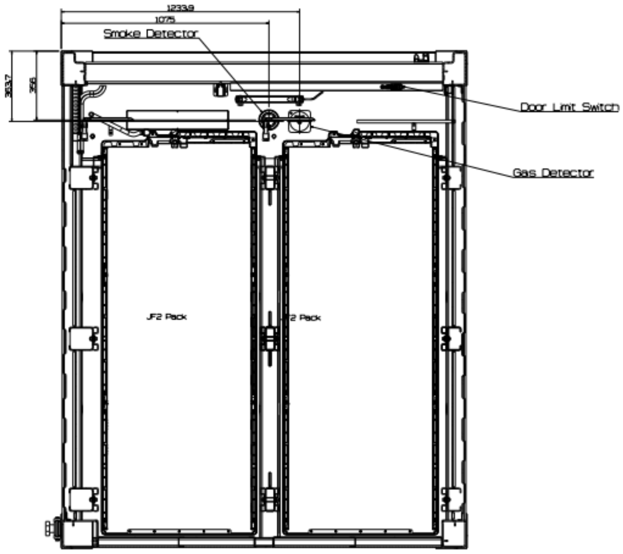


Figure 21. Location of Smoke Detector and Gas Detector (M-LINK, Front view)

5.3 Horn & Strobe (E-Panel)

The exact location can vary from site to site, but it always has the same height based on the ground as below.

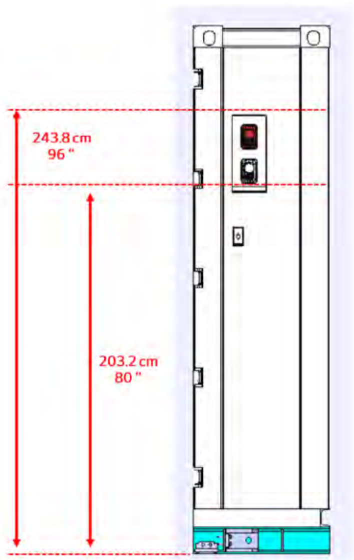


Figure 22. Location of Horn & Strobe (E-Panel)

5.4 FACP (E-Panel)

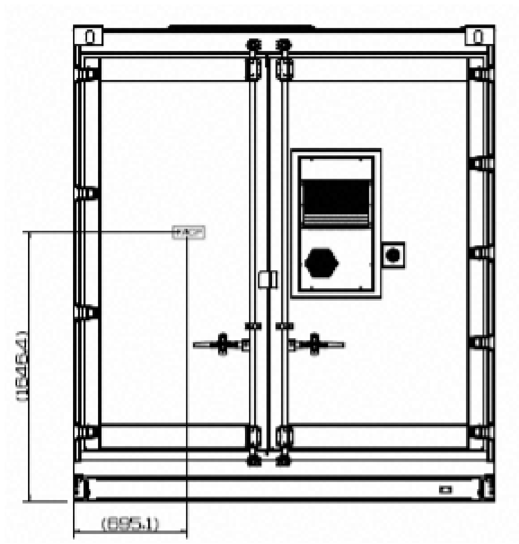


Figure 23. Location of FACP (E-Panel)

6. Power Supply of Fire Alarm System

6.1 FACP Lead-Acid Battery

The FACP (Fire Alarm Control Panel) uses its own batteries and it is designed to back up the loads for 24 hours ‘Standby’ and 2 hours ‘Alarm’ to meet requirement. The main loads are the FACP, smoke detectors, and Horn & Strobe.

Load	Power consumption	Back up time
FACP (Fire alarm control panel, Smoke detectors, Gas sensors, Horn & Strobe)	18[W] (for Standby) 34.8[W] (for Operation)	24 hours for standby power 2 hours for operation

Table 6. Power Load of FACP Lead-Acid Battery

Detail load lists by FACP battery and device current draw below.

NOTIFIER by Honeywell — **Device Current Draw**

NFS-320 Fire Alarm Control Panel

Quantity x [device current draw] = total current draw per device (in amps)

Part Number	Qty	Primary Non-Alarm	Primary Alarm	Secondary Non-Alarm
CPU-320	1	x [0.25000] = 0.25000	x [0.25000] = 0.25000	x [0.25000] = 0.25000
CPS-24	1	x [0.00000] = 0.00000	x [0.00000] = 0.00000	x [0.04000] = 0.04000
HS-NCM-W/WF/SF/WMF/WSF/WFS	1	x [0.40000] = 0.40000	x [0.40000] = 0.40000	x [0.40000] = 0.40000
FSP-951	4	x [0.00020] = 0.00080	x [0.00000] = 0.00000	x [0.00020] = 0.00080
XP10-M	1	x [0.00350] = 0.00350	x [0.00000] = 0.00000	x [0.00350] = 0.00350
XP6-R	4	x [0.00145] = 0.00580	x [0.00000] = 0.00000	x [0.00145] = 0.00580
FDM-1	3	x [0.00075] = 0.00225	x [0.00000] = 0.00000	x [0.00075] = 0.00225
SLC Loop Device Activation Current	1	x [0.00000] = 0.00000	x [0.40000] = 0.40000	x [0.00000] = 0.00000
P2GRKLED75	2	x [0.00000] = 0.00000	x [0.08700] = 0.17400	x [0.00000] = 0.00000
Gas Sensor	3	x [0.03000] = 0.09000	x [0.07500] = 0.22500	x [0.03000] = 0.09000
Total (Amperes):		0.7524 A	1.4490 A	0.7924 A

Part Number	Qty	Secondary Alarm
Total Primary Alarm Load - C2	1	x [1.44900] = 1.44900
CPS-24	1	x [0.04000] = 0.04000
Total (Amperes):		1.4890 A

Figure 24. Device Current Draw of FACP

Below presents the FACP battery calculation for achieving a target standby time of 24 hours and alarming time of 2 hours. Primary Loads are the FACP battery's load when AC power is supplied properly to the Fire Alarm Safety Components. Secondary Loads are the FACP battery's load to Fire Alarm Safety Components during outage.

NOTIFIER by Honeywell — **System Power Requirements**

Notifier NFS-320 Fire Alarm Control Panel

Protected Premises: ____ Date: ____
Address: ____
City: ____ State: ____ Zip: ____

Prepared By: ____ Phone: ____
Address: ____ Email: ____
City: ____ State: ____ Zip: ____

AC Branch Current Requirements — 2.50 AMPS @ 220/240 VAC
Current required by source to power the fire alarm system.

Primary Standby Load — 0.75 Amps
Current load on the primary power supply during **non-alarm** conditions.

Primary Alarm Load — 1.45 Amps
Current load on the primary power supply during **alarm** conditions.

Secondary Load Requirements — 27.49 Amp Hours
Total Secondary Load from the calculation table below.

Current Draw		Time (hours)	Total (AH)
Secondary Standby Load 0.792 A	x	Required Standby Time: 24 hours	19.02
Secondary Alarm Load 1.489 A	x	Required Alarm Time (hours): 2.000 hours	2.98
		Total Secondary Load	21.99
		Derating factor	x 1.25
		Secondary Load Requirements (Amp Hours)	**27.49** AH

FACP(Internal Battery)
24hours stand by
2hours alarm

Battery Selection — 30 Amp Hours
Select batteries from the list below.
30 AH CUSTOM BATTERY (12 volt)
Two / Four (two 12VDC sets in parallel)

Battery Selection
30Ah, 24VDC

Figure 25. FACP Battery Calculation

6.2 UPS Battery (in the E-Panel)

The load for UPS is associated with the Gas detection & Ventilation System. The target backup time for UPS is set to a minimum of 26 hours. This satisfies the Gas detection & Ventilation System 24-hour standby time and 2 hours in alarm requirement as required by IFC, CFC, PFC and NFPA 855.

Load			Power consumption	Back up time
UPS 3 (960W)	①	Relay (15ea, M-LINK #1-3)	2.86 W	26 hours
	②	Roof Exhaust Vent_ Operation (M-LINK Sequential)	331.2 W	1 min per 1 M-Link
	③	Intake Fan 2ea for M-LINK & Damper_ Standby (All M-LINK #1-3)	0.18 W (Standby)	24 hours
		Intake Fan 2ea for M-LINK & Damper_ Operation Start* (M-LINK Sequential)	330 W (Operation Start)	5 sec per 1 M-Link
		Intake Fan 2ea for M-LINK & Damper_ Operation (All M-LINK #1-3)	390 W (Operation)	2 hours
	④	UPS Module (1ea, E-Panel)	4.8 W (Standby)	26 hours
			25 W (Operation)	2 hours
	Sum		7.84 W (Standby)	24 hours
			689.06 W (Operation Start)	3 min
			417.86 W (Operation)	2 hours

Figure 26. Power load of UPS Battery

7. Operation & Maintenance

7.1 Operation Procedure

(1) Automatic Operation

A fire safety system is operated automatically by means of a detection and control system. If any smoke detector installed in JF2 DC/AC LINK 5.1 is activated, a Fire Alarm signal is sent to the FCC, and the HVAC at the corresponding location is shut down. If a smoke detector or a gas detector installed in M-LINK is activated, all ventilation systems in JF2 DC/AC LINK 5.1 are activated. For detailed operating logic by items, please refer to the "Fire Safety Logic with Cause & Effect Chart" in clause 3.2.

⚠ WARNING
Everyone must evacuate the hazard area promptly upon hearing the pre-discharge alarm. Make sure no one enters the hazard area. Call the fire department immediately.

7.2 Maintenance

This chapter contains maintenance instructions for the Fire Alarm System.

These procedures must be performed regularly in accordance with regulations. If problems arise, a corrective action must be taken.

Take note of the following precautions:

1) This Fire Alarm System must be serviced by qualified personnel only. Qualified personnel mean personnel who have met State approved or recognized certification, licensing, registration, or other comparable requirements that apply to the areas in which the individuals are conducting evaluations or assessments or providing early intervention services.
2) Any environmental or operating condition which causes shorting or grounding of system components can cause system malfunctions.
3) Before servicing any component, disarm the protection system by removing all AC and DC power from the control unit.

(1) Periodic Maintenance Schedule

A regular program of systematic maintenance is essential for continuous, proper operation of all Fire Alarm Systems. A periodic maintenance schedule must be followed and an inspection log maintained for ready reference. As a minimum, the log must record:

1) Inspection interval,
2) The inspection procedure performed,

3) Maintenance performed, if any, as a result of inspection, and

4) The name of inspector performing the task.

Schedule	Requirement	Regulation	Persons
Semi - annually	**Visual Inspection** Fire Alarm Control Panel, Smoke Detector, Horn and Strobe	NFPA 72, Table 14.3.1	1
Annually	**Testing** Fire Alarm Control Panel, Smoke Detector, Horn and Strobe, UPS Battery	NFPA 72, Table 14.4.3.2	2

Table 7. Periodic Maintenance Lists

(2) Annually

At least every 12 months, the enclosure shall be thoroughly inspected to determine if penetrations or other changes have occurred that could adversely affect some leakage or change volume of hazard or both.

Revision History

Version	Date	Writer	Change Description
1.0	01/16/2025-	Hyunmin Lee	Initial Release
2.0	01/30/2025	Hwanseok Choi	Update fire safety logic, connection diagram
3.0	05/15/2025	Hyunmin Lee	Update specification of two fan and deflagration panel
4.0	06/17/2025	Yoonsin Kim	Update certifications, CSFM, FACP battery breaker, figure 10, deflagration panel state signal, gas sensor DI name, UPS power consumption and UPS back up time
5.0	07/03/2025	Yoonsin Kim	Update plan for lockout kit on top of the existing MCB for FACP. Update note for figure 10.

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