



BUILDING PERMIT APPLICATION

SUBMIT PLANS & ALL ASSOCIATED DOCUMENTATION TO: CITY OF MOAB PLANNING DEPARTMENT | 217 E CENTER ST | MOAB UT 84532

Building Address				Receipt Number	Date Issued	Permit Number		
Assessor's Parcel # (from site plan)				Plan Review Receipt Number	Plans Received			
OWNER BUILDER <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> If yes, Owner Builder Certification Form attached				<input type="checkbox"/> Residential	<input type="checkbox"/> Commercial	Valuation \$		
PERMITTEE/OWNER	Name			Building SF	Building Fees	\$		
	Mail Address			Rough Basement SF	Plan Review Fees	\$		
	City/State/ZIP			Finish Basement SF	State 1% Fee	\$		
	Email			Covered Patio/Deck SF		\$		
	Phone			Garage/Carport SF	Demo	\$		
SOLAR CONTRACTOR	Name			Type of Construction	Investigation	\$		
	Mail Address			Occupancy Group	Floodplain Dev. Permit Fee	\$		
	Phone Cell			Number of Buildings		\$		
	Email			Number of Dwellings	Deferred Plan Review	\$		
	Utah State Contractor's License #			Number of Stories	Water Impact Fee	\$		
	Utah Municipality Business License #			Number of Bedrooms	Sewer Impact Fee	\$		
ELECTRICAL CONTRACTOR	Name			Number of Bathrooms	TOTAL FEES	\$		
	Mail Address			Max Occupancy Load	Plan Review Deposit	\$		
	Phone Cell			Fire Sprinkler Yes No	TOTAL FEES DUE	\$		
	Email			BRIEF DESCRIPTION OF BUILDING PROJECT				
	Utah State Contractor's License #							
Utah Municipality Business License #								
GENERAL CONTRACTOR	Name			FLOODPLAIN STATUS _____ Elevation Certification _____				
	Mail Address							
	Phone Cell			FIRE DEPARTMENT (REQUIRED FOR ALL COMMERCIAL APPLICATIONS)				
	Email			Approved by _____ Date _____				
	Utah State Contractor's License #			FLOODPLAIN DEVELOPMENT PERMIT				
ENGINEER	Utah Municipality Business License #			Approved by _____ Date _____				
	Name			CITY ENGINEER				
	Mail Address			Approved by _____ Date _____				
	Phone Cell			UTILITIES				
	Email			Water approved by _____		Date _____		
	Utah State Contractor's License #			Sewer approved by _____		Date _____		
Utah Municipality Business License #			ZONING ADMINISTRATION					
			Approved by _____			Date _____		
			Approved by _____			Date _____		
			HEALTH DEPARTMENT			Approved by _____		
			Approved by _____			Date _____		
			BUILDING DEPARTMENT			Approved by _____		
			Approved by _____			Date _____		
Minimum Setbacks in Feet								
Front		Side	Side	Rear				
I hereby acknowledge that I have read this application and state that the above is correct and agree to comply with all City of Moab Ordinances and State of Utah laws regulating building construction, zoning, and sanitation.								
ZONE	Site Plan	<input type="checkbox"/> Submitted <input type="checkbox"/> N/A		Owner's Signature		Date		
NOTE 24 HOURS NOTICE IS REQUIRED FOR ALL INSPECTIONS				Contractor's Signature		Date		



SOLAR PLAN REVIEW FORM

PLANNING AND ZONING DEPARTMENT | BUILDING OFFICIAL
217 East Center Street | Moab, Utah 84532
PH 435-259-5129 | WEB www.moabcity.org | EMAIL
inspections@moabcity.org

Solar Photovoltaic (PV) System Plan Review

MICRO-INVERTERS and **STRING INVERTER** with or without battery backup

INSTRUCTIONS

Only digital submittals will be accepted for solar permits and all incomplete submittals will be returned to contractor. Label all attachments as indicated next to each heading. Provide project details in the "Project details--BE SPECIFIC" portion of each section; **be specific to the project you are proposing.** Submit this solar packet and all attachments to the City of Moab Building Department electronically at inspections@moabcity.org. **Reduce all file sizes before saving;** our email server cannot accept attachments 10 MB or larger.

Green text indicates items specific to MICRO-INVERTERS and **blue text indicates items specific to STRING INVERTERS with or without battery backup.**

Owner's Name _____

Building Address _____

Contractor _____ Utah Contractor's License # _____

RMP Net Metering WO# _____ Valuation \$ _____

This checklist is compiled for plan submittals and plan checking purposes for residential solar photovoltaic (PV) systems utilizing **MICRO-INVERTERS** (specific items indicated by green text) and **STRING INVERTERS with or without battery backup** (specific items indicated by blue text). The information contained herein is compiled from the *2014 National Electrical Code (NEC)*, *2015 International Residential Code (IRC)*, manufacture and PV industry standards, and City of Moab requirements. It 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, local ordinances, and manufacture's requirements regardless of whether or not such items or issues have been addressed using this checklist.

Provide **one complete digital set** of construction drawings, line diagram(s), and site plan with the solar submittal, **PER ABOVE INSTRUCTIONS.**

Provide **one complete digital set** of manufacture's specifications and system component information. Manufacture's specifications are required (where applicable per the system design) for the following items: **micro-inverters**, **inverter(s)**, 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.

1. **Site Plan** – Label supporting documents "Attachment 1"

- A. Site plan must show the location of the home's service panelboard, any sub-panelboard (that is to be backed by the PV system), **location(s) of the inverter(s)**, locations of any disconnects, and layout of the solar PV modules (panels).
- B. 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.
- C. **Show on the site plan where the "rapid shutdown" disconnect** (for the "rapid shutdown" of the PV system, as required per **NEC 690.12**) will be located. **Note:** The location of the "rapid shutdown" disconnect is not specifically noted in the code and its required location could vary per AHJ.

2. **Solar PV Mounting System** – Label supporting documents “Attachment 2”

- A. Specify the type of roof covering and note how many layers of such covering.
- B. 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.
- C. 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 has only one layer of *asphalt shingles*, and the total weight of all racking system with PV modules (panels) installed does not exceed 5 psf and there is not more than 60 lbs per solar racking support (*subject to Building Official's approval*).
- D. Provide manufacture information that shows the mounting system is listed for the mounting of PV modules on the roof (for roof mounted systems).
- E. Specify on the plans the spacing of supports per the manufacture’s specifications and show that such system can handle the local wind and snow loads and is designed for such. Grand County/City of Moab’s maximum wind load is to be based on 115 mph, ground snow load is to be based on 36 psf below 500 ft or 65 psf 5000 ft and above, and roof snow load is to be based on 25 psf below 5000 ft and 45 psf 5000 ft and above.
- F. Provide information on how all roof penetrations (supports, J-boxes, conduit, etc.) are going to be properly flashed. **IRC M2302.2.2**
- G. 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.
- H. For a ground-mount racking system, 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.). **IRC R324.6**

Project details--BE SPECIFIC – Include letter preceding line item related to your comment

3. **Line Diagram** – Label supporting documents “Attachment 3”

- A. Specify exactly how many solar PV modules (panels) **per AC circuit will be installed (the number of micro inverters per circuit cannot exceed what is noted on the inverter spec sheets) or per string (DC source circuit) will be installed.**
- B. Specify how many **AC circuits or strings (DC source circuits)** are to be installed for the PV system.
- C. Show all PV system components, such as: J-boxes, **combiner box (if used), micro-inverters,** 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.
- D. Indicate the electrical panelboard that the PV system will tie into: A sub-panelboard or the home’s electrical service panelboard.
- E. Specify on the diagram the ratings of all breakers or fuses (**AC overcurrent protection devices or DC and AC overcurrent protection devices**) including existing breakers feeding any panels that are to be backfed by the PV system.
- F. Show all wire sizes and wire types including any existing feeder wires that are to be backfed by the PV system.
- G. **Trunk cables located outdoors for a micro inverter system are required to be either TC-ER or USE-2 cable and must be secured no more than 6’ oc. NEC 690.31(D)**
- H. **The wiring system used at the array must be the approved wiring system required per the micro inverter manufacture.**
- I. **Wires installed outside (even if in conduit) must be listed for wet locations. NEC 300.9**
- J. **If exposed outside, wires must be type USE-2 or listed “PV” conductors. NEC 690.31(B). All wires are strongly recommended to be rated 90°C (i.e., RHW-2, THWN-2, and XHHW-2) due to deration issues.**
- K. **For transformerless inverters, all DC wiring at the array must be the “PV wire” type and be listed as such. Specify this on the plans. NEC 690.35(D). Note: MC cable is permitted for DC wiring in the home or building. NEC 690.31(G)**
- L. Specify the size and type of all equipment grounding conductors and grounding electrode conductors. **Note:** Transformerless micro-inverters often do not require a grounding electrode conductor, but *all* types of PV systems will require **equipment grounding conductors or DC and AC equipment grounding conductors. NEC 690.43–690.47**

- M. The AC circuit conductors (wires) must be at least #12 AWG copper (#10 AWG is recommended). 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 310.15(B)(2)(a)*, where applicable.
- N. 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.
- O. Show conduit types, sizes, and how many conductors will be in each conduit.
- P. Specify locations where conduit and/or cables are to be installed.
- Q. If more than two strings (DC source circuits) are to be combined together, specify 15 amp DC fuses for each ungrounded wire (usually the positive DC wires) at the DC combiner. *NEC 690.9*. For transformerless inverters, specify a fuse for *both* the positive and negative conductors for each string when combining three or more strings. *NEC 690.35(B)*
- R. If a detached DC combiner panel is to be installed, 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, $9 \times 1.56 = 14.04$ amps, and if there are three 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)*
- S. Note that any DC circuits that penetrate and enter the home will be ran in metal conduit or be MC cable. *NEC 690.31(E)*
- T. The wires and breaker for the inverter’s AC output circuit must be sized by taking the inverter’s AC output current (amps from inverter spec sheet) and increase by 1.25 (125%). *Example:* If inverter AC output amps is 22A, $22 \times 1.25 = 27.5A$. 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 690.8(B)(1&2)*

Project details--BE SPECIFIC – Include letter preceding line item related to your comment

4. Grounding and Bonding – Label supporting documents “Attachment 4”

- A. Provide detailed info on the types of connectors and/or devices that will be used for bonding 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*
- B. If the metallic mounting structures (rails, supports, etc.) for the PV modules are also going to be used for grounding purposes, provide information showing that such are identified as equipment grounding conductors or shall have identified bonding jumpers connected between each separate metallic section and be bonded to the grounding system. *NEC 690.43(C)*
- C. If the PV racking system is equipped with integrated grounding/bonding, provide manufacture’s 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.
- D. 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 6.7 lug and clip assemblies are all ok for this purpose if installed per manufacture requirements. Must provide information on any other types of connectors if used.
- E. 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)*
- F. 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(F)*.
- G. Specify on the plans the type of grounding electrode(s) used for grounding the existing electrical service for the home and specify the size of the existing grounding electrode conductor (wire) that connects to it. If the existing grounding electrode system is not adequate, 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.). *NEC 250.50–250.66*

Project details--BE SPECIFIC – Include letter preceding line item related to your comment

5. **PV Modules (panels)**– *Label supporting documents “Attachment 5”*

- A. Provide manufacture’s specifications for the solar PV modules (panels).
- B. Manufacture’s specifications must show the PV modules are UL 1703 listed. **NEC 690.4(D)**
- C. Solar PV Module specification sheets must show the STC rated open circuit voltage (Voc) and short circuit current (Isc) of the modules (panels).
- D. 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. **NEC 690.7**

Project details--BE SPECIFIC – *Include letter preceding line item related to your comment*

6. **Inverter(s)**– *Label supporting documents “Attachment 6”*

- A. Provide manufacture specifications for the inverter(s).
- B. Manufacture specifications must show that inverter(s) is/are UL 1741 listed. **NEC 690.4(D)**
- C. For utility interactive inverters, specifications must show that the inverter is listed as such. **NEC 690.4(D) and 690.60–690.61**
- D. Specifications must show that the inverter has DC ground-fault protection. **NEC 690.5**
- E. Systems operating at over 80 volts DC require DC arc-fault protection (this is not required for micro-inverter systems currently on the market). **NEC 690.11**
- F. Specifications must show whether or not the **micro-inverters are the transformerless type or the inverter has a transformer or is transformerless.**
- G. Specifications must show the maximum **amount of micro-inverters that can be connected to each AC circuit or continuous AC output current (amps) and the rated output AC voltage of the inverter(s).**
- H. Specifications must note how many strings can be connected to the inverter, and note the ratings of any DC fuses (if applicable).
- I. “Rapid shutdown” of the PV system is required for any PV systems installed on or in a building. 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. **NEC 690.12.** See also the signage section of this checklist for signage requirements concerning the “rapid shutdown” system.

Project details--BE SPECIFIC – *Include letter preceding line item related to your comment*

7. **Point of Interconnection Requirements (rules for backfed panelboards)**– *Label supporting documents “Attachment 7”*

- A. 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(D)** are going to be met.
- B. If a service panelboard upgrade is to be performed, specify the rating, manufacture, and model number of the panelboard. Also provide manufacture’s specification sheets on such panel.
- C. 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)**

- D. *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 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, etc.). The connections must be per the listing of the panelboard. **NEC 110.3(B)**
- E. 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), provide manufacture’s 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**
- F. If the solar PV system is to backfed 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 (*check appropriate box*):

- 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. **NEC 705.12(D)(2)(1)**
- 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. **NEC 705.12(D)(2)(1)(a)**
- 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 less than the ampacity of the feeder wires must be provided on the load side of the inverter’s AC output connection to the feeders. **NEC 705.12(D)(2)(1)(b)**

For protection of panelboard’s busbars, one of the following must be met (*check appropriate box*):

- 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). **NEC 705.12(D)(3)(a)**
- 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. **NEC 705.12(D)(3)(b)**. If this **NEC** code item is to be utilized, then 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**

- 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 per **NEC 705.12(D)(3)(c)**:

**WARNING:
THIS EQUIPMENT FED BY MULTIPLE SOURCES.
TOTAL RATING OF ALL OVERCURRENT DEVICES,
EXCLUDING MAIN OVERCURRENT DEVICE
SHALL NOT EXCEED AMPACITY OF BUSBAR**

- V connections to multiple-ampacity busbars or to a center-fed panelboard are permitted as long as busbar loading calculations are provided to show that the ampacity of the panelboard’s busbars will not be exceeded. **NEC 705.12(D)(3)(d)**. *Note:* Please be aware that the noted busbar loading calculations are supposed to be provided under “engineering supervision,” as noted per **NEC 705.12(D)(3)(d)**. Whether or not such calculations are required to be performed by a licensed engineer is up to the AHJ. **NEC 90.4**
- G. 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, the sum of the rating of the main breaker (protecting the existing feeder conductors) and the rating of the PV breaker (or fuses) cannot exceed 120% of the ampacity rating of the feeder conductors being tapped. **NEC 705.12(D)(2)**

Project details--BE SPECIFIC – *Include letter preceding line item related to your comment*

8. General Equipment Requirements – Label supporting documents “Attachment 8”

- A. 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, specify one is to be installed adjacent to the inverter. **NEC 690.15. 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.
- B. Show that the DC combiner (if used) is listed in accordance with UL1741. **NEC 690.4(B)**
- C. If a DC combiner is used and mounted on the roof, 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 within 6 feet of the DC combiner. **NEC 690.15(C)**
- D. Show that DC to DC controllers (if used) are listed per UL1741. **NEC 690.4(B)**
- E. 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.* **NEC 110.2, 110.3(A&B), and 300.4**
- F. PV Source Circuits and PV Output Circuits (i.e., 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. **NEC 690.31(B)**
- G. For a ground-mount system, 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. **Note:** This item is subject to AHJ approval. **NEC 690.31(A)**
- H. Provide information showing that all equipment is listed and rated for wet locations and is listed as “rain tight” if installed outdoors. **NEC Table 110.28**
- I. Breakers or fuses used for protecting DC circuits must be designed for the maximum DC voltage. **NEC 690.9(D)**
- J. 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.

Project details--BE SPECIFIC – Include letter preceding line item related to your comment

9. Signage (specify the following signage requirements on the plans) – Label supporting documents “Attachment 9”

- A. 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) NOTE: Indicate location of all signage on plans.**
- B. 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)**
- C. A sign is required at the service panel stating that the home has a PV system as an additional power source. **NEC 705.10**
- D. A sign is required at the home’s service box giving the location of the main PV system disconnect if the disconnect is not located next to the utility service panel (this is typically **the first AC breaker that is backfed by the PV system or the inverter’s DC disconnect**). **NEC 690.4(H) and 705.10**
- E. A sign is required at the main PV system disconnect labeling it as such. **NEC 690.14(C)(2)**
- F. A sign is required at the main PV system disconnect (usually at the inverter) giving the total DC system STC rated max current (Impp), the rated max voltage (Vmpp), the open circuit voltage (Voc) which has been increased for coldest possible outside temperature, short circuit current (Isc), and the rated max output of a battery charge controller (if a battery charge controller is installed). **NEC 690.53.**
- G. 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**
- H. There must be a sign located at the service equipment which notes the following:

PHOTOVOLTAIC SYSTEM EQUIPPED WITH RAPID SHUTDOWN

The sign must be reflective, all letters capitalized, letters at least 3/8" in height, and in white on a red background.

Specify this information on the plans. NEC 690.56(C)

- I. A sign is required to be provided adjacent to the "rapid shutdown" disconnect(s) labelling it/them as such. **Specify this on the plans. Note:** For a micro-inverter system, the "rapid shutdown" disconnect is/are usually the electrical service disconnect(s) located in the service equipment. **NEC 690.12 and 690.56(C)**
- J. Specify that any conduits, enclosures, or MC cables 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 be reflective, all letters capitalized, letters at least 3/8" in height, and in white on a red background. **Specify this information on the plans. NEC 690.31(G)(3) and (G)(4)**

- K. There must be a sign located at the service equipment which notes the following:

PHOTOVOLTAIC SYSTEM EQUIPPED WITH RAPID SHUTDOWN

The sign must be reflective, all letters capitalized, letters at least 3/8" in height, and in white on a red background.

Specify this information on the plans. NEC 690.56(C)

- L. A sign is required to be provided adjacent to the "rapid shutdown" disconnect(s) labelling it/them as such. **NEC 690.12 and 690.56(C). Specify this on the plans. Note:** For a micro inverter system, the "rapid shutdown" disconnect is/are usually the electrical service disconnect(s) located in the service equipment.

Project details--BE SPECIFIC – Include letter preceding line item related to your comment

10. Battery Backup Systems (these requirements are in addition to those already mentioned in this review – if applicable)– Label supporting documents "**Attachment 10**"

- A. Detailed manufacture'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.
- B. Provide manufacture's info indicating that the battery inverter is listed as being utility interactive meeting UL 1741 if grid tied. **NEC 690.4(D), 690.60, 690.61, and 705.40**
- C. If the same inverter is to be used for the solar PV system and the battery system, show that the inverter contains DC ground fault protection, as required per **NEC 690.5**.
- D. 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, show that the inverter contains DC arc-fault protection, as required per **NEC 690.11**.
- E. Inverter manufacture's specification sheets must note the maximum allowable DC voltage and amperage from the PV array and/or the batteries that the inverter can safely handle.
- F. 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 specifications must note the rating of the battery system overcurrent protection device(s).
- G. Show that the batteries' overcurrent protection device(s) will protect all other equipment or conductors in the system from any overcurrent from the batteries and also be rated for the available short circuit current that could be produced by the batteries.
- H. The battery system overcurrent protection (DC fuses or breaker) must be located as close as possible to the batteries (no more than four or five feet is usually required by manufacture instructions, but closer is better) 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. **NEC 690.71(C), 240.21(H), and 480.5. Note:** See also **690.71(H)** in the **2014 NEC** for additional information.
- I. 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, 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 both the battery bank disconnect and the additional disconnect noting the locations of all disconnects. **NEC 690.71(H)**

- J. 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 manufacture (inverter specifications must note the rating of the battery overcurrent protection device). **NEC 690.8(A)(4) and 690.8(B)(1&2)**
- K. Where practicable, terminal plates must be used to interconnect batteries, rather than using cables. **NEC 480.3(C)**. If terminal plates are used, they are required to have protective non-conductive covers over them to help prevent accidental contact with live parts, as required per **NEC 690.71(B)(2) and 480.9(B)**
- L. If flexible (fine stranded) cables 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 690.74**
- M. 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 690.31(F) and 110.14**. All fittings for fine stranded cables must also meet UL 486 A&B.
- N. Specify that 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. 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).
- O. Specify the rating of the AC output overcurrent protection device(s) for the inverter. **NEC 690.8(A)(3) and 690.9(B)**.
- P. For the inverter AC output breaker that feeds a stand-alone panelboard (often called a “critical load panelboard”), specify on the plans that the AC output circuit overcurrent protection device shall be located at the output of the stand alone or battery backup inverter. **NEC 690.10(B)**. If this overcurrent device is a plug-in type breaker, it must be secured in accordance with **NEC 408.36** (secured in place by an additional fastener that requires other than a pull to release the breaker from the panelboard busbars), per **NEC 690.10(E)**.
- Q. Indicate what types of batteries are going to be installed and if they are the flooded/vented type or sealed type.
- R. Specify that the inverter or charge controller will not “equalize” or overcharge sealed batteries
- S. Show on plans how many batteries are to be installed, how they are connected (in series or parallel), the voltage of each battery, and the total battery bank voltage. Total battery system voltage in a residential home is typically limited to 48 volts unless the live parts of the batteries are not accessible during routine battery maintenance. **NEC 690.71 (B)(1)**. 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).
- T. 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 690.71(B)(2)**
- U. Specify that working space must be provided per **NEC 110.26** in the vicinity of any battery enclosure or electrical equipment, and note the dimensions of such working space. **NEC 480.9(C)**
- V. Provide information on how the battery enclosure will be ventilated. **NEC 480.9(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 manufacture’s recommendations for ventilation requirements.
- W. If a battery system over 48 volts is going to be installed, the batteries cannot be installed on or within conductive cases or racks. This requirement does not apply to VRLA or other types of sealed batteries. **NEC 690.71(D)**
- X. If any charge controllers are to be installed for the battery system, provide manufacture’s specification sheets for such and also show that the charge controller(s) is/are listed in accordance with UL 1741. **NEC 690.4(D)**
- Y. 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, etc.) that is/are connected to the batteries in order to control the charge of the batteries (this may sometimes require multiple charge controllers). **NEC 690.72. Note:** In some systems, such as a SMA Sunny Island system, the inverter acts as the charge controller and an external charge controller is not required (if installed per manufacture’s requirements).
- Z. Detailed information from the inverter manufacture on the requirements for grounding the battery system must be provided. **Note:** Some battery inverter manufactures require a grounding electrode conductor to be connected to the negative conductor at a single point external of the inverter, others may require a grounding electrode conductor to connect within the inverter, and some may not require a grounding electrode conductor at all (always follow manufacture’s requirements)

- AA. Any PV system employing battery storage must also have a sign giving the max operating voltage (including any equalization voltage) and the polarity of the grounded circuit conductor (positive or negative). *Specify this on the plans. NEC 690.55*
- BB. There must be a sign located at the battery disconnect which notes the nominal voltage of the system and gives the maximum available short-circuit current (amps) that the battery system could provide. Such sign must also note the date the calculation was performed. *Specify this information on the plans. NEC 480.6(D)B*
- CC. For the previous review item noted above, 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’s specification sheets, detailed calculations can be provided to show the calculated fault current of the battery system.)

Project details--BE SPECIFIC – *Include letter preceding line item related to your comment*

SIGNATURE (person who completed PV review form)

DATE

F O R O F F I C E U S E O N L Y

Approved

Approved with changes

Not approved

BUILDING OFFICIAL

DATE