



RESIDENTIAL ENERGY STORAGE SYSTEMS (ESS)

APPLICABLE CODES: 2019 CBC, CRC, CEC, CFC, CPAU's Rule 27 ([EUSERC 501](#)) and PAMC

INTRODUCTION

The purpose of this document is to assist permit applicants in the permitting and inspection process for residential ESS for R-3 and R-4 Occupancies. Our goal is to provide you with the quickest turnaround time possible, consistent review and inspections. The information provided in this document is general in nature and intended as a guide. Each project is unique and additional requirements may be required as deemed appropriate. All plans, forms and documents are to be submitted electronically through our Palo Alto Online Permitting System (OPS). Please see our [ONLINE PERMITTING SYSTEM \(OPS\) WEBSITE](#) for instructions on how to submit your application. For project scope that includes PV and/or EVCS components refer to their respective guidelines for additional information.



SUBMITTAL INFORMATION

This information will help prepare you for a successful permit submission.

APPLICABLE FORMS/DOCUMENTATION

These documents are also on our Online Permitting System (OPS) website.

- [BUILDING PERMIT APPLICATION](#)
- [CPAU PHOTOVOLTAIC ELECTRIC LOAD SHEET](#)
- [RESIDENTIAL ELECTRIC LOAD CALCULATOR](#)
- [CPAU SIGNED & APPROVED INTERCONNECTION AGREEMENT*](#)

***Informational Note:**

Applying for and obtaining pre-approval for a City of Palo Alto Utilities (CPAU) Interconnection Agreement is a crucial pre-requisite to applying for an energy storage building permit. The approved interconnection agreement must be signed by the property owner. Start with the [Electric Utilities Pre-Approval for ESS/PV Instructions](#) to apply for pre-approval.

The Interconnection Agreement must be refiled if there is an existing alternative power source and you are adding capacity or additional sources.



GENERAL REQUIREMENTS

- ☐ **Plan shall be printable at 11"x 17" minimum and a maximum of 30"x 42"**
- ☐ **Text shall be a minimum size 10 Font, 0.12" or 1/8"**
- ☐ **Specify the following information on the Cover Sheet:**
 - Applicable Codes
 - Identify if residence is sprinklered.
 - Capacity of System in kW (kilowatts) and kWh (kilowatt hours)
- ☐ **Type of ESS (Whole home backup, partial home backup, stand-alone)**
- ☐ **Provide Project Professional Design Documents (CBC 107 and CRC R106):**
 - Site Plan
 - Show location of existing main panel and meter. Include size of panel (AMPS)
 - Identify location of proposed ESS and location and size of any existing PV, ESS or EVCS.
 - Floor Plans, if equipment is installed indoors (including garage).
 - Identify location of proposed equipment, including panel boards and standalone disconnects.
 - Elevation Plans, if structure or equipment is in flood plain zone or if ESS is installed outside, to indicate location relative to doors, windows, gas meter, etc.
 - Lowest part of equipment must be installed 1 foot above Base Flood Elevation (BFE).
 - Structural Attachment Details and Structural Calculation, unless the information is provided in the ESS installation requirements.
 - Three-line Electrical Diagram
 - Residential Electrical Load Calculation
 - Signage and Labeling Plan
 - Manufacturer's Equipment Specification Sheets and Installation Instructions

All equipment shall be listed by a Nationally Recognized Testing Laboratory (NRTL) either individually or as a complete, self-contained system according to a recognized standard. (CEC 110.3, CRC R328.2 and CFC 1207.3)

PLAN REVIEW INFORMATION

This information will help provide an understanding of what our city's plan review staff will generally look for.

BUILDING

❑ Means of Access and Clearances to ESS (CEC 110.26 and 706.10(C))

- Working Clearances at Equipment (CEC 110.26, 706.10(C) and CFC 1206.4.2)
- Vegetation including trees, which impact working clearances, shall be removed or relocated.

❑ Manufacturer's Equipment Specification Sheets and Installation Instructions, such as:

All equipment shall be identified and listed for the application. (CEC 110.3)

- ESS shall be listed and labeled in accordance with UL 9540. (CEC 110.3, CRC R327.2 and CFC 1206.11.1)
- Inverter
- Transformer or Autotransformer
- Transfer Switch(es)
- Converter
- Combiner
- Interconnecting Cables and Connectors
- Recombiner
- Charge Controller

❑ Structural Attachment Details and Structural Calculation, unless the information is provided in ESS installation requirements.

- Wall- or Floor-Mounted
- If wall-mounted and its weight is in excess of 200 lbs., review structural details and calculations. (PAMC 16.04.275)

❑ Three-line Electrical Diagram

- Wiring Method/Materials/Sizes (CEC 110.8, 300)
- Method of Interconnection (CEC 705)
- Systems connected to the utility grid use inverters listed for utility interaction (CEC 705.6 and 706.23(3))
- Overcurrent Protection (CEC 705.30 and 706.21)
- Grounding and Bonding for the ESS and PV (if installed), including the ground return path. (CEC 250)

Determine whether the ESS is AC-coupled or DC-coupled. If system is DC-coupled, show that the rapid shutdown functionality for controlled conductors of a roof-mounted PV system remains unaffected by DC-coupled energy storage battery circuit(s). If AC Coupled, ensure that the PV can be rapid shutdown either with a dedicated and listed device, or by loss of AC power from the grid and energy storage system. (CEC 705.40 and 706.8(C))

❑ Disconnecting Means

- Interconnection Disconnect (CEC 705.21, 705.22, 110.25 and 706.7(A))
 - Interconnection Labeling (CFC 1206.4.1)
- Equipment Disconnect to be within sight of the ESS. (CEC 706.7(A))
- Disconnect Directory/Labeling (CEC 705.10, 706.11 and 110.22 (A))

FIRE & BUILDING'S CODE REQUIREMENT SUMMARY FOR INTERCONNECTION & EQUIPMENT DISCONNECT(S)

These disconnects are required, plainly indicating whether open or closed, lockable in the open (off) position, within sight of the alternative power source, such as PV or group of ESS. The manufacturer of a system may have in their design, a disconnect function integrated in an inverter, which might satisfy one or both disconnect requirements. All equipment must be listed for its intended use.

❑ Signs, Placards, Directories and Markings

- Field-Applied Hazard Markings ANSI Z535.4-2011 – Product Safety Signs and Labels (CEC 110.21 (B))
- Type and Location
- Point of Interconnection (CEC 706.8)
- Interconnected Power Production Sources Directory (CEC 706.11 (A))

See Illustrations 2, 3A, 3B, 3C and Signs and Labels Table for Clarification/Guidance

❑ Equipment subject to physical damage shall be protected by approved means. (CEC 110.27(B), CRC R327.8 and CFC 1206.11.7)

See Illustration 1 for Clarification/Guidance

CPAU ELECTRICAL ENGINEERING

- ❑ **A knife/blade type, lockable (Rule 27) disconnect is required to be within 10' and within sight of the main service panel.** (Utilities Rules and Regulation 27(D)(1) (d)). This disconnect shall be installed between the main service and the alternative energy source interconnection point. If not capable of being installed within sight, a phenolic directory indicating location is required.

UTILITIES' REQUIREMENT SUMMARY FOR (RULE 27) DISCONNECT EXPLANATION

An AC disconnect (Referred to as Rule 27 Disconnect), of the knife/blade type, lockable in the open (off) position, is required within 10 ft and within sight of the main service panel. It must plainly indicate whether open or closed. The manufacturer's term for this is 'safety switch.' This requirement by Utilities is intended to prevent back feed during servicing of their side of the meter. This is to assure Utilities personnel that they will not be affected by energy output from other sources. Note: If this disconnect is also within 10 feet and within sight of the equipment or alternative power source, it might also fulfill the Building and Fire code requirement for an alternative power source or equipment disconnect.

- ❑ **All electrical equipment clearance requirements to gas meter are to be as specified in Utilities Standard Detail SR-CN-0-1009 of the Electric Service Requirements and Gas Standard Detail GD-02A of Water, Gas, Wastewater Utility Standards.**

Conduit without couplings is allowed to pass through the "Restricted Area" at a height of more than 6 feet.

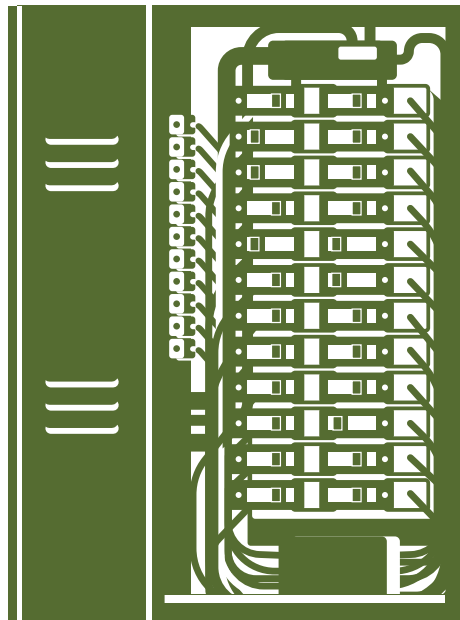
See Illustration 3 for Clarification/Guidance

PLANNING

- ❑ If an ESS is located on the exterior of buildings, verify that it does not encroach into the required setbacks or into required driveway clearance width area of 10 ft wide and not to encroach into the required uncovered parking areas of 9 ft wide by 17.5 ft deep. (PAMC Section 18.54.070)
- ❑ If an ESS is located within a required covered parking area (carports and garages), verify that the equipment does not encroach into the required parking space clearances of 10 ft wide by 20 ft deep per parking space.

FIRE

- ❑ Maximum Energy Rating (CFC 1206.11.4)
- ❑ Acceptable Locations (CFC 1206.11.3)
- ❑ Spacing (CFC 1206.11.2.1)
- ❑ Fire Detection at Interior Locations (CFC 1206.11.6 and CRC R327.7)
 - Smoke Detection needs to comply with CRC R314 and PAMC 16.06.200 - R314.1 (Refer to Inspection Information for detailed information.)
 - Heat Detection required in areas with ESS where smoke alarms are not otherwise allowed, such as garages.



INSPECTION INFORMATION

This information will help provide an understanding of what our city's inspection staff will generally look for.

PRIOR TO INSPECTION

- Approved plans, permit, and installation instructions shall be available on site at time of inspection.
- Major changes, including revisions, to the installation shall be submitted to the city for review and approval prior to inspection.
- De-energize relevant electrical panels prior to removing the dead-front. Notify tenant/owner/occupant prior to de-energizing. All equipment shall be open and ready for inspection.
- The installer shall check the existing electrical panel for unsafe conditions. If existing panel is found to be unsafe, it may be necessary to make repairs or replace equipment. This work may require change in scope of the permit and a revision.
- Torque specifications are to be determined and provided for any electrical termination, such as circuit breakers, equipment grounds, neutrals, and feeders. (CEC 110.3 (B) and 110.14 (D))
- We recommend that the electrical contractor be on site with the following tools:
(CEC 100.3(B) and CEC 110.14(D))
- Torque wrenches with in-lbs. or ft-lbs., as appropriate
- Torque screwdriver (with a range of up to 50 in-lb.)
- Slip-joint pliers to secure lugs in place when applying the proper torque
- Contractor to torque all connections per the manufacturer's listings prior to inspection. The inspector will witness a spot check. If all terminations are found to be torqued properly, nothing further will be required. If loose connections are found, all connections will be required to be torqued in the presence of the inspector. (CEC 110.3 (B) and 110.14 (D))

INSPECTION

- ☐ **Required Inspections (to be scheduled at the same time)**
 - 990 – FIRE INSPECTION FINAL
 - 707 – ENERGY STORAGE SYSTEM / FINAL
 - 280 – TRAVEL TIME WEST OF 280 (Use in addition to required inspections for projects west of 280)
- ☐ **Spacing, Location and Energy Ratings**
 - Spacing between individual units not less than 3 feet is required. Clearances MAY be reduced based on large scale fire test, with findings and recommendations accepted by the Fire Marshall.
(CRC R327.3.1 and UL 9540(A))
 - ESS shall be installed only in the following locations (CFC 1206.11.3 and CRC R327.4):
 - Detached garages and detached accessory structures.
 - Attached garages separated from the dwelling unit living space in accordance with Section R302.6.
 - Outdoors or on the exterior side of exterior walls located not less than 3 feet (914 mm) from doors and windows directly entering the dwelling unit.
 - Enclosed utility closets, basements, storage, or utility spaces within dwelling units with finished or noncombustible walls and ceilings. Walls and ceilings of unfinished wood-framed construction shall be provided with not less than 5/8" Type X gypsum wallboard.
 - ESS shall not be installed in sleeping rooms, closets, spaces opening directly into sleeping rooms or in habitable spaces of dwelling units.
 - Energy ratings of Individual ESS units shall be a maximum of 20 kWh. The aggregate rating of the ESS shall not exceed the requirements for the individual locations referenced in CRC 327.5. The maximum allowable per structure is 280 kWh.
- ☐ **Working Spaces About Electrical Equipment (CEC 110.26)**
 - Minimum 36 inches in depth, 30 inches in width, and 6 feet-6 inches in height.
 - Vegetation, including trees, which impact working clearances, shall be relocated.

- ☐ **Equipment subject to physical damage shall be protected by approved methods. (CEC 110.27, CRC R327.8, CFC 1206.11.7) See Illustration 1 for Clarification/Guidance**
- ☐ **Grounding will be verified in accordance with CEC 250.52(5), CEC 250.53(A)(3).**
- ☐ **Equipment grounding shall be as required by the manufacturer. (CEC 110.3(B))**
- ☐ **Circuit breakers shall be listed or classified as compatible with the panel they are installed in. (CEC 110.3 (B))**
- ☐ **Circuits shall be legibly identified for its specific purpose or use. (CEC 110.22(A) and CEC 408.4(A))**
- ☐ **Disconnects for Alternative Power Source and Equipment**
 - Interconnection (CEC 705.21, 705.22, 110.25 and 706.7(A))
 - Equipment disconnecting means shall be provided within sight of the ESS. (CEC 706.7)
 - Utility (Rule 27) AC disconnect(s) shall be located within sight and within 10 feet of main electrical service. They shall be configured with visible-blades and lockable. (CPAU Electrical Engineering Interconnection Requirement, Rule 27)
- ☐ **Flexible, fine-stranded cables (CEC 110.14)**
- ☐ **Wiring Methods (CEC 300)**
- ☐ **Conductor Size (CEC 310)**
- ☐ **Derating of more than three current-carrying conductors in conduit exceeding 24 inches in length. (CEC 310.15(B)(3))**
- ☐ **Access to all junction boxes (CEC 314.29)**
- ☐ **Conduit Fill (CEC Chapter 9)**
- ☐ **Signs, Placards, Directories and Markings**
 - Field-Applied Hazard Markings ANSI Z535.4-2011 – Product Safety Signs and Labels (CEC 110.21 (B))
 - Type and Location
 - Point of Interconnection (CEC 705.10) and Interconnected Power Production Sources Directory (CEC 706.11 (A))- There may be more than one location, depending on the system's configuration.

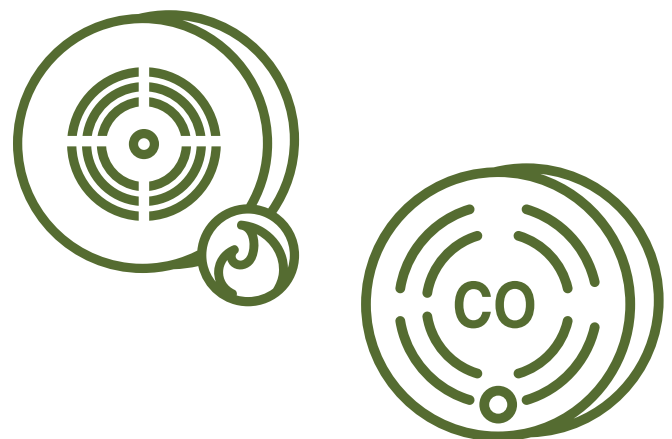
See Illustrations 2A, 2B, and 2C and Signs and Labels Table for Clarification/Guidance

- ☐ **Fire Detection - Indoor Locations including Garages (CRC R327.7 and CFC 1206.11.6)**
 - Smoke Detection needs to comply with CRC R314 and PAMC 16.06.200- R314.1
 - Heat Detection required in areas with ESS where smoke alarms are not otherwise allowed, such as garages.
- ☐ **Listed Smoke Alarms within the structure per CRC R314.8.**
 - PAMC 16.06.200- R314.1 Smoke detection and notification.

Listed single- and multiple-station smoke alarms complying with UL 217 shall be installed in accordance with the California Fire Code Sections 907.2.11.1 through 907.2.11.5 and manufacturer's installation and use instructions.

Smoke alarms and smoke detectors shall be in compliance with this code or subject to the provisions of the Health and Safety Code, they shall also be listed and approved for rapid response to smoldering synthetic materials. All smoke alarms or detectors shall be of the photoelectric type or shall have equivalent detection capabilities in compliance with UL 217.

Exception: A combination photoelectric/ionization smoke alarm or detector may be used if located no closer than 20 feet to a kitchen, bathroom, fireplace or woodburning stove.
- ☐ **Listed Carbon Monoxide Alarms if the residence has fuel-fired appliances and/or an attached garage with an adjoining opening. (R315.2)**



ILLUSTRATIONS/TABLE

Illustration 1: Vehicular Protection Example

Compliments of Cobalt Power Systems Inc.

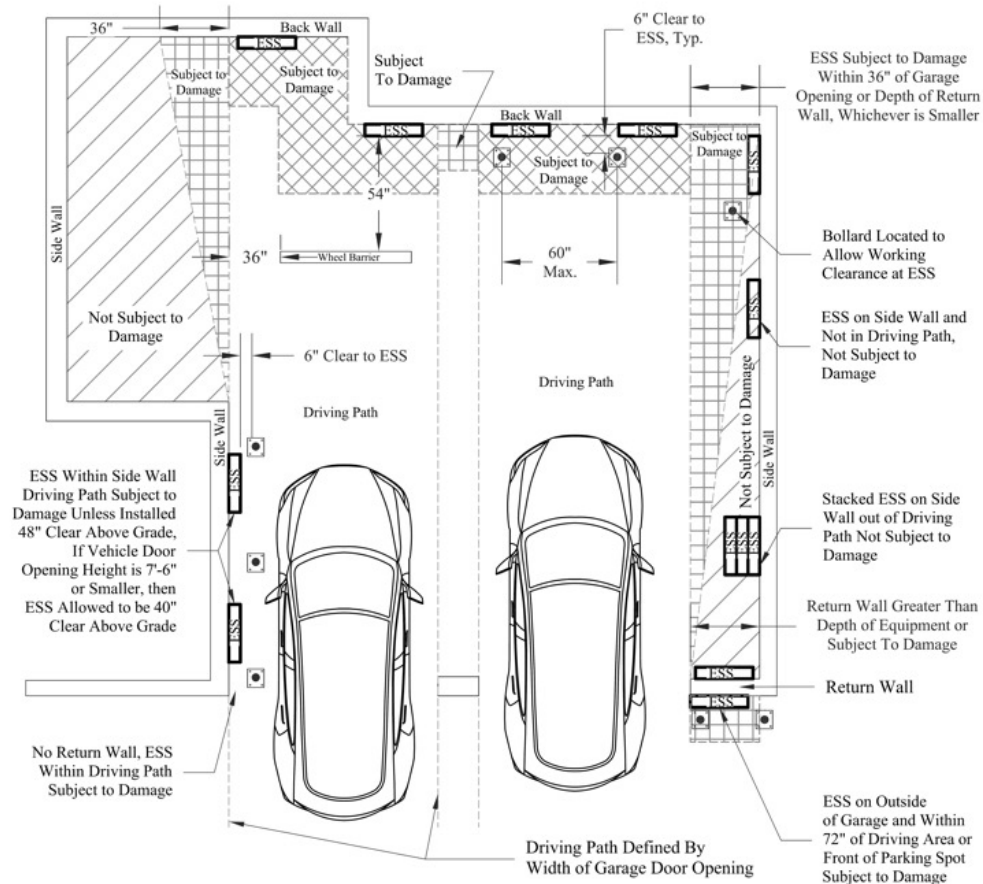
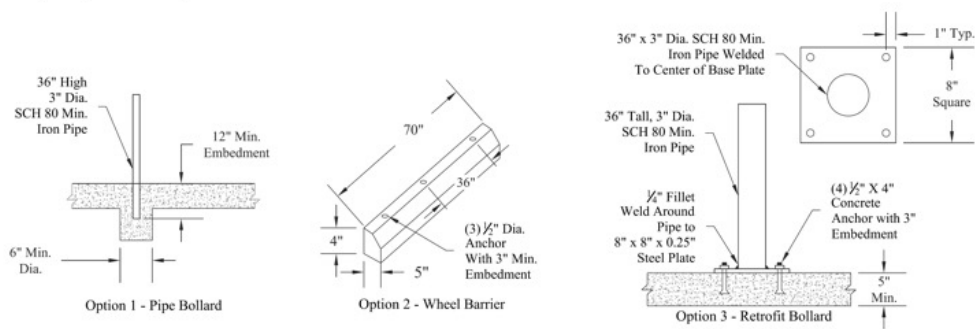

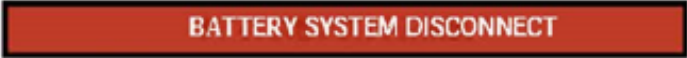





Image Courtesy of: Cobalt Power Systems



SIGNS AND LABELS TABLE

Labels shall be phenolic where exposed to sunlight. Labels required on conduit shall be permanent, weather resistant, and suitable for the environment. Labels shall be red background with white lettering. The following labels must be provided:

CEC Article (s)	Location of Label	Label Verbiage
705.10	Each Service Equipment Locations	 <p>WARNING: EQUIPMENT FED BY MULTIPLE SOURCES LOCATION OF DISCONNECTING MEANS</p> <p>LAYOUT OR DESCRIPTION PROVIDED HERE</p> <p><i>See Illustrations 2A, 2B and 2C for Clarification/ Guidance on the Layout and Description</i></p>
690.13(B) [2019] 706.15(C) [2022]	Alternative Energy Source AC System Disconnect	 <p>BATTERY SYSTEM DISCONNECT</p>  <p>WARNING: ELECTRIC SHOCK HAZARD TERMINALS ON LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION</p>
690.53 [2019] 706.15(C) [2022]	Alternative Energy Source DC System Disconnect Informational Note: These labels are only required on DC Coupled Multimode Interconnected Systems	 <p>BATTERY DC DISCONNECT</p>  <p>MAXIMUM VOLTAGE (V_{mp}) <input type="text"/> MAXIMUM CURRENT (I_{mp}) <input type="text"/></p> <p>Informational Note: This text must be included if this equipment is installed: “Maximum rated output current of the charge controller or DC-to-DC converter”</p>
690.54 [2019] 706.15(C) [2022]	Interactive Points of Interconnection	<p>“RATED AC OUTPUT CURRENT XXX AMPS NORMAL OPERATING AC VOLTAGE XXX VOLTS”</p>

SIGNS AND LABELS TABLE

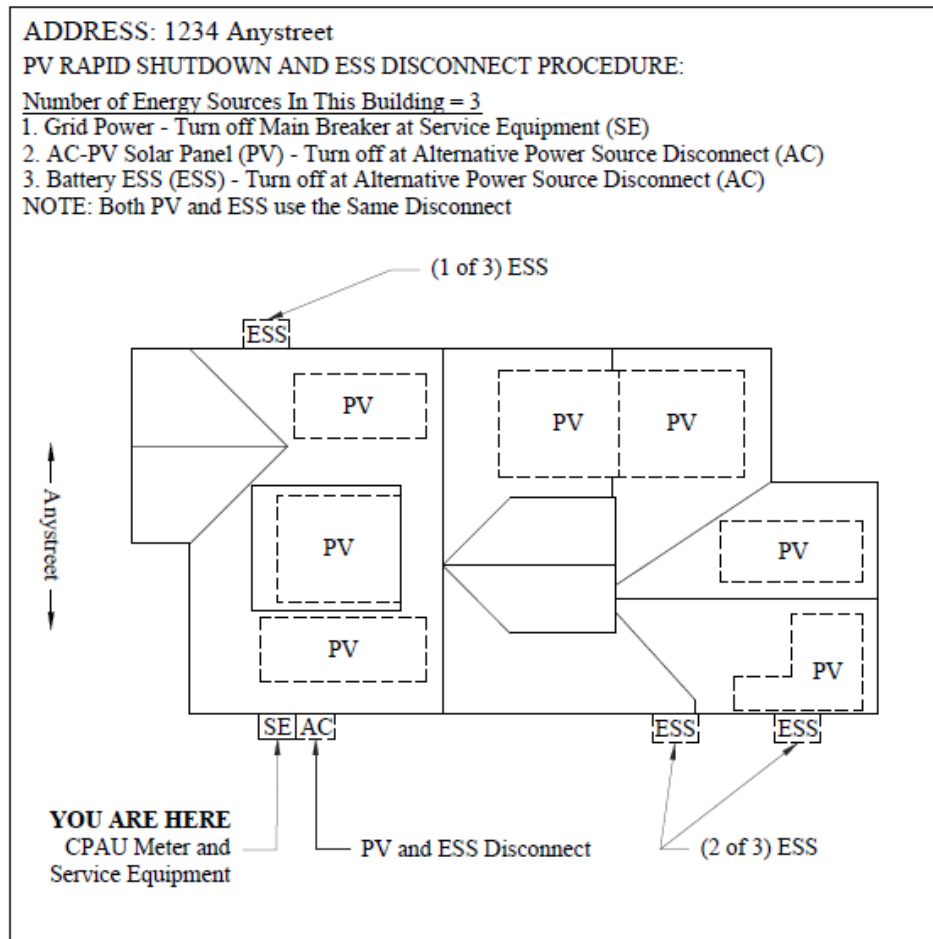
Labels shall be phenolic where exposed to sunlight. Labels required on conduit shall be permanent, weather resistant, and suitable for the environment. Labels shall be red background with white lettering. The following labels must be provided:

CEC Article (s)	Location of Label	Label Verbiage
690.55	When System is DC-Coupled	INDICATE THE POLARITY WHERE CONNECTED TO ENERGY STORAGE SYSTEMS
705.12(B)(2)(3)(b) [2019] 706.15(C) [2022]	Power Source Back Fed Output Breaker AKA: Inverter Output Breaker	WARNING: POWER SOURCE OUTPUT CONNECTION DO NOT RELOCATE THIS OVERCURRENT DEVICE
705.12(B)(2)(3)(c)	Interactive System Point of Interconnection <u>Informational Note:</u> <i>Install this signage only if the interconnection is directly tapped into the busbar.</i>	WARNING: DUAL POWER SOURCE SECOND SOURCE IS PV SYSTEM WARNING: THIS EQUIPMENT FED BY MULTIPLE SOURCES TOTAL RATING OF ALL OVERCURRENT DEVICES EXCLUDING MAIN SUPPLY OVERCURRENT DEVICE SHALL NOT EXCEED AMPACITY OF BUSBAR
690.31(G)(3) 690.31(G)(4)	DC Conduits, Raceways, Enclosures <u>Informational Notes:</u> 1. Mark Every 10', At Turns, Above/Below Penetrations 2. 3/8" Minimum Text Size	WARNING: ALTERNATE POWER SOURCE
	Electric Service <u>Informational Note:</u> <i>Only install if a de-rated main breaker is installed.</i>	"MAXIMUM MAIN BREAKER SIZE: XXX AMPS"
Utility Department Requirement	Electric Service <u>Informational Note:</u> <i>Only install when a supply side tap is utilized.</i>	CAUTION! SUPPLY SIDE TAP. OPEN AND LOCK AC BATTERY DISCONNECT BEFORE REMOVING METER

Illustration 2A: Directory Example with One Common Interconnection Disconnect for all Alternative Power Sources

Note that 'YOU ARE HERE' is at the Main Service Panel and Rapid Shutdown

Compliments of Cobalt Power Systems Inc.



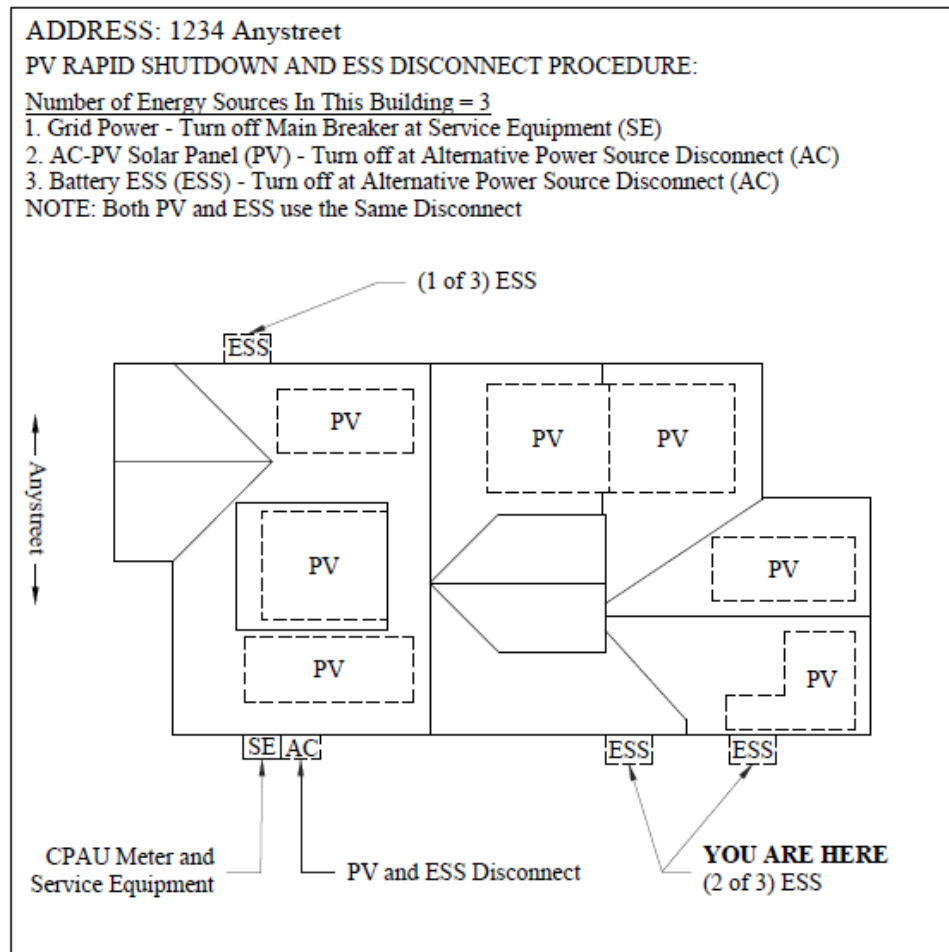
NOTES:

1. This Example does not Necessarily Represent Required Equipment Disconnect Locations.
2. Utility Department (Rule 27) Disconnect Should Not be Indicated Unless it Serves as an Alternative Power Source Disconnect.
3. Recommended Directory Placard Size = 7" x 7"
4. UV Resistant Red Plastic Material with White Lettering at $\frac{1}{8}$ " (0.12") Text Height

Illustration 2B: Directory Example with One Common Interconnection Disconnect for all Alternative Power Sources

Note that 'YOU ARE HERE' is at two of the three ESS Location

Compliments of Cobalt Power Systems Inc.



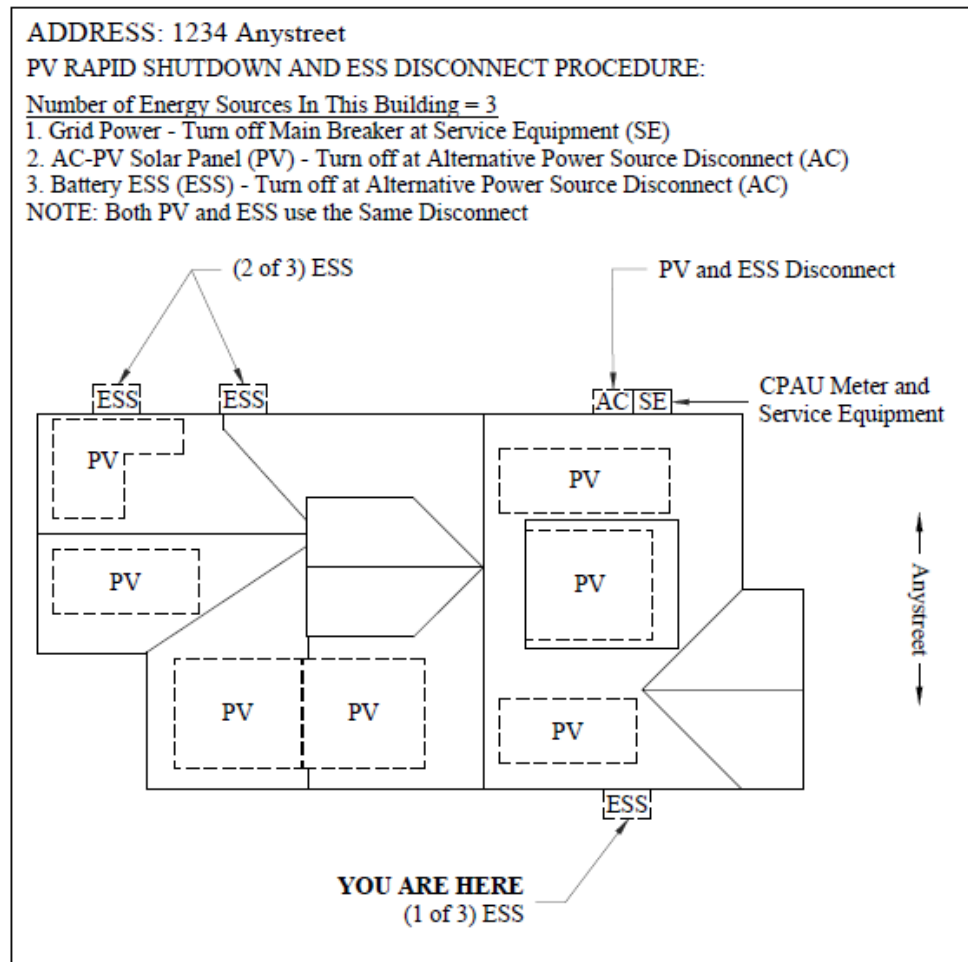
NOTES:

1. This Example does not Necessarily Represent Required Equipment Disconnect Locations.
2. Utility Department (Rule 27) Disconnect Should Not be Indicated Unless it Serves as an Alternative Power Source Disconnect.
3. Recommended Directory Placard Size = 7" x 7"
4. UV Resistant Red Plastic Material with White Lettering at $\frac{1}{8}$ " (0.12") Text Height

Illustration 2C: Directory Example with One Common Interconnection Disconnect for all Alternative Power Sources

Note that 'YOU ARE HERE' is at one of the ESS, opposite side of Main Service Panel and Rapid Shutdown

Compliments of Cobalt Power Systems Inc.

**NOTES:**

1. This Example does not Necessarily Represent Required Equipment Disconnect Locations.
2. Utility Department (Rule 27) Disconnect Should Not be Indicated Unless it Serves as an Alternative Power Source Disconnect.
3. Recommended Directory Placard Size = 7" x 7"
4. UV Resistant Red Plastic Material with White Lettering at $\frac{1}{8}$ " (0.12") Text Height

Illustration 3: Utilities Standard Detail SR-CN-0-1009

Extracted from Utilities Department Electric Service Requirements

Additional reference: Gas Standard Detail GD-02A of Water, Gas, Wastewater Utility Standards

