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Project Title:	Potentia-Viridi Battery Energy Storage System
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Document Title:	DR Response 2 - Attachment 11, Fire Protection Technical Assistance Report
Description:	This report identifies the project's compliance plan to meet the requirements of the 2022 California Fire Code (CFC) Section 1207 and NFPA 855 chapter 9
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Attachment 11

Fire Protection Technical Assistance Report

FIRE PROTECTION TECHNICAL ASSISTANCE REPORT

POTENTIA-VIRIDI BATTERY ENERGY STORAGE SYSTEM
ALAMEDA COUNTY, CALIFORNIA

Prepared for: Levy Alameda, LLC,
a subsidiary of Obra Maestra Renewables, LLC

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Revision History		
Revision	**Date**	**Description of Revision**
Rev A	2024-10-17	DRAFT - Issued for Internal Review
Rev B	2024-11-18	Revised per CEC Meeting – Internal Review
Rev C	2024-11-19	Added “ESS Enclosure Transportation to Job Site” section
Rev D	2025-01-17	Updated to reflect CalFire requirements

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1. Executive Summary

This Technical Assistance Report by Coffman Engineers, Inc. pertains to the Potentia-Viridi Battery Energy Storage System (BESS) in eastern Alameda County, California. This report identifies the project's compliance plan to meet the requirements of the 2022 California Fire Code (CFC) Section 1207 and NFPA 855 chapter 9.

Note that due to constantly improving and changing battery technologies, the developer has not selected a specific manufacturer or model at the time of this report. By the time the battery equipment is ordered in 6-12 months, the technical details of any proposed product are expected to change. As such, this report focuses on the high-level equipment selection criteria and the general approach to comply with the applicable codes.

Beyond the code minimums, it is noted that the developer has made the following design decisions that provide an additional level of safety:

- Design complies with the “Remote Outdoor Installation” definition which is a minimum of 100-feet from lot lines. Code allows ESS equipment to be located within 10-feet of a lot line.
- Design provides a non-pressurized “recognized water supply” as defined by NFPA 1142 (250 gpm for 2-hours or 30,000 gallons) for firefighting purposes vs the lower equipment volume calculation. In addition as an additional safety measure, a second 30,000 gallon tank is being provided at the secondary entrance.

Table 1 on the following page summarizes the required vs. provided fire and life safety code features provided in CFC section 1207.8 and NFPA 855 chapter 9 for the future proposed cabinet (non walk-in) outdoor enclosures.

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Table 1 NFPA 855 and CFC Code Requirements		
Description	**Quantity / Type**	**CFC / NFPA 855 Applicable Code**
Enclosure Manufacturer	To be determined	-
Battery Type	Lithium Ion	-
Outdoor ESS Installation Type	"Remote" (i.e. > 100-ft)	CFC § 1207.8.1 Any installation 100 ft or less from buildings, lot lines, or public ways is considered "near exposures" vs. a "remote" installation. NFPA 855 § 9.3.2 similar language.
Listing (Report Section 0)	All enclosures will be factory UL 9540 listed. (no field certification allowed)	CFC § 1207.3.1 requires ESS equipment to be listed in accordance with UL 9540 with limited exceptions for inverts. NFPA 855 § 4.6.1 similar language.
Size and Separation (Report Section 5)	No limitations as proposed design is considered "Remote"	CFC § Table 1207.8 states that the spacing separation between individual groups of 50 kWh batteries does not apply where the Outdoor ESS is remote. Note that while not required by code, the developer intends to provide manufacturer large-scale testing to justify the energy density spacing as well. NFPA 855 § Table 9.5.2 similar language.
Enclosure Type (Report Section 6)	Outdoor Installation (CFC § 1207.8 / NFPA 855 § 9.3.2) Non Walk-In Unit (CFC § 1207.4.12 / NFPA 855 § 9.5.2.3)	CFC § 1207.5.6 / NFPA 855 § 9.5.2.4 requires the maximum enclosure dimensions to not exceed: • Max 53' x 8' x 9.5 high
Fire Detection (Report Section 7)	Exact type / quantity will depend upon the final selected product, but at minimum a fire detection system will be provided.	CFC § 1207.5.4 requires a smoke or radiant energy sensing detection system for indoor areas, rooms and walk-in units containing ESS. As outdoor non-walk-in units, system is not explicitly required by code but is recommended to be provided. NFPA 855 § 9.6.1 similar language.
Fire Suppression Systems (Report Section 8)	No fire suppression system will be provided unless required by the manufacturer's thermal runaway management system. The selected equipment will not be water based suppression.	CFC § 1207.5.5 states that fire suppression is only required within "*rooms and areas within buildings and walk-in units …*" As these are non walk-in units, no fire suppression system is required.

Table 1 NFPA 855 and CFC Code Requirements		
Description	**Quantity / Type**	**CFC / NFPA 855 Applicable Code**
Vegetation Control	A gravel or paved area in excess of 10 ft is provided on all sides.	CFC § 1207.5.7 requires min 10-ft clear NFPA 855 § 9.5.2.2
Means of Egress Separation	These non walk-in enclosures have no interior egress paths. In addition, the enclosures will not be adjacent to any structures or occupied areas. No egress separation concerns exist.	CFC § 1207.5.8 min 10-feet separation from means of egress NFPA 855 § 9.5.2.6.1.7 similar language.
Exhaust Ventilation During Normal Operation	Not required/applicable for Lithium-Ion technology as it does not off-gas during normal charging operations	CFC § 1207.6.1 and Table 1207.6 NFPA 855 § 9.6.5.1 similar language.
Spill Control	It is not required/applicable for lithium-ion technology as the electrolyte is sealed.	CFC § 1207.6.2 and Table 1207.6 NFPA 855 § 9.6.5.2 similar language.
Explosion Control (Report Section 9)	The future proposed manufacturer will either utilize 1) Explosion prevention per NFPA 69; or 2) Deflagration Venting per NFPA 68	CFC § 1207.6.3 and 911 NFPA 855 § 9.6.5.6 similar language.
Safety Caps	Not required/applicable for Lithium-Ion technology	CFC § 1207.6.4 and Table 1207.6 NFPA 855 § 9.6.5.4 similar language.
Thermal Runaway	The battery management system (BMS) will actively monitor the voltage and temperature of all cells/modules and provide a first level of protection from thermal runaway. Passive thermal protection between the cells will provide a second level of protection.	CFC § 1207.6.5 and Table 1207.6 Per Table 1207.6(e), The thermal runaway protection is permitted to be part of a battery management system that has been evaluated with the battery as part of the evaluation to UL1973. NFPA 855 § 9.6.5.5 similar language.

Table 1 NFPA 855 and CFC Code Requirements		
Description	**Quantity / Type**	**CFC / NFPA 855 Applicable Code**
Clearance to Exposures (Report Section 10)	> 10 feet will be provided in all directions from the battery enclosure groups. Actual provided clearance to lot lines will be > 100 feet.	CFC § 1207.8.3 min 10-ft to lot lines, public ways, buildings, and other exposure hazards NFPA 855 § 9.5.2.6.1 similar language.
Water Supply (Report Section 11)	30,000 gallons of on-site non-pressurized fire water storage.	CFC § 507 to Appendix § B103.3 NFPA 855 § 9.6.3

2. General ESS System Description

Lithium-ion battery technology is widely-deployed in the United States and is considered a mature technology, and systems continue to be improved and develop each year. Improvements in recent years relate to battery cell chemistry, module construction, gas and smoke detection, system control, and energy management. Given these systems continue to improve, a specific manufacturer and model has not been selected. Rather than providing a specific product, this report identifies how the developer will be selecting the future proposed product to ensure compliance with the applicable codes and standards.

It can be confirmed at this time that UL9540 listed, non-walk-in, outdoor enclosures, utilizing lithium-ion technology will be used for the project. Lithium-ion is the appropriate technology for the energy storage duration required.

Other energy storage systems (including electrical, electro-chemical, mechanical, thermal, and chemical) exist and are being deployed in the United States, however none available on the market today exhibits the maturity level, specific energy density, manufacturing scale, reliability, and safety performance of lithium ion battery systems. Within the electro-chemical energy storage category (that is, batteries), lithium-ion battery storage systems have a proven track record for reliable performance, relative to other electro-chemical configurations, such as metal-air, zinc-bromide, and flow batteries.

3. Code Summary

The Authority Having Jurisdiction (AHJ) on the fire protection side for the project is the Alameda County Fire Department and the Department of Forestry and Fire Protection (CalFire). The applicable codes and standards for the project include the following, with local amendments:

- California Electrical Code (CEC), 2022 Edition
- California Fire Code (CFC), 2022 Edition, Alameda County Amended
- California Code of Regulations, Title 14 Natural Resources, Division 1.5 Department of Forestry and Fire Protection, Chapter 7 Fire Protection, Subchapter 2 State Minimum Fire Safe Regulations

The proposed ESS exceeds 20 kWh, making CFC 1207 requirements applicable.

4. Equipment Listing

The future proposed equipment will be factory listed to UL9540 by a nationally recognized testing laboratory (NRTL). UL9540 is the industry standard for large scale Energy Storage Systems. UL Listed means the ESS was evaluated as a stand-alone product, meaning the whole product was tested rather than just its components.

UL9540 listing includes evaluation of the product for a wide variety of other codes and standards including, but not limited to:

- UL 1564, Industrial Battery Chargers
- UL 1741, Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources
- UL 1973, Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail (LER) Applications
- IEC 60812, Failure mode and effects analysis (FEMA and FMECA)
- NFPA 70, National Electrical Code
- NFPA 70E, Electrical Safety in the Workplace

Future construction document permit submittals will include copies of the UL9540 certificates as well as appropriate related supporting documentation.

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5. Size and Separation

CFC Table 1207.8 states that the spacing separation between individual groups of 50 kWh batteries per CFC section 1207.5.1 does not apply where the Outdoor ESS is “Remote”. NFPA 855 Table 9.5.2 has similar exemptions and requirements. See Section 10 for additional discussion of clearance to exposures and remote definition.

While the Remote Location exemption is utilized, the developer still intends to utilize a battery manufacturer that has large-scale testing (i.e. UL9540A) documenting the maximum anticipated fire size will be limited. Based upon past experience with many manufacturers, the likely maximum anticipated fire size is limited to one-or-two modules entering thermal runaway at maximum. This equates to approximately 10% of an enclosure being consumed before self-extinguishing due to passive fire protection features. This future documentation will further justify the proposed enclosure spacing and battery capacities.

6. Enclosure Type

The future proposed equipment will be a non-walk-in enclosure type (CFC § 1207.4.12 / NFPA 855 § 9.5.2.3). Non-walk-in enclosures prevent any employees from occupying the enclosure and therefore they are not considered buildings per CBC / CFC. Note that the definition does allow personnel to partially enter into the outer enclosure to perform service or maintenance.

Enclosures will be of non-combustible construction (i.e. steel) and will not exceed the maximum dimensions of 53’ long x 8’ wide x 9.5 high per CFC § 1207.5.6 / NFPA 855 § 9.5.2.4.

7. Fire Detection

The future proposed equipment will include one of the two options depending upon the manufacturer per CFC § 1207.5.4 and NFPA 855 § 9.6.1 requirements:

- **Internal Smoke Detection** – OSFM approved smoke detector connected to either an external or internal listed fire alarm panel.
- **External Radiant Energy Sensing Detection** – External thermal cameras with adjustable fixed and rate-of-rise temperature setpoints reporting back to a listed fire alarm panel.

Regardless of the option selected, the alarm signals will be aggregated to a master or annunciator panel at a location approved by the AHJ (NFPA 855 § 4.8.2.2). In addition, the fire alarm signals will be transmitted to an approved off-site supervising station for prompt notification of the fire department of any alarms.

8. Fire Suppression

As non walk-in enclosures do not have any occupants to protect, the fire code does not require any fire suppression system unless it is required by the manufacturer as part of the UL 9540 listing for thermal runaway control. The future proposed equipment will be selected such that it utilizes passive thermal runaway protection methods (i.e. insulation between cells/modules). Passive designs are more reliable and effective than a water or other extinguishing agent. Water based suppression systems frequently can cause additional electrical shorting which can cause additional fires. Gaseous / Clean Agent systems provide short term protection against electrical fires but are not effective against a longer duration lithium fire and are negated in scenarios where an explosion ventilation system actively removes the agents.

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9. Explosion Control

The future proposed equipment will provide explosion control measures complying with CFC Section 911 where flammable gas concentrations could exceed 25% of the LEL/LFL. Exceptions are permitted where documentation demonstrates that the electrochemical ESS technology does not have this potential. It is expected that some level of explosion control may be necessary depending on the technology selected. If the selected technology requires explosion control based on its configuration, it will be provided via one of the two following options:

- **NFPA 68 Deflagration Venting** – This protection scheme provides built-in panels to control the discharge energy of a deflagration event. Generally light-weight panels designed to rupture at a specific pressure are provided on the roof of the enclosures. This type of system is becoming less favorable by manufacturers for a variety of reasons, and most likely an active explosion prevention system noted below will be provided.
- **NFPA 69 Explosion Prevention** – This protection scheme provides an active ventilation system (fans and dampers) activated by gas sensors to maintain the flammable gas concentration below the 25% of the LEL gases generated during thermal runaway.

10. Clearance to Exposures

Per CFC 1207.9.3, outdoor ESS shall have a minimum separation distance of 10 feet from the following exposures:

- Lot lines
- Public ways
- Buildings
- Stored combustible materials
- Hazardous material
- High-piled stock
- Other exposure hazards

CCR § 1276.01(a) requires a minimum setback distance of 30 ft. for buildings from property lines or public roads.

The developer has also chosen to provide a minimum 100-ft setback from buildings, lot lines, public ways, stored combustible materials, hazardous materials, high-piled stock and other exposure hazards. This allows the installation to be considered a “remote location” per CFC § 1207.8.1 and NFPA 855 § 9.3.2 (1). The code acknowledges that at 100-feet, the risk from radiant heat is not a risk.

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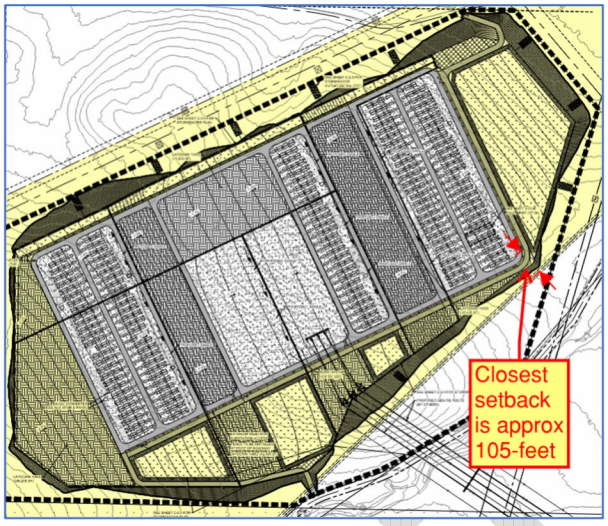

Figure 1 – Preliminary Site Plan with Setback Area Highlighted Yellow

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11. Water Supply

The developer will provide a minimum of 30,000 gallons of non-pressurized on-site water storage for firefighting purposes. This will consist of an aboveground tank connected to a fire hydrant immediately adjacent to the tank.

The fire code is not prescriptive in the water supply storage quantity for Energy Storage System sites. Since these sites consist of metal enclosures located within a gravel yard, large qualities of water for firefighting is not required. The most probable fire would be associated with a service vehicle catching fire.

CCR § 1275.02 (b) and CFC section 507.1 requires that an approved water supply be provided for “facilities”. The definition for facilities includes “storage lots” which could be applied to an ESS site. CFC section 507.3 and Appendix B103.3 “Areas Without Water Supply Systems” directs one to NFPA 1142 (*Standard on Water Supplies for Suburban and Rural Firefighting*). This is similar to NFPA 855-2023 section 9.6.3 and 4.9.4 which also recommend NFPA 1142.

NFPA 1142 provides volume-based calculations which are based upon larger structural fires. However, the volume-based calculation is less applicable when the volume of a single enclosure is typically in the 1,300 cubic feet range and the resulting fire-water storage quantity is less than 800 gallons.

The developer has chosen to provide a “Recognized Water Supply” per NFPA 1142 section 3.3.23 which is defined as a flow rate of 250 gpm for 2-hours or 30,000 gallons. To provide an additional level of safety, separate 30,000 gallon fire-water tank will be provided at each entrance for a total on-site fire-water storage capacity of 60,000 gallons.

12. Hazard Mitigation Analysis (HMA)

As the final battery energy storage equipment has not been selected, it is not possible to provide a hazard mitigation analysis per CFC section 1207.1.4 and NFPA 855 section 4.4. An HMA needs to be based upon the model specific UL9540A test data which documents the specific gases released during thermal runaway and expected propagation between cells and modules.

It is the applicant’s intent to utilize the “deferred submittal” allowance of CBC section 107.3.4.1 for the fire protection technical reports. The future HMA will specifically address the following single mode failures per CFC section 1207.1.4.1. Note that the manufacturer’s overall UL9540 listing will have also analyzed these failure modes:

- A thermal runaway condition in a single ESS rack, module or unit.
- Failure of any battery (energy) management system.
- Failure of any required ventilation or exhaust system.
- Voltage surges on the primary electric supply.
- Short circuits on the load side of the ESS.
- Failure of the smoke detection, fire detection, fire suppression or gas detection system as appropriate
- Required spill neutralization not being provided or failure of a required secondary containment system (not applicable to lithium-ion batteries)

13. Wildfire Mitigation

Reference section 3.17 of the Dudek report for detailed analysis of wildfire risks and section 3.17.5 for wildfire mitigation measures. In addition to the Dudek mitigation measures focused on construction activities, the following design decisions to minimize the risk of fire spreading from and to the battery energy storage area after construction include:

- Vegetation Management - Code only requires combustible vegetation within 10-feet of an outdoor ESS enclosure to be cleared. The proposed design includes a ring road of at least 20-feet width is provided around all ESS enclosures as an additional safety measure.
- Remote Clearance – Code only requires ESS enclosures to be located 10-feet from lot lines and buildings 30-feet from lot lines. The proposed design is based upon a minimum of 100-feet from all lot lines to enclosures and can be considered “remote” as defined by CFC and NFPA 855. This provides further privately owned buffer to the adjacent properties.

14. ESS Enclosure Transportation to Job Site

During Project construction and operation, the following transportation requirements and procedures would apply:

- **State of Charge Limitation:** Work with the battery supplier to limit the maximum state of charge to approximately 30% for lithium-ion batteries. Currently, there are no ground transport regulations for state of charge, but the 30% matches air transport regulations (special provision A100 – § 172.102) to minimize the chance of thermal runaway.
- **Signage:** Appropriate labeling, marking, and placarding will be applied to vehicles per the applicable regulations when transporting UN3536 (*Lithium batteries installed in cargo transport unit*) Class 9 (*Miscellaneous Dangerous Substances*) goods in commerce.
- **Requirements of haulers:** Qualified haulers would be retained to ESS enclosures to the job-site. The selected haulers would be fully licensed and insured. Haulers would follow all applicable requirements in the Code of Federal Regulations with regard to loading, unloading, and general handling, based on transport mode.
- **Truck loading operations**: Trucks would be loaded at designated staging areas for transportation to the designated receiving facility. Stray material on vehicles, tires, or the lip of the container, etc., would be removed manually with a brush. The container of the truck would be covered to prevent release of materials from the truck during transport.
- **Transportation:** Haulers would have a valid DTSC registration and would satisfy the following requirements:
    - Vehicles would have passed an annual inspection;
    - Vehicle operators would be trained in the safe handling of the material;
    - Haulers would maintain the ability to pay damages caused by their operations through proper insurance coverage;
- **Route**: In accordance with all applicable laws, transportation routes would be limited to arterial streets and freeways approved for truck traffic to minimize potential impacts in the local neighborhoods and sensitive receptors. Truck routes would be determined in advance of any hauling activity once the receiving port is identified.

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- **Contingency Plan**: The hauler would be required to have a contingency plan prepared for emergency situations (vehicle breakdown, accident, diesel spill, fire, explosion, etc.) during transportation of ESS enclosures to the job-site. Once the hauler is selected, a contingency plan would be reviewed and available on-site.

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