

SAN DIEGO COUNTY FIRE PROTECTION DISTRICT

INTERIM FIRE PROTECTION GUIDELINES FOR BESS FACILITIES



PUBLIC SAFETY GROUP

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I. PURPOSE

The San Diego County Fire Protection District (SDCFPD) is committed to ensuring the safety of Battery Energy Storage System (BESS) facilities through the application of a comprehensive framework of local, state, and national codes and standards. These regulations are designed to mitigate the risks associated with fire, explosion, and toxic hazards, thereby safeguarding public health and safety. As BESS technologies evolve, existing codes are being adapted to address the emerging and unique risks posed by these systems. Furthermore, the SDCFPD Fire Chief is vested with the authority to amend or modify the Fire Code, as necessary, to address new safety concerns and technological advancements. The regulations in this document are specific to the SDCFPD but may be adopted by other fire protection and municipal water districts in San Diego County.

II. BACKGROUND

The San Diego County Fire Protection District (SDCFPD) currently employs a mix of local, state, and national codes and standards to review Battery Energy Storage System (BESS) facilities, with the goal of mitigating fire and explosion risks and ensuring public safety. However, existing regulations, including the California Fire Code (CFC) and the Consolidated Fire Code, do not fully address the unique hazards posed by modern BESS technologies. For example, current property line setbacks (ranging from 20-50 feet) may not be sufficient for newer BESS designs, and the Consolidated Fire Code remains silent on specific provisions for BESS. While the CFC does not require site-specific emergency response plans, the National Fire Protection Association (NFPA) 855 mandates such plans for all BESS installations. Other NFPA standards guide fire detection, suppression, and system monitoring, while Underwriters Laboratory (UL) standards like UL 9540A ensure that BESS components are rigorously tested for fire and explosion resistance.

In 2024, SDCFPD introduced a requirement for a technical study, which now mandates that BESS facilities conduct comprehensive risk assessments and hazard mitigation plans. These studies are intended to address safety gaps and ensure compliance with fire codes. Under the 2022 California Fire Code, the Fire Chief has the authority to authorize changes to existing fire codes when new risks are identified, especially when dealing with emerging technologies like BESS. This gives the Fire Chief the discretion to adapt safety regulations based on evolving industry standards. By 2025, the Office of the State Fire Marshal (OSFM) will release an updated CFC, which will be enforced locally, and the changes will be incorporated into the San Diego County Consolidated Fire Code in 2026.

In addition to steps taken this year by SDCFPD and future changes by the State to the CFC, SDCFPD will implement Interim Fire Protection Guidelines for BESS facilities. The following are key safety measures in the Guidelines:

- *NFPA and UL Standards:*
 - Compliance with NFPA 855, UL 9540A, and other NFPA standards ensures proper safety measures for fire detection, suppression, and explosion mitigation.

- *Required Technical Studies (2024 Update):*
 - BESS facilities must submit detailed risk assessments and hazard mitigation plans, including plume modeling and failure scenario analysis.
- *Key Safety Measures:*
 - A key safety consideration for BESS facilities is plume modeling to assess toxic off-gassing during failure events. Various validated modeling tools, including AERMOD and Fire Dynamics Simulator (FDS), are approved and must be utilized to evaluate risks and determine appropriate setbacks from sensitive receptors like residential areas and healthcare facilities.
 - The Hazard Mitigation Analysis (HMA) plays a key role in identifying potential failure scenarios, including safety system malfunctions or temperature control failures.
 - All technical reports related to BESS safety, including hazard mitigation and plume modeling studies, must be prepared by a licensed California Fire Protection Engineer to ensure thorough and accurate safety assessments.
 - Separation Distances: BESS must have at least 10 feet of separation between adjacent enclosures within the property and 100 feet from property line to ensure firefighting effectiveness, safe access, equipment placement, and dispersion of toxic gases. Plume modeling may increase the setback distance.
 - Explosion Prevention: BESS facilities must have fire and explosion detection systems in place, including gas detectors that meet UL 9540A and NFPA 72 standards. These systems must be able to detect explosive gases, trigger alarms, and initiate ventilation systems to mitigate risks from thermal runaway.
 - BESS enclosures must meet fire-rated materials standards (e.g., UL 263 or ASTM E119). The enclosures should be capable of withstanding at least one hour of fire exposure, and systems for suppression, alarms, and monitoring must be in place.
 - New technologies for suppressing or minimizing thermal runaway may be emerging, but the current code requires these technologies to be third-party tested for accuracy before implementation.
 - For existing facilities using lithium-ion BESS not UL 9540 listed, HMA and Emergency Response Plans must be reviewed and updated. Local fire departments should conduct annual site familiarization for emergency response training.
- *Cost Recovery:*
 - Facility owners must reimburse emergency services for response costs, ensuring sustainability of public safety operations.
- *Root Cause Analysis:*
 - In the event of a fire, the Fire Chief will conduct a root cause analysis, with costs borne by the facility owner.
- *Ongoing Code Updates:*
 - The California Fire Code will be updated in 2025, with changes incorporated into the Consolidated Fire Code by 2026.

Future Actions to ensure BESS Safety:

- **California Fire Code (2025):**
 - The Office of State Fire Marshal (OSFM) is set to release a revised version in 2025, which will address new requirements for BESS facilities. These changes will be adopted locally by SDCFPD and incorporated into the Consolidated Fire Code in 2026.
- **Consolidated Fire Code New Chapter 2026**
 - Incorporate SDCFPD interim changes/requirements in the Consolidated Fire Code in 2026

This framework ensures that BESS facilities operate safely within the county while keeping pace with technological advancements. By integrating these evolving standards and measures, SDCFPD aims to reduce the risks associated with BESS facilities and ensure the safety of both responders and surrounding communities.

III. CURRENT CODES AND STANDARDS

The San Diego County Fire Protection District (SDCFPD) employs a combination of local, state, and national codes to ensure the safe operation of Battery Energy Storage System (BESS) facilities. These standards aim to mitigate risks such as fire, explosion, and toxic hazards while prioritizing public safety. However, existing codes are evolving to address the unique risks associated with modern BESS technologies.

- **California Fire Code (CFC):** Currently underperforming regarding BESS facilities. It addresses property line setbacks (20-50 feet depending on container venting) but does not fully capture the risks associated with newer technologies. CFC also requires Hazard Mitigation Analysis (HMA) and Emergency Response Plans.
- **Consolidated Fire Code:** Silent on BESS-specific guidelines, While the CFC does not mandate site-specific emergency plans, NFPA 855 requires such plans for all installations.
- **NFPA Standards:** The applicable standards include NFPA 855, 13, 72, 68, and 69, which provide guidance on fire protection, fire alarm systems, gas detection, and explosion prevention.
- **Underwriters Laboratory (UL) Standards:** UL 9540A, UL 1973, and UL 17 provide testing standards for fire safety and performance of battery systems.
- **Technical Study (2024 Requirement):** A technical study is now required for BESS facilities to address potential failure modes and mitigation strategies.

While NFPA standards and Underwriters Laboratory (UL) guidelines provide some safety measures, they do not fully account for the specific hazards of lithium-ion batteries. As a result, local authorities must consider additional safety protocols, including plume modeling for toxic gas dispersion and expanded setbacks from property lines to ensure safe firefighting operations and minimize exposure to toxic fumes.

IV. AUTHORITY

The following 2022 California Fire Code Sections provide the Authorizing Standards for the Fire Chief to implement the Interim Fire Protection Requirements for Battery Energy Storage Systems:

- *Chapter 1:* Gives the fire code official authority to determine requirements for matters that are not provided for in the existing fire code.
 - *102.8 Subjects Not Regulated by This Code:* Where applicable standards or requirements are not set forth in this code, or are contained within other laws, codes, regulations, ordinances or bylaws adopted by the jurisdiction, compliance with applicable standards of the National Fire Protection Association or other nationally recognized fire safety standards, as approved, shall be deemed as prima facie evidence of compliance with the intent of this code. Nothing herein shall derogate from the authority of the fire code official to determine compliance with codes or standards for those activities or installations within the fire code official's jurisdiction or responsibility.
 - *102.9 Matters Not Provided For:* Requirements that are essential for the public safety of an existing or proposed activity, building or structure, or for the safety of the occupants thereof, that are not specifically provided for by this code, shall be determined by the fire code official.

V. INTERIM FIRE PROTECTION GUIDELINES FOR BESS FACILITIES

1. Explosion Prevention, Ventilation, and Gas Detection

- 1.1 Fire and explosion detection, alarming, control, and suppression system must be UL 864 where commercially available. A gas detection system must be provided and meet the following requirements:
- 1.2 Gas detection must be based on UL 9540A data for explosive gas(es) most likely to be detected under fault conditions and located appropriately for the expected gas flows.
- 1.3 The system must trigger visual and audible alarms that are distance from fire alarms. The alarms must also be sent to FRS and must be supervised.
- 1.4 The detector must be able to continue operating under non-flaming thermal runaway conditions and be capable of determining if the environment is in the enclosure is below the flammability limit of the explosive gases.
- 1.5 Air circulation must be provided at 1 CFM per square foot. Hydrogen detectors are required to alarm at ten percent (10%) of LEL and ramp ventilation rate to 2.5 CFM per square foot.
- 1.6 Exhaust ventilation systems must be provided six (6) hours of standby power and provided with clearly identified manual controls.
- 1.7 Gas detection systems are required to comply with NFPA 72.

2. Enclosures

- 2.1 The enclosure and any insulation must be fire-rated using UL 263 (4th Edition) and/or ASTM E119 (2020) or equivalent materials. Fire rating is required to be at least the minimum of a fire event according to UL 9540A test results or one (1) hour, whichever is greater.
- 2.1 Prefabricated BESS enclosures must meet minimum outdoor enclosure rating as specified in NEMA 3R in accordance with ANSI/IEC 60529:2004, or an IP 54 rating.
- 2.2 Contractor licenses: C-16 licenses are required for automatic sprinkler systems and water supplies and C-10 licenses are required for fire alarm systems and gas detection systems.
- 2.3 Where required sprinkler protection for the room must provide a minimum density of 0.6 GPM/square-foot over the room with a 500-GPM hose stream allowing for a two (2) hour duration.
- 2.4 Provide a high temperature alarm, routed to a continuously attended location, for reach room, building or enclosure with BESS.
- 2.5 Battery Management System (BMS) must be approved and meet manufacturer's specifications. The BMS must transmit signals to an approved location if hazardous conditions are detected.
- 2.6 Central station or 24-hour monitoring facility
- 2.7 Alarm and supervisory signals from all fire protection and life safety systems must be transmitted to an approved central station and to the annunciator panel.
- 2.8 Extend signage location requirements beyond BESS to include perimeter fences or security barriers and include a site map. Signage should contain 24-hour emergency contact information and hazard warnings. Signage or maps should identify isolation distances response personnel should maintain from BESS during an emergency. Signage should be provided for grid-interactive BESS operating in parallel with other power generating sources. Signage should be provided indicating explosion hazard zones

3 Site Plans

- 3.1 Construction documents: Additional requirement for a site plan with the layout diagram of enclosures including size, distance between units, and distance to exposures. The plans must also show fire apparatus access and water supply.
- 3.2 Training
 - 3.2.1 Training shall be required of personnel and first responders prior to operation and annually.

4 Separation Distances and Site Requirements:

- 4.1 A fire safety and evacuation plan will be required.
- 4.2 BESS located outdoors must have at least 10 feet of separation between adjacent enclosures within the property.
- 4.3 A minimum 100-foot setback from property lines is essential for ensuring the safety of firefighting personnel and enabling effective tactical operations during a fire emergency at BESS facilities. Plume modeling may increase the setback distance.

4.3.1 Findings

- Tactical Operations: A minimum 100-foot setback from the property line is required for BESS installations to facilitate effective firefighting operations. This setback distance provides ample space for fire apparatus access, positioning of equipment and safe operational distance for firefighting personnel. The 100 foot-distance ensures that fire trucks and emergency responders can safely approach and access the site without risk of exposure to immediate hazards, such as fire or hazardous materials release.
- Ventilation and Evacuation: A 100 foot-setback supports the safe dispersal of smoke and toxic gases, reducing risks to both emergency responders and surrounding communities.
- *Surprise, Arizona*: On April 19, 2019, underlines the critical importance of setback requirements for fire safety in energy storage facilities. The event involved a lithium-ion BESS experiencing thermal runaway, which led to a significant fire and explosion that injured four firefighters.
- *Otay Mesa, California*: The fire that occurred at the Gateway Energy Storage facility in Otay Mesa on May 15, 2024, triggered by a thermal runaway in one of the battery units. The fire lasted 17 days and caused substantial structural damage. One key takeaway from this event is the pressing need to implement a minimum 100-foot setback requirement for BESS facilities. This setback distance is critical to ensuring safe access for fire apparatus, providing sufficient space for effective firefighting operations, and allowing for the safe dispersion of toxic fumes and gases released during a fire.

4.3.2 Supporting Standards

- The **Unified Facilities Criteria (UFC) guidelines** provide clear requirements for safe setbacks and access for high-risk facilities like BESS. These guidelines emphasize the importance of adequate clearance for emergency responder access, equipment positioning, and protection from hazardous conditions during firefighting operations.

5 Plume Modeling

5.1 A range of validated and industry-accepted plume modeling tools is available for analyzing toxic off-gassing during BESS failure events. Applicants may select from the following County-Fire recognized options to include in their technical studies. This list will be reviewed and updated periodically to incorporate advancements in technology and emerging methodologies. The Battery Energy Storage System (BESS) Best Practices report highlights the importance of setbacks and dispersion analysis, commonly referred to as Plume Modeling, as a critical requirement for all utility-scale BESS facilities. This process ensures the incorporation of specific inputs and adherence to established guidelines. To maintain consistency in evaluating potential sites for BESS facilities, SDCFPD requires pre-defined worst-case meteorological conditions based on EPA standards. These conditions include atmospheric stability class F (stable atmosphere), a wind speed of 1.5 meters per second (3.4 miles per hour), and a temperature of 77°F. Furthermore, local meteorological conditions found at the site must be modeled. The following is Acute Exposure Guideline Level (AEGL) 1 shall be evaluated. Ex: Level 1: Notable discomfort, irritation, or certain asymptomatic non-sensory effects. Effects and not disabling and are reversible

5.2 The findings from required plume studies will outline additional mitigation for setbacks beyond 100 feet from sensitive receptors, such as residential areas, care facilities (hospitals, nursing homes, etc.), and educational institutions. These setbacks aim to mitigate potential adverse effects on vulnerable populations.

5.3 Plume Modeling Tools

- 5.3.1 AERMOD (American Meteorological Society Regulatory Model): Used by the United States Environmental Protection Agency (EPA) for facility permitting. However, the program does not account for dense gas effects which may occur during failures at lower states of charge.
- 5.3.2 Fire Dynamics Simulator (FDS): FDS is typically used for modeling of fire and gas plumes in both indoor and outdoor conditions.
- 5.3.3 Process Hazard Analysis Software (PHAst): A proprietary model offered by Det Norske Veritas which can analyze accidental releases.
- 5.3.4 SAFER/TRACE: A proprietary model that was developed to evaluate toxic chemical spills.
- 5.3.5 SCICHEM: This model is used by the US federal government for emergency release models.

6 Hazardous Mitigation Analysis Failure Modes (HMA) and Hazard Identification Analysis (HIA):

- 6.1 HMA and HIA can be requested by the Fire Code Official for any utilities scale BESS facility.
- 6.2 HMA or HIA shall be prepared by a licensed fire protection engineer (FPE)
- 6.3 Three (3) additional failure modes for HMA study are required:
 - 6.3.1 The failure of a single safety system during a thermal runaway event
 - 6.3.2 The failure of multiple safety systems at the same time.
 - 6.3.3 Failure of temperature control required to be addressed by the HMA.

- 6.4 The HMA may identify the need for additional safety features that will need to be mitigated.

7 Emerging Protection Technologies

- 7.1 There are often new technologies emerging geared at suppression or minimizing thermal runaway. Current Code doesn't require these technologies are assessed and tested by third parties to ensure the accuracy of any claims. Third party testing shall be required.

8 Existing BESS Facilities

- 8.1 HMA's shall be prepared and provided to the Fire Authority Having Jurisdiction (FAHJ) for review and approval where existing installations that utilize lithium-ion BESS that are not UL 9540 listed.
- 8.2 Emergency Planning and Training
- 8.3 Operator/manager shall produce emergency planning and training procedures be developed for the existing facility.
- 8.4 Annual site familiarization be held for the local fire department as part of regular inspection activities.

9 Cost Recovery

- 9.1 The guidelines also include a cost recovery component to ensure that the financial burden of emergency response services, such as personnel, equipment, logistics, and other resources, is reimbursed by BESS facility owners or responsible parties. This approach promotes financial sustainability for emergency services while prioritizing public safety and environmental protection. Additionally, these requirements will be periodically reviewed and updated to current operational costs.

10 Cause and Origin

- 10.1 As a part of cause and origin for fires in BESS facilities root cause analysis shall be conducted by the Fire Chief or their designee any associated costs to conduct the analysis shall be borne by BESS facilities owners or responsible parties.

11 NFPA

- 11.1 SDCFPD will employ the latest version of appropriate NFPA standards for BESS facilities.
- 11.2 SDCFPD will monitor and participate to the level we can with the development of NFPA 800 which will specifically pertain to BESS facilities.

12 Technical Reports Requirements

- 12.1 All submitted technical reports shall be produced by California licensed Fire Protection Engineer.
- 12.2 Minimum Requirements
 - 12.2.1 Specific Details of The Project Including a Site Plan
 - 12.2.2 Comprehensive Study of the Projects Fire Code Compliance Including Interim Guidelines
 - 12.2.3 Hazard Mitigation Analysis (HMA)
 - 12.2.4 Hazard Identification Analysis (HIA)
 - 12.2.5 Plume Modeling
 - 12.2.6 Proposed Mitigation

VI. APPROVAL

I hereby certify that these **INTERIM FIRE PROTECTION GUIDELINES FOR BESS FACILITIES** are a part of the San Diego County Fire Protection District, Technical Report Format and Content Requirements and were considered by the Fire Chief, in coordination with the County of San Diego's Public Safety Group on the 10th day of December 2024.

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