North Central Texas Council of Governments

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Solar Permitting & Inspection: Training on best practices for permitting and inspecting solar arrays

June 4, 2024

Session 3 agenda

- Welcome
- Session Overview & Check-in
- Solar Permitting Best Practices & Considerations
- Break
- Solar Inspection Best Practices & Considerations
- Next Steps

Who you'll hear from

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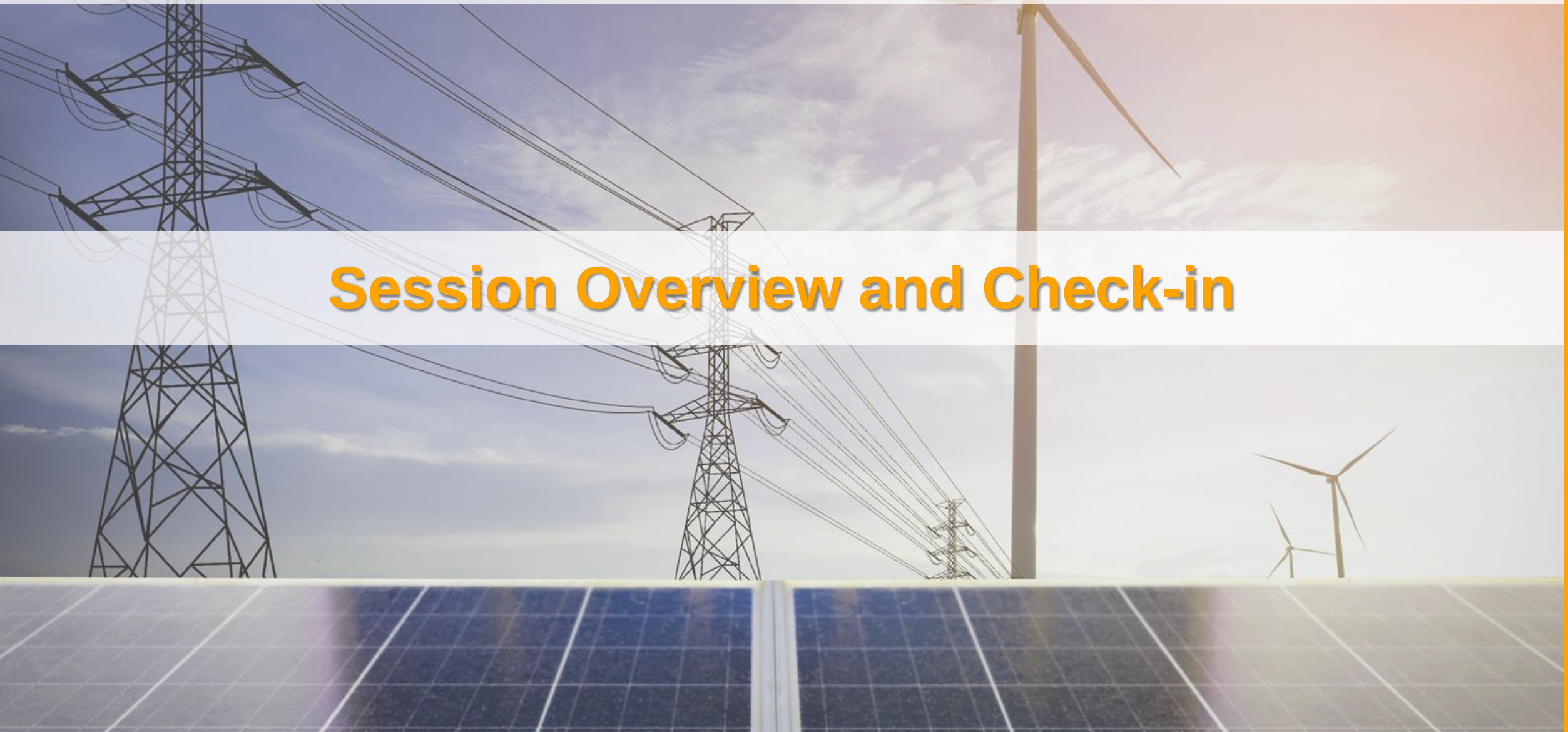


Session Overview and Check-in

Cohort structure & timeline

1-on-1 check-ins

Session #1: Setting the stage for solar development

Overview of regional and state energy context

April 2024

Session 2: Planning for solar

Best practice guidance for planning and zoning of small and large-scale solar arrays

May 2024

Session 3: Permitting & inspection for solar

Training on best practices for permitting and inspecting solar arrays

June 2024

Session 4: Community engagement & municipal operations

Guidance on how to support residents, businesses, and your own operations teams as they consider adopting solar

June/July 2024

Session 5: Wrap up & next steps

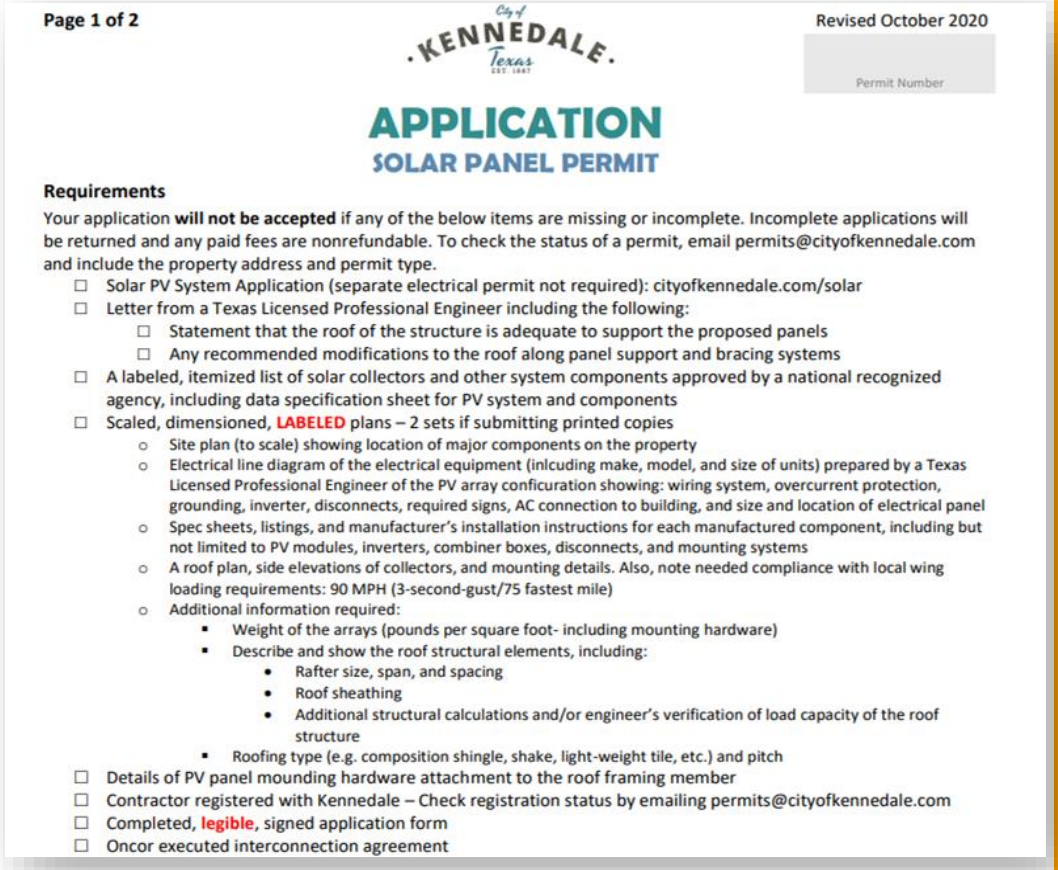
Address any outstanding questions and chart a pathway forward

July/August 2024

Access to 1-on-1 technical assistance support

Session 3 overview

- This session is focused on SolSmart's "Permitting and Inspection" (PI) category.
- Communities that have permitting/inspection staff attend today's session (or watch the recording) will earn both *PI-2: Train permitting staff on best practices for permitting solar PV and/or solar and storage systems* & *PI-3: Train inspection staff on best practices for inspecting solar PV and/or solar and storage systems.*
  - For those watching the recording, please complete a verification memo and send it to zach.greene@wri.org.
- This session will also introduce best practices included within multiple other "PI" criteria.
- Your community will need to develop and publish a "permitting checklist" that details the required permit(s), submittals, and steps of your community's permitting process for residential rooftop solar PV. This is criterion *PI-1* and a prerequisite for Bronze designation.



Page 1 of 2

City of KENNEDALE Texas

Revised October 2020

Permit Number

APPLICATION

SOLAR PANEL PERMIT

Requirements

Your application **will not be accepted** if any of the below items are missing or incomplete. Incomplete applications will be returned and any paid fees are nonrefundable. To check the status of a permit, email permits@cityofkennedale.com and include the property address and permit type.

- ☐ Solar PV System Application (separate electrical permit not required): cityofkennedale.com/solar
- ☐ Letter from a Texas Licensed Professional Engineer including the following:
  - ☐ Statement that the roof of the structure is adequate to support the proposed panels
  - ☐ Any recommended modifications to the roof along panel support and bracing systems
- ☐ A labeled, itemized list of solar collectors and other system components approved by a national recognized agency, including data specification sheet for PV system and components
- ☐ Scaled, dimensioned, **LABELED** plans – 2 sets if submitting printed copies
  - Site plan (to scale) showing location of major components on the property
  - Electrical line diagram of the electrical equipment (inlcuding make, model, and size of units) prepared by a Texas Licensed Professional Engineer of the PV array conficuration showing: wiring system, overcurrent protection, grounding, inverter, disconnects, required signs, AC connection to building, and size and location of electrical panel
  - Spec sheets, listings, and manufacturer's installation instructions for each manufactured component, including but not limited to PV modules, inverters, combiner boxes, disconnects, and mounting systems
  - A roof plan, side elevations of collectors, and mounting details. Also, note needed compliance with local wing loading requirements: 90 MPH (3-second-gust/75 fastest mile)
  - Additional information required:
    - Weight of the arrays (pounds per square foot- including mounting hardware)
    - Describe and show the roof structural elements, including:
      - Rafter size, span, and spacing
      - Roof sheathing
      - Additional structural calculations and/or engineer's verification of load capacity of the roof structure
    - Roofing type (e.g. composition shingle, shake, light-weight tile, etc.) and pitch
- ☐ Details of PV panel mounding hardware attachment to the roof framing member
- ☐ Contractor registered with Kennedale – Check registration status by emailing permits@cityofkennedale.com
- ☐ Completed, **legible**, signed application form
- ☐ Oncor executed interconnection agreement

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Peer Check-in

Peer check-in prompts & poll

Please share in the chat:

- Your name
- The community you represent
- Your title
- Any initial questions or thoughts

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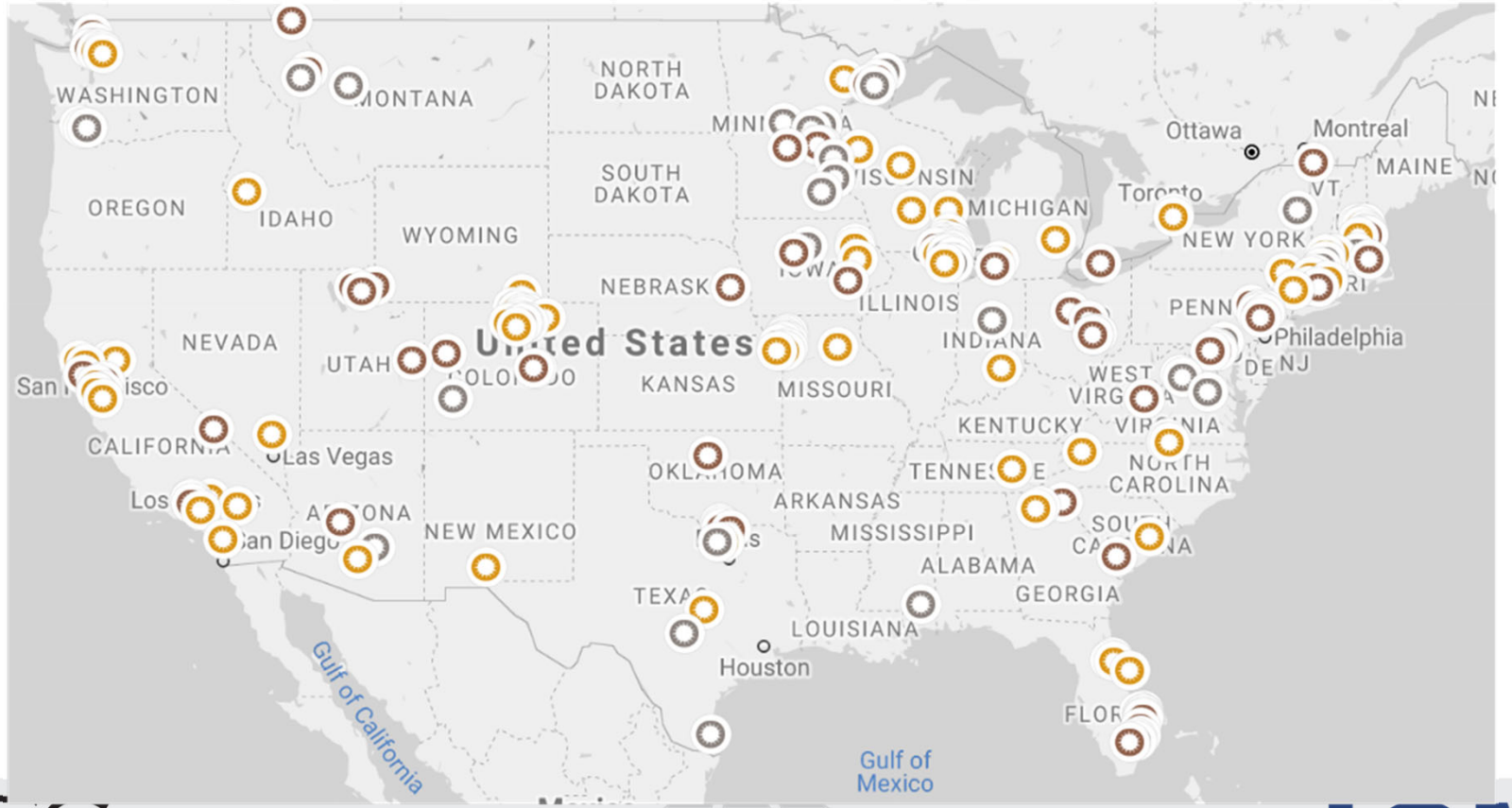
Solar Permitting & Inspection Best Practices

SolSmart Permitting and Inspection

Improving Permit Review and Inspection for Small Solar Systems

SOLSMART COMMUNITY MAP



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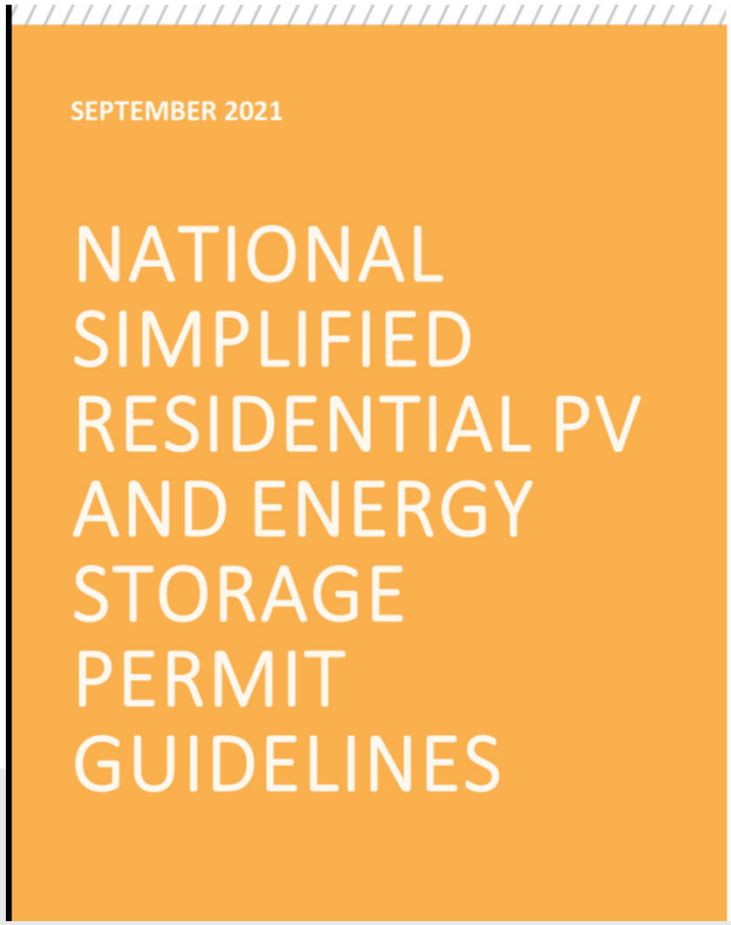
ICMA

SIMPLIFIED PV PERMIT GUIDELINES

- The information in these guidelines are intended to provide a format whereby local jurisdictions and contractors can permit simple PV system installations where only a basic review is necessary.
- It is likely that most residential and some small commercial PV systems will comply with these simple criteria that address the requirements for PV systems in the building, electrical, and fire codes.

PV+ESS Permitting Guidelines



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BROOKS ENGINEERING

IREC

SEAC
Sustainable Energy Action Committee

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Guideline Contents

- Defines the size, electrical, structural,and fire safety requirements for solar installations to qualify for simplified permitting.
- Enable applicants to “fill in the blanks” to explain the structural details of a rooftop solar PV system.
- Enable applicants to “fill in the blanks” to explain the electrical configuration of a solar PV system.

CURRENT LAWS, REGS & CODES

- NEC Article 690, 705, 706, and chapters 1-4
- IRC R324, R328
- IBC 1505
- IFC 1205, 1207
- ASCE 7-10, 7-16, 7-20

Purposes of Simplified Permitting

- A simplified, expedited permit process for small solar PV systems simplifies and consolidates the structural, electrical and fire review of the PV system
- It can eliminate the need for detailed engineering studies and often avoids unnecessary delays
- It is not the intent of an expedited process to circumvent the engineering process
- It is to recognize the similarities among these smaller systems and establish guidelines to determine when a PV project is within the boundaries of typical, well-engineered systems that are clearly compliant with electrical and building codes.

SIMPLIFIED PV PERMIT GUIDELINES

- Step 1: Gather required information for permit:
- 1. Permit application required by the local jurisdiction. Permit applications normally include information about the project scope, project location, and the installer.
- 2. Site plan showing location of major components on the property. This drawing need not be exactly to scale, but it should represent relative location of components at site (see supplied example site plan). PV arrays in compliance with IRC fire setback requirements need no separate fire service review (with Fire Service MOU).

SIMPLIFIED PV PERMIT GUIDELINES

- Gather required information for permit (cont.):
- 3. Electrical worksheets showing PV array configuration, wiring system, overcurrent protection, inverter, disconnects, required signs, and ac connection to building (see supplied standard electrical diagram).
- 4. Specification sheets and installation manuals (if available) for all major PV system components such as, PV modules, dc-to-dc converters, inverters, and mounting systems.

PV+ESS Permitting Guidelines

Step 1: Gather Required Information for Permit

1.	Permit application required by the local jurisdiction: Permit applications normally include information about the project scope, project location, and the installer.	☐
2.	Site plan showing location of major components on the property: This drawing need not be exactly to scale, but it should represent relative location of components at site (see supplied example site plan). PV arrays in compliance with IRC fire setback requirements. Energy storage in acceptable locations.	☐
3.	Electrical worksheets showing PV array configuration, wiring system, overcurrent protection, ESS components, inverters, disconnects, required signs, and AC connection to building (see supplied standard electrical diagram).	☐
4.	Specification sheets and installation manuals (if available) for all major PV system components such as: PV modules, DC-to-DC converters, ESS components, inverters, and mounting systems.	☐

PV+ESS Permitting Guidelines

Step 2: PV System Electrical Code Installation Requirements

1.	Major electrical components including PV modules, DC-to-DC converters, and inverters, are identified for use in PV systems.	☐
2.	Array mounting system UL2703 certified for bonding and grounding. Alternatively, the array mounting system may incorporate UL2703 grounding devices to bond separate exposed metal parts together or to the equipment grounding conductor.	☐
3.	The PV array consists of no more than 2 series strings per inverter input and no more than 4 series strings in total per inverter.	☐
4.	Field-installed PV array wiring meets the following requirements (all boxes must be checked): ☐ a. All exposed PV source circuit wiring is no smaller than 12 AWG PV Wire or MFG Cable. ☐ b. All PV source circuit wiring in raceway is no smaller than 12 AWG THWN-2, XHHW-2, or RHW-2.	☐
5.	Equipment is rated for the maximum DC voltage applied to the equipment (put N/A in all blanks that do not apply to the specific installation): ☐ a. ASHRAE Extreme Annual Mean Minimum Design Dry Bulb Temperature (one source is https://energyresearch.ucf.edu/solar-certification/solar-reference-map/)=_____; Table 690.7 (NEC) value_____ ☐ b. Max module Voc (adjusted at minimum temperature): Rated Voc _____V x Table 690.7 value_____=_____V ☐ c. DC-to-DC converter(s) or microinverter rated maximum input voltage: _____V (must be greater than Max module Voc in (b.)) ☐ d. Maximum number of DC-to-DC converters allowed in series (up to 600Vdc): _____ ☐ e. Maximum voltage of DC-to-DC converter circuit with maximum number in (c.): _____V ☐ f. Inverter(s) rated maximum input voltage: _____V (must be greater than g. below) ☐ g. Inverter input max V: Max module Voc (b.) _____V x max # in series_____= _____V	☐
6.	PV system circuits on buildings meet requirements for controlled conductors in 690.12.	☐
7.	The PV system disconnecting means meets the requirements of 690.13.	☐

PV+ESS

Step 3: ESS Electrical Code Installation Requirements

1.	ESS is listed to UL9540 by a recognized testing laboratory (UL, Intertek, CSA, etc.).	☐
2.	ESS is installed according to manufacturer's installation instructions for the UL9540 listing.	☐
3.	The *standard electrical diagrams can be used to accurately represent the ESS.	☐

Step 4: ESS Residential Code Installation Requirements

1.	The individual ESS units are no larger than 20 kWh. Units installed meet one of the size and location limitations shown in items (2) and (3) below.	☐
2.	The individual ESS units are installed are separated by 36" or are installed in accordance with approved large-scale fire testing results (UL 9540a or equivalent approved tests).	☐
3.	Each ESS meets one of the size and location limitations shown below: ☐ a. 80 kWh in attached garages separated from the dwelling unit living space in accordance with Section R302.6. ☐ b. 80 kWh on exterior walls a minimum 3 feet (914 mm) from doors and windows directly entering the dwelling unit (garage doors and windows do not enter the dwelling unit). ☐ c. 40 kWh within utility closets, basements, and storage or utility spaces with finished or noncombustible walls and ceilings. Walls and ceilings of unfinished wood-framed construction shall be provided with minimum 5/8 in. Type X gypsum. ☐ d. 80 kWh in detached garages and detached accessory structures. ☐ e. 80 kWh outdoors on the ground a minimum 3 feet (914 mm) from doors and windows directly entering the dwelling unit.	☐
4.	Where an ESS is installed in a garage, units are installed along side walls and units installed on end walls above 48" do not need vehicle protection. Where units are installed on end walls below 48", approved vehicle protection is installed (e.g., parking curb, barrier, bollard).	☐
5.	Where required, smoke or heat alarms are installed.	☐

PV+ESS Permitting Guidelines

Step 5: PV and ESS Electrical Code Interconnection Requirements

1.	The inverter installation meets the requirements of Article 705 (choose one below): ☐ Supply-side connection complying with 705.12(A)[2017 NEC]; 705.11[2020 NEC] ☐ Load-side connection complying with 705.12(B)[2017 NEC]; 705.12[2020 NEC] ☐ Load-side Power Control System connection complying with 705.13[2020 NEC] ☐ Load-side distribution equipment listed to combine sources and supply loads	☐
2.	The *standard electrical diagrams can be used to accurately represent the PV or ESS or both. Diagrams can be found in the electrical commentary document.	☐

Fill out the standard electrical diagram completely. If the electrical system is more complex than the standard electrical diagram can effectively communicate, the project does not meet the requirements

PV+ESS Permitting Guidelines

Step 6 (Simplified): Structural PV Array Mounting Requirements

For jurisdictions that require detailed structural PV array mounting information, skip to Step 6 (Detailed)

1.	The weight of the PV system 4 lbs/sq ft. or less.	☐
2.	The attachment points of the mounting system are staggered (no check requires low snow and wind load location).	☐
3.	The maximum spacing in inches between adjacent attachment points of the mounting system 48" or less (no check means that the spacing is no larger than 72" and requires no snow and low wind load location).	☐
4.	The array is on a single roof face (if no check, how many roof surfaces at different slopes and/or orientations will be used for installation? _____(fill in).	☐
5.	The PV array is flush mounted (parallel to roof).	☐
6.	If "5" not checked, is the maximum distance off the roof no greater than 10" (if no check, this process cannot be used).	☐
7.	The solar module and mounting system rated by the manufacturer to withstand the upward force of the local wind speed and evenly distribute load into the supporting structure at the proposed maximum spacing, and confirmed in UL 1703 or 61730, and 2703 listings (validated through the UL 1703 or 61730 module rating for mechanical load rating, and UL 2703 mounting system mechanical load rating).	☐
8.	The individual roof structure appears to be structurally sound, without signs of alterations or significant structural deterioration or sagging.	☐
9.	What is the roof covering material?_____(fill in blank)	☐
10.	What is the slope of the roof surface? _____(fill in blank)	☐

PV+ESS Permitting Guidelines

Step 6 (Detailed): Structural PV Array Mounting Requirements

This version of Step 6 is for jurisdictions requiring detailed structural PV array mounting information.

Both Framing-Attached and Sheathing-Attached Provisions

A. General Site and Array Requirements *(all square boxes must be checked; where slanted check box sub-options occur, one sub-option must be checked):*

1.	Wind Exposure and Design Wind Speed (as defined by ASCE 7, select one below): ☐ *a. Framing-Attached System: Exposure B or C, and design wind speed does not exceed 180mph.* ☐ *b. Sheathing-Attached System: see section G.7 for wind exposure and wind speed limits.*	☐
2.	The structure is not in Wind Exposure D (within 200 yards of a water body wider than a mile).	☐
3.	The structure is not on a hill with a grade steeper than 5%, where topographic effects can significantly increase wind loads.	☐
4.	Ground snow loads do not exceed 60 psf.	☐
5.	Distributed weight of the PV array is less than 4 lbs/sq ft (less than 5 lbs/sq ft for thermal systems).	☐

B. Roof Information *(all must apply):*

1.	Array is mounted on a permitted, one- or two-family roof structure or similar structure. *For a roof without a building permit, show compliance with International Residential Code (IRC) span tables.*	☐
2.	Roof is framed with wood rafters or trusses at no greater than 48" on center. Roof framing members run upslope/downslope (not horizontal purlins).	☐
3.	Roof structure appears to be structurally sound, without signs of alterations or significant structural deterioration or sagging.	☐
4.	Sheathing is at least 7/16" or thicker plywood, or 7/16" or thicker oriented strand board	☐

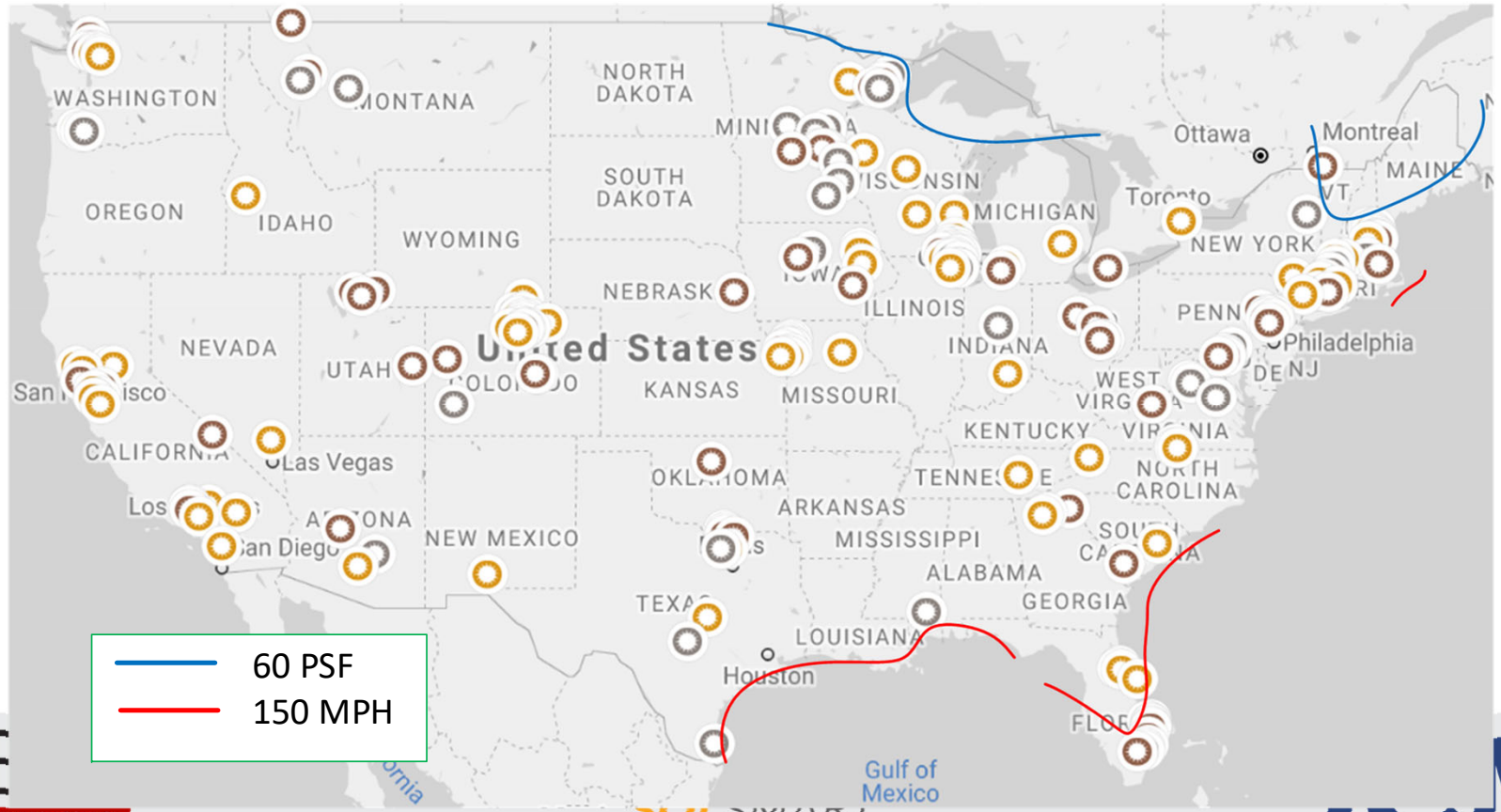
The “Box” to Qualify Simple Permits

- PV system uses standard diagrams
- One- and two-family rooftop installations or structure of same construction.
- String inverter, dc converter, or microinverter
- Complies with eligibility checklist

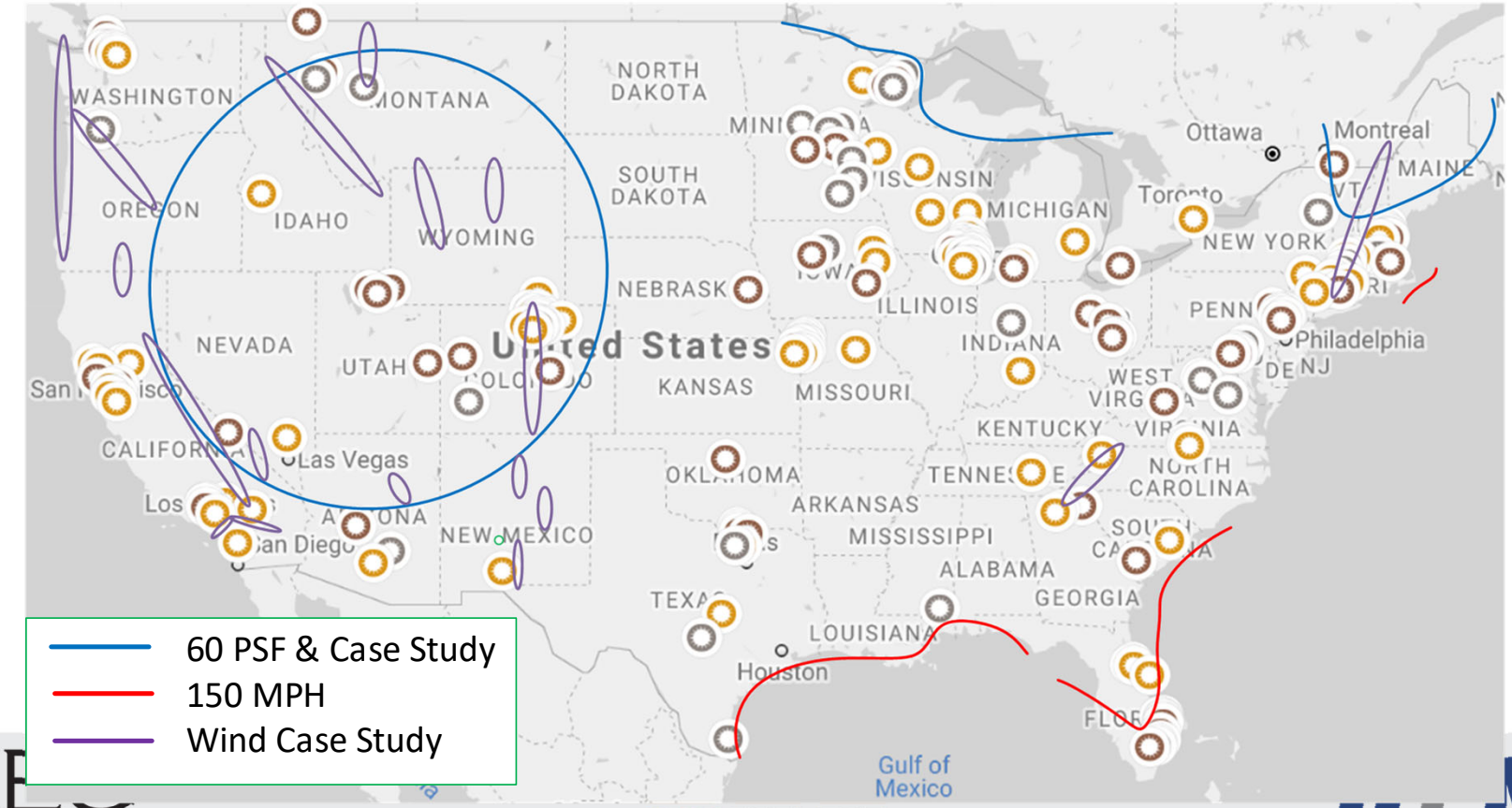
Overall Limitations of Location

- Snow load no greater than 60 PSF (pounds per square foot).
- Wind load no greater than 150 MPH

Guidelines Cover Most of 48 States



Guidelines Cover Most of 48 States



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Member Attached Limitations

- Snow load no greater than 60 PSF (pounds per square foot).
- Wind load no greater than 150 MPH
- Not Exposure D (waterfront)
- Not on steep hill (5% grade)
- Roof mean height 40’ or less
- Roof structure meets IRC
- No structural damage

ELIGIBILITY CHECKLIST FOR SIMPLIFIED PV PERMITTING

- Member-Attached PV Array Requirements:
- ☐ 1. Array is set back from all roof edges and ridge by at least twice the gap under the modules (or more, where fire access pathways are required).
- ☐ 2. Array does not cantilever over the perimeter anchors more than 19”.
- ☐ 3. Gap under modules (roof surface to underside of module) is no greater than 10”.
- ☐ 4. Gaps between modules are (select one below):
- ☐ *a. at least 0.25” on both short and long sides of modules, or*
- ☐ *b. 0” on short side, and at least 0.50” on long sides.*

ELIGIBILITY CHECKLIST FOR SIMPLIFIED PV PERMITTING

- Member-Attached PV Array Requirements (cont):
- ☐ 5. Mounting rail orientation or rail-less module long edges:
  ☐ *a. run perpendicular to rafters or trusses, and attached to them*

- ☐ 6. The anchor/mount/stand-off spacing perpendicular to rafters or trusses:
- ☐ *a. does not exceed 4'-0", and anchors in adjacent rows are staggered where rafters or trusses are at 24" or less on center*

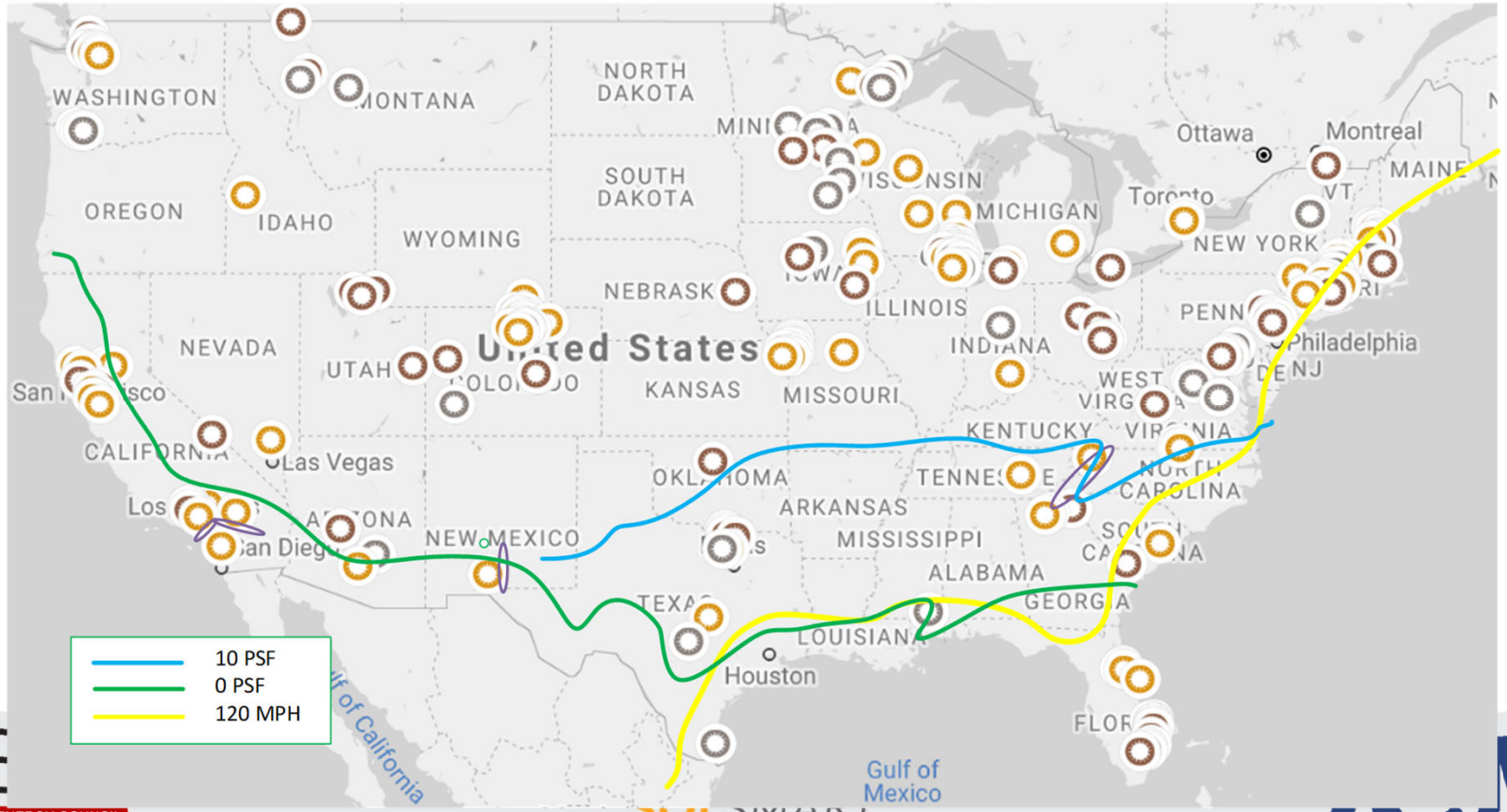
ELIGIBILITY CHECKLIST FOR SIMPLIFIED PV PERMITTING

- Member-Attached PV Array Requirements (cont):
- ☐ 7. Upslope/downslope anchor spacing follows manufacturer's instructions.
- ☐ 8. Anchor fastener is (select one below):
- ☐ *a. 5/16" diameter lag screw with 2.5" embedment into structural member, or*
- ☐ *b. fastener other than (a.) embedded in structural members in accordance with manufacturer's structural attachment details. Manufacturer's anchor layout requirements must not exceed the anchor spacing requirements shown in Items 5 and 6 above.*

Structural Summary Takeaway

1. Houses that were built in compliance with building structural codes, can support PV.
2. Single layer of roofing (no second layer of comp).
3. PV modules mounted within 2” and 10” of roof deck.
4. PV array distributed weight less than 4 lb/ft^2
5. Typical rafter with supports 48” apart or closer (each anchor row mounted on alternating trusses) meet structural code requirements (represents most of housing stock).

Options for Low Snow and Wind



ELIGIBILITY CHECKLIST FOR SIMPLIFIED PV PERMITTING

- Member-Attached PV Array Requirements (cont):

☐ 5. Mounting rail orientation or rail-less module long edges:

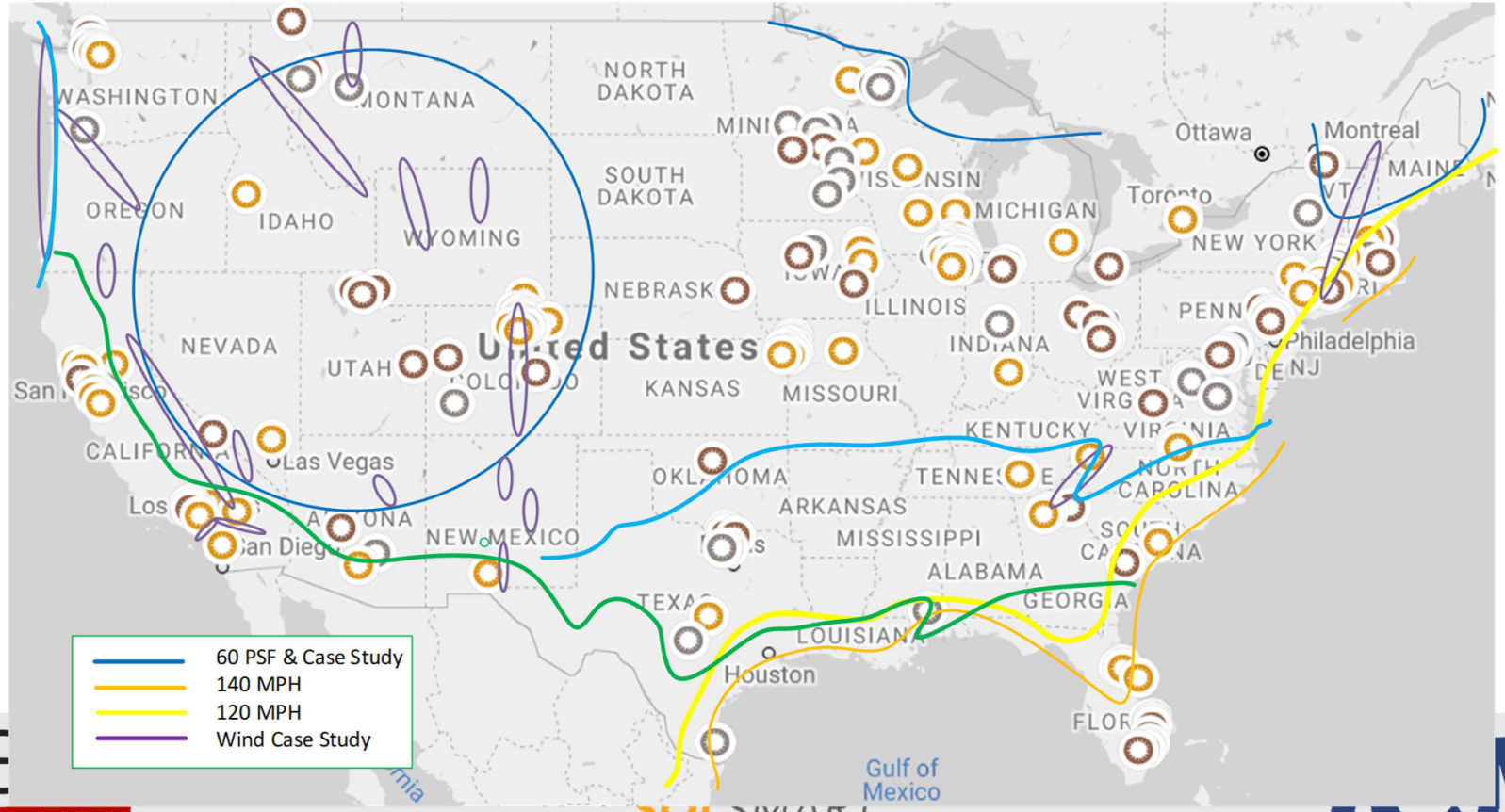
- ☐ *b. run parallel to rafters and are spaced no more than 4'-0" apart, Ground Snow Load is no greater than 10 psf, and Design Wind Speed does not exceed 120 mph.*

- ☐ 6. The anchor/mount/stand-off spacing perpendicular to rafters or trusses (select one below):
- ☐ *a. does not exceed 4'-0", and anchors in adjacent rows are staggered where rafters or trusses are at 24" or less on center (see Figure), or*
- ☐ *b. does not exceed 4'-0", anchor layout is orthogonal, roof slope is 6:12 or less, Ground Snow Load is no greater than 10 psf, and Design Wind Speed does not exceed 120 mph, or*
- ☐ *c. does not exceed 6'-0", anchor layout is orthogonal, roof slope is 6:12 or less, Ground Snow Load is zero, and Design Wind Speed does not exceed 120 mph.*

Sheathing Attached Limitations

- Snow load no greater than 60 PSF
- Wind load no greater than 140 MPH
- Not Exposure D (waterfront)
- Not on steep hill (5% grade)
- Roof mean height 30’ or less
- Roof structure meets IRC
- Mfg Truss or Kiln Dry Rafters
- No structural damage
- Tributary area matters

Options for Sheathing Attached



BANDS OF STRENGTH—Middle 16” of Sheet

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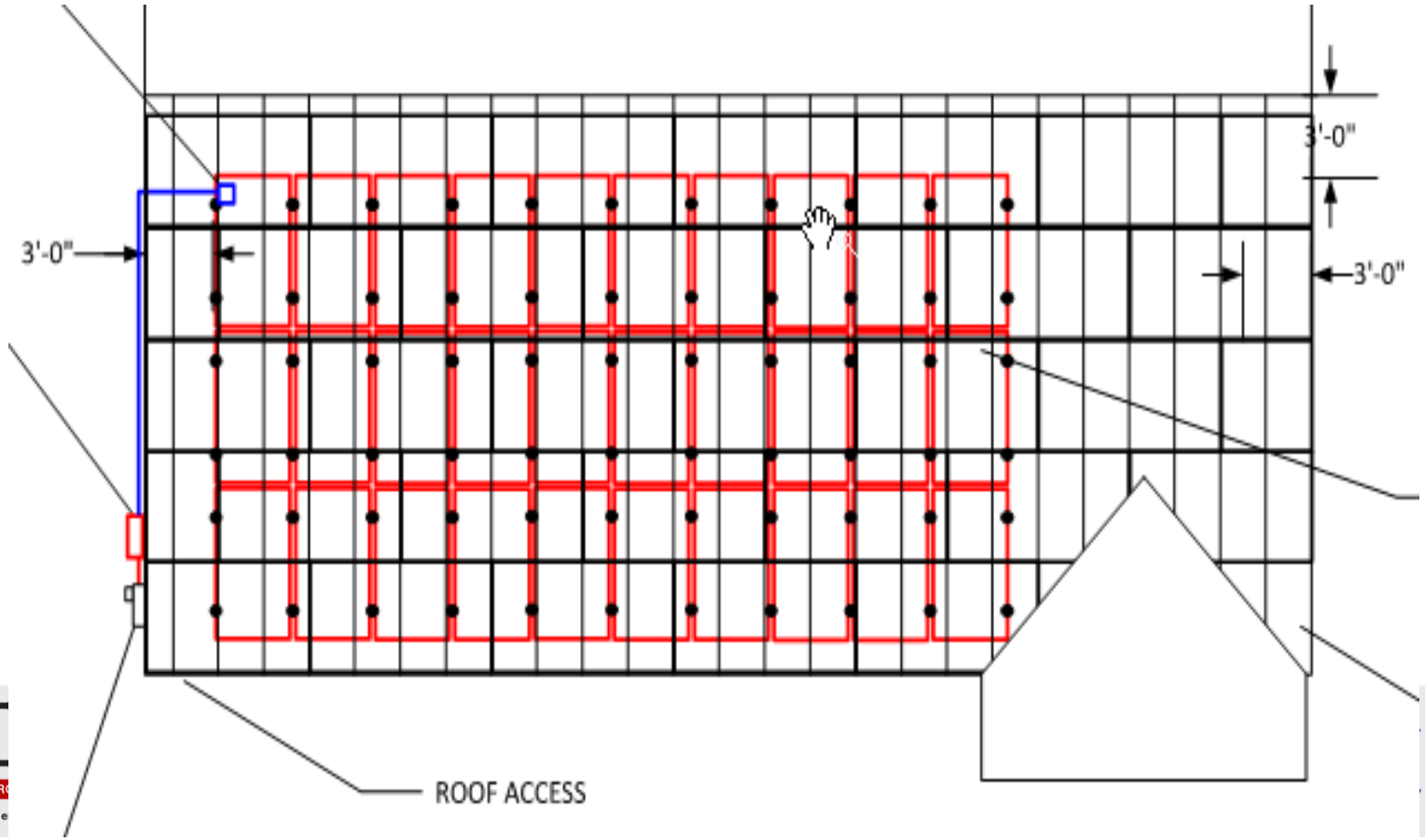


ELIGIBILITY CHECKLIST FOR SIMPLIFIED PV PERMITTING—Sheathing—No Bands of Strength

☐ *a. Some anchors are <u>not</u> within bands of strength, and all the following (i., ii. & iii.) apply:*

- ☐ *i. Edge of array is more than 3 feet from any roof edge (Wind Zone 1), and*
- ☐ *ii. Tributary area is 9 ft^2 or less (up to half the area of a 60 cell PV module), and*
- ☐ *iii. Wind Exposure B only, and design wind speed does not exceed 120 mph.*

ELIGIBILITY CHECKLIST FOR SIMPLIFIED PV PERMITTING—Sheathing—Bands of Strength

☐ *b. All anchors are within bands of strength, and all of the following (i., ii. & iii.) apply:*

- ☐ *i. Edge of array is more than 3 feet from any roof edge (Wind Zone 1), and*
- ☐ *ii. Tributary area is 14 ft^2 or less (40”x48”).*
- ☐ *iii. One of the two wind cases below (x. or y.) applies:*
  - ☐ x. *Exposure B, and design wind speed does not exceed 140 mph, or*
  - ☐ y. *Exposure C, and design wind speed does not exceed 120 mph.*

ELIGIBILITY CHECKLIST FOR SIMPLIFIED PV PERMITTING

☐ 8. Anchor-to-sheathing connection has an allowable stress design (ASD) uplift capacity of at least 166 lbs. under short duration loading, which corresponds to a mean ultimate tested uplift capacity of at least 520 lbs.

GENERAL STATEMENT FOR CHECKLIST:

If any structural item cannot be checked off, the building official may require the installer to provide structural calculations and/or details, stamped and signed by a design professional, addressing the unchecked item.

ELIGIBILITY CHECKLIST FOR SIMPLIFIED PV PERMITTING

Step 2: Electrical PV System Requirements Checklist

For a simplified PV permit, following are the electrical requirements:

1. Major electrical components including PV modules, dc-to-dc converters, and inverters, are identified for use in PV systems.
2. Array mounting system UL2703 certified for bonding and grounding. Alternatively, the array mounting system may incorporate UL2703 grounding devices to bond separate exposed metal parts together or to the equipment grounding conductor.
3. The PV array consists of no more than 2 series strings per inverter input and no more than 4 series strings in total per inverter.

PV+ESS Permitting Guidelines

Step 2: PV System Electrical Code Installation Requirements

1.	Major electrical components including PV modules, DC-to-DC converters, and inverters, are identified for use in PV systems.	☐
2.	Array mounting system UL2703 certified for bonding and grounding. Alternatively, the array mounting system may incorporate UL2703 grounding devices to bond separate exposed metal parts together or to the equipment grounding conductor.	☐
3.	The PV array consists of no more than 2 series strings per inverter input and no more than 4 series strings in total per inverter.	☐
4.	Field-installed PV array wiring meets the following requirements (all boxes must be checked): ☐ a. All exposed PV source circuit wiring is no smaller than 12 AWG PV Wire or MFG Cable. ☐ b. All PV source circuit wiring in raceway is no smaller than 12 AWG THWN-2, XHHW-2, or RHW-2.	☐
5.	Equipment is rated for the maximum DC voltage applied to the equipment (put N/A in all blanks that do not apply to the specific installation): ☐ a. ASHRAE Extreme Annual Mean Minimum Design Dry Bulb Temperature (one source is https://energyresearch.ucf.edu/solar-certification/solar-reference-map/)=_____; Table 690.7 (NEC) value_____ ☐ b. Max module Voc (adjusted at minimum temperature): Rated Voc _____V x Table 690.7 value_____=_____V ☐ c. DC-to-DC converter(s) or microinverter rated maximum input voltage: _____V (must be greater than Max module Voc in (b.)) ☐ d. Maximum number of DC-to-DC converters allowed in series (up to 600Vdc): _____ ☐ e. Maximum voltage of DC-to-DC converter circuit with maximum number in (c.): _____V ☐ f. Inverter(s) rated maximum input voltage: _____V (must be greater than g. below) ☐ g. Inverter input max V: Max module Voc (b.) _____V x max # in series_____= _____V	☐
6.	PV system circuits on buildings meet requirements for controlled conductors in 690.12.	☐
7.	The PV system disconnecting means meets the requirements of 690.13.	☐

PV+ESS Permitting Guidelines

Step 5: PV and ESS Electrical Code Interconnection Requirements

1.	The inverter installation meets the requirements of Article 705 (choose one below): ☐ Supply-side connection complying with 705.12(A)[2017 NEC]; 705.11[2020 NEC] ☐ Load-side connection complying with 705.12(B)[2017 NEC]; 705.12[2020 NEC] ☐ Load-side Power Control System connection complying with 705.13[2020 NEC] ☐ Load-side distribution equipment listed to combine sources and supply loads	☐
2.	The *standard electrical diagrams can be used to accurately represent the PV or ESS or both. Diagrams can be found in the electrical commentary document.	☐

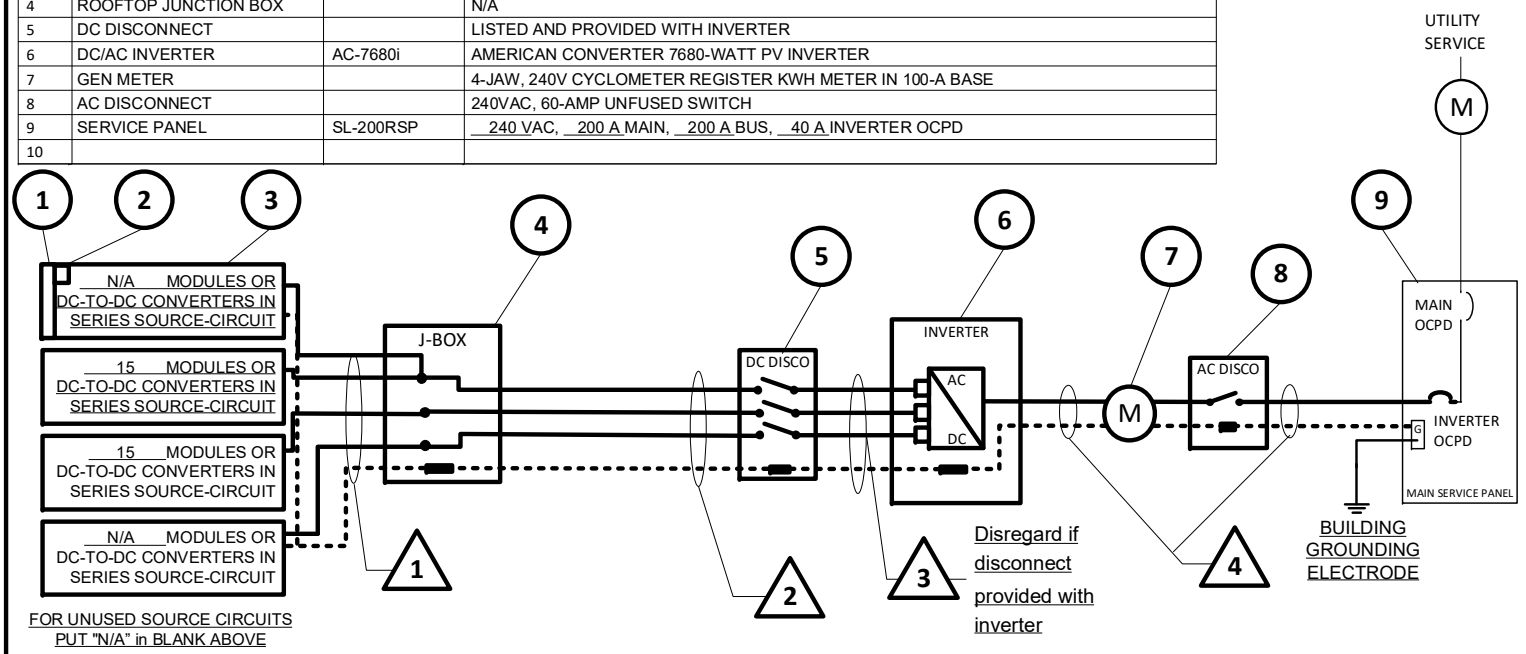
Fill out the standard electrical diagram completely. If the electrical system is more complex than the standard electrical diagram can effectively communicate, the project does not meet the requirements

Interconnection—No MID

- 120% Option for Small PV and/or ESS
- 100% Option for Larger PV or PV+ESS. Split service into 2 breakers to 2 subpanels (sum of breakers option)
- PV and/or ESS as part of 6-handle Service Disconnecting Means (ESS within load calcs for service or PCS installed to protect service)
- Supply side option for PV (no ESS allowed)

EQUIPMENT SCHEDULE

TAG	DESCRIPTION	PART NUMBER	NOTES (N/A IF NOT USED)
1	SOLAR PV MODULE	AS-360	AMERICAN SOLAR 360-WATT PV MODULES
2	DC-DC CONVERTER	AC-SB360	AMERICAN CONVERTER SOLARBUCK 360-WATT DC-TO-DC CONVERTER
3	PV ARRAY CIRCUIT 1		N/A
	PV ARRAY CIRCUIT 2		15 DC-TO-DC CONVERTERS IN SERIES
	PV ARRAY CIRCUIT 3		15 DC-TO-DC CONVERTERS IN SERIES
	PV ARRAY CIRCUIT 4		N/A
4	ROOFTOP JUNCTION BOX		N/A
5	DC DISCONNECT		LISTED AND PROVIDED WITH INVERTER
6	DC/AC INVERTER	AC-7680i	AMERICAN CONVERTER 7680-WATT PV INVERTER
7	GEN METER		4-JAW, 240V CYCLOMETER REGISTER KWH METER IN 100-A BASE
8	AC DISCONNECT		240VAC, 60-AMP UNFUSED SWITCH
9	SERVICE PANEL	SL-200RSP	240 VAC, 200 A MAIN, 200 A BUS, 40 A INVERTER OCPD
10			



CONDUIT AND CONDUCTOR SCHEDULE

TAG	DESCRIPTION OR CONDUCTOR TYPE	COND. GAUGE	NUMBER OF CONDUCTORS	CONDUIT TYPE	CONDUIT SIZE
1	USE-2 ☐ or PV WIRE ☒	12	4-B	N/A	N/A
	BARE COPPER EQ. GRD. COND. (EGC)	6		N/A	N/A
2	THWN-2 ☒ or XHHW-2 ☐ or RHW-2 ☐	12	2-R, 2-B	EMT	¾"
	INSULATED EGC	12	1-G		
3	THWN-2 ☐ or XHHW-2 ☐ or RHW-2 ☐		N/A		
	INSULATED EGC		N/A		
4	THWN-2 ☒ or XHHW-2 ☐ or RHW-2 ☐	8	1-B, 1-R, 1-W	EMT	¾"
	INSULATED EGC	10	1-G		

Contractor Name, Address and Phone:

SolarBright
2688 Washington St.
Minneapolis, MN
800-555-1212

Drawn By:

Checked By:

One-Line Standard Electrical Diagram for Small-Scale, Single-Phase PV Systems

Site Name: Joe and Jane Homeowner
Site Address: 2400 Monroe St., St. Paul, MN
System AC Size: 7.6 kWac

SIZE	FSCM NO	DWG NO	REV
		E1.1a	

SCALE NTS | Date: | SHEET

Central/String Inverter Standard Plans

- Use this plan ONLY for central/string inverter systems with or without dc converters on the roof of a one- or two-family dwelling or similar structure.
- The photovoltaic system must interconnect to the load side of a 120/240Vac service panel rated 400A or less (80-amp PV breaker or less).
- Not intended for more than two inverters, or more than one dc combiner per inverter (non-inverter-integrated).

Example 1—7.6kW Central Inverter PV System

PV System Components

PV Modules

Qty. 27, 360W, American Solar AS360

Inverter

Qty. 1, 7.6 kW, American Inverter AI-7600

Mounting System

OmniRack ModMount 5.0; sheathing attached;

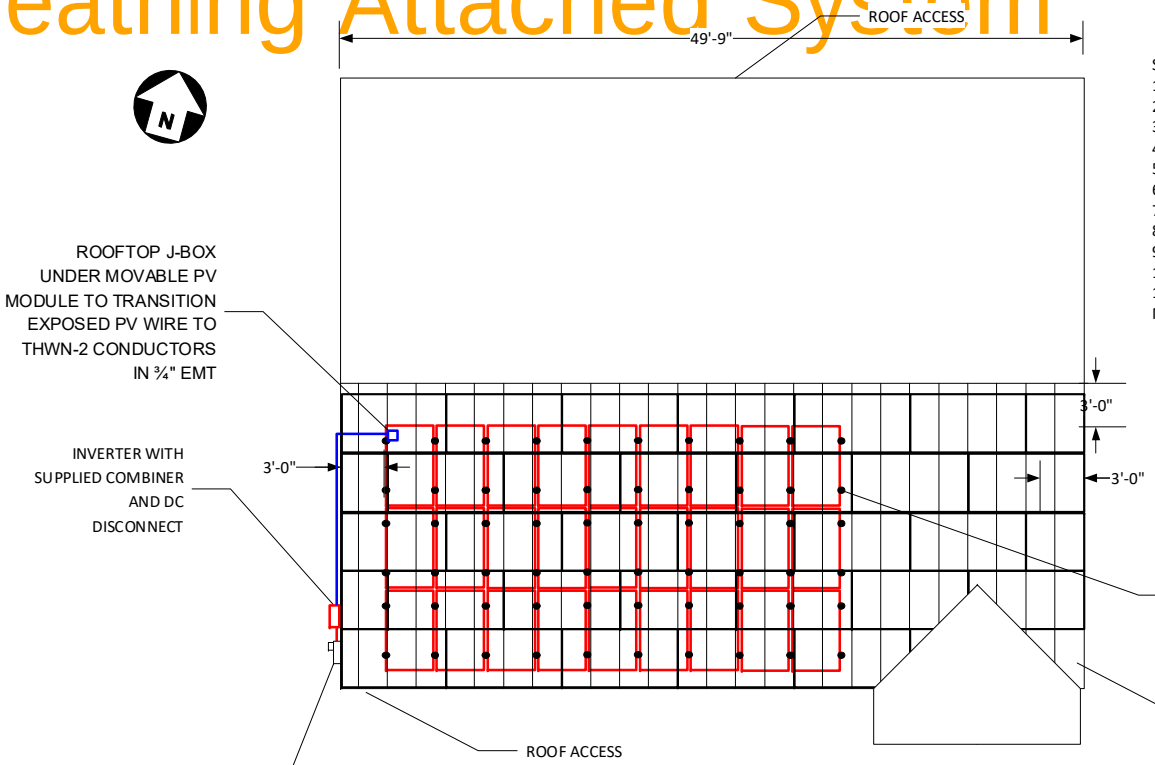
House

Roof Pitch 4:12; House built in 1988. Comp shingle roof. [structurally compliant]

Form Fill-Out Demonstration

Compliance Document
Standard Plan—Simplified Central Inverter
Structural Criteria—compliant

Sheathing Attached System



STRUCTURAL NOTES:
1. ROOF PITCH 4:12
2. ROOF COVERING: SINGLE OVERLAY ASPHALT SHINGLES
3. BLACK DOTS REPRESENT ANCHOR POINTS
4. MEAN ROOF HEIGHT LESS THAN 30'
5. ROOF STRUCTURE: TRUSS ON 24" CENTERS
6. ROOF DECK 7/16" OSB
7.MAXIMUM ANCHOR POINT DISTANCE: 48"
8. DWELLING IN WIND EXPOSURE B
9. PV MODULES MOUNTED 2" ABOVE ROOF COVERING
10. PV MODULES CERTIFIED TYPE 1 FOR FIRE PURPOSES
11. OMNIRACK MOD 5.0 LISTED CLASS A WITH TYPE 1 MODULES

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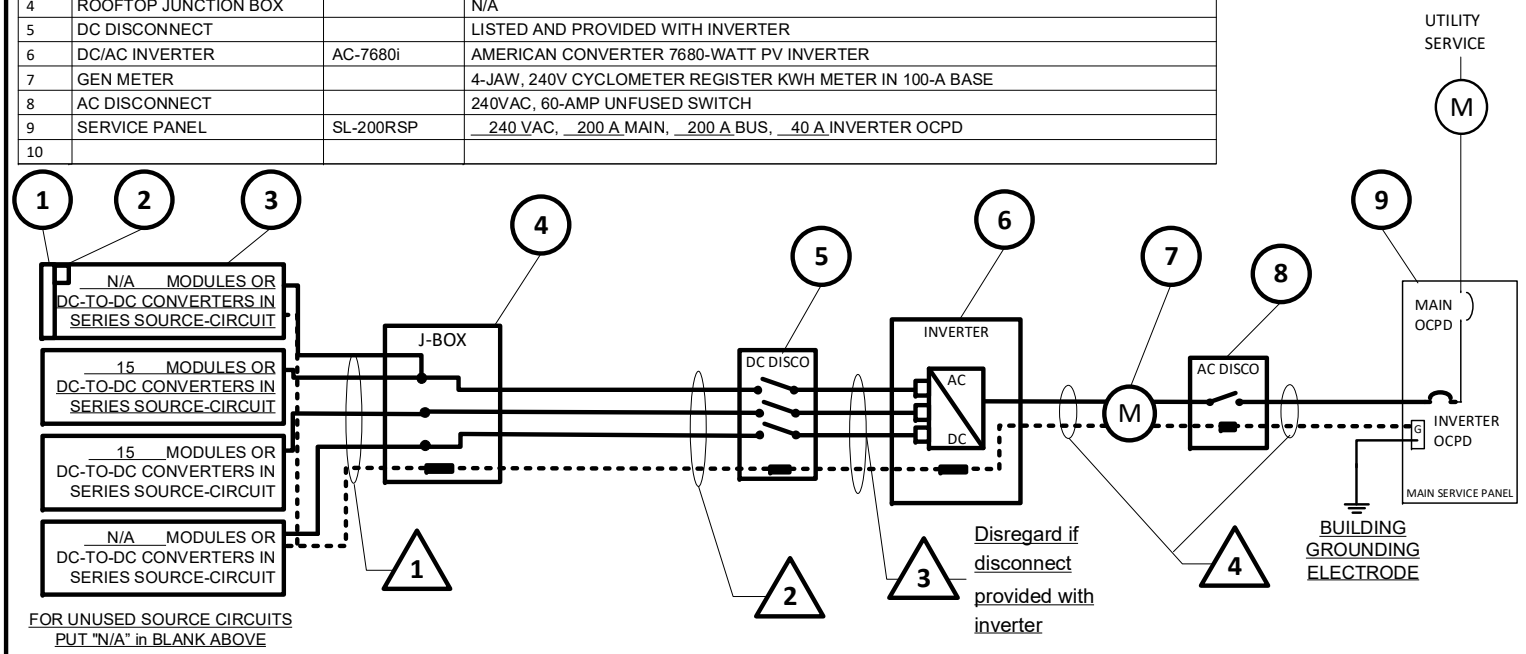
Contractor Name, Address and Phone:	Site Plan for Small-Scale, PV System with Sheathing Attached Array			
SolarBright 789 Washington St. Alexandria, VA 800-555-1212	Site Name: Joe and Jane Homeowner Site Address: 1200 Monroe St., Alexandria, VA System AC Size: 7.6 kW Solar Array			
Drawn By: Bill	SIZE	FSCM NO	DWG NO	REV

MA

EQUIPMENT SCHEDULE

TAG	DESCRIPTION	PART NUMBER	NOTES (N/A IF NOT USED)
1	SOLAR PV MODULE	AS-360	AMERICAN SOLAR 360-WATT PV MODULES
2	DC-DC CONVERTER	AC-SB360	AMERICAN CONVERTER SOLARBUCK 360-WATT DC-TO-DC CONVERTER
3	PV ARRAY CIRCUIT 1		N/A
	PV ARRAY CIRCUIT 2		15 DC-TO-DC CONVERTERS IN SERIES
	PV ARRAY CIRCUIT 3		15 DC-TO-DC CONVERTERS IN SERIES
	PV ARRAY CIRCUIT 4		N/A
4	ROOFTOP JUNCTION BOX		N/A
5	DC DISCONNECT		LISTED AND PROVIDED WITH INVERTER
6	DC/AC INVERTER	AC-7680i	AMERICAN CONVERTER 7680-WATT PV INVERTER
7	GEN METER		4-JAW, 240V CYCLOMETER REGISTER KWH METER IN 100-A BASE
8	AC DISCONNECT		240VAC, 60-AMP UNFUSED SWITCH
9	SERVICE PANEL	SL-200RSP	240 VAC, 200 A MAIN, 200 A BUS, 40 A INVERTER OCPD
10			



CONDUIT AND CONDUCTOR SCHEDULE

TAG	DESCRIPTION OR CONDUCTOR TYPE	COND. GAUGE	NUMBER OF CONDUCTORS	CONDUIT TYPE	CONDUIT SIZE
1	USE-2 ☐ or PV WIRE ☒	12	4-B	N/A	N/A
	BARE COPPER EQ. GRD. COND. (EGC)	6		N/A	N/A
2	THWN-2 ☒ or XHHW-2 ☐ or RHW-2 ☐	12	2-R, 2-B	EMT	¾"
	INSULATED EGC	12	1-G		
3	THWN-2 ☐ or XHHW-2 ☐ or RHW-2 ☐		N/A		
	INSULATED EGC		N/A		
4	THWN-2 ☒ or XHHW-2 ☐ or RHW-2 ☐	8	1-B, 1-R, 1-W	EMT	¾"
	INSULATED EGC	10	1-G		

Contractor Name, Address and Phone:

SolarBright
2688 Washington St.
Minneapolis, MN
800-555-1212

Drawn By:

Checked By:

One-Line Standard Electrical Diagram for Small-Scale, Single-Phase PV Systems

Site Name: Joe and Jane Homeowner
Site Address: 2400 Monroe St., St. Paul, MN
System AC Size: 7.6 kWac

SIZE	FSCM NO	DWG NO	REV
		E1.1a	

SCALE NTS | Date: | SHEET

PV MODULE RATINGS @ STC

MODULE MAKE	AMERICAN SOLAR
MODULE MODEL	AS-360
MAX POWER-POINT CURRENT (I_{MP})	9.1 A
MAX POWER-POINT VOLTAGE (V_{MP})	39.4 V
OPEN-CIRCUIT VOLTAGE (V_{OC})	47.4 V
SHORT-CIRCUIT CURRENT (I_{SC})	9.7 A
MAX SERIES FUSE (OCPD)	25 A
MAXIMUM POWER (P_{MAX})	360 W
MAX VOLTAGE (TYP 600V_{DC})	1000 V
VOC TEMP COEFF (mV/°C ☐ or %/°C ☒)	-0.28

NOTE FOR ARRAY CIRCUIT WIRING

LOWEST EXPECTED AMBIENT TEMPERATURE BASED ON ASHRAE MINIMUM MEAN EXTREME DRY BULB TEMPERATURE FOR ASHRAE LOCATION MOST SIMILAR TO INSTALLATION LOCATION.
LOWEST EXPECTED AMBIENT TEMP -27 °C

NOTES FOR INVERTER CIRCUITS

1) IF UTILITY REQUIRES A VISIBLE-BREAK SWITCH, DOES THIS SWITCH MEET THE REQUIREMENT? YES ☒ NO ☐ N/A ☐

2) IF GENERATION METER REQUIRED, DOES THIS METER SOCKET MEET THE REQUIREMENT? YES ☐ NO ☐ N/A ☒

3) SIZE INVERTER OUTPUT CIRCUIT (AC) CONDUCTORS ACCORDING TO INVERTER OCPD AMPERE RATING. (See Table 705.12)

4) DOES TOTAL SUPPLY BREAKERS COMPLY WITH
   a) 120% BUSBAR RULE IN 705.12(B) [2017 NEC]
   b) SUM OF BRANCH BREAKERS
   c) POWER CONTROL SYSTEMS
   d) LISTED EQUIPMENT FOR COMBINING SOURCES

SIGN FOR DISTRIBUTION PANELS

THIS PANEL FED BY MULTIPLE SOURCES (UTILITY AND SOLAR)

SIGN FOR 120% OPTION (if used)

WARNING:
INVERTER OUTPUT CONNECTION;
DO NOT RELOCATE THIS
OVERCURRENT DEVICE.

NOTES FOR ALL DRAWINGS:

OCPD = OVERCURRENT PROTECTIVE DEVICE

NATIONAL ELECTRICAL CODE® REFERENCES SHOWN AS *(NEC XXX.XX)*

DC-TO-DC CONVERTER RATINGS (if used)

CONVERTER MAKE	AMERICAN CONVERTER
CONVERTER MODEL	AI-360
MAX CURRENT	12 A
MAX VOLTAGE	80 V
MAXIMUM POWER	360 W
MAX OUTPUT CIRCUIT V (TYP 600V_{DC})	600 V

INVERTER RATINGS

INVERTER MAKE	AMERICAN CONVERTER
INVERTER MODEL	AC-7680i
MAX DC VOLT RATING	80 V
MAX POWER @ 40°C	7680 W
NOMINAL AC VOLTAGE	240 V
MAX AC CURRENT	32 A
MAX OCPD RATING	40 A

SIGN FOR SUM OF BREAKERS OPTION (if used)

WARNING:
TOTAL RATING OF ALL OVERCURRENT DEVICES EXCLUDING MAIN SUPPLY OVERCURRENT DEVICE SHALL NOT EXCEED AMPACITY OF BUSBAR.

*SIGN FOR PV DC DISCONNECT (if used)

PHOTOVOLTAIC POWER SOURCE	
MAX VOLTAGE	575 V
MAX CIRCUIT CURRENT	15 A
MAX OUTPUT CURRENT	12 A

WARNING: ELECTRICAL SHOCK HAZARD–LINE AND LOAD MAY BE ENERGIZED IN OPEN POSITION

SIGN FOR PV SYSTEM DISCONNECT (if used)

PV SYSTEM DISCONNECT	
AC OUTPUT CURRENT	32 A
NOMINAL AC VOLTAGE	240 V

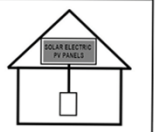
SIGN FOR ESS DISCONNECT (if used)

ESS DISCONNECT	
ESS VOLTAGE (AC OR DC)	240 Vac

SIGN FOR NEC 690.12 (if used—shaded is yellow)

SOLAR PV SYSTEM EQUIPPED WITH RAPID SHUTDOWN

TURN RAPID SHUTDOWN SWITCH TO THE "OFF" POSITION TO SHUTDOWN PV SYSTEM AND REDUCE SHOCK HAZARD IN ARRAY



*NOTE: MICROINVERTER AND AC MODULE SYSTEMS DO NOT NEED DC DISCONNECT SIGN SINCE MARKING ON PV MODULE COVERS NEEDED INFORMATION

Contractor Name, Address and Phone:

SolarBright
2688 Washington St.
Cary, NC
800-555-1212

TITLE

Notes for One-Line Diagram for PV and Energy Storage Systems

Site Name: Joe and Jane Homeowner
Site Address: 2400 Monroe St., La Crosse, WI
Size: 7.1KW NEW SOLAR; 7.6KW, 20KWH ESS

DRAWN BY:	CHECKED BY:	SCALE	DATE	DWG NO	REV NO
BILL	TED	NTS	15 JULY 2023	PVESS 1.2a	0

Microinverter Standard Plans--Scope

- Use this plan ONLY for systems using microinverters or ac modules (ACM), with no more than 4 output circuits, one PV module/microinverter, installed on the roof of a one- or two-family dwelling or similar structure.
- The PV system must interconnect to the load side of a 120/240Vac, service panel rated 400A or less (80-amp breaker or less).

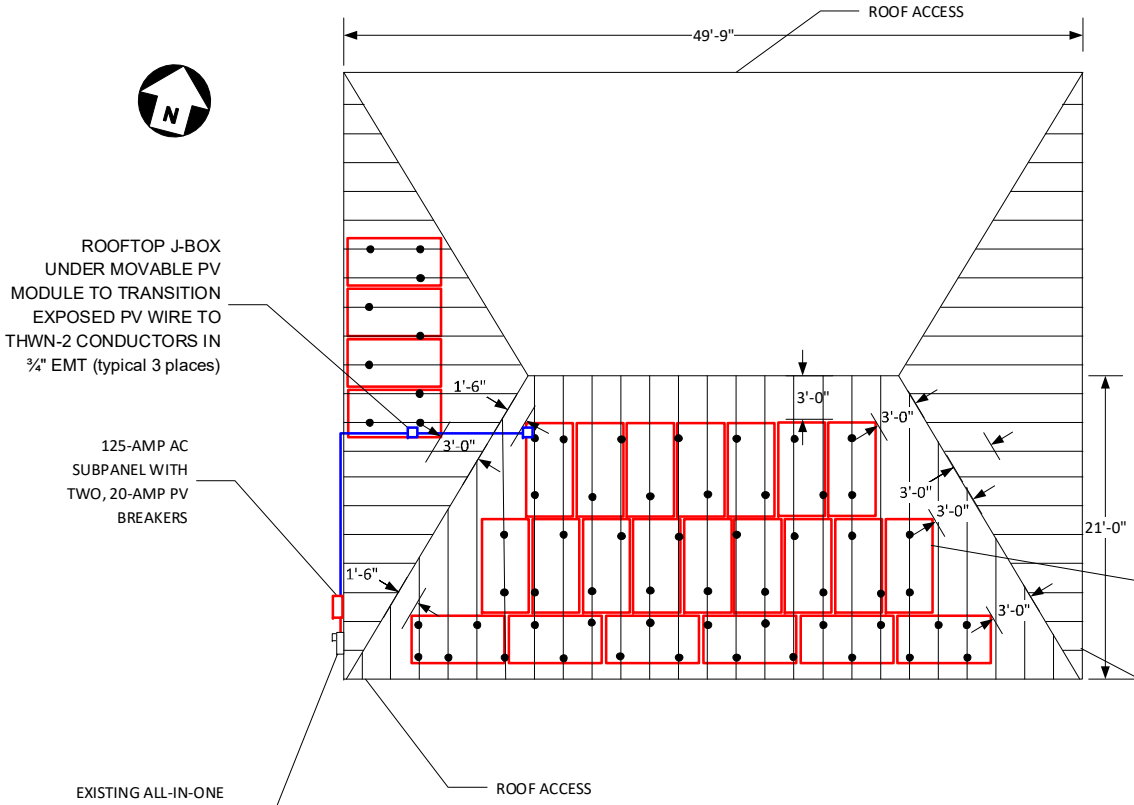
Example 2— 7.6kW Microinverter PV System

- PV System Components
  - PV Modules
    - Qty. 26, 360W, American Solar AS360
  - Inverters
    - Qty. 26, 295W, American Inverter AI-295
  - Mounting System
    - OmniRack ModMount 4.0; Maximum span 72”;
  - House
    - Roof Pitch 4:12; House built in 1988. Comp shingle roof. [structurally compliant]

Form Fill-Out Demonstration

Compliance Document
Standard Plan—Simplified Microinverter
Structural Criteria (compliant)

Member Attached System



STRUCTURAL NOTES:
1. ROOF PITCH 4:12
2. ROOF COVERING: SINGLE LAYER ASPHALT SHINGLES
3. BLACK DOTS REPRESENT ANCHOR POINTS
4. MEAN ROOF HEIGHT LESS THAN 30'
5. ROOF STRUCTURE: 2x6 RAFTERS ON 24" CENTERS WITH MIDSPAN SUPPORT—MAX SPAN 11'6".
6. ROOF DECK 7/16" OSB
7.MAXIMUM ANCHOR POINT HORIZONTAL DISTANCE: 48"
8. DWELLING IN WIND EXPOSURE B
9. ANCHORS ARE 5/16" LAG SCREWS WITH 2.5 EMBEDMENT IN STRUCTURE
10. EACH ANCHOR FLASHED WITH "ANCHOR-FLASH" ALUMINUM FLASHING
11. ALL MODULE RAILS RUN PERPENDICULAR TO RAFTERS
12. PV MODULES MOUNTED 5" ABOVE ROOF COVERING
13. PV MODULES CERTIFIED TYPE 1 FOR FIRE PURPOSES
14. OMNIRACK MOD 3.0 LISTED CLASS A WITH TYPE 1 MODULES

26 AMERICAN SOLAR AS 360 MODULES EACH CONNECTED TO AN AMERICAN INVERTER AS-295 MICROINVERTER IN TWO CIRCUITS OF 15 MICROINVERTERS EACH ON EXISTING ROOF STRUCTURE

Contractor Name, Address and Phone: SolarBright 1234 Washington St. Alexandria, VA 800-555-1212	Site Plan for Small-Scale, Single-Phase PV Systems Site Name: Joe and Jane Homeowner Site Address: 12 Monroe St, Alexandria, VA System AC Size: 7.6 kW Solar Array			
Drawn By: Bill	SIZE	FSCM NO	DWG NO S1.1a	REV 0

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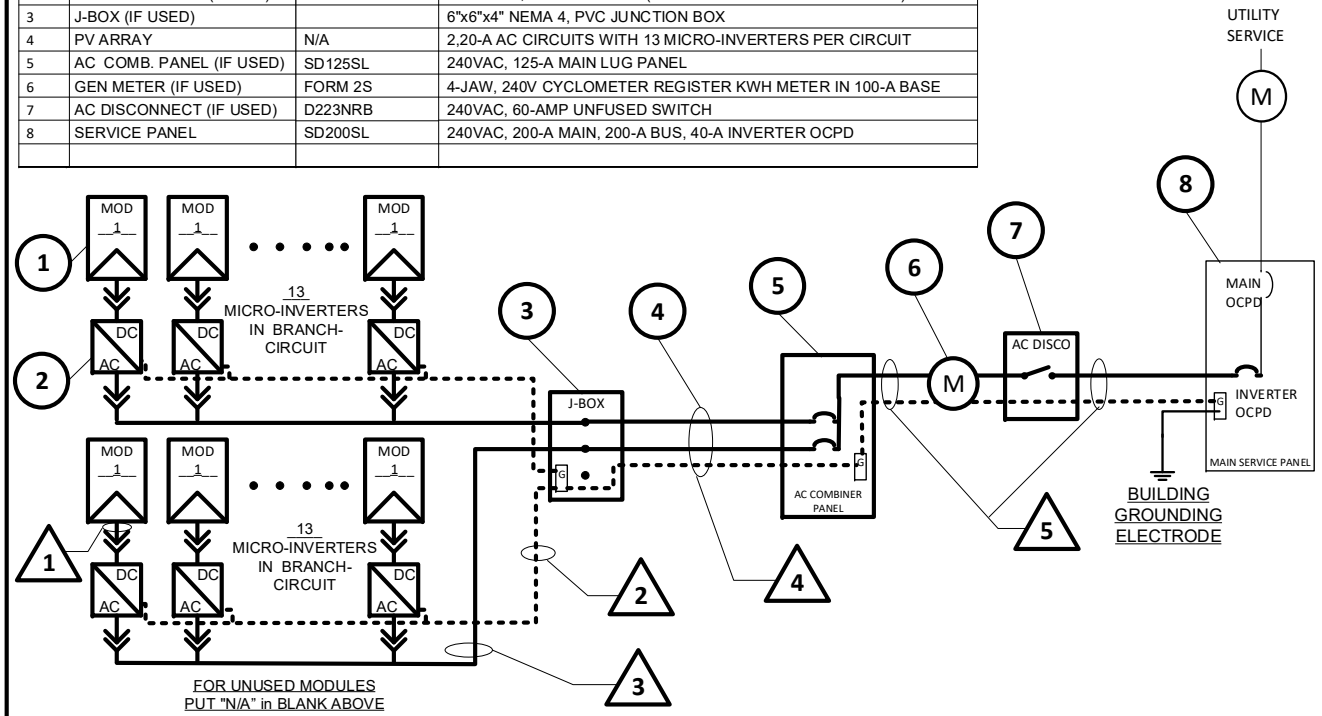
EQUIPMENT SCHEDULE			
TAG	DESCRIPTION	PART NUMBER	NOTES
1	PV DC or AC MODULE	AS 360	AMERICAN SOLAR, QUANTITY - 26 (SEE NOTES SHEET FOR DETAILS)
2	DC/AC INVERTER (MICRO)	AI-295	295 WATT, SINGLE PHASE (SEE NOTES SHEET FOR DETAILS)
3	J-BOX (IF USED)		6"x6"x4" NEMA 4, PVC JUNCTION BOX
4	PV ARRAY	N/A	2,20-A AC CIRCUITS WITH 13 MICRO-INVERTERS PER CIRCUIT
5	AC COMB. PANEL (IF USED)	SD125SL	240VAC, 125-A MAIN LUG PANEL
6	GEN METER (IF USED)	FORM 2S	4-JAW, 240V CYCLOMETER REGISTER KWH METER IN 100-A BASE
7	AC DISCONNECT (IF USED)	D223NRB	240VAC, 60-AMP UNFUSED SWITCH
8	SERVICE PANEL	SD200SL	240VAC, 200-A MAIN, 200-A BUS, 40-A INVERTER OCPD



CONDUIT AND CONDUCTOR SCHEDULE					
TAG	DESCRIPTION OR CONDUCTOR TYPE	COND. GAUGE	NUMBER OF CONDUCTORS	CONDUIT TYPE	CONDUIT SIZE
1	USE-2 ☐ or PV WIRE ☐ or MFG Cable ☒	MFG	MFG Cable	N/A	N/A
2	EQUIPMENT GROUNDING COND. (EGC)	6 AWG	1 BARE CU	N/A	N/A
3	EXTERIOR CABLE LISTED W/ INV.	MFG	MFG Cable	N/A	N/A
4	THWN-2 ☒ or XHHW-2 ☐ or RHW-2 ☐	12 AWG	2-B, 2-R, 2-W	EMT	¾"
	INSULATED EGC	12 AWG	1 GREEN	SAME	SAME
5	THWN-2 ☒ or XHHW-2 ☐ or RHW-2 ☐	8 AWG	1-R, 1-B, 1-W	EMT	¾"
	INSULATED EGC	10 AWG	1 GREEN	SAME	SAME

Contractor Name, Address and Phone:

SolarBright
2688 Washington St.
Minneapolis, MN
800-555-1212

Drawn By: Bill

Checked By: Ted

TITLE One-Line Standard Electrical Diagram for Micro-Inverter or AC Module PV Systems

PROJECT Site Name: Joe and Jane Homeowner
Site Address: 2400 Monroe St., St. Paul, MN
System AC Size: 7.6 kWac

SIZE	FSCM NO	DWG NO	REV
		E1.1b	0

SCALE NTS | Date: | SHEET

PV MODULE RATINGS @ STC

MODULE MAKE	AMERICAN SOLAR
MODULE MODEL	AS-360
MAX POWER-POINT CURRENT (I_{MP})	9.1 A
MAX POWER-POINT VOLTAGE (V_{MP})	39.4 V
OPEN-CIRCUIT VOLTAGE (V_{OC})	47.4 V
SHORT-CIRCUIT CURRENT (I_{SC})	9.7 A
MAX SERIES FUSE (OCPD)	25 A
MAXIMUM POWER (P_{MAX})	360 W
MAX VOLTAGE (TYP 600V_{DC})	1000 V
VOC TEMP COEFF (mV/°C☐ or %/°C☒)	-0.28

NOTE FOR ARRAY CIRCUIT WIRING

LOWEST EXPECTED AMBIENT TEMPERATURE BASED ON ASHRAE MINIMUM MEAN EXTREME DRY BULB TEMPERATURE FOR ASHRAE LOCATION MOST SIMILAR TO INSTALLATION LOCATION.
LOWEST EXPECTED AMBIENT TEMP ___-27___ °C

NOTES FOR INVERTER CIRCUITS

1) IF UTILITY REQUIRES A VISIBLE-BREAK SWITCH, DOES THIS SWITCH MEET THE REQUIREMENT? YES☒ NO ☐ N/A ☐

2) IF GENERATION METER REQUIRED, DOES THIS METER SOCKET MEET THE REQUIREMENT? YES☐ NO ☐ N/A ☒

3) SIZE INVERTER OUTPUT CIRCUIT (AC) CONDUCTORS ACCORDING TO INVERTER OCPD AMPERE RATING. (See Table 705.12)

4) DOES TOTAL SUPPLY BREAKERS COMPLY WITH
a) 120% BUSBAR RULE IN 705.12(B) [2017 NEC]
b) SUM OF BRANCH BREAKERS
c) POWER CONTROL SYSTEMS
d) LISTED EQUIPMENT FOR COMBINING SOURCES

NOTES FOR ALL DRAWINGS:

OCPD = OVERCURRENT PROTECTIVE DEVICE

NATIONAL ELECTRICAL CODE® REFERENCES SHOWN AS *(NEC XXX.XX)*

DC-TO-DC CONVERTER RATINGS (if used)

CONVERTER MAKE	
CONVERTER MODEL	
MAX CURRENT	
MAX VOLTAGE	
MAXIMUM POWER	
MAX OUTPUT CIRCUIT V (TYP 600V_{DC})	

INVERTER RATINGS

INVERTER MAKE	AMERICAN CONVERTER
INVERTER MODEL	AC-295i
MAX DC VOLT RATING	80 V
MAX POWER @ 40°C	295 W
NOMINAL AC VOLTAGE	240 V
MAX AC CURRENT	1.23 A
MAX OCPD RATING	20 A

*SIGN FOR PV DC DISCONNECT (if used)

PHOTOVOLTAIC POWER SOURCE	
MAX VOLTAGE	V
MAX CIRCUIT CURRENT	A
MAX OUTPUT CURRENT	A

WARNING: ELECTRICAL SHOCK HAZARD–LINE AND LOAD MAY BE ENERGIZED IN OPEN POSITION

SIGN FOR PV SYSTEM DISCONNECT (if used)

PV SYSTEM DISCONNECT	
AC OUTPUT CURRENT	32 A
NOMINAL AC VOLTAGE	240 V

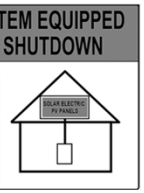
SIGN FOR ESS DISCONNECT (if used)

ESS DISCONNECT	
ESS VOLTAGE (AC OR DC)	240 Vac

SIGN FOR NEC 690.12 (if used—shaded is yellow)

SOLAR PV SYSTEM EQUIPPED WITH RAPID SHUTDOWN

TURN RAPID SHUTDOWN SWITCH TO THE "OFF" POSITION TO SHUTDOWN PV SYSTEM AND REDUCE SHOCK HAZARD IN ARRAY



*NOTE: MICROINVERTER AND AC MODULE SYSTEMS DO NOT NEED DC DISCONNECT SIGN SINCE MARKING ON PV MODULE COVERS NEEDED INFORMATION

SIGN FOR DISTRIBUTION PANELS

THIS PANEL FED BY MULTIPLE SOURCES (UTILITY AND SOLAR)

SIGN FOR 120% OPTION (if used)

WARNING:
INVERTER OUTPUT CONNECTION;
DO NOT RELOCATE THIS
OVERCURRENT DEVICE.

SIGN FOR SUM OF BREAKERS OPTION (if used)

WARNING:
TOTAL RATING OF ALL OVERCURRENT DEVICES EXCLUDING MAIN SUPPLY OVERCURRENT DEVICE SHALL NOT EXCEED AMPACITY OF BUSBAR.

Contractor Name, Address and Phone:

SolarBright
2688 Washington St.
Cary, NC
800-555-1212

TITLE

Notes for One-Line Diagram for PV and Energy Storage Systems

Site Name: Joe and Jane Homeowner
Site Address: 2400 Monroe St., La Crosse, WI
Size: 7.1KW NEW SOLAR; 7.6KW, 20KWH ESS

DRAWN BY:	CHECKED BY:	SCALE	DATE	DWG NO	REV NO
BILL	TED	NTS	15 JULY 2023	PVESS 1.2a	0

Recently released!

New ESS Permitting Guidelines for Residential Energy Storage with PV

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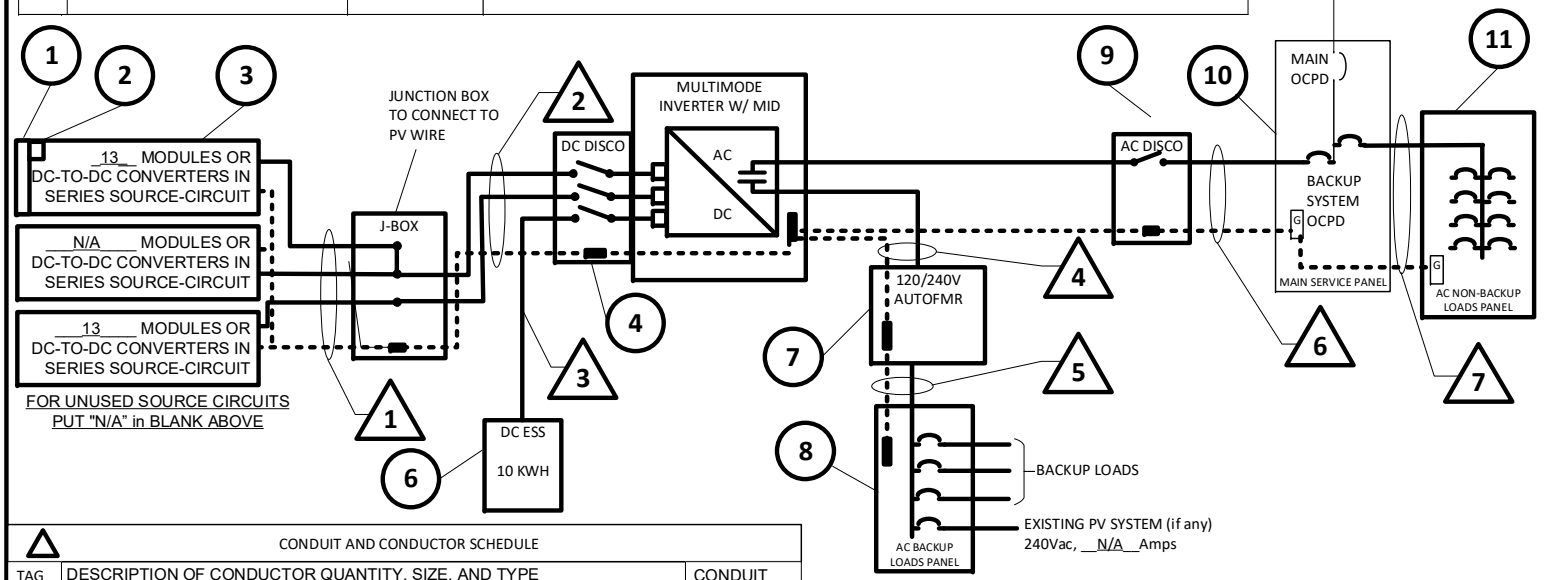
ICMA

Interconnection—MID in Inverter

- 120% Option for Small PV and/or ESS
- 100% Option for Larger PV or PV+ESS. Split service into 2 breakers to 2 subpanels (sum of breakers option)
- PV and/or ESS as part of 6-handle Service Disconnecting Means (ESS within load calcs for service or PCS installed to protect service)

EQUIPMENT SCHEDULE			
TAG	DESCRIPTION	PART NUMBER	NOTES (N/A IF NOT USED)
1	PV DC or AC MODULE	BMF 350	BIG MODULE 350, QTY 26 (SEE NOTES SHEET)
2	MODULE RSD	APS-RSD	APS SINGLE MODULE RSD WITH SUNSPEC COMS
3	PV ARRAY	N/A	TWO CIRCUITS, WITH 13 MODULES W/ RSD PER CIRCUIT
4	BATTERY (IF USED)	B-BOX H10.0	BYD BATTERY BOX H 10.0, 10KWH, 400VDC BATTERY
5	DC DISCONNECT	N/A	INCLUDED WITH LISTED INVERTER
6	DC/AC INVERTER	RHI-1P7.6K	SOLIS MULTI-MODE 7600 WATT, 240VAC, RHI-1P7.6-HVES-5G INVERTERV (SEE NOTES SHEET)
7	AUTOTRANSFORMER (IF USED)	6KXFMR	6KVA 120/240VAC AUTOTRANFORMER FOR 240VAC ONLY INVERTER
8	BACKUP PANEL (IF USED)	MLO125	240VAC, 125-A MAIN LUG PANEL FED BY 6KVA AUTOFORMER
9	AC DISCONNECT (IF USED)	D222NRB	240VAC, 60-AMP UNFUSED SWITCH (IF REQUIRED BY UTILITY)
10	SERVICE PANEL	SD200SL	240VAC, 200-A MAIN, 200-A BUS, W/ 60-A BACKUP SYSTEM CB (32-A BACKFEED CURRENT)
11	NONBACKUP PANEL (IF USED)	N/A	N/A



CONDUIT AND CONDUCTOR SCHEDULE		
TAG	DESCRIPTION OF CONDUCTOR QUANTITY, SIZE, AND TYPE	CONDUIT SIZE & TYPE
1	QTY. 4 12 AWG PV WIRE, 6 AWG BARE COPPER EGC	N/A
2	QTY. 5, 12 AWG, THWN-2 COND., 2-B, 2-R, 1-G	¾" EMT
3	QTY. 2, 10 AWG; QTY. 1, 10AWG, 1-G THWN CONDUCTORS	¾" EMT
4	QTY. 2, 10 AWG; QTY. 1, 10AWG, 1-G THWN CONDUCTORS	¾" EMT
5	QTY. 2, 6 AWG, QTY. 2, 10AWG, 1-W, 1-G THWN CONDUCTORS	1" EMT
6	QTY. 2, 6 AWG; QTY. 2, 10AWG, 1-W, 1-G THWN CONDUCTORS	1" EMT
7		

Contractor Name, Address and Phone:

SolarBright
2688 Washington St.
Hollywood, FL
800-555-1212

Drawn By: Bill

Checked By: Ted

One-Line Diagram: PV String or DC Converter Multi-Mode Inverter with DC ESS, and Backup Loads

Site Name: Joe and Jane Homeowner
Site Address: 2400 Monroe St., Hollywood, FL
Size: 7.6KW SOLAR; 6KW, 10KWH ESS

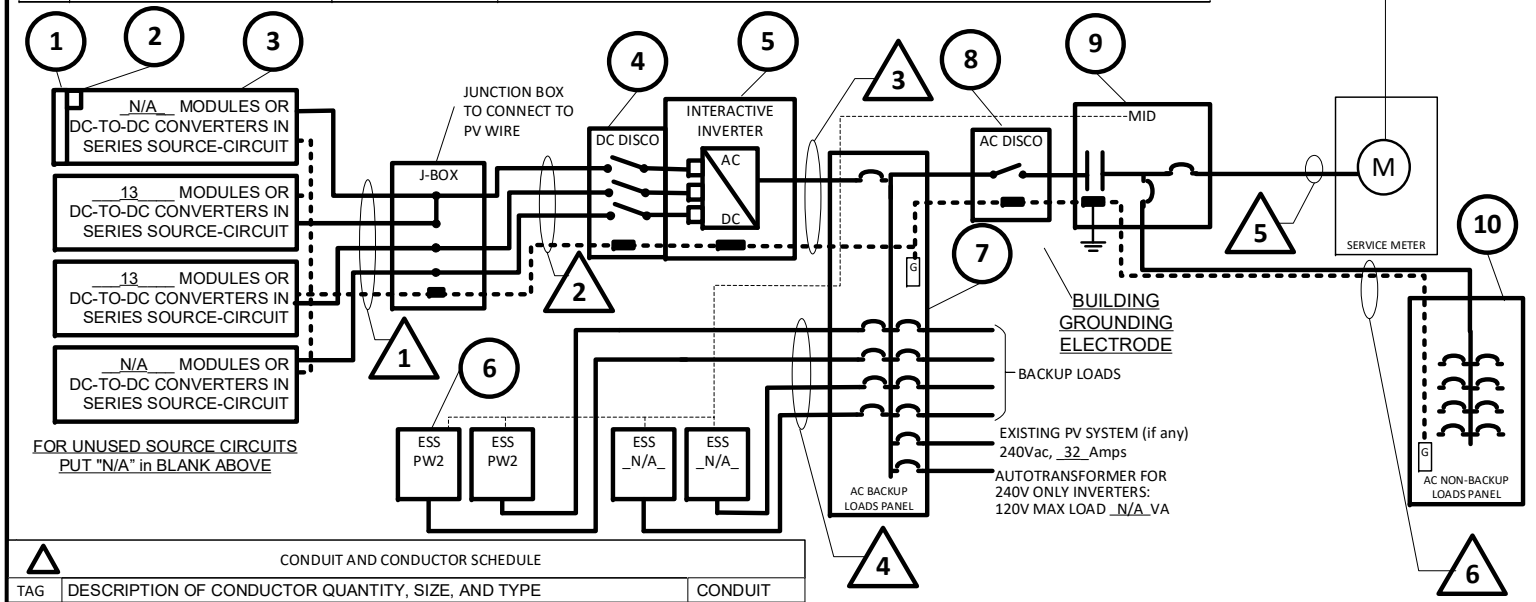
SIZE	FSCM NO	DWG NO	REV
		ESS1.1a	0

SCALE NTS | Date: | SHEET

Interconnection at MID

- 120% Option for Small PV or ESS
- 100% Option for Larger PV or PV+ESS. Split service into 2 breakers to 2 subpanels (MID on one of two breakers)
- Feed to MID as part of 6-handle Service Disconnecting Means
- Service disconnect at new MID

EQUIPMENT SCHEDULE			
TAG	DESCRIPTION	PART NUMBER	NOTES (N/A IF NOT USED)
1	PV DC or AC MODULE	BMF 350	BIG MODULE 350, QTY 26 (SEE NOTES SHEET)
2	MODULE RSD	APS-RSD	APS SINGLE MODULE RSD WITH SUNSPEC COMS
3	PV ARRAY	N/A	TWO CIRCUITS, WITH 13 MODULES W/ RSD PER CIRCUIT
4	DC DISCONNECT	N/A	INCLUDED WITH LISTED INVERTER
5	DC/AC INVERTER	AI-7600	7600 WATT, 240V, INTERACTIVE INVERTER (SEE NOTES SHEET)
6	ESS (IF USED)	PW2	TESLA POWERWALL 2, 30-A 13.6 KWH ESS WITH 120/240VAC OUTPUT
7	BACKUP PANEL (IF USED)	MLO200	240VAC, 200-A MAIN LUG PANEL FED BY 100-A CB IN MAIN PANEL
8	AC DISCONNECT (IF USED)	D223NRB	240VAC, 100-AMP UNFUSED SWITCH (IF REQUIRED BY UTILITY)TESLA GATEWAY
9	MID (IF USED)	GATEWAY2	MICROGRID INTERCONNECT DEVICE WITH 200-A SERVICE DISCONNECT
10	NONBACKUP PANEL (IF USED)	MLO125	240VAC, 125-A MAIN LUG PANEL FED BY 100-A CB IN MAIN PANEL



CONDUIT AND CONDUCTOR SCHEDULE		
TAG	DESCRIPTION OF CONDUCTOR QUANTITY, SIZE, AND TYPE	CONDUIT SIZE & TYPE
1	QTY. 4 12 AWG PV WIRE, 6 AWG BARE COPPER EGC	N/A
2	QTY. 5, 12 AWG, THWN-2 COND., 2-B, 2-R, 1-G	¾" EMT
3	QTY. 2, 8 AWG; QTY. 1, 10AWG, 1-G THWN CONDUCTORS	¾" EMT
4	QTY. 4, 10 AWG, THWN COND., 1-BL, 1-Y, 1-W, 1-G (2 PLACES)	2-¾" EMT
5	QTY. 2, 2/0 AWG; QTY. 1, 2AWG, 1-W; QTY.1, 2AWG, 1-G THWN CONDUCTORS	2" EMT
6	QTY. 2, 2 AWG; QTY. 1, 6AWG, 1-W; QTY.1, 6AWG, 1-G THWN CONDUCTORS	1½" EMT
7		
8		

Contractor Name, Address and Phone:

SolarBright
2688 Washington St.
Hollywood, FL
800-555-1212

Drawn By: Bill

Checked By: Ted

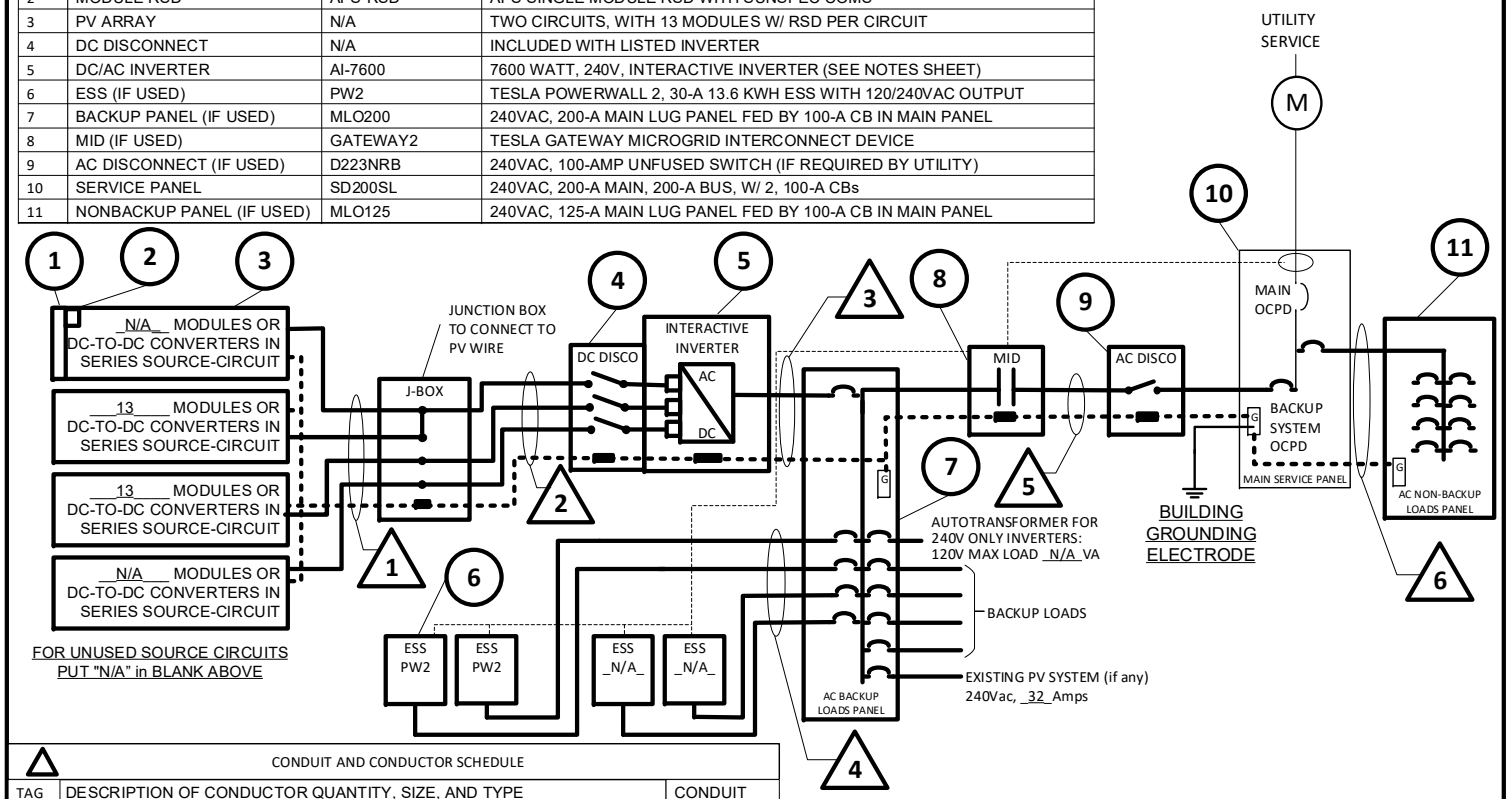
One-Line Diagram: PV String Inverter with ESS Inverters, MID, and Backup Loads

Site Name: Joe and Jane Homeowner
Site Address: 2400 Monroe St., Hollywood, FL
Size: 7.5KW NEW SOLAR; 10KW, 27KWH ESS

SIZE	FSCM NO	DWG NO	REV
		ESS1.1c	0

SCALE NTS | Date: | SHEET

EQUIPMENT SCHEDULE			
TAG	DESCRIPTION	PART NUMBER	NOTES (N/A IF NOT USED)
1	PV DC or AC MODULE	BMF 350	BIG MODULE 350, QTY 26 (SEE NOTES SHEET)
2	MODULE RSD	APS-RSD	APS SINGLE MODULE RSD WITH SUNSPEC COMS
3	PV ARRAY	N/A	TWO CIRCUITS, WITH 13 MODULES W/ RSD PER CIRCUIT
4	DC DISCONNECT	N/A	INCLUDED WITH LISTED INVERTER
5	DC/AC INVERTER	AI-7600	7600 WATT, 240V, INTERACTIVE INVERTER (SEE NOTES SHEET)
6	ESS (IF USED)	PW2	TESLA POWERWALL 2, 30-A 13.6 KWH ESS WITH 120/240VAC OUTPUT
7	BACKUP PANEL (IF USED)	MLO200	240VAC, 200-A MAIN LUG PANEL FED BY 100-A CB IN MAIN PANEL
8	MID (IF USED)	GATEWAY2	TESLA GATEWAY MICROGRID INTERCONNECT DEVICE
9	AC DISCONNECT (IF USED)	D223NRB	240VAC, 100-AMP UNFUSED SWITCH (IF REQUIRED BY UTILITY)
10	SERVICE PANEL	SD200SL	240VAC, 200-A MAIN, 200-A BUS, W/ 2, 100-A CBs
11	NONBACKUP PANEL (IF USED)	MLO125	240VAC, 125-A MAIN LUG PANEL FED BY 100-A CB IN MAIN PANEL



CONDUIT AND CONDUCTOR SCHEDULE		
TAG	DESCRIPTION OF CONDUCTOR QUANTITY, SIZE, AND TYPE	CONDUIT SIZE & TYPE
1	QTY. 4 12 AWG PV WIRE, 6 AWG BARE COPPER EGC	N/A
2	QTY. 5, 12 AWG, THWN-2 COND., 2-B, 2-R, 1-G	¾" EMT
3	QTY. 2, 8 AWG; QTY. 1, 10AWG, 1-G THWN CONDUCTORS	¾" EMT
4	QTY. 4, 10 AWG, THWN COND., 1-BL, 1-Y, 1-W, 1-G (2 PLACES)	2-¾" EMT
5	QTY. 2, 2 AWG; QTY. 1, 6AWG, 1-W; QTY.1, 6AWG, 1-G THWN CONDUCTORS	1½" EMT
6	QTY. 2, 2 AWG; QTY. 1, 6AWG, 1-W; QTY.1, 6AWG, 1-G THWN CONDUCTORS	1½" EMT
7		
8		

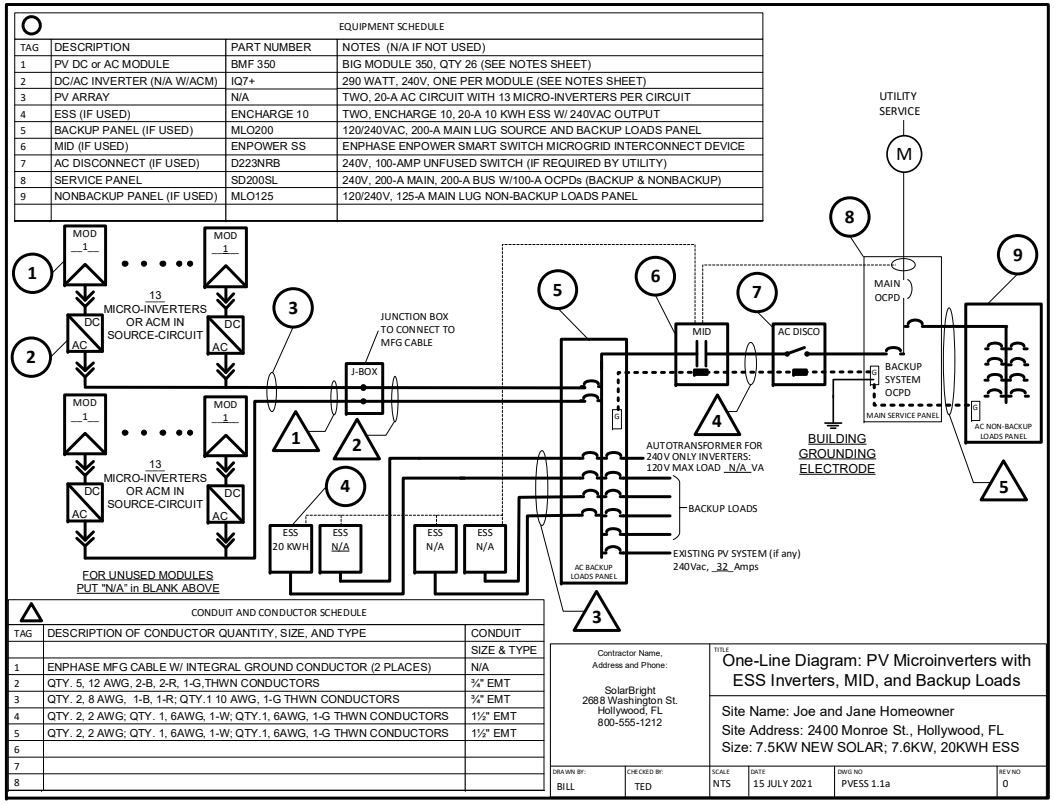
Contractor Name, Address and Phone:

SolarBright
2688 Washington St.
Hollywood, FL
800-555-1212

One-Line Diagram: PV String Inverter with ESS Inverters, MID, and Backup Loads

Site Name: Joe and Jane Homeowner
Site Address: 2400 Monroe St., Hollywood, FL
Size: 7.5KW NEW SOLAR; 10KW, 27KWH ESS

Drawn By:	Bill	SIZE	FSCM NO	DWG NO: ESS1.1c / REV: 0
Checked By:	Ted	SCALE: NTS	Date:	SHEET



EQUIPMENT SCHEDULE

TAG	DESCRIPTION	PART NUMBER	NOTES (N/A IF NOT USED)
1	PV DC or AC MODULE	BMF 350	BIG MODULE 350, QTY 26 (SEE NOTES SHEET)
2	DC/AC INVERTER (N/A W/ACM)	IQ7+	290 WATT, 240V, ONE PER MODULE (SEE NOTES SHEET)
3	PV ARRAY	N/A	TWO, 20-A AC CIRCUIT WITH 13 MICRO-INVERTERS PER CIRCUIT
4	ESS (IF USED)	ENCHARGE 10	TWO, ENCHARGE 10, 20-A 10 KWH ESS W/ 240VAC OUTPUT
5	BACKUP PANEL (IF USED)	MLO200	120/240VAC, 200-A MAIN LUG SOURCE AND BACKUP LOADS PANEL
6	MID (IF USED)	ENPOWER SS	ENPHASE ENPOWER SMART SWITCH MICROGRID INTERCONNECT DEVICE
7	AC DISCONNECT (IF USED)	D223NRB	240V, 100-AMP UNFUSED SWITCH (IF REQUIRED BY UTILITY)
8	SERVICE PANEL	SD200SL	240V, 200-A MAIN, 200-A BUS W/100-A OCPDs (BACKUP & NONBACKUP)
9	NONBACKUP PANEL (IF USED)	MLO125	120/240V, 125-A MAIN LUG NON-BACKUP LOADS PANEL

CONDUIT AND CONDUCTOR SCHEDULE

TAG	DESCRIPTION OF CONDUCTOR QUANTITY, SIZE, AND TYPE	CONDUIT SIZE & TYPE
1	ENPHASE MFG CABLE W/ INTEGRAL GROUND CONDUCTOR (2 PLACES)	N/A
2	QTY. 5, 12 AWG, 2-B, 2-R, 1-G,THWN CONDUCTORS	¾" EMT
3	QTY. 2, 8 AWG, 1-B, 1-R; QTY.1 10 AWG, 1-G THWN CONDUCTORS	¾" EMT
4	QTY. 2, 2 AWG; QTY. 1, 6AWG, 1-W; QTY.1, 6AWG, 1-G THWN CONDUCTORS	1½" EMT
5	QTY. 2, 2 AWG; QTY. 1, 6AWG, 1-W; QTY.1, 6AWG, 1-G THWN CONDUCTORS	1½" EMT
6		
7		
8		

Contractor Name, Address and Phone:
SolarBright
2688 Washington St.
Hollywood, FL
800-555-1212

TITLE: One-Line Diagram: PV Microinverters with ESS Inverters, MID, and Backup Loads

Site Name: Joe and Jane Homeowner
Site Address: 2400 Monroe St., Hollywood, FL
Size: 7.5KW NEW SOLAR; 7.6KW, 20KWH ESS

DRAWN BY:	CHECKED BY:	SCALE	DATE	DWG NO	REV NO
BILL	TED	NTS	15 JULY 2021	PVESS 1.1a	0

MID on Load Side with Ac Coupled PV Microinverters and Energy Storage System

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PV MODULE RATINGS @ STC

MODULE MAKE	AMERICAN SOLAR
MODULE MODEL	AS-360
MAX POWER-POINT CURRENT (I_{MP})	9.1 A
MAX POWER-POINT VOLTAGE (V_{MP})	39.4 V
OPEN-CIRCUIT VOLTAGE (V_{OC})	47.4 V
SHORT-CIRCUIT CURRENT (I_{SC})	9.7 A
MAX SERIES FUSE (OCPD)	25 A
MAXIMUM POWER (P_{MAX})	360 W
MAX VOLTAGE (TYP 600V$_{DC}$)	1000 V
VOC TEMP COEFF (mV/°C ☐ or %/°C ☒)	-0.28

NOTE FOR ARRAY CIRCUIT WIRING

LOWEST EXPECTED AMBIENT TEMPERATURE BASED ON ASHRAE MINIMUM MEAN EXTREME DRY BULB TEMPERATURE FOR ASHRAE LOCATION MOST SIMILAR TO INSTALLATION LOCATION.
LOWEST EXPECTED AMBIENT TEMP -12 °C

NOTES FOR INVERTER CIRCUITS

1) IF UTILITY REQUIRES A VISIBLE-BREAK SWITCH, DOES THIS SWITCH MEET THE REQUIREMENT? YES ☒ NO ☐ N/A ☐

2) IF GENERATION METER REQUIRED, DOES THIS METER SOCKET MEET THE REQUIREMENT? YES ☐ NO ☐ N/A ☒

3) SIZE INVERTER OUTPUT CIRCUIT (AC) CONDUCTORS ACCORDING TO INVERTER OCPD AMPERE RATING. (See Table 705.12)

4) DOES TOTAL SUPPLY BREAKERS COMPLY WITH
a) 120% BUSBAR RULE IN 705.12(B) [2017 NEC]
b) SUM OF BRANCH BREAKERS
c) POWER CONTROL SYSTEMS
d) LISTED EQUIPMENT FOR COMBINING SOURCES

NOTES FOR ALL DRAWINGS:

OCPD = OVERCURRENT PROTECTIVE DEVICE

NATIONAL ELECTRICAL CODE® REFERENCES SHOWN AS *(NEC XXX.XX)*

DC-TO-DC CONVERTER RATINGS (if used)

CONVERTER MAKE	
CONVERTER MODEL	
MAX CURRENT	
MAX VOLTAGE	
MAXIMUM POWER	
MAX OUTPUT CIRCUIT V (TYP 600V$_{DC}$)	

INVERTER RATINGS

INVERTER MAKE	AMERICAN CONVERTER
INVERTER MODEL	AC-295i
MAX DC VOLT RATING	80 V
MAX POWER @ 40°C	295 W
NOMINAL AC VOLTAGE	240 V
MAX AC CURRENT	1.23 A
MAX OCPD RATING	20 A

*SIGN FOR PV DC DISCONNECT (if used)

PHOTOVOLTAIC POWER SOURCE	
MAX VOLTAGE	V
MAX CIRCUIT CURRENT	A
MAX OUTPUT CURRENT	A

WARNING: ELECTRICAL SHOCK HAZARD–LINE AND LOAD MAY BE ENERGIZED IN OPEN POSITION

SIGN FOR PV SYSTEM DISCONNECT (if used)

PV SYSTEM DISCONNECT	
AC OUTPUT CURRENT	32 A
NOMINAL AC VOLTAGE	240 V

SIGN FOR ESS DISCONNECT (if used)

ESS DISCONNECT	
ESS VOLTAGE (AC OR DC)	240 Vac

SIGN FOR NEC 690.12 (if used—shaded is yellow)

SOLAR PV SYSTEM EQUIPPED WITH RAPID SHUTDOWN

TURN RAPID SHUTDOWN SWITCH TO THE "OFF" POSITION TO SHUTDOWN PV SYSTEM AND REDUCE SHOCK HAZARD IN ARRAY

*NOTE: MICROINVERTER AND AC MODULE SYSTEMS DO NOT NEED DC DISCONNECT SIGN SINCE MARKING ON PV MODULE COVERS NEEDED INFORMATION

SIGN FOR DISTRIBUTION PANELS

THIS PANEL FED BY MULTIPLE SOURCES (UTILITY AND SOLAR)

SIGN FOR 120% OPTION (if used)

WARNING:
INVERTER OUTPUT CONNECTION;
DO NOT RELOCATE THIS
OVERCURRENT DEVICE.

SIGN FOR SUM OF BREAKERS OPTION (if used)

WARNING:
TOTAL RATING OF ALL OVERCURRENT DEVICES EXCLUDING MAIN SUPPLY OVERCURRENT DEVICE SHALL NOT EXCEED AMPACITY OF BUSBAR.

Contractor Name, Address and Phone:

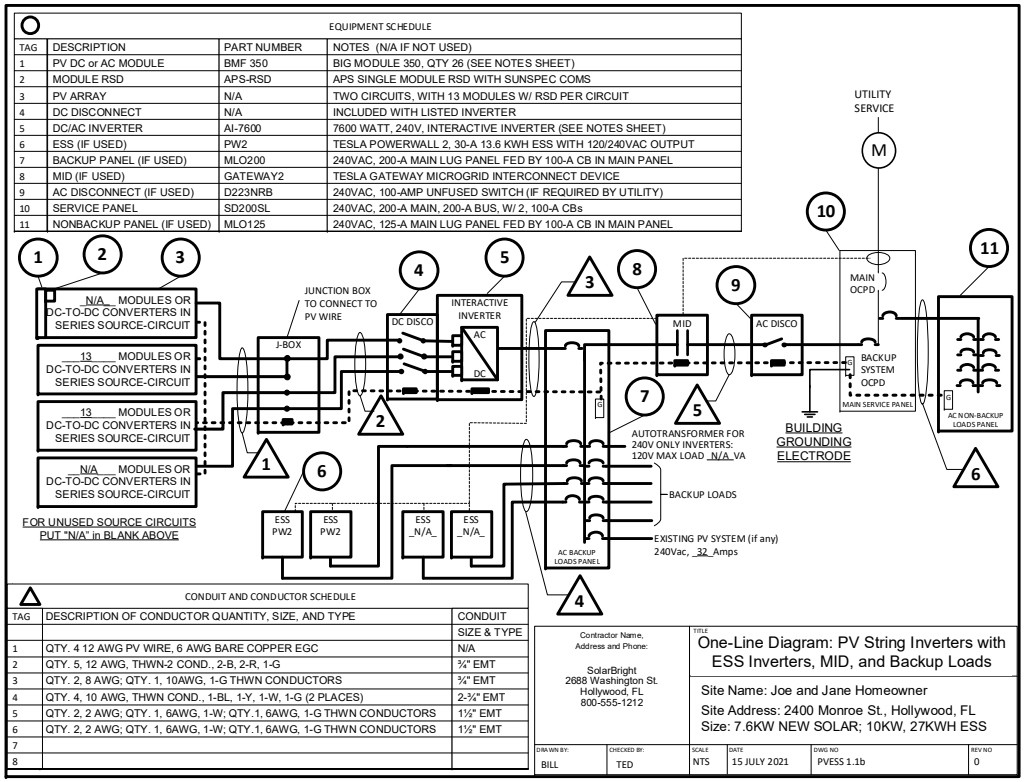
SolarBright
2688 Washington St.
Cary, NC
800-555-1212

TITLE

Notes for One-Line Diagram for PV and Energy Storage Systems

Site Name: Joe and Jane Homeowner
Site Address: 2400 Monroe St., Raleigh, NC
Size: 7.1KW NEW SOLAR; 7.6KW, 20KWH ESS

DRAWN BY:	CHECKED BY:	SCALE	DATE	DWG NO	REV NO
BILL	TED	NTS	15 JULY 2021	PVESS1.2a	0



MID on Load Side with Ac Coupled PV String Inverter and Energy Storage System

IREC INTERSTATE RENEWABLE ENERGY COUNCIL
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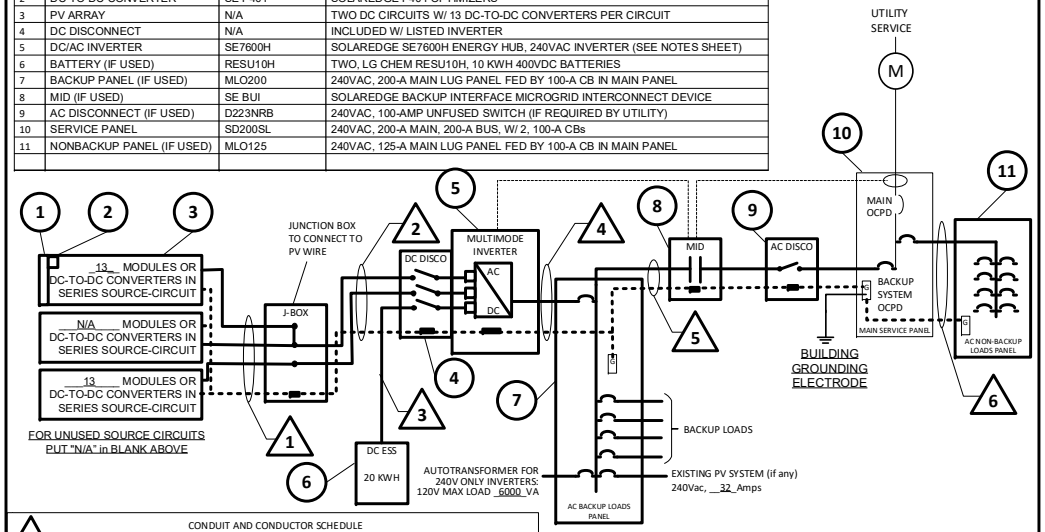
EQUIPMENT SCHEDULE

TAG	DESCRIPTION	PART NUMBER	NOTES (N/A IF NOT USED)
1	PV DC or AC MODULE	BMF 350	BIG MODULE 350-WATT (SEE NOTES SHEET)
2	DC-TO-DC CONVERTER	SE P401	SOLAREDGE P401 OPTIMIZERS
3	PV ARRAY	N/A	TWO DC CIRCUITS W/ 13 DC-TO-DC CONVERTERS PER CIRCUIT
4	DC DISCONNECT	N/A	INCLUDED W/ LISTED INVERTER
5	DC/AC INVERTER	SE7600H	SOLAREDGE SE7600H ENERGY HUB, 240VAC INVERTER (SEE NOTES SHEET)
6	BATTERY (IF USED)	RESU10H	TWO, LG CHEM RESU10H, 10 KWH 400VDC BATTERIES
7	BACKUP PANEL (IF USED)	MLO200	240VAC, 200-A MAIN LUG PANEL FED BY 100-A CB IN MAIN PANEL
8	MID (IF USED)	SE BUI	SOLAREDGE BACKUP INTERFACE MICROGRID INTERCONNECT DEVICE
9	AC DISCONNECT (IF USED)	D223NRB	240VAC, 100-AMP UNFUSED SWITCH (IF REQUIRED BY UTILITY)
10	SERVICE PANEL	SD200SL	240VAC, 200-A MAIN, 200-A BUS, W/ 2, 100-A CBs
11	NONBACKUP PANEL (IF USED)	MLO125	240VAC, 125-A MAIN LUG PANEL FED BY 100-A CB IN MAIN PANEL



CONDUIT AND CONDUCTOR SCHEDULE

TAG	DESCRIPTION OF CONDUCTOR QUANTITY, SIZE, AND TYPE	CONDUIT SIZE & TYPE
1	QTY. 4 12 AWG PV WIRE, 6 AWG BARE COPPER EGC	N/A
2	QTY. 5, 12 AWG, 2-B, 2-R, 1-G,THWN-2 CONDUCTORS	¾" EMT
3	QTY. 4, 10 AWG, 1-BL, 1-Y, 1-W, 1-G, THWN CONDUCTORS (2 PLACES)	2-¾" EMT
4	QTY. 2, 8 AWG; QTY. 1, 10AWG, 1-G THWN CONDUCTORS	¾" EMT
5	QTY. 2, 2 AWG; QTY. 1, 6AWG, 1-W; QTY.1, 6AWG, 1-G THWN CONDUCTORS	1½" EMT
6	QTY. 2, 2 AWG; QTY. 1, 6AWG, 1-W; QTY.1, 6AWG, 1-G THWN CONDUCTORS	1½" EMT
7		
8		

Contractor Name, Address and Phone:

SolarBright
2688 Washington St.
Hollywood, FL
800-555-1212

TITLE: One-Line Diagram: PV String or DC Converter with DC ESS Inverters, MID, and Backup Loads

Site Name: Joe and Jane Homeowner
Site Address: 2400 Monroe St., Hollywood, FL
Size: 7.6KW NEW SOLAR; 7.6KW, 20KWH ESS

DRAWN BY:	CHECKED BY:	SCALE	DATE	DWG NO	REV NO
BILL	TED	NTS	15 JULY 2021	PVESS 1.1d	0

PV MODULE RATINGS @ STC

MODULE MAKE	AMERICAN SOLAR
MODULE MODEL	AS-360
MAX POWER-POINT CURRENT (I_{MP})	9.1 A
MAX POWER-POINT VOLTAGE (V_{MP})	39.4 V
OPEN-CIRCUIT VOLTAGE (V_{OC})	47.4 V
SHORT-CIRCUIT CURRENT (I_{SC})	9.7 A
MAX SERIES FUSE (OCPD)	25 A
MAXIMUM POWER (P_{MAX})	360 W
MAX VOLTAGE (TYP 600V_{DC})	1000 V
VOC TEMP COEFF (mV/°C ☐ or %/°C ☒)	-0.28

NOTE FOR ARRAY CIRCUIT WIRING

LOWEST EXPECTED AMBIENT TEMPERATURE BASED ON ASHRAE MINIMUM MEAN EXTREME DRY BULB TEMPERATURE FOR ASHRAE LOCATION MOST SIMILAR TO INSTALLATION LOCATION.
LOWEST EXPECTED AMBIENT TEMP. -12 °C

NOTES FOR INVERTER CIRCUITS

1) IF UTILITY REQUIRES A VISIBLE-BREAK SWITCH, DOES THIS SWITCH MEET THE REQUIREMENT? YES ☒ NO ☐ N/A ☐

2) IF GENERATION METER REQUIRED, DOES THIS METER SOCKET MEET THE REQUIREMENT? YES ☐ NO ☐ N/A ☒

3) SIZE INVERTER OUTPUT CIRCUIT (AC) CONDUCTORS ACCORDING TO INVERTER OCPD AMPERE RATING. (See Table 705.12)

4) DOES TOTAL SUPPLY BREAKERS COMPLY WITH
a) 120% BUSBAR RULE IN 705.12(B) [2017 NEC]
b) SUM OF BRANCH BREAKERS
c) POWER CONTROL SYSTEMS
d) LISTED EQUIPMENT FOR COMBINING SOURCES

SIGN FOR DISTRIBUTION PANELS

THIS PANEL FED BY MULTIPLE SOURCES (UTILITY AND SOLAR)

SIGN FOR 120% OPTION (if used)

WARNING:
INVERTER OUTPUT CONNECTION;
DO NOT RELOCATE THIS
OVERCURRENT DEVICE.

NOTES FOR ALL DRAWINGS:

OCPD = OVERCURRENT PROTECTIVE DEVICE

NATIONAL ELECTRICAL CODE® REFERENCES SHOWN AS *(NEC XXX.XX)*

DC-TO-DC CONVERTER RATINGS (if used)

CONVERTER MAKE	AMERICAN CONVERTER
CONVERTER MODEL	AI-360
MAX CURRENT	12 A
MAX VOLTAGE	80 V
MAXIMUM POWER	360 W
MAX OUTPUT CIRCUIT V (TYP 600V_{DC})	600 V

INVERTER RATINGS

INVERTER MAKE	AMERICAN CONVERTER
INVERTER MODEL	AC-7680i
MAX DC VOLT RATING	80 V
MAX POWER @ 40°C	7680 W
NOMINAL AC VOLTAGE	240 V
MAX AC CURRENT	32 A
MAX OCPD RATING	40 A

SIGN FOR SUM OF BREAKERS OPTION (if used)

WARNING:
TOTAL RATING OF ALL OVERCURRENT DEVICES EXCLUDING MAIN SUPPLY OVERCURRENT DEVICE SHALL NOT EXCEED AMPACITY OF BUSBAR.

*SIGN FOR PV DC DISCONNECT (if used)

PHOTOVOLTAIC POWER SOURCE	
MAX VOLTAGE	575 V
MAX CIRCUIT CURRENT	15 A
MAX OUTPUT CURRENT	12 A

WARNING: ELECTRICAL SHOCK HAZARD–LINE AND LOAD MAY BE ENERGIZED IN OPEN POSITION

SIGN FOR PV SYSTEM DISCONNECT (if used)

PV SYSTEM DISCONNECT	
AC OUTPUT CURRENT	32 A
NOMINAL AC VOLTAGE	240 V

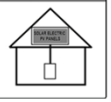
SIGN FOR ESS DISCONNECT (if used)

ESS DISCONNECT	
ESS VOLTAGE (AC OR DC)	240 Vac

SIGN FOR NEC 690.12 (if used—shaded is yellow)

SOLAR PV SYSTEM EQUIPPED WITH RAPID SHUTDOWN

TURN RAPID SHUTDOWN SWITCH TO THE "OFF" POSITION TO SHUTDOWN PV SYSTEM AND REDUCE SHOCK HAZARD IN ARRAY



*NOTE: MICROINVERTER AND AC MODULE SYSTEMS DO NOT NEED DC DISCONNECT SIGN SINCE MARKING ON PV MODULE COVERS NEEDED INFORMATION

Contractor Name, Address and Phone:
SolarBright
2688 Washington St.
Cary, NC
800-555-1212

TITLE: Notes for One-Line Diagram for PV and Energy Storage Systems

Site Name: Joe and Jane Homeowner
Site Address: 2400 Monroe St., Raleigh, NC
Size: 7.1KW NEW SOLAR; 7.6KW, 20KWH ESS

DRAWN BY:	CHECKED BY:	SCALE	DATE	DWG NO	REV NO
BILL	TED	NTS	15 JULY 2021	PVESS 1.2a	0

Notes for DC-to-DC Converter System

Inspection Guide for PV Systems—Field Guide

Make sure all PV system ac/dc disconnects and circuit breakers are in the open position and verify the following.

SHOULD BE “OFF” TO START THE INSPECTION

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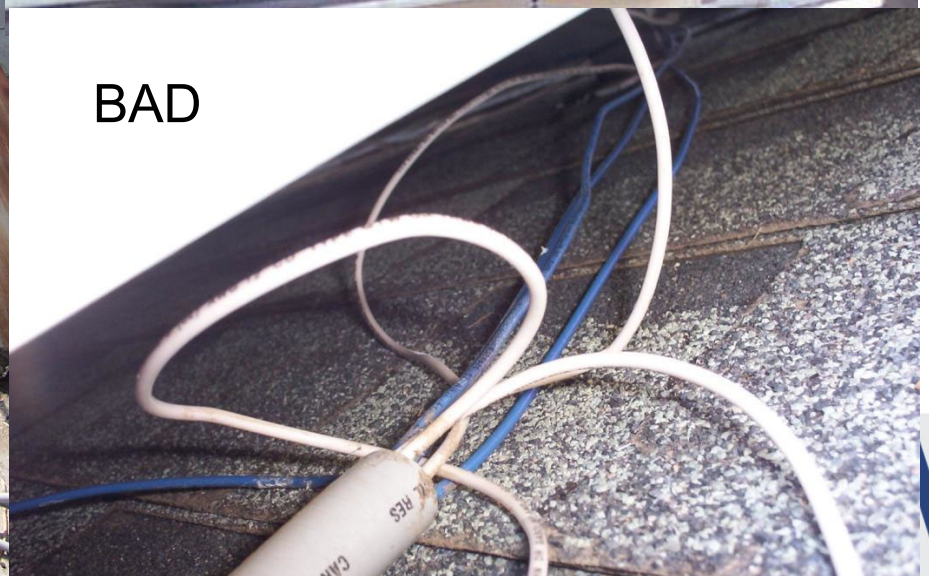
1. All work done in a neat and workmanlike manner (NEC 110.12)

1. All work done in a neat and workmanlike manner (NEC 110.12)

NO CONDUCTORS HANGING DOWN ATTRACTING ATTENTION OR DEBRIS

1. All work done in a neat and workmanlike manner (NEC 110.12)



2. PV module model number, quantity and location (also neat and workmanlike)

2. PV module model number, quantity and location (bad structurally and aesthetically)

3. Array mounting system/structural connections according to approved plan.
4. Roof penetrations flashed/sealed according to the approved plan.

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5. Array exposed cables are properly secured, supported and routed to prevent physical damage.

POORLY ROUTED
UNSECURED AND LAYING ON ROOF SURFACE AND VENT

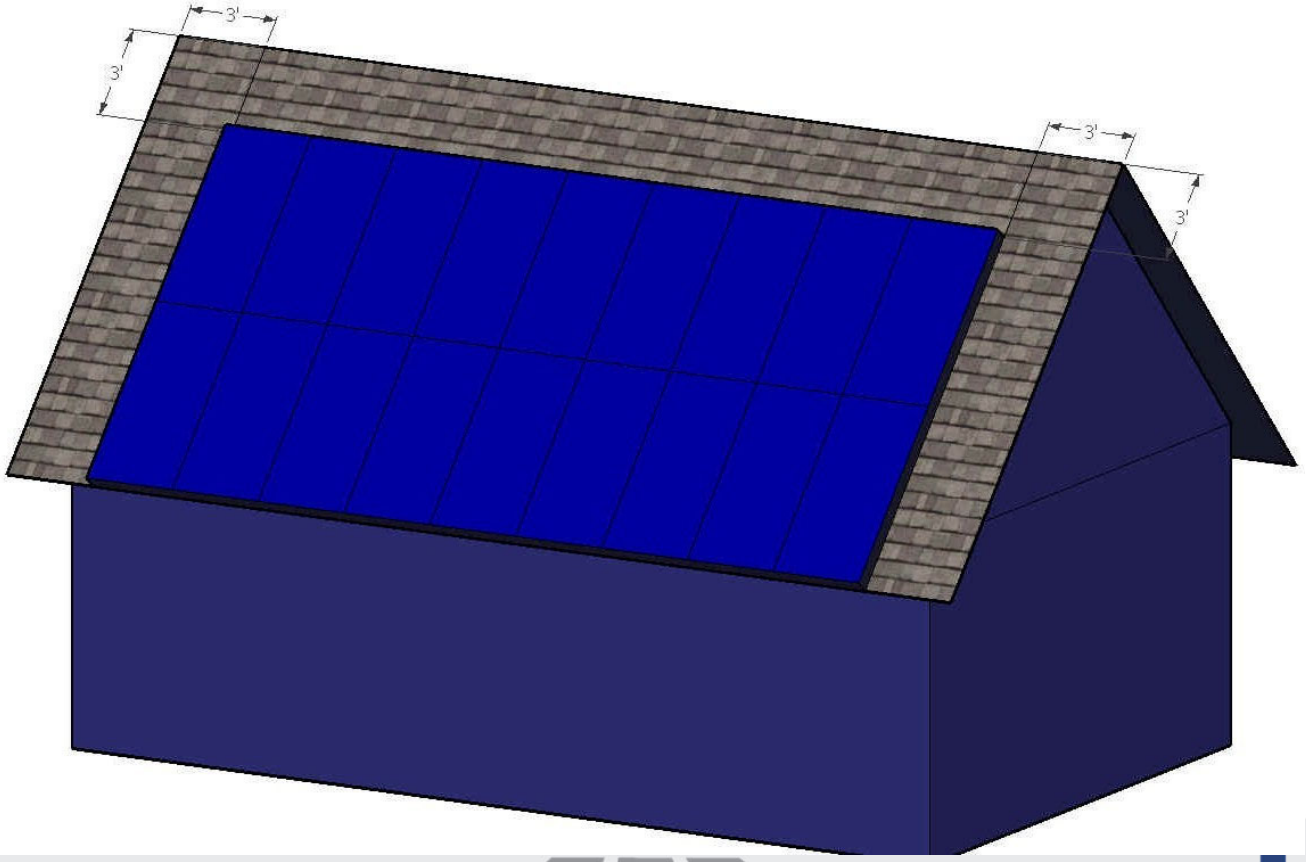
5. Array exposed cables are properly secured, supported and routed to prevent physical damage.

6. Conduit correctly installed and according to IRC R331.3 and NEC 690.4(F).

RUN ALONG RIDGE CONSISTENT WITH 690.4(F)

UNSECURED FLEX LAYING ON ROOF

7. Firefighter access according to approved plan.



7. Firefighter access according to approved plan.

FIRE FIGHTERS HAD PLENTY OF ROOM TO FIGHT THE FIRE AT THIS RESIDENCE

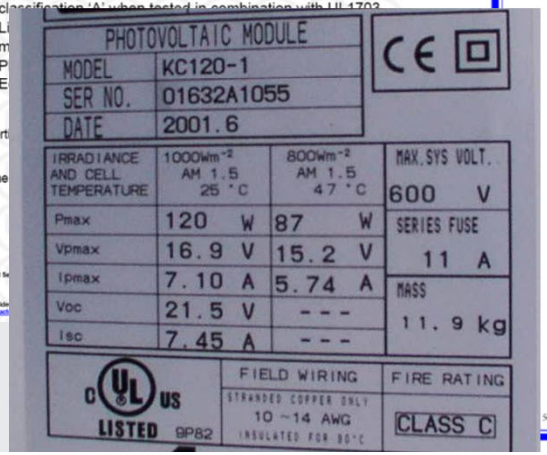
8. Roof-mounted PV systems have the required fire classification

CERTIFICATE OF COMPLIANCE

Certificate Number	20150102 - E346702
Report Reference	E346702 - 20140208
Issue Date	2015-JANUARY-02
Issued to:	ZEP SOLAR INC 161 Mitchell Blvd Ste 104 San Rafael, CA 94903-2085 USA
This is to certify that representative samples of	Mounting Systems, Mounting Devices, Clamping Devices and Ground Lugs for Use with Photovoltaic Modules and Panels Zep System (Steep Slope) with Type 1 modules
	Have been investigated by UL in accordance with the Standard(s) indicated on this Certificate.
Standard(s) for Safety:	UL 2703, "Outline of Investigation for Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels."
Additional Information:	See the UL Online Certifications Directory at www.ul.com/database for additional information
	The Zep System (Steep Slope) achieved a system fire classification 'A' when tested in combination with UL 1703

Only those products bearing the UL Cert
Certification and Follow-Up Service.

Look for the UL Certification Mark on the



CSA Group

Certificate of Compliance

Certificate: 2593411 **Master Contract:** 257442

Project: 70016432 **Date Issued:** December 3, 2014

Issued to: SolarWorld AG
24 Martin Luther King Strasse
Bonn, Nrth Rhine Westfalia 53175
Germany

The products listed below are eligible to bear the CSA Mark shown with adjacent indicators 'C' and 'US' for Canada and US or with adjacent indicator 'US' for US only or without either indicator for Canada only.

C US

Tatjana Galonja-Stojsavljevic

Issued by: Tatjana Galonja-Stojsavljevic

PRODUCTS
CLASS 5311 10 - POWER SUPPLIES - Photovoltaic Modules and Panels
CLASS 5311 90 - POWER SUPPLIES - Photovoltaic Modules and Panels - Certified to US Standards

PART A:

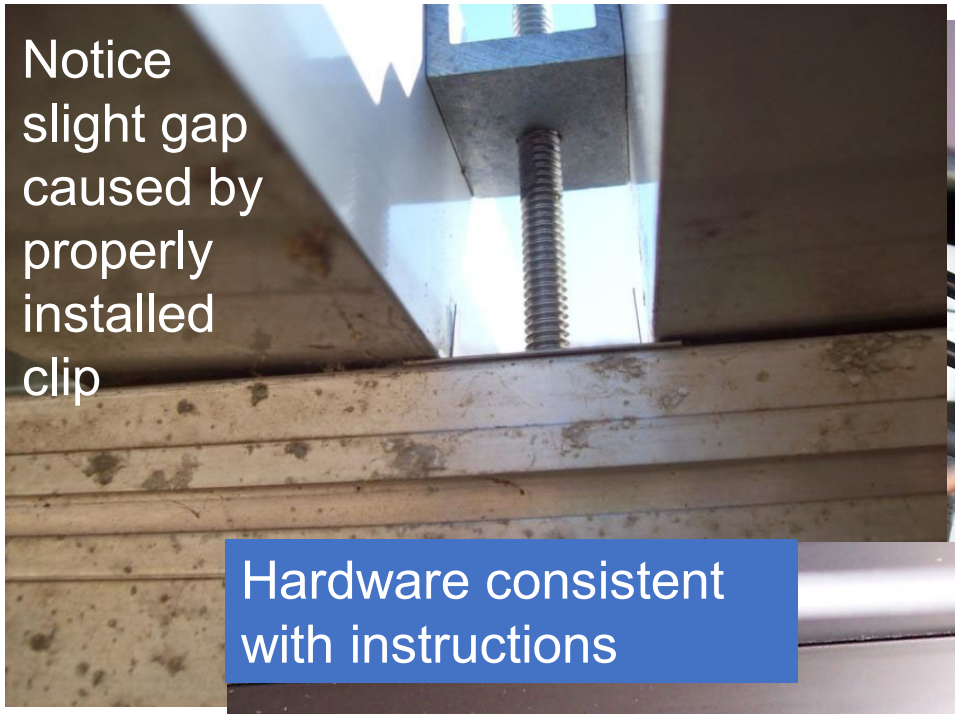
Photovoltaic Modules with maximum system voltage of 600 V dc or 1000 V dc and with Fire Performance of Type 1, Model Series:

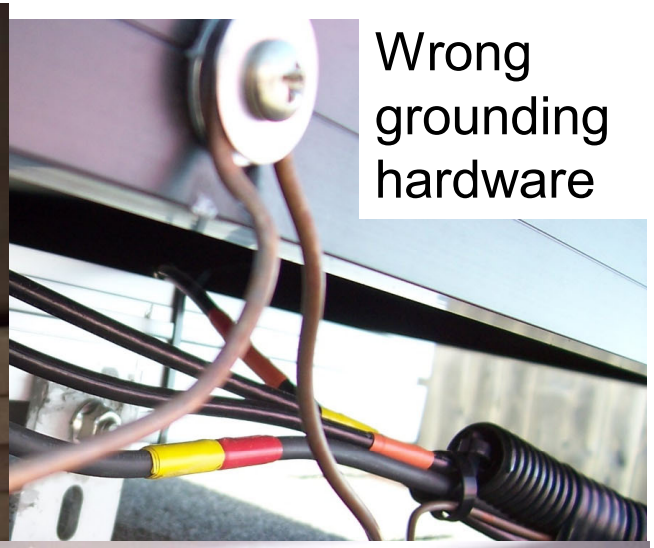
Sunmodule Plus SW, followed by 200, 205, 210, 215, 220, 225, 230, 235, 240, 245, 250, 255, 260, 265, 270, 275, 280, 285, 290, 295 or 300 followed by "mono", may be followed by "black".

Sunmodule Plus SW, followed by 200, 205, 210, 215, 220, 225, 230, 235, 240, 245, 250, 255, 260, 265, 270, 275 or 280 followed by "poly", may be followed by "black".

XL modules - "Sunmodule SW", followed by 260, 265, 270, 275, 280, 285, 290, 295, 300, 305, 310, 315, 320, 325, 330, 335, 340, 345, 350, 355 or 360 followed by "XL mono", may be followed by "black"

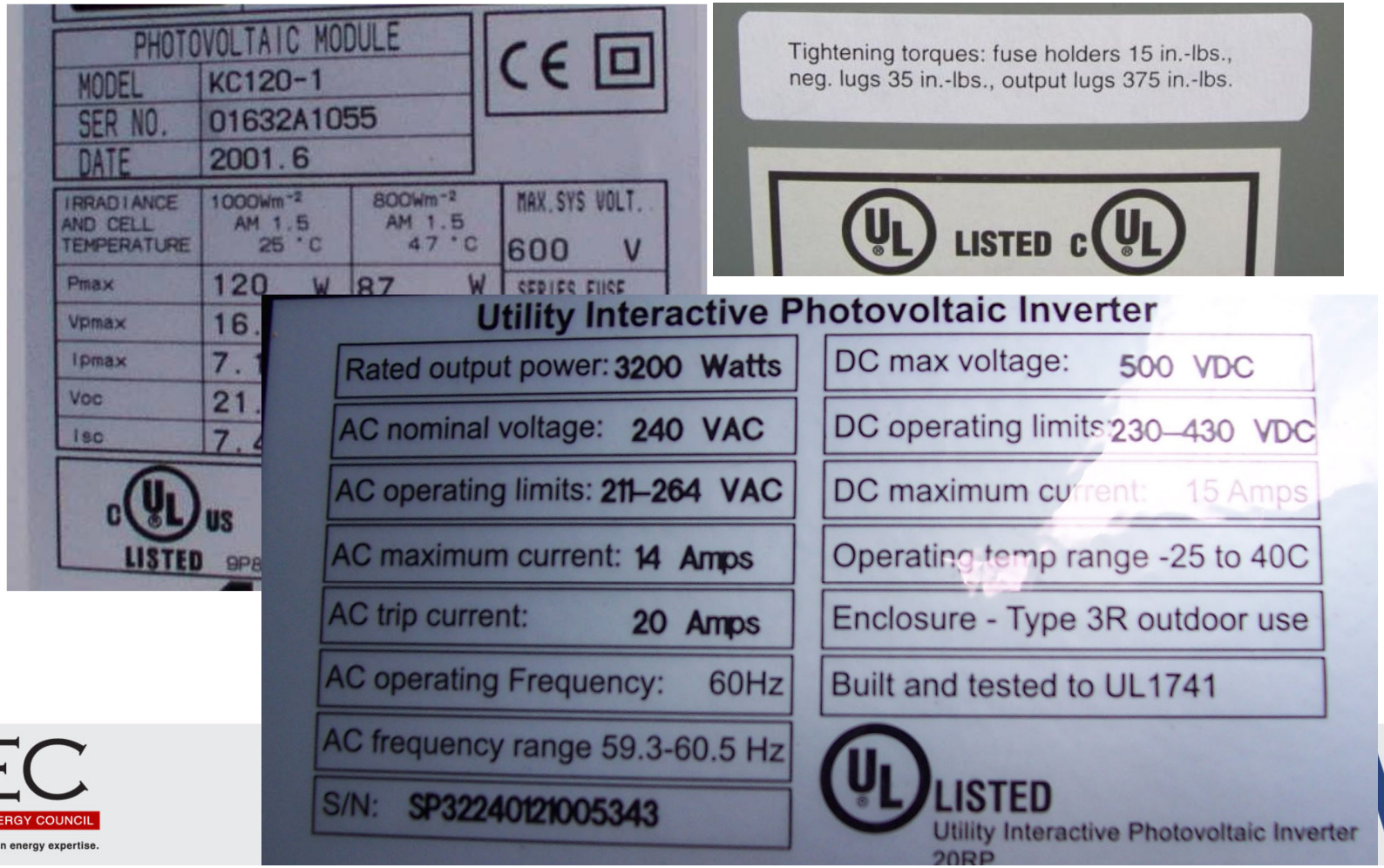
S07 Rev. 2012-05-22 Page: 1



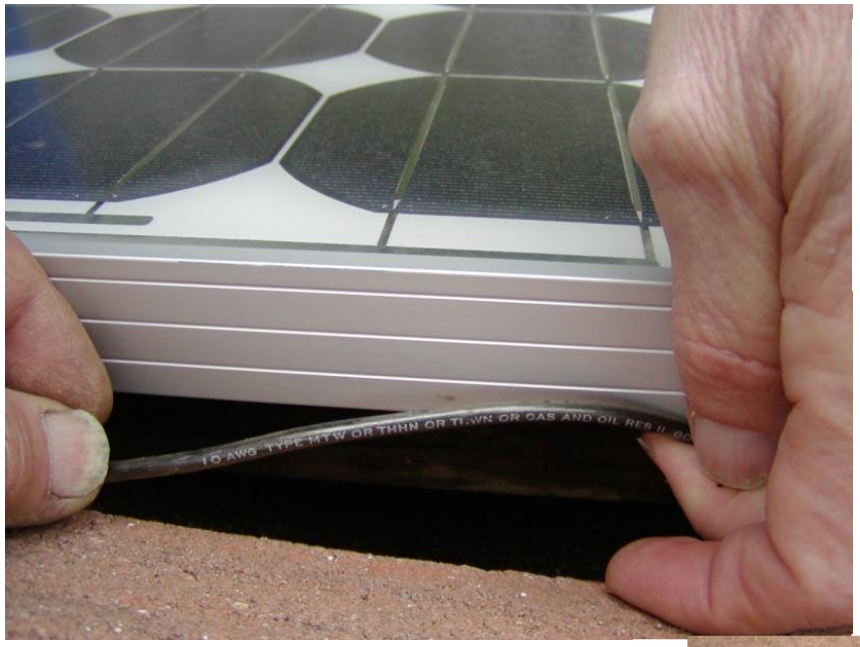


9. Grounding/bonding of rack and modules according to the manufacturer's installation instructions

10. Equipment listed and installed according to the approved plan
11. Inverter is marked “utility interactive.”



12. Conductors, cables and conduit types, sizes and markings according to the approved plan.



THWN WIRE USED OUTSIDE CONDUIT IN SUNLIGHT-NOT ALLOWED

PV WIRE HAS CORRECT OUTDOOR RATINGS

13. Overcurrent devices are the type and size according to the approved plan

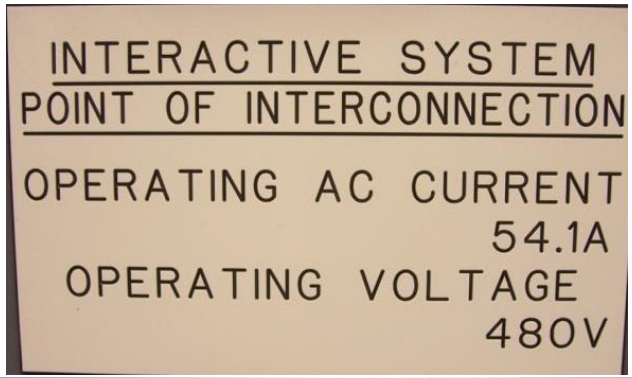
14. Disconnects according to the approved plan and properly located as required by the NEC

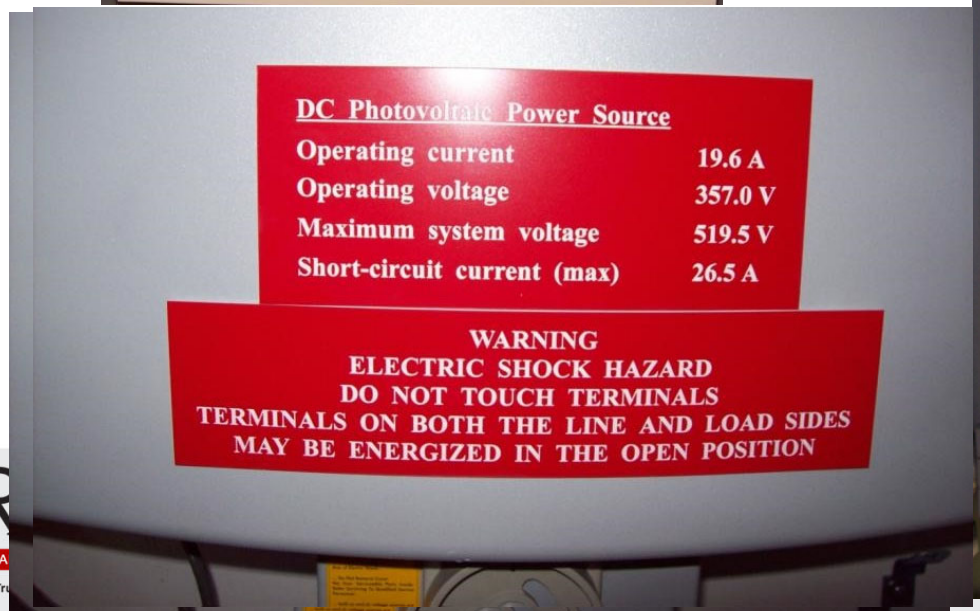
14. Disconnects according to the approved plan and properly located as required by the CEC?

15. Inverter output circuit breaker is located at opposite end of bus from utility supply

Photo courtesy of Bill McGovern

16. PV system markings, labels and signs according to the approved plan

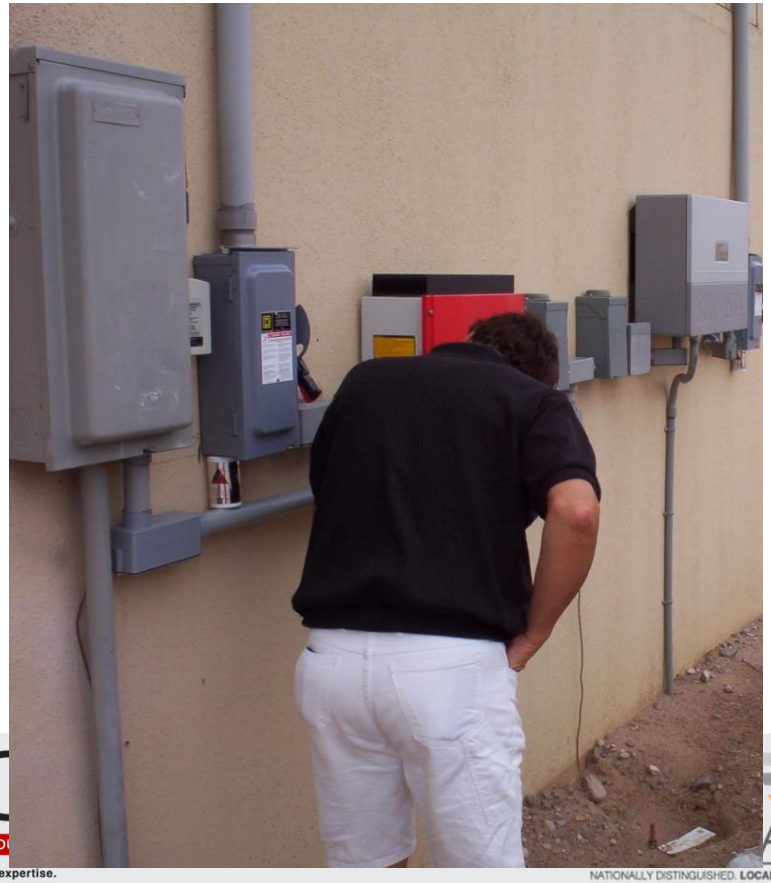




16. PV system markings, labels and signs according to the approved plan

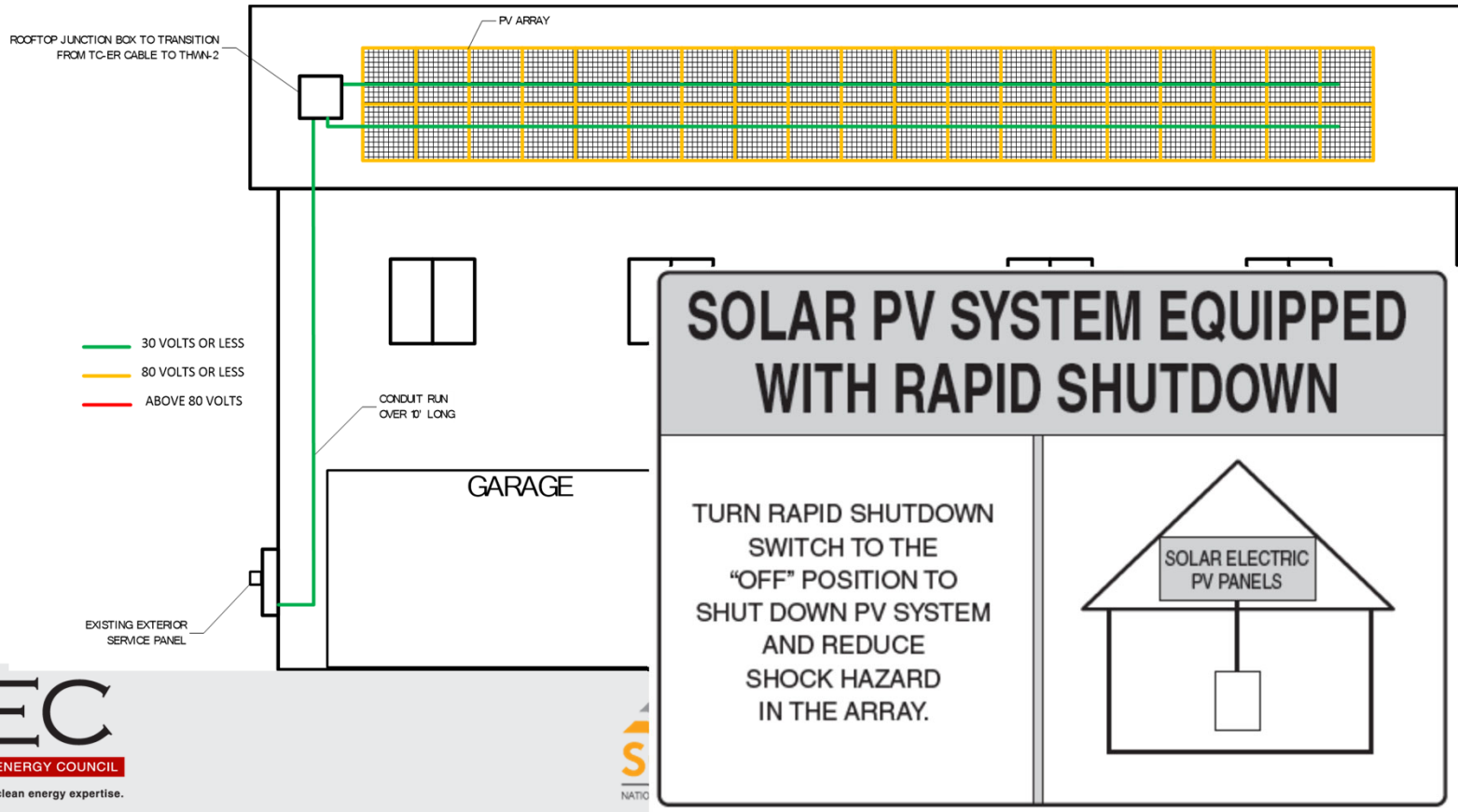
OWNER HAD ALL THE EQUIPMENT STUCCOED—INCLUDING ALL THE SIGNS

17. Connection of the PV system to the grounding electrode system according to the approved plan.



18. Access and working space for operation and maintenance of PV equipment

19. The rapid shutdown system is installed according to the approved plan [690.12]



North Central Texas Council of Governments

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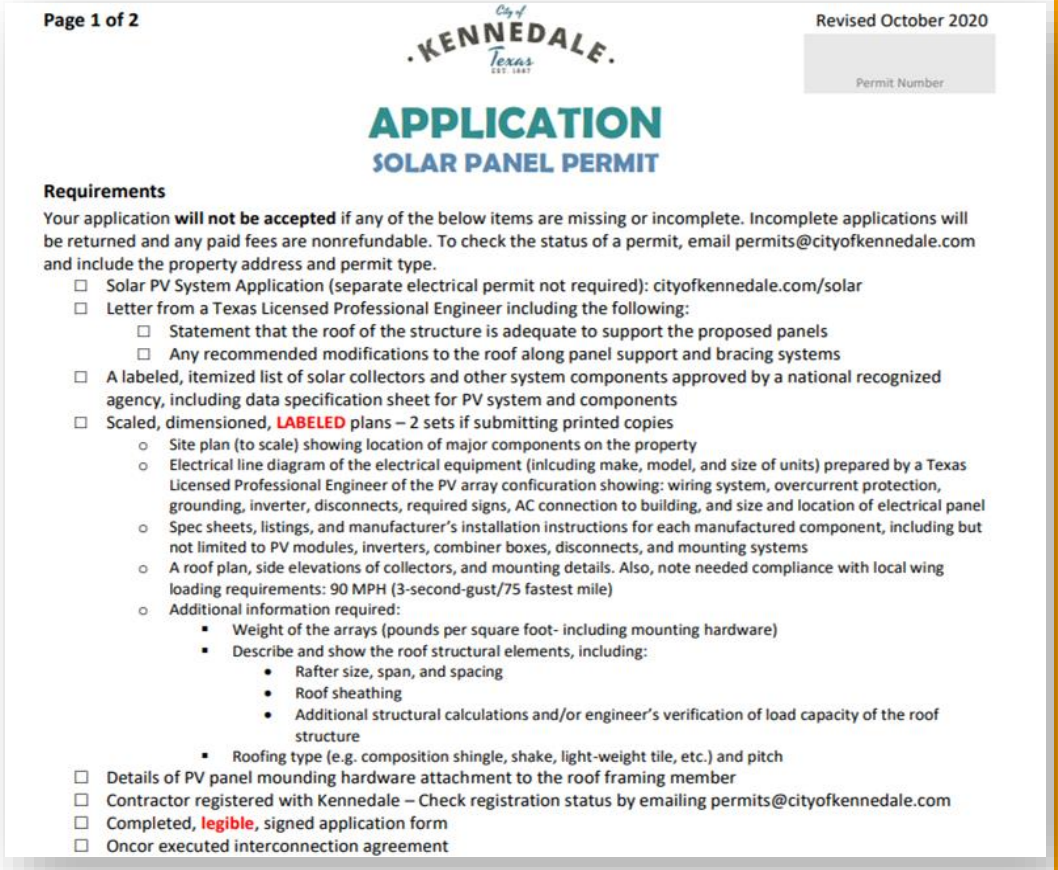
Next Steps

Supporting activities post workshop 3

1. Review your current permitting process and determine if there is interest in/an opportunity to streamline it.
    - Please remember that the SolSmart team can help you strategize potential modifications, share best practice guidance and resources, and support your efforts to adopt any proposed changes.
2. Develop and publish a “permitting checklist” that details the required permit(s), submittals, and steps of your community’s permitting process for residential rooftop solar PV. This is criterion PI-1 and a prerequisite for Bronze designation.
3. Determine if there’s interest in pursuing other PI criteria.



Page 1 of 2

City of KENNEDALE Texas

Revised October 2020

Permit Number

APPLICATION

SOLAR PANEL PERMIT

Requirements

Your application **will not be accepted** if any of the below items are missing or incomplete. Incomplete applications will be returned and any paid fees are nonrefundable. To check the status of a permit, email permits@cityofkennedale.com and include the property address and permit type.

- ☐ Solar PV System Application (separate electrical permit not required): cityofkennedale.com/solar
- ☐ Letter from a Texas Licensed Professional Engineer including the following:
    - ☐ Statement that the roof of the structure is adequate to support the proposed panels
    - ☐ Any recommended modifications to the roof along panel support and bracing systems
- ☐ A labeled, itemized list of solar collectors and other system components approved by a national recognized agency, including data specification sheet for PV system and components
- ☐ Scaled, dimensioned, **LABELED** plans – 2 sets if submitting printed copies
    - Site plan (to scale) showing location of major components on the property
    - Electrical line diagram of the electrical equipment (inlcuding make, model, and size of units) prepared by a Texas Licensed Professional Engineer of the PV array conficuration showing: wiring system, overcurrent protection, grounding, inverter, disconnects, required signs, AC connection to building, and size and location of electrical panel
    - Spec sheets, listings, and manufacturer’s installation instructions for each manufactured component, including but not limited to PV modules, inverters, combiner boxes, disconnects, and mounting systems
    - A roof plan, side elevations of collectors, and mounting details. Also, note needed compliance with local wing loading requirements: 90 MPH (3-second-gust/75 fastest mile)
    - Additional information required:
        - Weight of the arrays (pounds per square foot- including mounting hardware)
        - Describe and show the roof structural elements, including:
            - Rafter size, span, and spacing
            - Roof sheathing
            - Additional structural calculations and/or engineer’s verification of load capacity of the roof structure
        - Roofing type (e.g. composition shingle, shake, light-weight tile, etc.) and pitch
- ☐ Details of PV panel mounding hardware attachment to the roof framing member
- ☐ Contractor registered with Kennedale – Check registration status by emailing permits@cityofkennedale.com
- ☐ Completed, **legible**, signed application form
- ☐ Oncor executed interconnection agreement

Workshop 4 overview

- Workshop 4 is titled **"*Community Engagement & Municipal Operations*"**. It will cover best practices for how to support residents and businesses as they consider adopting solar energy. It will also cover considerations for municipal procurement of solar.
- The date of the session is TBD, but NCTCOG will be in touch soon.
- This session is open to all interested local government staff, so please feel free to attend and invite other colleagues.

North Central Texas Council of Governments

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Thank You!

- If you want to **have questions about the cohort**, please reach out to Joaquin Escalante (energy@nctcog.org)
- If you have **questions about SolSmart or external TA**, please reach out to Zach Greene (zach.greene@wri.org)