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ENERGY STORAGE SYSTEMS

Requirements Handout #27:

INTRODUCTION

The information in this handout provides general guidelines by the City of Covina to obtain Construction permits for stationary ESS installations and for mobile ESS charging and storage installations covered by the current code sections:

California Building Code CBC 1206

California Fire Code CFC Article 1206

County of Los Angeles Fire Code. LACFD Rev (04/01/2024)

California Electrical Code CEC Article 480

California Residential Code CRC R327

To obtain complete information for your project, please contact our friendly staff in person or over the phone at **Planning (626) 384-5450 or Building & Safety (626) 384-5460, Business hours (Monday - Thursday from 7:00 a.m. to 6:00 p.m.).**

GENERAL REQUIREMENTS:

- Planning clearance is required prior to submission to Building Application for permit.
- Commercial energy storage systems must be designed by an Electrical Engineer.
- If a photovoltaic system is also part of the installation, please refer to the City of Covina – Residential Submittal” checklist. Solar PV systems will be on a separate SPV permit.
***NOTE: that LA County Fire review and approval is required prior to permit issuance. ***
- Disconnecting means. A disconnecting means shall be provided for all ungrounded conductors. The disconnecting means shall be readily accessible and on the exterior of the building.
- Ventilation. Provisions appropriate to the battery technology shall be made for sufficient diffusion and ventilation of gases from the battery, if present, to prevent the accumulation of an explosive mixture, per the manufacturer’s instructions.
- ESS shall be installed in accordance with the manufacturer’s installation instructions.
- When a SPV system is part of the ESS, show the location and/or method of rapid shutdown and the point of interconnection between the ESS and other power production sources.
- For the ESS, include a note, on the plans, that a plug-in type back-fed circuit breaker(s) connected to an interconnected supply shall be secured in accordance with *CEC 408.36(D)*
- Moderate-hazard factory industrial: Group F-1 Occupancy
- Addresses indoor, outdoor and mobile situations.
- Rated enclosures including exterior walls. Fire protection-rated glazing is not allowed in fire barriers enclosing ESS. *[F] 907.2.22*
- Battery rooms Energy Storage Systems. An automatic smoke detection system or radiant-energy detection system shall be installed in rooms, walk-in units and areas containing energy storage systems as required in CBC and CFC *Section 1206*.

THE PERMIT APPLICATION AND PLANS SHOULD INCLUDE THE FOLLOWING

Energy Storage Systems (ESS) 1206.1.3 CBC

- Location and layout diagram of the room or area in which the ESS is to be installed.
- Details on the hourly fire resistance ratings of assemblies enclosing the ESS. .
- Quantities and types of ESS.
- Manufacturer’s specifications, ratings, and listings of each ESS. ESS must be UL 9540 listed.
- Description of energy (battery) management systems and their operation.

- Identify if the system is to be used as a partial or a whole home backup.
- Location and content of required signage.
- Details on fire suppression, smoke or fire detection, thermal management, ventilation, exhaust and deflagration venting systems, if provided.
- Support arrangement associated with the installation, including any required seismic restraint.
- A commissioning plan complying with 1206.2.1. 1 1
- A decommissioning plan complying with 1206.2.3. 2
- Show required working clearances for all existing/new electrical equipment.
- Show method and location of required ventilation for equipment.
- Show method of protection against physical damage (e.g., bollards for vehicular impact) for the ESS, per the manufacturer's instructions.
- Provide a single line diagram:
 - Show grounding and bonding for the ESS and PV (if installed), including the ground return path.
 - Show method of interconnection.
 - Show overcurrent protection method and rating when required.
 - Include detailed wiring information for all new circuits, including:
 - Conductor size and type.
 - Conduit size and type.
 - Show all disconnecting means.
 - Show ratings (voltage, ampacity, environmental, etc.) for new and existing service equipment.
- Denote whether the ESS is ac-coupled or dc-coupled.
- If system is dc-coupled, show that the rapid shutdown functionality for controlled conductors of PV system remains unaffected by dc-coupled energy storage battery circuit(s)
- Location and content of signage. In addition to the mandatory signage, show on the plans a warning sign with the following:
 - 8" x 10" plaque on or adjacent to the main disconnect to state the number of energy sources (e.g., utility power, PV panels and energy storage system) along with shut-off instructions.
 - The plaques shall be UV and water resistant with white lettering on red backing mechanically fastened.
- Structural requirements:
 - Identify if the ESS will be wall or floor-mounted.
 - Provide manufacturer's anchorage detail. A battery(s) installed at the same location, weighing > 400 pounds requires structural calculations and mounting details stamped and signed by a CA licensed professional Engineer.

INSPECTION PROCEDURES:

Provide AMP inspection prior to calling for Building Department inspection. • AMP inspection is to verify that the ESS is not back feeding the grid.

City inspector responsibilities:

- LA County Fire Department inspection.
- Planning Inspection may be required
- Placement per plan • Disconnects per plan
- Conductor numbers, gauge, and type per plan
- Conduit size and type per plan
- Equipment per plan • Grounding and bonding
- Labeling per plan All else to be certified in writing by the installer
- Working Clearance



COUNTY OF LOS ANGELES FIRE DEPARTMENT



ANTHONY C. MARRONE
FIRE CHIEF
FORESTER & FIRE WARDEN

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the Environment, and Property"*

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FIFTH DISTRICT

March 26, 2024

All Interested Parties

RESIDENTIAL ESS INSTALLATIONS – CODE CLARIFICATIONS

ITEM #1: Residential ESS "Unit"- Based Provisions

The Los Angeles County Fire Department (LACoFD) enforces the 2023 Los Angeles County Fire Code (2023 LACFC; LACC Title 32), which is a locally amended version of the 2022 California Fire Code (2022 CFC; CCR Title 24, Part 9). The Fire Code requires that:

“Individual [energy storage system] units shall be separated from each other by at least 3 feet (914 mm) of spacing” (§[1207.11.2.1](#)).

When this provision was written, the term “unit” identified an assembly of battery cells and other essential components for composing a single functional energy storage system (ESS), where said assembly was listed to UL 9540 as a single functional ESS “unit”.

As technology advanced, battery manufacturers began making smaller individual ESS units, with the intent of scaling installations of units to the demand of the applicable use. However, the Fire Code did not allow by default for closer groupings of such smaller units.

Therefore, it is clear to see why a discrepancy exists between the battery industry, solar installation companies, and the fire- and life-safety regulatory agencies as to what is the appropriate use of the term “unit”. After meeting with industry professionals on February 26, 2024, and listening to the issues associated with the ESS “unit” definition, LACoFD issues the following interim interpretation of the term “unit” to meet the intent of the 2023 LACFC.

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POMONA
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ROSEMEAD
SAN DIMAS
SANTA CLARITA

SIGNAL HILL
SOUTH EL MONTE
SOUTH GATE
TEMPLE CITY
VERNON
WALNUT
WEST HOLLYWOOD
WESTLAKE VILLAGE
WHITTIER

Interim Code Interpretation:

In lieu of a clear definition of a **residential ESS “unit”**, and in accordance with the intent as it pertains to the individual amassment of ESS representing a single grouping of fire and/or hazardous-materials load, exclusively for the purposes of Sections 1207.11.2.1 and 1207.11.4 of the 2023 LACFC, the following shall serve to clarify:

1. An ESS “unit” shall mean a single grouping of one or more complete UL-9540-listed residential ESS units, not to exceed an aggregate nominal capacity of 20 kWh in that grouping.

A “unit”/grouping may consist of more than one ESS unit only where the units are expressly allowed, by the manufacturer’s NRTL-approved installation instructions, to be separated by less than 3 feet. See Figure 1.

2. If multiple UL-9540-listed ESS units are installed within a cabinet*, the cabinet shall be purpose-manufactured, approved by the manufacturer(s) for the specific UL-9540-listed ESS units being placed within, and minimize the amount of void space within [after the installation of the ESS unit(s) within] in which flammable/explosive gases can accumulate during a failure event.

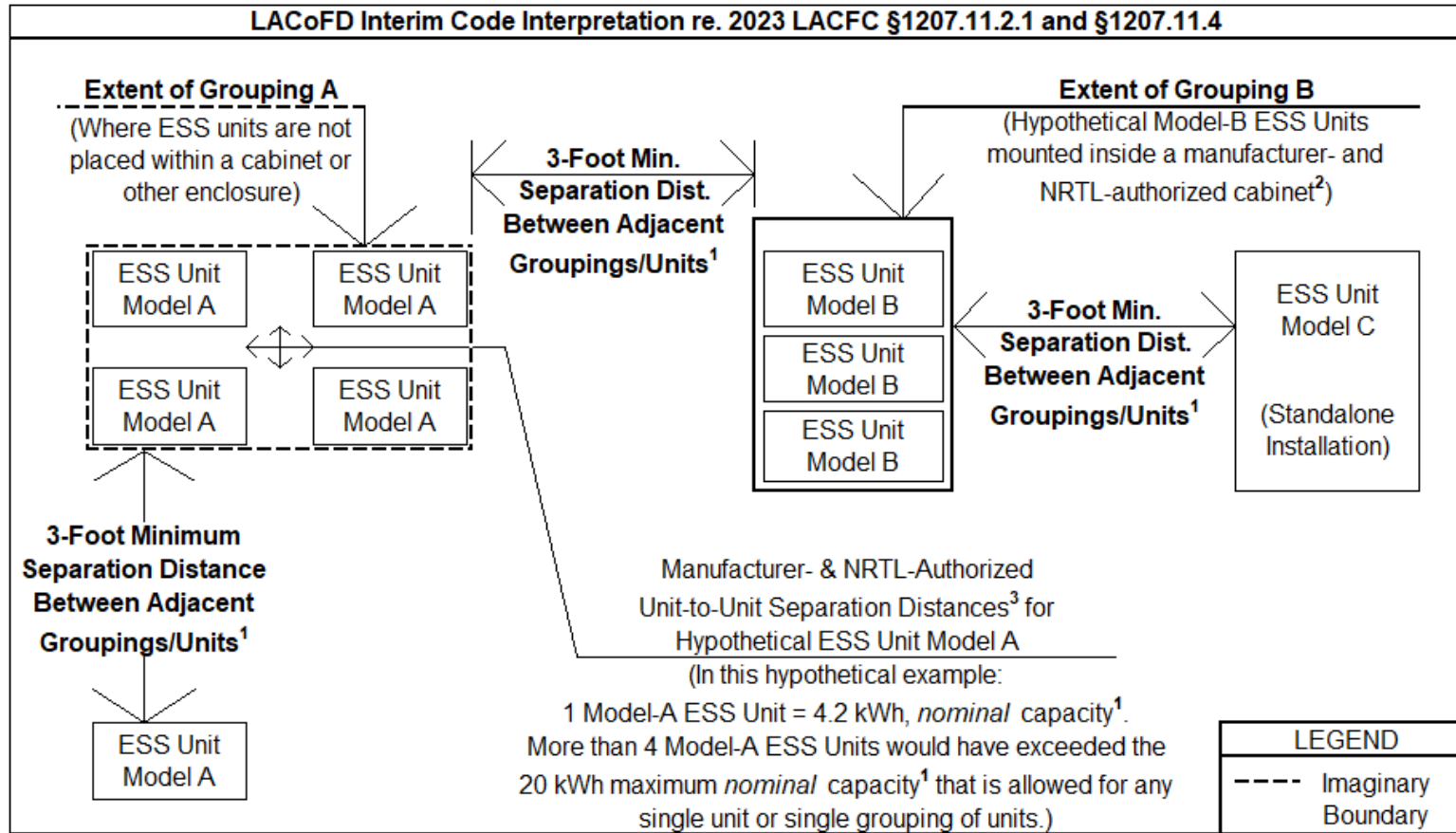
*2022 CFC / 2023 LACFC Definition:

ENERGY STORAGE SYSTEM CABINET. A cabinet containing components of the energy storage system that is included in the UL 9540 listing for the system. Personnel are not able to enter the enclosure other than reaching in to access components for maintenance purposes.

3. In no case shall a reduction be allowed to the minimum requirements, nor separation distances, specified in the manufacturer's installation instructions, specifically those instructions that were approved by the nationally recognized testing laboratory (NRTL) that granted the UL-9540 listing to that make and model of ESS unit.
 - a. This rule shall also pertain to the manufacturer's installation requirements regarding the placement of an ESS unit in relation to other units, etc.
 - b. A grouping shall not consist of a mixture of different makes and/or models of UL-9540-listed residential ESS units unless specifically authorized by the aforementioned manufacturer's installation instructions.

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1. No individual grouping/unit shall exceed 20 kWh *nominal* capacity. Footnote "a" of Table 1207.1.1 (2022 CFC / 2023 LACFC):
"a. Energy capacity is the total energy capable of being stored (nameplate rating), not the usable energy rating. For units rated in amp-hours, kWh shall equal rated voltage times amp-hour rating divided by 1,000."
2. Where a cabinet is used, the cabinet shall be purpose-manufactured, included and specified in the UL-9540 listing for the specific UL-9540-listed ESS units being placed within, and minimize the amount of void space within the cabinet [after the installation of the ESS unit(s) within] in which flammable/explosive gases can accumulate during a failure event.
3. In no case shall a reduction be allowed to the minimum requirements, nor separation distances, specified in the manufacturer's installation instructions. A grouping shall *not* consist of a mixture of different makes and/or models of UL-9540-listed residential ESS units unless specifically authorized by the aforementioned NRTL-approved manufacturer's installation instructions.

FIGURE 1: Grouping/Unit-to-Grouping/Unit Separations

LOS ANGELES COUNTY FIRE DEPARTMENT OFFICE OF THE FIRE MARSHAL

ITEM #2: Acceptable Installation Locations at Group R-3/R-4 Occupancies

The 2023 LACFC explicitly states the following regarding the allowable installation locations for these types of ESS installed in association with Group R-3 and R-4 occupancies:

1207.11.3 Location.

ESS shall be installed only in the following locations:

1. Inside detached garages.
2. Inside attached garages when separated from the dwelling unit living space and sleeping units in accordance with Section *R302.6*.
3. Outdoors *or* on the outer side of the exterior building walls in accordance with Section 1207.11.3.1.

ESS shall not be installed inside any of the following locations:

1. Dwelling units, including accessory dwelling units (ADU's).
2. *Sleeping* units.
3. *Spaces opening directly into sleeping rooms or units.*
4. *Closets.*
5. Bathrooms.
6. Basements.
7. Accessory structures that are not garages.
8. Vaults.

1207.11.3.1 Outdoors or on outer side of exterior building walls. ESS shall be permitted to be installed outdoors, or on the outer side of exterior building walls, when all of the following conditions are met, in addition to those otherwise required by Section 1207.11:

1. The ESS shall be installed and maintained a minimum of 5 feet (1524 mm) from all of the following:
 - 1.1. Lot lines.
 - 1.2. Public ways.
 - 1.3. Other buildings.
 - 1.4. Stored combustible materials.
 - 1.5. Hazardous materials.
2. The ESS shall be installed and maintained a minimum of 10 feet (3048 mm) from vegetation, as specified in Section 1207.5.7.
3. The ESS shall be installed and maintained a minimum of 3 feet (914 mm) from all doors, windows, operable openings, HVAC inlets and other penetrations directly or indirectly into habitable or occupiable spaces, or bathrooms.

Exception: The fire code official shall have the authority to authorize smaller separation distances where such distances are documented and approved to be

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adequate for the ESS model(s) in question based on large-scale fire testing, in accordance with Section 1207.1.5.

In summary, **interior** installation of ESS units relative to R-3/R-4 occupancies is only allowed within a garage, that being either an attached garage [i.e., a garage physically attached to a residential dwelling unit, with the appropriate safety systems in place, e.g., detection, notification, and code-compliant separations from the dwelling unit(s)]; or a detached garage. It is not allowed within other occupiable or non-occupiable interior areas.

Rationale:

The inherent dangers associated with lithium-ion battery chemistries (including the various sub-categories on the market, such as lithium-iron-phosphate chemistries) have the potential to place homeowners or occupants at significant life-safety risk. Though it is recognized that recent designs and chemistries have perhaps made it more difficult to initiate thermal runaway within a battery cell and/or assembly of cells, once thermal runaway occurs, the flammable and toxic/asphyxiant gases generated remain significantly dangerous and can issue forth from the involved unit in mass without warning to nearby occupants, whether those occupants are sleeping or awake. The gases generated during failure may immediately ignite (creating a fire, blow-torch-like effect, or a fireball), or they may continue to issue forth without ignition. When these gases accumulate within an enclosed space (i.e., room, closet, etc.) they can quickly present an explosion hazard. The heat-generating chemical reaction at the heart of the thermal-runaway process can present the necessary ignition source, or it can be presented by the electrical charges of the system, or by any number of other incidental ignition sources that may be present in/at an occupancy.

No manufacturer of a lithium-ion-based ESS currently on the market has presented to LACoFD the following UL-9540A performance criteria, both of which are required by current State and local codes in order for an ESS to be permitted to be installed within a habitable space:

- a) Thermal runaway cannot be induced in the cell; and
- b) The cell vent gas does not present a flammability hazard when mixed with any volume of air, as determined in accordance with ASTM E918 at both ambient and vent temperatures.

(UL 9540A, 4th Edition, §7.7.1)

Using the currently most-popular ESS chemistry sub-category, lithium iron phosphate (LiFePO₄), as an example, the *flammable* component gases of the vent-gas cocktail that are very quickly produced in relatively large quantities during thermal runaway, include (but are not limited to) hydrogen (H₂) and carbon monoxide (CO). These two gases are consistently the two main flammable gases produced and detected during current minimum testing standards. These flammable gases are colorless, odorless, and

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tasteless. Hydrogen gas also produces a non-visible flame component once ignited and has the highest flammability range of any gas known within the scientific community. At this time, despite the existence of UL 9540A and its evaluation of flammability hazards from limited-scale failure of cells within a unit, no true *large*-scale fire test standard or methodology exists by which to accurately characterize maximum-potential failure of an ESS unit, and real-world failures of ESS units continue to occur with results well beyond the degree that the UL-9540A testing demonstrated.

Carbon monoxide also presents a significant toxicity hazard, but the *toxicity* profile of the gases produced during these failures is not well understood because current testing standards for ESS are limited in scope to assess only the flammability and explosivity profile of the gases produced during cell failure.

Neither disconnecting an ESS unit from the circuitry of the associated structure(s)/load(s), nor remotely opening the electrical connections within the unit, will stop the process of a thermal-runaway failure that has already begun within the unit. Likewise, doing so also does not eliminate the electrocution/shock hazard that the “stranded” electricity stored in its cells/modules may present.

Neither the resident nor first responders can stop the process of thermal runaway. Regarding extinguishment, assuming access can be made by which to sufficiently apply water streams to the involved battery cells located beneath the ESS cover, efforts to extinguish a lithium-ion-based ESS fire that is actively consuming the flammable and toxic vent gases being generated by an interior-mounted ESS in thermal runaway complicates the hazard because:

- Extinguishing the fire allows these dangerous gases to now accumulate within the structure.
- When “successful”, extinguishment slows down, but does not stop, the thermal-runaway failure, thereby prolonging the event. Stopping the chemical reaction responsible for the event in compromised cells would require disassembling the chemical components within each affected cell.
- Extinguishing the fire turns the remaining, compromised cells of the ESS into what some have described as unexploded ordnance.
- Extinguishing the fire can subject the interior space to costly water damage.
- The introduction of water can cause otherwise unaffected ESS to then become compromised.
- Water runoff presents an unknown toxicity concern.

Regarding efforts to remove the hazard from the structure during or after the initial incident, which is the method fire departments usually use to render a site safe to turn back over to the owner, thereby releasing the fire department personnel back to availability for other emergencies, this is not usually an option, especially when ESS are mounted within the dwelling envelope. As these units are very heavy, they usually require installation whereby they are bolted in place, often to bearing walls. Fire fighters are unable to remove such mounted ESS from the structure because the ESS unit(s) not only

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present an electrocution hazard and the possibility of unexpected reignition and ejection of shrapnel, but in many cases fire fighters would need to cut out portions of bearing walls.

Code requires of interior-installed commercial ESS installations utilizing these chemistries that they provide for fire-resistance-rated separations; clearance from combustible materials; ample signage; a listed, third-party monitored, approved commercial automatic smoke-detection system or radiant energy-sensing fire detection system, with occupant notification; explosion control; security against unauthorized access; and periodic inspection.

Causes of ESS failures include mechanical puncture or impact, thermal abuse (e.g., exposure to fire), electrical abuse (e.g., overcharging, over-discharging, water intrusion, short circuiting), failure of the battery management system, manufacturer defect, and degradation over time or use. Los Angeles County contains many earthquake fault lines that could result in failure of these units. Residents may also contribute to mechanical failure, and units are likely to fall into neglect as occupants age and/or cannot afford to maintain, remove, or replace aging/damaged units. Without a fail-safe system approach, the Los Angeles County Fire Code prohibits interior installations at Group R-3/R-4 occupancies, with the exception of the garage space. Fortunately, garages and many exterior- or outdoor-installation options remain, including on the outer side of exterior building walls, on outdoor pads like air-conditioning units, and on exterior “wing” walls.

As the regulatory fire authority for areas within its jurisdiction, LACoFD has determined that the aforementioned hazards inherent in lithium-ion-based ESS are a life-safety risk to homeowners and occupants; and, therefore, these lithium-ion-based ESS are not permitted for installation within interior residential spaces (beyond compliant garages). As new technologies and chemistry types develop and meet the aforementioned performance criteria that allow devices to qualify for other options, ESS may no longer require such oversight for the safety of the public.

CLOSING

LACoFD reserves the right to rescind or clarify any or all of the rulings presented in this document. Should there be any questions related to this document, please contact the LACoFD Fire Prevention Division.

Sincerely,

LOS ANGELES COUNTY FIRE DEPARTMENT OFFICE OF THE FIRE MARSHAL