Uintah County
Residential Solar Photovoltaic (PV) System
Plan Submittal Checklist

This checklist is only a basic list of items needed **to begin** a solar PV system plan review and is **not** all inclusive. Having all the items listed on this checklist does **not** guarantee a permit will be issued and any additional plans, information, and/or requirements may be requested or required by Uintah County at any time.

1. **Site plan**: A detailed site plan showing the location of the home, electrical service panel, service meter (if not part of the service panel), any sub-panelboards (which are to be backfed by the solar PV system), and all PV system components.

2. **Mounting system:** Provide detailed information on the module mounting system. The support manufacture specs must also specify the required support spacing based on the local wind and snow loads (typically manufacturers have wind loading tables or online generated reports for this). Note on the plans if the home roof rafters are engineered trusses or provide information on the type and size of the roof rafters if they are other than engineered trusses. Also note the type of the roof covering (shingles, metal, or tile) and how many layers of the roof coverings there are. If the racking system has integrated grounding/bonding, please also provide spec sheets showing such.

3. **One-line diagram**: A detailed one-line (or three-line) diagram is required and must show the type of PV system being installed (a string inverter system, micro inverter system, or AC module system), show the **exact** number and layout of modules and how they are connected together (in series or in parallel), show all wire types, all wire sizes, how many wires per circuit, conduit types and sizes, detailed info on the equipment grounding wiring and connections, note the locations of all circuits and system components on or in the house, show the ratings of all fuses or breakers, show ratings of all equipment, and note on the diagram if equipment is new or is existing. The diagram must also note the model numbers of equipment.

4. **Electrical panel to be backfed:** Note which home electrical panel the PV system will backfeed and give the location and rating of that panel. Please provide pictures of the service panelboard with a picture of its interior label also. Please also provide photos of labels of any sub-panel that will be backfed by the PV system.

5. **Module spec sheets**: Provide the PV module (solar panels) manufacture spec sheets showing the modules' **STC** rated watts (Pmp), volts (Vmp), amps (Imp), open circuit voltage (Voc), and short circuit current (Isc). Modules must also be shown to be listed UL 1703.

6. **Inverter spec sheets**: Provide the inverter manufacture spec sheets showing the amount of watts and volts the inverter can safely handle, and also noting the inverter's max rated AC output amps and AC voltage. Utility tied inverters must be shown to be listed as "utility interactive." All inverters must also be shown to be listed per UL 1741, and must have DC ground fault protection (this is required even for micro inverters and AC modules).

7. **Total array power**: (This is not required for systems with micro inverters) Provide the total amount of watts, amps, volts, open circuit voltage (Voc at the coldest possible outside temperature-see NEC 690.7), and short circuit current that the array can produce. This information must be based on the solar PV module manufacture specs.

8. **System components or equipment**: Provide information on the different types of components (such as j-boxes, disconnect switches, panelboards, etc.) that will be used in the system and how they are to be installed. Also show that all equipment is listed and rated for the type of voltage (AC or DC), amount of voltage, and the amount of current (amps) that it could be subjected to.

Uintah County Residential Solar Photovoltaic (PV) System Plan Review
For systems utilizing MICRO-INVERTERS

BUILDING ADDRESS_____
SUBDIVISION_____LOT_____
OWNER'S NAME_____
CONTRACTOR_____

This checklist is compiled for plan checking purposes for residential solar photovoltaic (PV) systems utilizing **MICRO-IVERTERS**. The information contained herein is compiled from the *2017 National Electrical Code (NEC), 2015 International Residential Code*, manufacture and PV industry standards, and **Uintah County** requirements. This checklist is not intended to indicate any change of any code or ordinance by inference or omission.

This review is not all inclusive and all system components and equipment must be installed per adopted code, city ordinances, and manufacture requirements regardless of whether or not such items or issues have been addressed using this checklist.

ITEMS REQUIRING CORRECTION (items marked with an X):

General

1. ___ Provide two complete sets of construction drawings, line diagram(s), and site plan.
2. ___ Provide two complete sets of manufacture specs and system component information. Manufacture specifications are required for the following items: micro-inverters, solar modules (panels), disconnect switches, any new AC panelboards, and the supporting racking system.

Site Plan

3. ___ Site plan must show the location of the home's service panelboard, any sub-panelboard (that is to be backfed by the PV system), locations of any disconnects, and layout of the solar PV modules (panels).
4. ___ Show any detached structure on the property if solar modules (panels) are to be installed thereon and show dimensions from such structure to property lines.
5. ___ 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.
6. ___Show on the site plan the location of the rapid shutdown disconnect (or location of any disconnect or breaker that will be acting as the rapid shutdown disconnect for the system). The rapid shutdown disconnect must be readily accessible on the outside of the home. *NEC* 690.12(C). Note: since the micro inverters must be listed as utility interactive, they shut down within two seconds upon loss of connection with a utility source of power. Therefore, any AC disconnect or breaker that isolates the micro inverters from the utility grid, and such disconnect or breaker is readily accessible and located outside the home or building, could be considered as the rapid shutdown disconnect for the PV system.

Solar PV Mounting System

7. ___ Specify the type of roof covering and note how many layers of such covering.

8. ___ Indicate what type of rafters the roof is composed of (engineered trusses, dimensional lumber, TJI etc…), and note the size, spans, and spacing of the rafters.
9. ___ Show that the existing roof rafters can safely handle the new loads of the system. Note: Engineering to meet this requirement *may* not be required if the existing rafters are engineered trusses, the roof only has one layer of asphalt shingles, and the total weight of all racking system with PV modules (panels) installed does not exceed 5 lbs per square foot and there is not more than 60 lbs per solar racking support.
10. ___ Provide manufacture info that shows the mounting system is listed for the mounting of PV modules on the roof (for roof mounted systems). PV racking must be listed per UL 2703.
11. ___ Specify on the plans the spacing of supports per the manufacture specs and show that such system can handle the local wind and snow loads and is designed for such. Maximum wind load is to be based on 115 mph, ground snow load is to be based on 39 psf, and roof snow load is to be based on 30 psf.
12. ___ Provide information on how all roof penetrations (supports, J-boxes, conduit etc…) are going to be properly flashed. *IRC* R903.2.
13. ___ Specify on the plans that solar PV modules (panels) cannot be installed over or block any attic vents, plumbing vents, furnace or water heater vents etc.
14. ___ For a ground-mount racking system, please provide complete plans of the structure indicating that all associated requirements of the code are met (setbacks, square footage of the racking footprint, size/spacing of footings, connectors, snow loads, wind loads etc). The documents must also show how the racking is to be constructed. *IRC* R324.6. The ground-mount racking system must also be shown to be listed per UL 2703.
15. ___ For a ballasted roof racking system, please provide documentation and engineering calculations from the ballast racking manufacture to show that such system can handle the local wind loads 115 mph and has also been evaluated to be able to withstand seismic loads (for a seismic zone D). Such documentation must also specify how many ballast blocks are required for each section of the array in order to withstand such loads. The racking system must also be shown to be listed per UL 2703.

Line Diagram

16. ___ Specify exactly how many solar PV modules (panels) there will be per AC circuit (the number of micro inverters per circuit cannot exceed what is noted on the inverter spec sheets).
17. ___ Specify how many AC circuits (ie. how many AC strings) are to be installed for the PV system.
18. ___ Show all PV system and electrical components, such as: J-boxes, micro-inverters, panelboards, and disconnects. Indicate where all the components will be located in or on the home.
19. ___ Indicate the electrical panelboard that the PV system will tie into: A sub-panelboard or the home's electrical service panelboard.
20. ___ Specify on the diagram the ratings of all breakers or fuses (AC overcurrent protection devices), including existing breakers feeding any panelboards that are to be backfed by the PV system.
21. ___ Show all wire sizes, and wire types (including any existing feeder wires that are to be backfed by the PV system).
22. ___ Manufacturer AC trunk cables located outdoors for a micro inverter system are required to be listed and identified for the application and must be secured no more than 6' oc. *NEC* 690.31(D). Typically, the cables are TC-ER or USE-2 rated cable.
23. ___ Wires installed outside (even if in conduit) must be listed for wet locations per *NEC* 300.9.
24. ___ Specify the size and type of all equipment grounding conductors for each section of wiring on the diagram and note size and type of any grounding electrode conductors. (note: What were traditionally called transformerless inverters are now referred in the 2017 NEC as "functionally grounded" inverters. Such inverters typically do not require a grounding electrode conductor,

but all types of PV systems will require equipment grounding conductors ran with circuit wiring). *NEC* 690.43 through 690.47.

25. ___ The AC circuit conductors (wires) must be at least #12 AWG copper (#10 AWG is recommended). Note: wires may need to be increased in sized due to conduit fill or ampacity derations per *NEC* 310.15(B)(3)(a), 310.15(B)(3)(c), and table 310.15(B)(2)(a) where applicable. (note: if conduit is ran above the roof, the requirements of *NEC* 310.15(B)(3)(c) will not apply as long as the conduit is held at least 7/8" or more above the roof's surface).
26. ___ The rating of the fuses or breaker for the micro-inverter's AC output circuit must be sized in accordance with the micro-inverter's manufacture spec sheets.
27. ___ If an AC combiner panelboard is to be installed (which is dedicated only for the PV system AC breakers and monitoring), the AC combiner panelboard itself and the conductors (wires) between an AC combiner panel and the point of interconnection breaker, must have an ampacity not less than the sum of the rated AC output current (amps) of all micro inverters for the system multiplied by 125%. *NEC* 690.8(B) and 690.9(B).
28. ___ Show conduit types, sizes, and how many conductors will be in each conduit.
29. ___ Specify locations where conduit and/or cables are to be installed.

Grounding and Bonding

30. ___ Provide detailed info on the types of connectors and/or devices that will be used for bonding solar modules, supports, and other metal equipment to the equipment grounding conductor. All devices used for bonding frames of PV modules or other equipment to the grounding system must be listed and identified for the purpose. *NEC* 690.43.
31. ___ If the PV racking system is equipped with integrated grounding/bonding, please provide manufacture specification sheets showing how integrated grounding/bonding is provided and show that such racking system is listed for such and is also listed in accordance with UL2703.
32. ___ Lugs for bonding aluminum rails and modules must be listed for outdoor use and also for bonding PV rails and modules. Burndy CL50.1TN lugs, ILSCO GBL4 DBT lugs, and WEEBL lug and clip assemblies are all ok for this purpose if installed per manufacture requirements. Must provide info on any other types of connectors if used.
33. ___ Indicate on the plans how the equipment grounding conductor(s) will be installed and protected from damage. If grounding conductors are exposed then a minimum of #6 copper conductors must installed. All grounding conductors must be protected from damage or be installed in conduit. *NEC* 690.46, 250.120(C), and 250.64(B)
34. ___ Please note on the plans that equipment grounding conductors shall be ran with the associated circuit conductors when those conductors leave the vicinity of the PV array, as required per *NEC* 690.43(C). If the array circuit conductors enter conduit or enclosures, the equipment grounding conductor must also be installed in such conduit or enclosures. *NEC* 300.3(B) and 690.43(C).
35. ___ Please specify on the plans the type of grounding electrode(s) used for grounding the existing electrical equipment for the home (or detached structure) and specify the size of the existing grounding electrode conductor (wire) that connects to it. If the existing grounding electrode system is not adequate, please specify that a new system will be installed and specify the type of electrode to be used (concrete encased, ground rods, metal water pipe and ground rod, etc). See *NEC* 250.50 through 250.66 and 690.47(A).

PV Modules (Panels)

36. ___ Provide manufacture specifications for the solar PV modules (panels).
37. ___ Manufacture specs must show the PV modules are UL 1703 listed. *NEC* 690.4(B) and *IRC* R324.3.1.
38. ___ Solar PV Module spec sheets must show the **STC** rated open circuit voltage (Voc) and short circuit current (Isc) of the modules (panels).

Inverter(s)

39. ___ Provide manufacture specifications for the inverter(s).

40. ___ Manufacture specs must show that inverter(s) is/are UL 1741 listed. *NEC* 690.4(B) and *IRC* R324.3.
41. ___ For utility interactive inverters, specs must show that the inverter is listed as such. *NEC* 690.4(B), 705.40, and *IRC* 324.3.
42. ___ Specs must show the maximum number of micro-inverters that can be connected to each AC circuit.

Point of Interconnection Requirements (Rules for backfed panelboards)

43. ___ 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* 705.12(A) or 705.12(B) are going to be met.
44. ___ If a service panelboard upgrade is to be performed, please specify the rating, manufacture, and model number of the panelboard. Please also provide manufacture spec sheets on such service panel.
45. ___ If the solar PV system is to backfeed an AC breaker on the supply side (service side) of the home's main service breaker(s), 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* 705.12(A).
46. ___ Factory installed conductors (wires) or bubars within a service panelboard cannot be tapped unless such taps are allowed by the service panel manufacture (documentation from the service equipment manufacture 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).
47. ___ 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 PV disconnect switch (which protects the tap wires) must be listed and labeled as service equipment. This is required per *NEC* 230.66 and 690.13(C).
    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(B).
    c. The ground wire within the conduit between the PV disconnect switch and the main service equipment will be considered as the grounding electrode conductor (GEC) for the PV 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).
48. ___ If a meter adapter is going to be used for the connection of the PV 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.
49. ___ If the solar PV system 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:

    For protection of feeder wires, one of the following must be met:

    a. If the PV system 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 *NEC* 705.12(B)(2)(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 inverter plus the rating of the main breaker protecting the feeder wires. See *NEC* 705.12(B)(2)(1)(a).

c. If the PV system 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 inverter's AC output connection to the feeders. See *NEC* 705.12(B)(2)(1)(b). Please be aware that if the PV backfed breaker will be connected to busbars which have feeder wires connected to feed-through lugs at the busbars, then this requirement must be complied with for protecting the feeder wires that are connected to the feed-through lugs.

For protection of panelboard's busbars, one of the following must be met:

a. 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 inverter(s). See *NEC* 705.12(B)(3)(a).

b. 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)(b). 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."

c. The busbars in the panelboard must be rated not less than the sum of the ratings of all breakers in the panelboard, including the solar PV 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 PV system, 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)(c).

d. PV connections to multiple-ampacity busbars or to a center-fed panelboard is permitted as long as the PV 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)(d). The rating of the PV backfed breaker cannot exceed the rating of the breaker slot that it will be plugged into (as noted per the panelboard's label).

50. ___ If feeder taps are to be performed in order to connect the PV system to the electrical system of the home, then the tap rules of *NEC* 240.21(B) must be followed (in addition to those found under *NEC* 705.12(B)(2)(1)). See also the above requirements for connections on the load side of the service disconnect(s).

General Equipment Requirements

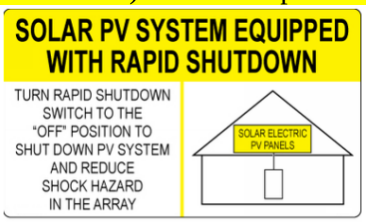
51. ___ PV equipment and disconnecting means are not permitted to be installed in a bathroom. *NEC* 690.4(E).
52. ___ Provide a note on the plans stating that all wiring must be properly supported by devices or mechanical means designed and listed for such use, and for roof-mounted systems, wiring must be permanently and completely held off of the roof surface. See *NEC* 110.2, 110.3(A), 110.3(B), and 300.4.
53. ___ For a ground-mount system, please specify on the plans exactly how the wiring at the array is going to be protected so the wiring is not readily accessible. Typically, this is accomplished by providing a lockable fence immediately around the array, or to enclose the back sides of the solar modules (panels) so there is not any readily accessible wiring. The plans must be very specific on

the method of protection and how the equipment or materials for such protection will be installed. See *NEC* 690.31(A) which notes that the wiring must be "guarded.". The plans must be very specific on the method of protection and how the equipment or materials for such protection will be installed.

54. ___ Provide info showing that all equipment is listed and rated for wet locations and is listed as "rain tight" if installed outdoors. See *NEC* table 110.28.

Signage (specify the following signage requirements on the plans)

55. ___ All signage is required to be permanently affixed to equipment or wiring method and be sufficiently durable to withstand the environment they are installed. *NEC* 110.21(B).
56. ___ Signage is not permitted to be hand written (unless it's necessary due to the information on the sign is subject to change). *NEC* 110.21(B).
57. ___ A sign is required at the service panel stating that the home has a PV system as an additional power source. *NEC* 705.10.
58. ___ A sign is required at any breaker or AC panelboard which is backfed by the PV system. Such sign must note the rated AC output current (amps) and AC voltage of the inverter(s). *NEC* 690.54.
59. ___ The following sign (with wording on yellow bacground must be provided on the outside (or within 3' of) the service panelboard, as required per NEC 690.56(C)(1):



60. ___ A sign is required at the home's service equipment giving the location of the rapid shutdown disconnect if the disconnect is not located next to the utility service panel. *NEC* 690.56(C)(1) (see last sentence of such section) and *NEC* 705.10.
61. If the home or building has an existing solar PV system, and the existing PV system has a different type of rapid shutdown system (ie. not module-level shutdown), or no rapid shutdown system at all, then a sign must be provided on the service equipment which shows a detailed layout of the both the new and existing solar PV array on the building, and such sign must highlight which portion of the array has a different or no rapid shutdown system provided (ie. the sign must show which portion of the array will remain energized even after rapid shutdown is initiated). *NEC* 690.56(C)(2).
62. ___ A sign is required to be provided adjacent to the disconnect(s) or breaker(s) that activate rapid shutdown labelling it/them as the "Rapid Shutdown Switch for Solar PV System" (*NEC* 690.55(C)(3)). Please specify this on the plans.

Additional items to be corrected on the plans:

_____
_____
_____
_____
_____
_____
_____
_____

Uintah County Residential Solar Photovoltaic (PV) System Plan Review
For systems utilizing a STRING INVERTER with or without battery backup

BUILDING ADDRESS_____
SUBDIVISION_____LOT_____
OWNER'S NAME_____
CONTRACTOR_____

This checklist is compiled for plan checking purposes for residential solar photovoltaic (PV) systems utilizing a **STRING INVERTER** (non-micro inverter systems) **with or without battery backup**. The information contained herein is compiled from the *2017 National Electrical Code (NEC), 2015 International Residential Code*, manufacture and PV industry standards, and **Uintah County** requirements. This checklist is not intended to indicate any change of any code or ordinance by inference or omission.

This review is not all inclusive and all system components and equipment must be installed per adopted code, city ordinances, and manufacture requirements regardless of whether or not such items or issues have been addressed using this checklist.

ITEMS REQUIRING CORRECTION (items marked with an X):

General

1. ___ Provide two complete sets of construction drawings, line diagram(s), and site plan.
2. ___ Provide two complete sets of manufacture specs and system component information. Manufacture specifications are required (where applicable per the system design) for the following items: inverter(s), solar modules (panels), any DC combiner panels, any DC to DC converters/power optimizers, disconnect switches, any new AC panelboards, batteries, charge controllers, and the supporting racking system.

Site Plan

3. ___ Site plan must show the location of the home's service panelboard, any sub-panelboard (that is to be backfed by the solar PV system), location(s) of the inverter(s), locations of any disconnects, and layout of the solar PV modules (panels).
4. ___ Show any detached structure on the property if solar modules (panels) are to be installed thereon and show dimensions from such structure to property lines.
5. ___ Show on the site plan the location of the rapid shutdown disconnect (or location of any disconnect or breaker that will be acting as the rapid shutdown disconnect for the system). The rapid shutdown disconnect must be readily accessible on the outside of the home. *NEC* 690.12(C).
6. ___ If the PV system will contain any additional rapid shutdown equipment, such as disconnect boxes located under the solar modules, please show the locations of such equipment on the site plan.
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.

Solar PV Mounting System

8. ___ Specify the type of roof covering and note how many layers of such covering.

9. ___ Indicate what type of rafters the roof is composed of (engineered trusses, dimensional lumber, TJI etc…), and note the size, spans, and spacing of the rafters.
10. ___ Show that the existing roof rafters can safely handle the new loads of the system. Note: Engineering to meet this requirement *may* not be required if the existing rafters are engineered trusses, the roof only has one layer of asphalt shingles, and the total weight of all racking system with PV modules (panels) installed does not exceed 5 lbs per square foot and there is not more than 60 lbs per solar racking support .
11. ___ Provide manufacture info that shows the mounting system is listed for the mounting of PV modules on the roof (for roof mounted systems). The racking system must also be shown to be listed per UL 2703.
12. ___ Specify on the plans the spacing of supports per the manufacture specs and show that such system can handle the local wind and snow loads and is designed for such. **Maximum wind load is to be based on 115mph, ground snow load is to be based on 39psf, and roof snow load is to be based on 30psf.**
13. ___ Provide information on how all roof penetrations (supports, J-boxes, conduit etc…) are going to be properly flashed. *IRC* R903.2.
14. ___ Specify on the plans that solar PV modules (panels) cannot be installed over or block any attic vents, plumbing vents, furnace or water heater vents etc.
15. ___ For a ground-mount racking system, please provide complete plans of the structure indicating that all associated requirements of the code are met (setbacks, square footage of the racking footprint, size/spacing of footings, connectors, snow loads, wind loads etc). The documents must also show how the racking is to be constructed. *IRC* R324.6. The ground-mount racking system must also be shown to be listed per UL 2703.
16. ___ For a ballasted roof racking system, please provide documentation and engineering calculations from the ballast racking manufacture to show that such system can handle the local wind loads 115 mph and has also been evaluated to be able to withstand seismic loads (for a seismic zone D). Such documentation must also specify how many ballast blocks are required for each section of the array in order to withstand such loads. The racking system must also be shown to be listed per UL 2703.

Line Diagram

17. ___ Specify exactly how many solar PV modules (panels) per DC string (DC source circuit) will be installed.
18. ___ Specify how many DC strings (DC source circuits) are to be installed.
19. ___ Show all PV system components, such as: J-boxes, combiner box (if used), inverter(s), panelboards, disconnects, and other equipment like charge controllers and batteries (if used). Indicate where all the components will be located in or on the home.
20. ___ Indicate the electrical panelboard that the PV system will tie into: A sub-panelboard or to the home's electrical service panelboard.
21. ___ Specify on the diagram the ratings of all breakers or fuses (DC and AC overcurrent protection devices), including existing breakers feeding any panelboards that are to be backfed by the PV system.
22. ___ Show all wire sizes, and wire types (including any existing feeder wires that are to be backfed by the PV system).
23. ___ If exposed outside, wires must be type USE-2 or listed "PV wire" conductors (*NEC* 690.31(C)). Wires installed outside (even if in conduit) must be listed for wet locations (*NEC* 300.9). All wires are strongly recommended to be rated 90°C (for example: RHW-2, THWN-2, and XHHW-2) due to deration issues.
24. ___ Specify the size and type of all equipment grounding conductors for each section of wiring on the diagram and note size and type of any grounding electrode conductors. (note: What were traditionally called transformerless inverters are now referred in the 2017 NEC as "functionally grounded" inverters. Such inverters typically do not require a grounding electrode conductor

(GEC), but all types of PV systems will require equipment grounding conductors ran with circuit wiring) For battery backup systems, verify from inverter manufacture if a GEC is required for the inverter. *NEC* 690.43 through 690.47.

25. ___ String (DC source circuit) conductors (wires) must be at least #12 AWG copper (#10 AWG is recommended). Note: wires may need to be increased in sized due to conduit fill or ampacity derations per *NEC* Tables 310.15(B)(3)(a), 310.15(B)(3)(c), and table 310.15(B)(2)(a) where applicable. (note: if conduit is ran above the roof, the requirements of *NEC* 310.15(B)(3)(c) will not apply as long as the conduit is held at least 7/8" or more above the roof's surface).
26. ___ Show conduit types, sizes, and how many conductors will be in each conduit.
27. ___ Specify locations where conduit and/or cables are to be installed.
28. ___ If more than two strings (DC source circuits) are to be combined together (which is typically only seen with certain battery backup systems), please specify 15 amp DC fuses for each ungrounded wire at the DC combiner (*NEC* 690.9(A)). For transformerless inverters, specify a fuse for both the positive and negative conductors for each DC string when combining 3 or more DC strings, unless documentation from the inverter manufacturer specifies otherwise. Note: SolarEdge® string inverter systems do not have to comply with this item (per manufacture's installation instructions).
29. ___ If a detached DC combiner panel is to be installed (which is typically only seen with certain battery backup systems), please specify the size of wires between the DC combiner and the inverter (this is called the "PV output circuit" per the *NEC*). These wires are sized by multiplying the solar PV module (panel) short circuit current (Isc) rating by 1.56 and then multiplying by the number of DC strings being combined (example: solar module Isc of 9 amps, 9 × 1.56= 14.04 amps, and if there are 3 strings being combined together then the PV output circuit wires must be sized per 42.12 amps). *NEC* 690.8(A)(1&2) and 690.8(B)(2).
30. ___ Note that any DC circuits that penetrate and enter the home will be ran in metal conduit or be MC cable. *NEC* 690.31(G)
31. ___ The wires and breaker for the inverter's AC output circuit(s) must be sized by taking the inverter's rated AC output current (amps - from inverter spec sheet) and increased by 1.25 (125%). Example: if inverter AC output amps is 22A, 22 × 1.25= 27.5A. Thus the wires in this example are sized per 27.5A and connect to a 30 amp AC breaker. *NEC* 690.8(A)(3) and 690.9(B).
32. ___ If an AC combiner panelboard is to be installed (which is dedicated only for the PV system AC breakers and monitoring), the AC combiner panelboard itself and the conductors (wires) between an AC combiner panel and the point of interconnection breaker, must have an ampacity not less than the sum of the rated AC output current (amps) of all inverters for the system multiplied by 125%. *NEC* 690.8(B) and 690.9(B).
33. ___If the PV system will have additional equipment for rapid shutdown, such as disconnect switches and/or rapid shutdown enclosures/equipment, please show such equipment and wiring on the line diagram and include any conduit if applicable.

Grounding and Bonding

34. ___ Provide detailed info on the types of connectors and/or devices that will be used for bonding solar modules, supports, and other metal equipment to the equipment grounding conductor. All devices used for bonding frames of PV modules or other equipment to the grounding system must be listed and identified for the purpose. *NEC* 690.43.
35. ___ If the PV racking system is equipped with integrated grounding/bonding, please provide manufacture specification sheets showing how integrated grounding/bonding is provided and show that such racking system is listed for such and is also listed in accordance with UL2703.
36. ___ Lugs for bonding aluminum rails and modules must be listed for outdoor use and also for bonding PV rails and modules. Burndy CL50.1TN lugs, ILSCO GBL4 DBT lugs, and WEEBL lug and clip assemblies are all ok for this purpose if installed per manufacture requirements. Must provide info on any other types of connectors if used.

37. ___ Indicate on the plans how the equipment grounding conductor(s) will be installed and protected from damage. If grounding conductors are exposed then a minimum of #6 copper conductors must installed. All grounding conductors must be protected from damage or be installed in conduit. *NEC* 690.46, 250.120(C), and 250.64(B)
38. ___ Please note on the plans that equipment grounding conductors shall be ran with the associated circuit conductors when those conductors leave the vicinity of the PV array, as required per *NEC* 690.43(C). If the array circuit conductors enter conduit or enclosures, the equipment grounding conductor must also be installed in such conduit or enclosures. *NEC* 300.3(B) and 690.43(C).
39. ___ Please specify on the plans the type of grounding electrode(s) used for grounding the existing electrical equipment for the home (or detached structure) and specify the size of the existing grounding electrode conductor (wire) that connects to it. If the existing grounding electrode system is not adequate, please specify that a new system will be installed and specify the type of electrode to be used (concrete encased, ground rods, metal water pipe and ground rod, etc). See *NEC* 250.50 through 250.66, and 690.47(A).

PV Modules (Panels)

40. ___ Provide manufacture specifications for the solar PV modules (panels).
41. ___ Manufacture specs must show the PV modules are UL 1703 listed. *NEC* 690.4(B) and *IRC* R324.3.1.
42. ___ Solar PV Module spec sheets must show the **STC** rated open circuit voltage (Voc) and short circuit current (Isc) of the modules (panels).
43. ___ The maximum DC voltage (Voc) at the coldest outside temperature cannot exceed 600V DC (for residential). To find the max DC voltage, add the Voc from each module on a single string and increase such voltage by 16% to 20% (depending on the module spec sheets). Note: 20% increase is considered very conservative (for areas where temperature can be as low as -13˚F) but module spec sheets can be used to obtain a more accurate calculation when needed. See *NEC* 690.7. Note: If the system contains DC-to-DC converters or power optimizers, the maximum system DC voltage is permitted to be as per specified per the manufacturer of such devices. See *NEC* 690.7(B).

Inverter(s)

44. ___ Provide manufacture specifications for the inverter(s).
45. ___ Manufacture specs must show that inverter(s) is/are UL 1741 listed. *NEC* 690.4(B) and *IRC* R324.3.
46. ___ For utility interactive inverters, specs must show that the inverter is listed as such. *NEC* 690.4(B), 705.40, and *IRC* 324.3.
47. ___ Specs must show that the inverter has DC ground fault protection (or DC ground fault protection is provided somewhere in the system). *NEC* 690.41(B).
48. ___ Systems operating at over 80 volts DC require DC arc-fault protection (this is <u>not</u> required for micro inverter systems currently on the market), unless the exception of *NEC* 690.11 is met.
49. ___ Specs must show whether the inverter has a transformer or is transformerless.
50. ___ Specs must show the maximum continuous AC output current (amps) and the rated output AC voltage of the inverter(s).
51. ___ Specs must note how many strings can be connected to the inverter, and note the ratings of any DC fuses (if applicable).

Rapid Shutdown

52. ___ "Rapid shutdown" of the PV system is required for any PV system *circuits* (which includes AC and/or DC circuits) installed on or in a building. Please provide manufacture's specification sheets and installation instructions showing how rapid shutdown is to be provided and installed. The manufacture's documentation must also show that the equipment is listed and identified for rapid shutdown of PV systems. See *NEC* 690.12, 690.12(C), and 690.12(D). Note: if the rapid

shutdown system is designed to be initiated via a breaker or disconnect switch, the breaker or disconnect switch themselves do not have to be listed for use as a rapid shutdown disconnect.

53. ___ Documentation must be provided to show that the equipment that performs rapid shutdown must reduce the voltage of all wiring (located within 1 foot of the array and up to 3 feet inside the building) to not less than 80V within 30 seconds of rapid shutdown initiation (unless the system can be shown to meet one of the other options per *NEC* 690.12(B)(2), but typically 690.12(B)(2)(2) will apply). This type of rapid shutdown system is commonly referred to per the industry as "module-level" shutdown. Note: micro inverters and SolarEdge® systems meet these requirements.
54. ___ See also the site plan, line diagram, and signage sections of this checklist for additional requirements concerning the "rapid shutdown" system.

Point of Interconnection Requirements (rules for backfed panelboards)

55. ___ 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* 705.12(A) or 705.12(B) are going to be met.
56. ___ If a service panelboard upgrade is to be performed, please specify the rating, manufacture, and model number of the panelboard. Please also provide manufacture spec sheets on such service panel.
57. ___ If the solar PV system is to backfeed an AC breaker on the supply side (service side) of the home's main service breaker(s), 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* 705.12(A).
58. ___ Factory installed conductors (wires) or bubars within a service panelboard cannot be tapped unless such taps are allowed by the service panel manufacture (documentation from the service equipment manufacture 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).
59. ___ 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 PV disconnect switch (which protects the tap wires) must be listed and labeled as service equipment. This is required per *NEC* 230.66 and 690.13(C).
    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(B).
    c. The ground wire within the conduit between the PV disconnect switch and the main service equipment will be considered as the grounding electrode conductor (GEC) for the PV 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).
60. ___ If a meter adapter is going to be used for the connection of the PV 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.
61. ___ If the solar PV system 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:

    For protection of feeder wires, one of the following must be met:

    a. If the PV system 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 *NEC* 705.12(B)(2)(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 inverter plus the rating of the main breaker protecting the feeder wires. See *NEC* 705.12(B)(2)(1)(a).

c. If the PV system 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 inverter's AC output connection to the feeders. See *NEC* 705.12(B)(2)(1)(b). Please be aware that if the PV backfed breaker will be connected to busbars which have feeder wires connected to feed-through lugs at the busbars, then this requirement must be complied with for protecting the feeder wires that are connected to the feed-through lugs.

For protection of panelboard's busbars, one of the following must be met:

a. 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 inverter(s). See *NEC* 705.12(B)(3)(a).

b. 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)(b). 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."

c. The busbars in the panelboard must be rated not less than the sum of the ratings of all breakers in the panelboard, including the solar PV 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 PV system, 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)(c).

d. PV connections to multiple-ampacity busbars or to a center-fed panelboard is permitted as long as the PV 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)(d). The rating of the PV backfed breaker cannot exceed the rating of the breaker slot that it will be plugged into (as noted per the panelboard's label).

62. ___ If feeder taps are to be performed in order to connect the PV system to the electrical system of the home, then the tap rules of *NEC* 240.21(B) must be followed (in addition to those found under *NEC* 705.12(B)(2)(1)). See also the above requirements for connections on the load side of the service disconnect(s).

General Equipment and Wiring Requirements

63. ___ PV equipment and disconnecting means are not permitted to be installed in a bathroom. *NEC* 690.4(E).

64. ___ Show that the inverter(s) have both a DC disconnect and an AC disconnect. If a DC or AC disconnect is not provided as part of the inverter, please specify one is to be installed adjacent to the inverter (or be within 10'). See *NEC* 690.15(A). Note: Most string inverters contain at least a

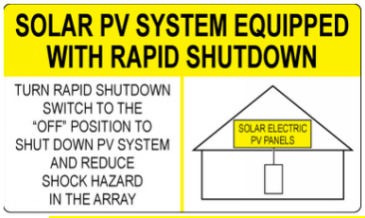
DC disconnect. Also, if the inverter is installed next to the AC breaker it is to backfeed, then the AC breaker can count as the AC disconnect for the inverter.

65. ___ Show that the DC combiner (if used) is listed in accordance with UL1741. *NEC* 690.4(B).
66. ___ Where a DC combiner is used and the maximum output current of the DC combiner is more than 30A, please provide manufacture's documentation showing that such DC combiner is equipped with a main disconnect switch for the PV Output Circuit, **or** specify on the plans and show on the line diagram that a detached DC disconnect will be provided for the PV Output Circuit. *NEC* 690.15.
67. ___ Show that DC to DC controllers/power optimizers (if used) are listed per UL1741. *NEC* 690.4(B).
68. ___ Provide a note on the plans stating that all wiring must be properly supported by devices or mechanical means designed and listed for such use, and for roof-mounted systems, wiring must be permanently and completely held off of the roof surface. See *NEC* 110.2, 110.3(A), 110.3(B), and 300.4.
69. ___ PV Source Circuits and PV Output Circuits (ie: any DC solar PV circuits) cannot be located within the same raceway, cable tray, cable, outlet box, J-box, etc. with any non-PV system circuits or Inverter AC Output Circuits (ie. DC circuits cannot be in same conduit or enclosures as AC wiring). *NEC* 690.31(B).
70. ___ For a ground-mount system, please specify on the plans exactly how the wiring at the array is going to be protected so the wiring is not readily accessible. Typically, this is accomplished by providing a lockable fence immediately around the array, or to enclose the back sides of the solar modules (panels) so there is not any readily accessible wiring. The plans must be very specific on the method of protection and how the equipment or materials for such protection will be installed.See *NEC* 690.31(A) which notes that the wiring must be "guarded." The plans must be very specific on the method of protection and how the equipment or materials for such protection will be installed.
71. ___ Provide info showing that all equipment is listed and rated for wet locations and is listed as "rain tight" if installed outdoors. See *NEC* table 110.28.
72. ___ Breakers or fuses used for protecting DC circuits must be designed for the maximum DC voltage (see item #43). See *NEC* 110.3(B).
73. ___ For DC systems operating at more than 50 volts, ungrounded DC conductors (wires) are required to be marked as to their polarity. (Note: In general, positive ungrounded conductors to be red, and ungrounded negative conductors to be black. See *NEC* 210.5(C)(2) or 215.12(C)(2) for more specific requirements for color or marking of ungrounded DC conductors)

Signage (specify the following signage requirements on the plans)

74. ___ All signage is required to be permanently affixed to equipment or wiring method and be sufficiently durable to withstand the environment they are installed. *NEC* 110.21(B).
75. ___ Signage is not permitted to be hand written (unless it's necessary due to the information on the sign is subject to change). *NEC* 110.21(B).
76. ___ A sign is required at the service panel stating that the home has a solar PV system as an additional power source. *NEC* 705.10.
77. ___ A sign is required at the home's service equipment giving the location of the inverter(s) if the inverter(s) is/are not located next to the utility service panel. *NEC* 690.4(D) and *NEC* 705.10. This is required since the DC disconnect of the inverter is typically considered as the PV disconnect for the system.
78. ___ A sign is required at any breaker or AC panelboard which is backfed by the PV system. Such sign must note the rated AC output current (amps) and AC voltage of the inverter(s). *NEC* 690.54.
79. ___ Per the 2017 NEC, there must be a sign on the string inverter which notes the DC maximum voltage, maximum DC amps of the system, and maximum DC amps of the power optimizers. *NEC* 690.53. This sign has been changed from what was required in the 2014 NEC.

80. ___ Specify that any conduits, enclosures, or MC cable that contain DC circuits shall be marked on their exterior with the wording "WARNING: PHOTOVOLTAIC POWER SOURCE." The markings shall be provided at every enclosure, every 10' along conduit or MC cable, and at each side of where the conduit or cable passes through a wall, floor, or any other partition. The markings shall be permanently affixed and visible after installation. The signs must also be reflective, and all letters must be capitalized with white words (3/8" min in height) on red background. *NEC* 690.31(G)(3) and (G)(4). Please specify this information on the plans.
81. ___ The following sign (with wording on yellow background) must be provided on the outside (or within 3' of) the service panelboard, as required per NEC 690.56(C)(1):



82. ___ A sign is required at the home's service equipment giving the location of the rapid shutdown disconnect if the disconnect is not located next to the utility service panel. *NEC* 690.56(C)(1) (see last sentence of such section) and *NEC* 705.10.
83. ___ If the home or building has an existing solar PV system, and the existing PV system has a different type of rapid shutdown system (ie. not module-level shutdown), or no rapid shutdown system at all, then a sign must be provided on the service equipment which shows a detailed layout of the both the new and existing solar PV array on the building, and such sign must highlight which portion of the array has a different or no rapid shutdown system provided (ie. the sign must show which portion of the array will remain energized even after rapid shutdown is initiated). *NEC* 690.56(C)(2).
84. ___ A sign is required to be provided adjacent to the disconnect(s) or breaker(s) that activate rapid shutdown labelling it/them as the "Rapid Shutdown Switch for Solar PV System" (*NEC* 690.55(C)(3)). Please specify this on the plans.

Battery Backup Systems (these requirements are in addition to those already mentioned in this review – if applicable)

85. ___ Detailed manufacturer's installation instructions and requirements for the inverter or a listed PV center (if used) must be submitted for plan review and all requirements must be followed when installing the system. *NEC* 110.3(B).
86. ___ Provide manufacture's info indicating that the battery inverter is listed as being utility interactive (if grid-tied) and be listed per UL 1741. *NEC* 690.4(B), 705.40, 706.5, 706.8(C), and *IRC* 324.3.
87. ___ 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).
88. ___ 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).
89. ___ Inverter manufacture spec sheets must note the maximum allowable DC voltage and amperage from the PV array and/or the batteries that the inverter can safely handle. *NEC* 110.3(B).
90. ___ Show that the battery system will have overcurrent protection for all equipment (including the inverter and charge controllers) and such overcurrent protection devices must be rated for the available short circuit current that could be produced by the batteries. *NEC* 706.21, 110.9, and 110.10.

91. ___ Specify the rating and type of DC overcurrent protection (fuses or breaker) that is/are to be provided for protecting the battery conductors (wires). The inverter specs must note the rating of the battery system overcurrent protection device(s) if they are included as part of the equipment. *NEC* 706.21.
92. ___ The battery system overcurrent protection (DC fuses or breaker) must be located as close as possible (within 5') to the batteries and cannot be located in a different room than the batteries. However, such overcurrent protection cannot be located within the same enclosure as flooded or vented batteries. See *NEC* 706.7(E) and 706.21(F).
93. ___ If the battery bank and disconnect (as specified in the above noted plan review comment) is not within sight of the inverter or battery system equipment (or is in a different room than the batteries), then an additional disconnect is required to be provided adjacent to the inverter or battery system (for disconnection of the battery cables). Signage is also required at <u>both</u> the battery bank disconnect and the additional disconnect noting the locations of all disconnects. *NEC* 706.7(E).
94. ___ Specify the size and type of conductors (wires) that interconnect batteries and extend to the inverter. Such wires must be sized in accordance with the rating of the battery system DC fuses or DC breaker as specified by per the inverter manufacturer. See *NEC* 706.20(A)(3), 706.20(B), and 706.21(A).
95. ___ Where practicable, terminal plates must be used to interconnect batteries, rather than using cables. See *NEC* 706.31(C).
96. ___ If flexible (fine stranded) cables (ie. one of the types of wires allowed per *NEC* Article 400) are going to be used to connect the batteries together, then a minimum of 2/0 copper conductors must be used. The conductors must also be listed for "hard-service" and be identified as moisture resistant. *NEC* 706.32.
97. ___ 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.
98. ___ Specify the size and type of equipment grounding conductor that is to be installed with the battery conductors (wires) and is to bond all metal parts of battery racking, metal conduit, metal enclosures, etc. to the inverter grounding system. Such equipment grounding conductor is to be sized in accordance with *NEC* 250.122 based on the rating of the battery system overcurrent protection device (DC fuses or breaker).
99. ___ Specify the rating of the AC output overcurrent protection device(s) for the inverter. *NEC* 706.20(A)(2), and 706.21(A).
100. ___ Indicate what types of batteries are going to be installed and if they are the flooded/vented type or sealed type.
101. ___ If the batteries are to be the <u>NON</u>-lead-acid type, please provide manufacture specification sheets for the batteries and show that they are listed per UL 1973 (see UL product category BBFX). *NEC* 480.3 and 706.5.
102. ___ Specify that the inverter or charge controller will <u>not</u> "equalize" or overcharge sealed batteries (see manufacturer's instructions for the batteries). *NEC* 110.3(B).
103. ___ 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* 706.30). Note: most residential battery systems are typically 48V systems. An example of a 48 volt battery system would be four-12 volt batteries connected in series per string (more than one string can be parallel connected together if the total battery system amp-hours is within the limits of the inverter).
104. ___ Please specify on the plans the location of the batteries on the premise. Specify that all batteries must be located inside a lockable enclosure or room (guarded against accidental

contact by persons) and cannot be installed in the inverter's working space area. *NEC* 706.10(B), 706.10(C), and 110.26.

105. ___ Please provide a floorplan layout of the room(s) in the home or building that will contain battery backup system (and any solar PV) equipment. Please show the locations of all equipment on such floorplan and show clear working spaces in front of all equipment. *NEC* 706.10(C) and 110.26. Note: the batteries cannot be installed in the clear working space of any other electrical equipment.
106. ___ Provide information on how the battery enclosure will be ventilated. *NEC* 706.10(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: The battery manufacturer may not require ventilation for the battery- see battery manufacture recommendations for ventilation requirements)
107. ___ If any charge controllers are to be installed for the battery system, please provide manufacture spec sheets for such and also show that the charge controller(s) is/are listed in accordance with UL 1741. *NEC* 706.5.
108. ___ One or more charge controller(s) are required to prevent over-charging and excessive discharging of the batteries. There must be a charge controller between the batteries and any source of power (utility, generator, solar PV, wind turbine ect.) that is/are connected to the batteries in order to control the charge of the batteries (this may sometimes require multiple charge controllers). See *NEC* 706.23.
109. ___ Detailed information from the inverter manufacture on the requirements for grounding the battery system must be provided. Note: This item is referring to a grounding electrode conductor (wire) to extend to the building's electrode system. Some battery inverter manufacturers require a grounding electrode conductor to be connected to the negative conductor at a single point external of the inverter, while others may require a grounding electrode conductor to connect within the inverter at a specified connection point, and some may not require a grounding electrode conductor at all (always follow manufacture's requirements). *NEC* 110.3(B).
110. ___ Any PV system employing battery storage must also have a sign giving the max operating voltage and the maximum available fault current that the batteries could provide. *NEC* 706.7(D). The fault current rating of any disconnects, breakers, or fuses must not be less than the amount of available fault current the batteries could provide. *NEC* 110.9 and 110.10.
111. ___ For the previous review item noted above, please provide specification sheets from the battery manufacture which clearly show the maximum amount of potential fault current that the batteries could provide. (as an alternate to providing manufacture spec sheets, detailed calculations can be provided to show the calculated fault current of the battery system)

Additional items to be corrected on the plans:

_____
_____
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_____
_____