

# ELECTRICAL CHECKLIST

## Battery Energy Storage Systems



Applicable Codes: NEC 2017,

The information provided in this document is general and intended as a guide only. Each project is unique and additional requirements may be enforced as deemed appropriate.

Project Information	
Permit Number	
Primary Contractor	
Project Address	
Date	

Pre-Inspection	
	De-energize electrical panels prior to removing the dead-front. All equipment shall be open and ready for inspection
	The approved plans, permit, and installation instructions shall be on site at time of inspection
	Major changes, including revisions, to the installation shall be submitted to the AHJ for review and approval prior to inspection.

### Inspection

General	
	Exact match of component product number and rating with plan
	All equipment shall bear the appropriate listing mark of a Nationally Recognized Testing Laboratory where such marking is required as part of the listing, and installed in accordance with its listing (NEC Article 110.3(B))
	Battery energy storage system includes a manual (system description, operating and safety instructions, maintenance requirements, safe battery handling requirements/recommendations)
	A personnel door(s) intended for entrance to and egress from rooms designed as BESS rooms shall open in the direction of egress and shall be equipped with listed panic hardware, (NEC 706.10(D))
	Provide sufficient working spaces and clearances for batteries. Working space shall be measured from the edge of the battery cabinet, racks, or trays, (NEC 480.9, 110.26)
	Spaces about the ESS shall comply with NEC 110.26. Working space shall be measured from the edge of the ESS modules, battery cabinets, racks, or trays, (NEC 706.10(C)) <ul style="list-style-type: none"><li>• For battery racks, there shall be a minimum clearance of 1 inch between a cell container and any wall or structure on the side not requiring access for maintenance.</li><li>• ESS modules, battery cabinets, racks, or trays shall be permitted to contact adjacent walls or structures, provided that the battery shelf has a free air space for not less than 90% of its length.</li><li>• Pre-engineered and self-contained ESSs shall be permitted to have working space between components within the system in accordance with the manufacturer's recommendations and listing of the system.</li></ul>

<b>Equipment</b>	
	Flexible Battery DC conductors are listed as hard service use and/or moisture resistant, (NEC 690.74, 706.32)
	Fine stranded flexible cables (if used) terminated in accordance with NEC 110.14, (NEC 110.14, 706.32)
	Ungrounded conductor is not marked using white, grey, or white striped conductors to avoid confusion with grounded conductor markings, (NEC 200.7)
	Electrochemically dissimilar metals are not in direct physical contact, (NEC 110.14)
	All connections shall be secure, (NEC 110.14, 706.31)
	All metallic raceways and equipment shall be bonded and electrically continuous, (NEC 110.3(B), 250.8)
	Unused opening shall be close with protection equivalent to the wall of enclosure, (NEC 110.3(B), 408.7)
	The selected wiring methods are appropriate for the location and installed in accordance with their intended use, (NEC 310, 706)
	All live parts of batteries must be guarded regardless of voltage or battery type, (NEC 706.10(B))
	Batteries' live parts shall be guarded in accordance with (NEC 110.27, 480.10(B))
	Verify that the attachment of the battery storage unit to the wall or floor is per the approved plans. If the wall or floor construction differs from the approved plans, a revision is required prior to inspection

<b>Grounding</b>	
	Any conductive battery racks, cases or trays must be connected to an equipment grounding conductor. (NEC 250.110)
	Equipment grounding conductor is properly identified as either bare, green, or green with continuous yellow stripe(s), (NEC 250.119)
	If there is no existing AC grounding electrode, the ESS contractor shall install (2) ground rods at the main electrical service. If there is only (1) ground rod, a second one shall be installed. Ground rods shall be a minimum of 6' apart, (NEC Exhibit 250.25, Article 250.53, 706)

<b>Main Electric Service</b>	
	Circuit breakers shall be of the same manufacturer as the main service panel, (NEC 110.3)

<b>Ventilation</b>	
	Provide adequate ventilation for batteries per manufacturer's requirements. (NEC 706.10(A))
	Batteries/enclosures contain ventilation equipment to prevent excessive accumulation of gas pressure and/or gas ignition, (NEC 706.10)

<b>Connections and Terminations</b>	
	Cell terminations have measures taken to prevent corrosion
	Electrical connections do not put mechanical strain on battery terminals, (NEC 706.31, 110.14(A))
	Overcurrent protection of ungrounded conductors shall have overcurrent protection device(s) located as close as practicable to the battery terminals in an unclassified location, (NEC 480.5, 706.7)
	Battery circuit and equipment shall be protected by overcurrent protective devices as close as practicable to the storage battery terminals in accordance with the requirements of NEC Article 240, (NEC 240.21(H), 705.65(A))
	Unless the short-circuit currents from all sources do not exceed the ampacity of the conductors, storage battery inverters shall be protected by overcurrent protective devices from all other sources, (NEC 705.65(A))
	A listed current-limiting overcurrent protective device shall be installed adjacent to the ESS for each dc output circuit, (NEC 706.21(C))
	In an ac-coupled system, the plug-in type circuit breaker connected to the output of the storage battery or multimode inverter is required to be secured, (NEC 408.36(D), 710.15(E))
	Storage battery, multimode, and utility-interactive inverter output circuit breakers that are marked "Line" and "Load" are not permitted to be back-fed, (NEC 710.15(E), 110.3(B), 705.12(B)(4))
	Single 120-volt inverter in ac coupled systems should not supply back-up loads containing multiwire branch circuit or any 240 volt outlets. Such action can overload the common neutral in such a wiring method, (NEC 710.15(C))

<b>Monitoring and Charge Control</b>	
	Charge controllers shall be compatible with the battery or ESS manufacturer's electrical ratings and charging specifications, (NEC 110.3(B))
	Charge controller is properly installed to prevent overcharging or damaging batteries, (NEC 690.72, 706.23)
	Diversionary charge controllers with utility-interactive and multimode inverters shall have a second independent controller to prevent battery overcharge in the event the diversion loads are unavailable, or the diversion charge controller fails, (NEC 706.23(B)(3)(b))

<b>Disconnecting Means</b>	
	A disconnecting means is provided for all ungrounded conductors derived from a dc stationary battery system with a voltage of over 60 volts dc, (NEC 480.7)
	A disconnecting means shall be provided for all ungrounded conductors derived from an ESS. A disconnecting means shall be readily accessible and located within sight of the ESS, (NEC 706.7(A))
	Battery circuits subject to field servicing where exceeding 240 volts nominal between conductors or to ground, shall have provisions to disconnect the series-connected strings into segments not exceeding 240 volts nominal for maintenance by qualified persons. Non-load-break bolted, or plug-in disconnects shall be permitted, (NEC 706.30(B))
	ESS exceeding 100 volts between conductors or to ground shall have a disconnecting means, accessible only to qualified persons, that disconnects ungrounded and grounded circuit conductor(s) in the electrical storage system for maintenance. This disconnecting means shall not disconnect the grounded circuit conductor(s) for the remainder of any other electrical system. A non-load-break-rated switch shall be permitted to be used as a disconnecting means, (NEC 706.30(C))
	Where battery energy storage system input and output terminals are more than 5ft from the connected equipment, or where these terminals pass through a wall or partition must comply with all of NEC 706.7(E), <ul style="list-style-type: none"> <li>(1) A disconnecting means shall be provided at the energy storage system end of the circuit. Fused disconnecting means or circuit breakers shall be permitted to be used.</li> <li>(2) A second disconnecting means located at the connected equipment shall be installed where the disconnecting means required by 706.7(E)(1) is not within sight of the connected equipment.</li> <li>(3) Where fused disconnecting means are used, the line terminals of the disconnecting means shall be connected toward the energy storage system terminals.</li> <li>(4) Disconnecting means shall be permitted to be installed in energy storage system enclosures where explosive atmospheres can exist if listed for hazardous locations.</li> <li>(5) Where the disconnecting means in (1) is not within sight of the disconnecting means in (2), placards or directories shall be installed at the locations of all disconnecting means indicating the location of all other disconnecting means. (NEC 706.7(E))</li> </ul>
	Where a disconnecting means, located in accordance with NEC 480.7(A) (out of sight of the battery storage system), is provided with remote controls to activate the disconnecting means and the controls for the disconnecting means are not located within sight of the stationary battery system, the disconnecting means shall be capable of being locked in the open position, (NEC 480.7(B))
	The equipment grounding lug shall be as specified by the manufacturer, (NEC 110.3(B))
	Remove any insulating finish, such as paint, under the equipment grounding lug prior to installation (NEC 250.8, 250.12)
	Maximum height requirements for disconnects applies to integrated disconnect (e.g., Tesla PowerWalls or similar applications)

<b>Interconnection</b>	
	The interconnection methods comply with NEC Article 705.12 (if connected to other energy sources)

<b>Signage</b>	
	<p>The signage shall be in compliance with ANSI Z535 and shall include the following information</p> <ol style="list-style-type: none"> <li>1. Labeled “Energy Storage Systems” with symbol of lightning bolt in a triangle</li> <li>2. Type of technology associated with the ESS</li> <li>3. Special hazards associated</li> <li>4. Type of suppression system installed in the area of the ESS</li> <li>5. Emergency contact information</li> </ol>
	<p>A permanent plaque or directory denoting the location of all electric power source disconnecting means on or in the premises shall be installed at each service equipment location and at the location(s) of the system disconnect(s) for all electric power production sources capable of being interconnected. The marking shall comply with NEC 110.21(B) (NEC 706.11)</p>
	<p>Equipment containing overcurrent devices in circuits supplying power to a busbar or conductors supplied from multiple sources shall be marked to indicate the presence of all sources. (NEC 705.12(B)(3))</p>
	<p>PV system output circuit conductors shall be marked to indicate the polarity where connected to battery energy storage systems. (NEC 690.55)</p>
	<p>DC system conductors of 4 AWG or larger shall be identified using colored marking tape, (NEC 210.5(C)(2))</p>
	<p>Where controls to activate the disconnecting means of a battery are not located within sight of a stationary battery system, the location of the controls shall be field marked on the disconnecting means. (NEC 480.7(B))</p>
	<p>Where controls to activate the disconnecting means of an ESS are not located within sight of the system, the disconnecting means shall be capable of being locked in the open position, in accordance with 110.25, and the location of the controls shall be field marked on the disconnecting means. (NEC 706.7(B))</p>
	<p>Where the sum of the ampere ratings of all overcurrent devices on panelboards, both load and supply devices, excluding the rating of the overcurrent device protecting the busbar, shall not exceed the ampacity of the busbar. The rating of the overcurrent device protecting the busbar shall not exceed the rating of the busbar. Permanent warning labels shall be applied to distribution equipment displaying the following or equivalent wording: (NEC 705.12(B)(2)(3)(c)):</p> <p style="text-align: center;">WARNING: THIS EQUIPMENT FED BY MULTIPLE SOURCES. TOTAL RATING OF ALL OVERCURRENT DEVICES, EXCLUDING MAIN SUPPLY OVERCURRENT DEVICE, SHALL NOT EXCEED AMPACITY OF BUSBAR.</p>
	<p>Where two sources, one a primary power source and the other another power source, are located at opposite ends of a busbar that contains loads, the sum of 125 percent of the power source(s) output circuit current and the rating of the overcurrent device protecting the busbar shall not exceed 120 percent of the ampacity of the busbar. The busbar shall be sized for the loads connected in accordance with Article 220. A permanent warning label shall be applied to the distribution equipment adjacent to the back-fed breaker from the power source that displays the following or equivalent wording: (NEC 705.12(B)(2)(3)(b)):</p> <p style="text-align: center;">WARNING: INVERTER OUTPUT CONNECTION; DO NOT RELOCATE THIS OVERCURRENT DEVICE.</p>
	<p>All battery and battery management equipment and associated switchgear are marked and labeled according to all applicable codes, including arc flash incident calculations for the safety of operation and maintenance personnel required by the National Electrical Code and OSHA: (NEC 110.16)</p>
	<p>If a battery dc disconnecting means is not provided at the batteries, the disconnecting means shall be legibly marked in the field. The marking shall be of sufficient durability to withstand the environment involved and shall include the following (NEC 480.7(D)):</p> <ul style="list-style-type: none"> <li>• Nominal battery voltage</li> <li>• Maximum available short-circuit current derived from the stationary battery system</li> <li>• Date the calculation was performed for the value above</li> <li>• The battery disconnecting means shall be marked in accordance with 110.16</li> </ul>