

means or its remote control located at a readily accessible location on the outside of the home or building. See *NEC 706.15(A)*.

6. ___ If required per the AHJ due to a large number of individual devices installed for a system, please provide a floorplan layout of the room(s) in the home or building that will contain battery backup system (and any other equipment associated with the system). Please show the locations of all equipment on such floorplan and show clear working spaces in front of all equipment. *NEC 706.20(C)* and 110.26. The batteries cannot be installed in the clear working space of any other electrical equipment. **Note: many jurisdictions may choose to not require a floorplan layout when all equipment will be outside or in a garage.**
7. ___ If there will be new underground conduit installed for the system, please show on the site plan the location where such conduit will be installed and also specify the burial depth of such conduit, in accordance with *NEC 300.5*.

Line Diagram

8. ___ Show all system components and electrical equipment on the diagram, such as: J-boxes, combiner box (if used), inverter(s), panelboards, disconnects, batteries (or other energy storage component) and other equipment like charge controllers (if used). Indicate where all the components will be located in or on the home.
9. ___ Show any electrical panelboards that will be backed up by the ESS system (a backed-up loads panel is also often called a critical load panel – which is for the loads that will receive power from the battery system when the utility source of power (or other primary source of power) is not available for the home).
10. ___ Specify on the diagram the ampacity rating of all panelboards and the ampacity rating of any breakers that feed such panelboards.
11. ___ Show on the line diagram a disconnect that will shut down the energy storage system (ESS). For one-family and two-family dwellings, there must be a disconnecting means or its remote control located at a readily accessible location on the outside of the home or building. See *NEC 706.15(A)*.
12. ___ Please specify on the line diagram if equipment, panelboards, and wiring will be new or existing.
13. ___ Show all wire sizes, and wire types to be provided for each section of wiring between electrical equipment. *NEC* Articles 240 and 310.
14. ___ Wire sizing for circuits connected to the ESS system must be sized per the ESS manufacturer's instructions and *NEC 706.30*.
15. ___ Please show on the plans that all circuits (AC and DC) connected to the ESS will be protected from overcurrent. *NEC 706.31(A)*. See installation instructions for the ESS concerning requirements for overcurrent protection.
16. ___ Per *NEC 706.31(F)*, when overcurrent protection is required for a circuit connected to an energy storage component (such as batteries), and such circuit passes through a wall, floor, or ceiling, the required overcurrent protection must be provided at the energy storage component end of the circuit. **For example**, if a battery enclosure (not having built-in overcurrent protection) is installed on the other side of a wall from the battery inverter, there must be provided an overcurrent device for the battery circuit and the overcurrent device needs to be next to the battery enclosure. See installation instructions for the ESS concerning requirements for overcurrent protection.
17. ___ Specify on the diagram the ratings of all breakers or fuses (DC and AC overcurrent protection devices). *NEC 706.31(B)* and 240.4. Please also show on the diagram the ampacity ratings of any breakers that are included as part of listed ESS equipment.
18. ___ Unless wiring will be factory installed as part of listed equipment, please specify on the diagram the size and type of conductors (wires) that interconnect batteries and extend to the inverter. Such wires must be sized in accordance with the ampacity rating of the battery system

DC fuses or DC breaker as specified by per the inverter manufacturer. See **NEC 706.31 and 110.3(B)**.

19. ___ If fine-stranded cables are going to be installed, specify on the plans that only terminals, lugs, devices, and connectors that are listed and marked for such use can be installed for such wires. *NEC 110.14*. All fittings for fine stranded cables must also meet UL 486 A&B.
20. ___ Specify the size and type of all equipment grounding conductors for each section of wiring on the diagram. *NEC Article 250, Parts VI and VII*.
21. ___ Specify the size and type of any required grounding electrode conductors for the system. *NEC Article 250, Part III*.
22. ___ Show on the diagram all conduit types, sizes, and how many conductors will be in each conduit for each section of wiring between electrical equipment. *NEC Chapter 3*.
23. ___ Specify locations where conduit and/or cables are to be installed.
24. ___ Indicate on the diagram what types of batteries are going to be installed and if they are the flooded/vented type or sealed type.
25. ___ Show on plans how many batteries are to be installed, how they are connected (in series or parallel), specify the voltage of each battery, and note the total battery bank voltage. Total battery system voltage in a residential home is typically limited to 100 volts unless the live parts of the batteries are not accessible during routine battery maintenance (**NEC 706.20(B)**).

General Equipment and Wiring Requirements (note: energy storage systems come in all different layouts and configurations – as such, not all below noted items apply to all systems)

26. ___ Detailed manufacturer’s installation instructions and requirements for the ESS system must be submitted for plan review and all requirements must be followed when installing the system. **Utah Amendment IRC R327.3** and *NEC 110.3(B)*.
27. ___ Provide manufacturer’s info indicating that the battery inverter is listed as being utility interactive (if grid-tied) and be listed per **UL 1741**. **Utah Amendment IRC R327.6**, *NEC 705.40*, *NEC 706.5*, **NEC 706.16(B) and (C)**.
28. ___ Please provide documentation for the energy storage system to show that such system has been tested and listed per **UL 9540**. **Utah Amendment IRC R327.2**, *NEC 706.5*, and *NEC Annex A*.
29. ___ If the batteries are to be the NON-lead-acid type, please provide manufacturer specification sheets for the batteries and show that they are listed per **UL 1973**. *NEC 706.5* (see also informational note #4 under *NEC 706.1*, and *NEC Annex A*).
30. ___ If the same inverter is to be used for the solar PV system and the battery system (which is often referred to as a DC coupled system), please show that the inverter contains DC ground fault protection, as required per *NEC 690.41(B)*.
31. ___ If the same inverter is to be used for the solar PV system and the battery system and there are DC voltages over 80 volts for the solar PV portion of the system, please show that the inverter contains DC arc-fault protection, as required per *NEC 690.11* (unless the exception applies).
32. ___ Inverter manufacturer spec sheets must note the maximum allowable DC voltages of the energy storage system and include the maximum DC voltage of the solar PV system if a PV DC system will directly connect to the inverter. *NEC 110.3(B)*.
33. ___ For systems where the terminals of the batteries are exposed, specify on the plans that all batteries must be located inside a lockable enclosure or room (guarded against accidental contact by persons). *NEC 110.27(A)*.
34. ___ If flooded (vented) batteries will be used for the system, provide information on how the battery enclosure will be ventilated. **NEC 706.20(A)** requires provisions appropriate to the battery technology shall be made for sufficient diffusion and ventilation of the gases from the battery, if present, to prevent the accumulation of an explosive mixture. (Note: see battery manufacturer recommendations for any ventilation requirements)
35. ___ If any charge controllers are to be installed for the battery system, please provide manufacturer spec sheets for such and also show that the charge controller(s) is/are listed in

accordance with UL 1741. NEC 706.5, 706.33, and 110.3(B). Charge controllers must be installed per manufacturer requirements where required per the ESS manufacturer.

36. ___ There must be provided a sign or marking next to the ESS system disconnect with the sign having the words “ENERGY STORAGE SYSTEM DISCONNECT.” The sign must also include the Nominal AC voltage and maximum DC voltage of the ESS system. NEC 706.15(C).
37. ___ Any ESS disconnects that have line and load terminals that may be energized in the open position must have a sign or marking with the following words or equivalent: “WARNING, ELECTRIC SHOCK HAZARD, TERMINALS ON THE LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION.” NEC 706.15(C).

Point of Interconnection Requirements (Rules for backfed panelboards): If the ESS is listed as utility interactive having the capability to provide power from the ESS to the electric utility, and the ESS system is connected to the home’s electrical system that is also connected to an electric utility, please see the point of interconnection requirements noted in either the micro inverter solar PV system or string inverter solar PV system plan review checklists. The ESS must comply with the applicable requirements of NEC Article 705. Note: not all ESS have the capability to export battery power (after converting the power to AC) onto the electric utility grid.

Utah Amendments for Energy Storage Systems (ESS) – These requirements must be addressed in addition to all other applicable requirements noted in this plan review checklist:

Note: for a direct link to Utah State Code Amendments 15A-3-202, see the following - https://le.utah.gov/xcode/Title15A/Chapter3/15A-3-S202.html?v=C15A-3-S202_2021050520210701

IRC Definition of an Energy Storage System (ESS) is as follows: “One or more devices, assembled together, that are capable of storing energy for supplying electrical energy at a future time.”

38. ___ **R327.1 General.** Energy storage systems (ESS) shall comply with the provisions of this section.
 - a. Exception 1: ESS listed and labeled in accordance with **UL 9540** and marked “For use in residential dwelling units”, where installed in accordance with the manufacturer’s instructions and NFPA 70.
 - b. Exception 2: ESS less than 1 kWh (3.6 megajoules)
39. ___ **R327.2 Equipment listings.** ESS shall be listed and labeled in accordance with **UL 9540**.
 - a. Exception: Where approved, repurposed unlisted battery systems from electric vehicles are allowed to be installed outdoors or in detached sheds located not less than 5 feet (1524 mm) from exterior walls, property lines and public ways.
40. ___ **R327.3 Installation.** ESS shall be installed in accordance with the manufacturer’s instructions and their listing.
41. ___ **R327.3.1 Spacing.** Individual units shall be separated from each other by not less than three feet (914 mm) except where smaller separation distances are documented to be adequate based on large scale fire testing complying with Section 1206.2.3 of the adopted International Fire Code. (Note: Large-scale fire testing is based on **UL 9540A** testing.)
42. ___ **R327.4 Locations.** ESS shall be installed only in the following locations:
 - a. Detached garages and detached accessory structures.
 - b. Attached garages separated from the dwelling unit living space in accordance with Section R302.6.
 - c. 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.

- d. 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-inch Type X gypsum wallboard.
ESS shall not be installed in sleeping rooms, or closets or spaces opening directly into sleeping rooms.
43. R327.5 Energy ratings. Individual ESS units shall have a maximum rating of 20 kWh. The aggregate rating of the ESS shall not exceed:
- 40 kWh within utility closets, basements, and storage or utility spaces.
 - 80 kWh in attached or detached garages and detached accessory structures.
 - 80 kWh on exterior walls.
 - 80 kWh outdoors on the ground.
- ESS installations exceeding the permitted individual or aggregate ratings shall be installed in accordance with Sections 1206.2.1 through 1206.2.12 of the adopted International Fire Code. (NOTE: multiple systems, each in different locations, could have capacity ratings up to the above noted values (per R327.5). For example, there could be up to an 80kWh system in the attached garage, up to a 40kWh system inside a storage room in the house, and up to an 80kWh system in a detached building (if the provisions of R327.4 are met for each system)).
44. R327.6 Electrical installation. ESS shall be installed in accordance with NFPA 70. Inverters shall be listed and labeled in accordance with UL 1741 or provided as part of the UL 9540 listing. Systems connected to the utility grid shall use inverters listed for utility interaction. (Note: NFPA 70 is the National Electrical Code)
45. R327.7 Fire detection. Rooms and areas within dwelling units, basements, and attached garages in which ESS are installed shall be protected by smoke alarms in accordance with Section R314. A heat detector, listed and interconnected to the smoke alarms, shall be installed in locations within dwelling units and attached garages where smoke alarms cannot be installed based on their listing.
46. R327.8 Protection from impact. ESS installed in a location subject to vehicle damage shall be protected by approved barriers.
47. R327.9 Ventilation. Indoor installation of ESS that include batteries that produce hydrogen or other flammable gases during charging shall be provided with mechanical ventilation in accordance with Section M1307.4. (Note: typically flooded or vented batteries are the type where hydrogen is released during normal charging of the batteries.)
48. R327.10 Electric vehicle use. The temporary use of an owner or occupant's electric powered vehicle to power a dwelling unit while parked in an attached or detached garage or outdoors shall comply with the vehicle manufacturer's instructions and NFPA 70 (i.e. *National Electrical Code*).
49. R327.11 Signage. A sign located on the exterior of the dwelling shall be installed at a location approved by the authority having jurisdiction which identifies the battery chemistry included in the ESS. This sign shall be of sufficient durability to withstand the environment involved and shall not be handwritten.

Electrical Service Upgrades

50. **IF** the home's service panel will be upgraded, please clearly specify on the line diagram the exact model number of the new service panel you are going to install and provide manufacturer specification sheets for such service panelboard. Such information is required in order to verify compliance with the requirements of NEC 705.11 or 705.12 for the interconnection of the PV system. **Also, the authority having jurisdiction (AHJ) has the authority to determine if the existing service equipment for the home is required to be upgraded. NEC 110.3(A).**
51. **IF** the service panelboard will be upgraded, then the **new** service panel must be shown to comply with the requirements of **NEC 230.71 and 230.62(C)**. Such requirements specify that the

new service panelboard can only have one main service breaker (to shut off all other breakers in such new service panel) and there essentially cannot be any other supply-side breaker slots in the **new** service panel. This requirement **ONLY** applies to **new** service equipment to be installed. It does **NOT** apply to existing service panelboards that do not require upgrading.

Point of Interconnection Requirements (rules for backfed panelboards) – Note: the following items may not be required for ESS that are completely stand-alone and not connected to any other primary source of power (such as an electric utility, for example).

52. ___ Provide photos of the service panelboard and any backfed sub-panelboards, and provide photos of all panelboard's interior labels. Photos must be with the panelboard's front covers open and show the ratings of all breakers therein. The photos of labels must also clearly show the rating of the panelboard. These photos are essential to determining if the requirements of **NEC 705.11 or 705.12** are going to be met.
53. ___ If the ESS is to backfeed an AC breaker on the supply side (service side) of the home's main service breaker(s) (in existing service equipment), then the rating of the backfed AC breaker cannot exceed what is allowed to be plugged into the breaker slot (noted on the panelboard label), and also cannot exceed the rating of the service conductors (wires) for the home. **NEC 705.1(A) and 110.3(B)**.
54. ___ Factory installed conductors (wires) or busbars within a service panelboard cannot be tapped unless such taps are allowed by the service panel manufacture (documentation from the service equipment manufacturer is required to prove this), or if the service equipment is to be field evaluated and approved by a listed testing agency (such as UL, Intertek, ect). The connections must be per the listing of the panelboard. **NEC 110.3(B) and 705.11(D)**.
55. ___ If taps will be made to non-factory-installed conductors between the utility meter base and service disconnect for the building (ie. supply-side taps), then each of the following must be specified on the plans:
 - a. Please specify that the fused disconnect switch (which protects the tap wires) must be listed and labeled as "suitable for use as service equipment." This is required per **NEC 705.11, 230.82(6), and 230.66**.
 - b. Since the fused PV disconnect is to be considered as a service disconnect, please also specify that there must be a main bonding jumper within such enclosure and specify the size and type of such main bonding jumper. This is in accordance with **NEC 250.24 and 250.25**.
 - c. The ground wire within the conduit between the disconnect switch and the main service equipment will be considered as the grounding electrode conductor (GEC) for the disconnect service equipment (see **NEC 250.24(D)**). As such, please note on the plans that the GEC must be bonded to each end of the metal conduit, as required per **NEC 250.64(E)**.
 - d. The supply-side tap conductors (wires) leading from the fused disconnect to the point of taps at the service cannot be less than #6 AWG copper (or #4 AWG aluminum) and such tap conductors must be installed per NEC 230.30. See NEC 705.11(B). The conductors also cannot be smaller than what is required per NEC 705.28 (i.e. which is usually 125% multiplied by the output ampacity rating of the inverter(s)).
 - e. The disconnect must be located on either the outside of the home or the first readily accessible location inside the home where the tap conductors first enter the building (unless item 705.11(C)(1) is met). See NEC 705.11(C).
56. ___ If a meter adapter is going to be used for the connection of the ESS system to the supply-side of the service disconnect(s), please provide manufacture specification sheets and installation instructions for such meter adapter. Documentation must also be provided to show that the meter adapter is listed in accordance with UL 414. **NEC 110.3**.

57. ____ If the ESS is to backfeed electrical equipment on the **load side** (the home's side of the main service breaker(s)), then the following must be addressed:

(note: instead of using 125% of the output current rating of the ESS inverter(s), if there is a PCS system (Power Control System) then it is permissible to use 125% of the ampacity output setting of the PCS equipment instead of the amp rating of the inverter(s) – See NEC 705.12):

For protection of feeder wires, ONE of the following items ('a' through 'd' shown below) must be met:

- a. If the ESS will be connected to the end of feeder wires opposite to the feeder wire's main breaker, then the feeder wires must have an ampacity not less than the main breaker for the feeders or 125% of the inverter(s) AC output current (amps), whichever is larger. See **first sentence of NEC 705.12(B)(1)**.
- b. If the PV system will not be connected to the end of feeder wires opposite to the feeder wire's main breaker, then the feeder wires must have an ampacity not less than 125% of the AC output current (amps) of the ESS inverter plus the rating of the main breaker protecting the feeder wires. See **NEC 705.12(B)(1)(a)**.
- c. If the ESS will not be connected to the end of feeder wires opposite to the feeder wire's main breaker, then an overcurrent protection device (fuses or breaker) which is/are rated not more than the ampacity of the feeder wires must be provided on the load side of the ESS inverter's AC output connection to the feeders. See **NEC 705.12(B)(1)(b)**.
- d. **If the ESS backfed breaker will be connected to busbars which have feeder wires connected to feed-through lugs on the same busbars as the ESS breaker, then either of the plan review requirements per items 56-b or 56-c (shown above in this checklist) must be complied with for protecting the feeder wires that are connected to the feed-through lugs (see NEC 705.12(B)(3)(6)).**

For protection of panelboard's busbars, ONE of the following items ('e' through 'h' shown below) must be met:

- e. The busbars must be rated not less than the main breaker (or fuses) protecting the panelboard plus 125% of the AC output current (amps) of the ESS inverter(s). See **NEC 705.12(B)(3)(1)**.
- f. If the inverter's AC breaker is located at the very end of the panelboard's busbars (at the opposite end of where the panel is fed from for the utility source), then the rating of the main breaker (or fuses) protecting the panelboard plus 125% of the inverter's AC output current (amps) cannot exceed 120% of the rating of the panelboard's busbars. See **NEC 705.12(B)(3)(2)**. If this *NEC code* item is to be utilized, then please specify that a sign is required at the PV backfed breaker location noting the following: "WARNING, INVERTER OUTPUT CONNECTION, DO NOT RELOCATE THIS OVERCURRENT DEVICE."
- g. The busbars in the panelboard must be rated not less than the sum of the ratings of all breakers in the panelboard, including the ESS breaker but not counting the main breaker (or fuses) protecting the panelboard. If this *NEC code* item is to be used for the interconnection of the ESS, there must also be a sign located at the panelboard noting the following: "WARNING: THIS EQUIPMENT FED BY MULTIPLE SOURCES. TOTAL RATING OF ALL OVERCURRENT DEVICES, EXCLUDING MAIN OVERCURRENT DEVICE, SHALL NOT EXCEED AMPACITY OF BUSBAR." See **NEC 705.12(B)(3)(3)**.
- h. ESS connections to multiple-ampacity busbars or to a center-fed panelboard is permitted as long as the ESS backfed breaker is in either the very top or the very bottom slot of the center-fed panelboard, AND the rating of the main breaker (or fuses) protecting the panelboard plus 125% of the inverter's AC output current (amps) cannot exceed 120% of the rating of the panelboard's busbars. See **NEC 705.12(B)(3)(4)**. The rating of the ESS

