# Washoe County
# PLAN SUBMITTAL

## Solar Photo Voltaic Systems

*Electrical Generation Systems*

**July 2016**

PERMITS+PLUS ZONE

**Washoe County**
1001 East Ninth Street
Reno, NV 89512

# Solar Photo Voltaic System

**Permit Application**

Submittal guide

The following is an application form and outline for the requirements for a Solar Photo Voltaic System Plan submittal. This list is for reference purposes only and includes most common items needed to assist in the plan review process. Additional project specific items may be requested to complete the plan review process.

## Set of Plans

**Roof Mounted -** Your submittal will consist of:

- **Two** complete sets of plans **with two** copies of this application.
  - Engineered diagrams used for construction require the engineer's wet signed/stamp.
- **One (1) additional** site plan sheet **and** elevation view sheet for Planning.

**Ground Mounted -** Your submittal will consist of:

- **Two** complete sets of plans **with two** copies of this application.
  - Engineered diagrams used for construction require the engineer's wet signed/stamp.
- **Two (2) additional** site plan sheets **and** elevation view sheets for Planning/Engineering.
- If property is on a septic system**, Two (2) additional** site plan sheets for Health District.

Site plans shall include:

- ☐ The name, address and contact phone number of applicant.
- ☐ The Assessor's parcel number of the property which is the subject of the permit.
- ☐ Clearly showing the location of all buildings, septic system components, wells, water lines, a North arrow, and a vicinity map. (Minimum 18" x 24" plan sheet with a maximum plan sheet size of 24" x 36"). Please see attached example site plan.

## Required Information

Please **fill in all the blanks** and submit with your plan sheets. (Indicate:Yes, No, N/A, specific data)

- ☐ Customer name: _____
- ☐ Location address: _____
- ☐ Provide contract price of the installation: $_____
- ☐ Provide electrical generation capacity: _____ Watts, _____Volts, _____Amps.
- ☐ Provide total square footage of system panels: _____ sq. ft.
- ☐ Provide number of DC to AC inverters: _____
- ☐ Provide number of electrical junction or panel boxes installed 'After' the inverter (s) _____
- ☐ Provide number of electrical combiner boxes installed between the solar panels and the inverter_____
- ☐ Will the existing electrical service panel box for this installation be upgraded? _____ Yes/No
- ☐ Will the system include batteries? _____ Yes/No
- ☐ Battery type?_____
- ☐ Will an equipment shed be used to house electrical panels or batteries? _____ Yes/No
- ☐ Will the system use a motorized tracking panel support structure? _____ Yes/No
- ☐ Define if solar panels are ungrounded. _____ Yes/No

- ☐ Does the site have wind electric power generation? _____ Yes/No
- ☐ Does the site have a gas power generator? _____ Yes/No
- ☐ Will the system incorporate a lighting arrestor? _____ Yes/No
- ☐ Will the system incorporate surge protection? _____ Yes/No
- ☐ Is a site plan provided? _____ Yes/No
- ☐ Is an elevation view plan sheet provided? _____ Yes/No
- ☐ Is an electrical single line diagram provided? _____ Yes/No
- ☐ Indicate if REC meter is used? _____ Yes/No

## Ground Mount Applications

The following information needs to be present on the site plan (See attached example site plan):

- ☐ Clearly show placement of solar array with dimensions to structures, property lines, propane tanks, electrical pedestals, etc.
- ☐ If a septic system is on the property include all Health Department required information on the site plan sheet.
- ☐ Combiner box(s)
- ☐ DC disconnect location.
- ☐ Transfer switch location.{2011 NEC 705-40}
- ☐ AC disconnect location.
- ☐ REC meter location.
- ☐ Main service meter location.
- ☐ Provide details for barrier/fencing or conduit/raceway enclosures that make solar panel wires inaccessible to unqualified individuals. Wires are considered accessible when less than eight feet from grade.

Provide solar panel array footing plan.

- ☐ Is the footing a grid assembly of embedded posts design? _____ Yes/No
- ☐ Is the footing a slab? _____ Yes/No
- ☐ Is the footing grade beam strips? _____ Yes/No
- ☐ Is the footing a single caisson/pier design? _____ Yes/No

The dimensioned footing plan will show dimensions between footing piers, concrete grade beam footing strips, slab size, slab thickness, and rebar placement.

The dimensioned concrete footing plan will show details for connections (anchor bolt or expansion bolt size, bolt spacing, and depth of embedment). Arrays over eight (8) feet in height may require engineering.

For rack assemblies with multiple post connections, you may utilize a **prescriptive** footing design which will provide a minimum (0.403) cubic feet concrete per square foot of array. [2.46 sqft of array/cubic foot concrete]. The number of the bolted connections (minimum 3/8 diameter, minimum 2” embedment) anchoring the array to the concrete shall be one (1) for each ten (10) square foot of array. Rack framing shall be space no greater than five feet apart.

## Roof Mounted Systems

Provide roof plan views (as viewed from above) showing:

- ☐ Roof plan with dimensions showing panel placements relative to roof eaves, gable end edges, and ridgelines.
- ☐ Spacing of rack support standoffs with horizontal and vertical spacing dimensions.
- ☐ Details showing lag bolt sizes and placement. Clearly show standoff connection details. If using a manufactures racking system, provide on the roof plan, the page numbers for the details that correspond to the connection.
- ☐ Provide details for panel support rack to roof standoffs connections. Indicate bolt size, number of bolts.
- ☐ Provide details for solar panel to support rack rails connection.

## Provide Elevation Views

Show location of electrical panels on all structures and/or pedestals.

- ☐ Provide an elevation view showing:
  - Combiner boxes
  - Inverters
  - AC disconnect
  - REC meter panel
  - Main service disconnect locations. *This may require more than one elevation view.*
- ☐ Provide dimensions to grade for panels and working space clearances in front of panels.
- ☐ Indicate conduit size, type and location.
- ☐ Provide a dimensioned roof elevation view showing solar panel height above grade.

## Structural Design Considerations for Solar Panel Installation

Roof loading (weight of panels): Provide structural calculations if existing roof material & sheathing exceeds eight (8) pounds per square foot. Asphalt shingled roofs that have only one layer of shingles in place may utilize a manufactures rack stand off spacing design provided the vertical placement of standoff spacing does not exceed 48 inches on center (parallel to eve). Metal structures and tile roofs need their structural frames reviewed for the added loading from panel installation. Snow loading (drift & sliding snow) of panels and roof structure needs to be addressed for elevations above 6750' East of Highway 395, 5350' West of Highway 395, and Incline Village. East of Highway 395 minimum roof snow load applied to solar panels is 21 PSF. Roof snow loads increase above 5080 feet.

## Wind Uplift Connection

- ☐ Provide documentation for roof rack stand off bracket connections.
- ☐ Provide lag screw size, spacing, and depth of lag screw penetration.
- ☐ Your design must be based on a minimum 130 mph (Vult) exposure 'C' meeting component and cladding design wind uplift requirements. {ASCE 7-10}

## Solar Panels

- ☐ Provide specification sheets for the solar photo voltaic panels.

- ☐ Provide details and clearly show on your plans the grounding wire connection which connects all the panels and the rack assembly.

## Rack Assembly

- ☐ Provide specifications and details for the support rack frame. Indicate on your plans how rack is grounded.

## DC Combiner Boxes

Provide the quantities, listings, and ratings for all combiner boxes.

- ☐ Number of Series strings _____ and the output operating voltage _____ Volts
- ☐ Maximum system voltage _____ (calculation based on Washoe County minimum cold temperature of minus 16°F) See calculation sheet at end of application for assistance.
- ☐ Number of parallel source circuits _____ and the output operating current. _____ Amps

Indicate if:

- ☐ The DC electrical circuits are fused. _____ Yes/No
- ☐ There are Blocking diodes in the circuit. _____ Yes/No
- ☐ The parallel circuits are switched. _____ Yes/No
- ☐ The combiner box will have the **signage permanently and durably** affixed to it. (See Signage below for requirements.)
- ☐ If the inverter is use as a combiner, signage requirements for a combiner box must be placed on the inverter. (See Signage below for requirements.)

## Inverters

- ☐ Provide specifications cut sheet for each type of inverter.
- ☐ Indicate if inverter has multiple inputs (i.e. functions as combiner). _____ Yes/No
- ☐ Indicate the individual amps for each circuit feeding the inverter from the separate combiner box(s). _____ Amps.
- ☐ Indicate if transfer switch is integral to inverter. _____ Yes/No
- ☐ Indicate if Ground fault protection device is integral to inverter. _____ Yes/No
- ☐ Provide rated output power of inverter (used to size conductors & panel boxes)._____ Watts.
- ☐ Provide inverter maximum output current. _____ Amps
- ☐ Provide inverter output voltage. _____ Volts.
- ☐ Indicate if inverter is single phase two-pole _____; single sole _____; or Three Phase_____.
- ☐ Is the inverter {IEEE 1547.1} listed? _____ Yes/No
- ☐ Is it {UL 1741} listed? _____ Yes/No
- ☐ What approved agency provided the listing? _____

## AC Disconnect

- ☐ Provide amperage rating for AC disconnect: _____ Amps.
- ☐ Is the AC disconnect a visible exposed blade (no dead front) panel box? _____ Yes/No
- ☐ If the panel box does not have a dead front (power company requirement) then provide a note on your plans stipulating: “An owner installed padlock is required on the AC disconnect cover per {2011 NEC 110.27, 408.38}”

## Renewal Energy Credit Meter Panel (REC)

- ☐ Provide specification for meter socket. Minimum amperage rating is dependant on the inverter rating.

## Main Service Panel (existing or new)

- ☐ Provide load rating for panel_____
- ☐ Provide busbar rating_____
- ☐ Provide main service breaker rating_____
- ☐ Provide back-fed circuit breaker amperage rating_____ Amps (Breaker must not be labeled with separate line/load contacts)
- ☐ Provide AIC (arc interrupt capacity) rating for service panel_____ Amps. {commercial installation requirement, not required for residential installation}
- ☐ Provide available arc fault current supplied by the power company _____amps (commercial installation requirement, not required for residential installation)
- ☐ Will the main service disconnect circuit breaker be reduced in size to allow the connection of the solar electrical source? _____ Yes/No
- ☐ Provide calculations showing the sum of ampere ratings of **over-current devices** in circuits supplying power to the main busbar does not exceed (120% for residential) rating of service panel busbar {2011 NEC 690.64 (B) (2)} See calculation sheet at end of application for assistance.

  _____
  _____
  _____
  _____

**Note:** Line side taps in a panel box that is not listed for such taps will require the panel box to be recertified in the field by United Labs (UL) or Intertek ETL or other approved third party listing agency.

## Provide an Electrical One-line Diagram

- ☐ Show all major field-installed electrical components.
- ☐ Provide wire insulation identification for each circuit segment (insulation type & conductor size).
- ☐ Show each circuit segments maximum ampacity value.
- ☐ Provide conductor size for each circuit segment.
- ☐ Provide conduit type and sizing per 2011 NEC 690.31 (metallic raceways).
- ☐ Provide conduit lengths. (metallic conduits in attics with lengths greater than 30 feet require expansion design) {2011 NEC 300.7, 352.44}
- ☐ Provide equipment grounding conductor size.(Continuous ground mount solar minimum # 6 copper)
- ☐ Provide system grounding conductor sizing.
- ☐ Exposed wires must be sunlight resistant rated.
- ☐ Show PV source current 125% amperage design value increase (for irradiance).
- ☐ Show your conductor de-rating calculations (for temperature).
- ☐ Provide wire sizing calculations for temperature de-rating. Attic mezzanine temperatures can be expected to be significantly higher than base design values. ASHRAE fundamentals has a 36 degree Fahrenheit above ambient for attics. Washoe County prescriptive ambient high

temperature is 94°F So {2011 NEC table 310.16}. derating factor is (0.76) [copper-THWN-2 wire type].

- ☐ Provide wire sizing calculations for temperature de-rating, for roof top run electrical conduits and attic conduits.
- ☐ Show your conductor sizing calculations for voltage drop. (wire length-resistance)
- ☐ Show solar PV source current conductor sizing calculated at 125% amperage design value increase (for continuous duty). These are the conductors traveling from the combiner box to the first inverter.

## Grid Tied Systems

You must notify NV Energy or Plumas Sierra Power informing them of the power generation system, to comply with their safety notification requirements. Indicate your contact person and contact date. Name_____ Date_____

## Net Metering Systems

Follow all power company regulations and 2011 NEC. {NV energy} Sierra Pacific standard 'ENG03U'.

- ☐ Provide the electrical contractor's name that will be certifying the installation for NV energy rebate program: _____.

  http://www.nvenergy.com/renewablesenvironment/renewablegenerations/resources.cfm

  http://www.nvenergy.com/business/newconstruction/newconstructionS/distribution_standards/RE/ESRNPC-RE003-REV04.pdf

- ☐ If this installation is **not** connected to the power company grid system; provide minimum residential service load calculations as per {2012 IRC 3502}.

## Signage

NV Energy will install three signs when they provide their NET metering pre hook-up visit. **The warning signs applied by NV Energy do NOT fulfill the signage requirements.**

- ☐ Provide the following note on the plans: "PV equipment shall be installed in accordance with 2011 NEC 690 and posted with applicable warnings, signage & plaques per NEC 705-10, 690-17 & 690-64(b)(5)."
- ☐ Signage at power source (first panel with source wires from panels) example: [Combiner box]
- ☐ Signage identifying switch/disconnect for alternate power system. (At source) example: at inverter with integral or separate adjacent AC disconnect.
- ☐ At AC disconnect. Example: [Solar power system, AC Disconnect, 240 volt}
- ☐ The dedicated circuit breaker in the main service panel box MUST be clearly and durably labeled as a power source.
- ☐ Signage at main service disconnect notifying the type and location of the optional standby system.
- ☐ Signage shall have minimum lettering size of (3/16"), Arial font size #16 or equivalent.

At service meter:

| |
|---|
| Interactive System Point of connection |
| Operating AC Current _____ amps |
| Operating AC Voltage _____ Volts |

On the combiner box:

| |
|---|
| Operating Current ____ Amps |
| Operating Voltage _____ Volts |
| Maximum system voltage _____Volts |
| Short-circuit Current (Max) _____Amps |
| **DANGER HIGH VOLTAGE** Access by Qualified Persons Only |

(2011 NEC 690.7) (2011 NEC 690.8)
Note that the Max Isc is 125% of the PV panels Isc value.
Signage required at all electrical power sources. (Example; at a multiple inverter system junction box.)
Signage identifying transfer switch for alternate power system.
Signage at main service disconnect
Label at back fed circuit breaker
All signage must be permanent and durable. (Consider metal engraved plaques)

# Field Inspection Checklist

Indicate a[Y] for yes or [N] for no

## Signage

Yes ___ No ___ Verify all signs and labels are in place and are durable (must withstand years of weathering)
Yes ___ No ___ Sign on combiner panel box; Or inverter if used as a combiner
Yes ___ No ___ Sign on DC disconnect
Yes ___ No ___ Sign on AC disconnect
Yes ___ No ___ Label adjacent to Circuit breaker connecting system to main busbar, in main service panel box.
Yes ___ No ___ Sign on main service disconnect (external) providing notification of the type and location of the secondary power source(s).

## Approved Plan Set One-line Diagram Comparison

_____Inverter model number matches plans and specifications.
_____PV panel module model number matches plans and cut sheets.
_____PV modules are properly grounded with lugs on each solar panel {or equivalent (listed) approved grounding method. Note sheet metal screws are not code compliant connections, need fine threaded screws.
_____PV array is consistent with plans. {Number of modules, number of inverters)
_____Verify all **grounding** wires and connections are tight and of correct size.
_____Check that **ground** wires and conduits are properly supported.
_____Verify minimum wire sizes are consistent with plan. (wiring from array to combiner, combiner to inverter)
_____Verify that plug connections (PV modules) are fully engaged and NOT accessible to unqualified persons.
_____Verify that Solar panel support stand offs or footings are spaced and installed as per plan diagram.
_____Verify that the attachment of the panels to the rack/frame matches the plans.
_____Check that ground wires and conduits are properly supported.
_____Verify minimum wire sizes are consistent with plan. (inverter to disconnect, disconnect to REC meter, Rec meter to main disconnect circuit breaker (clearly labeled))
_____Verify that circuits with voltages of greater than 150 volts to ground are NOT accessible to unqualified persons.
_____Verify footings are spaced and installed as per plan diagram.

# References

*Washoe County does not endorse the sites behind these links. These links are offered for information and additional research. These links should be used for educational purposes only.*

NVenergy (formerly Sierra Pacific Power):
http://www.nvenergy.com/renewablegenerations/resources.cfm

Plumas-Sierra Electric: http://www.psrec.coop/

Washoe County Building Department:
www.washoecounty.us/bldgsafety click on Applications/forms/handouts.

Nevada State alternative energy regulations: See NRS 278.0208
www.leg.state.nv.us/NRS/NRS-278.html

New Mexico State University:
http://www.nmsu.edu/~tdi/Photovoltaics/PV-Energy.html

# Calculation Assistance Sheet

The following is an example of electrical service entrance busbar calculation. Based on 2011 NEC 690.64.

Provide calculation showing the sum of ampere ratings of over-current protection devices (OCPD) in circuits supplying power to the main busbar does not exceed (120% for residential) rating of service panel busbar {2011 NEC 690.64 (B) (2)} {If commercial the 2008 NEC may be used. ALL 2008 NEC code design requirements MUST be indicated on the plans}. Line side taps must be done per the factory UL, ETL or other third party listing of the service panel or an approved third party Field Engineering services Listing is required. {2009 UL white book page 39}.

**Data**

Main utility service meter panel busbar rating [_____] *Use main Circuit breaker value if panel does not specify a Busbar value*

Busbar rating multiplied by 1.2 = Maximum code allowable feeding source(s) amperage.

[Busbar (_____) X (1.2) = Max source(s) OCPD(s) (_____)]

Main service meter panel 'utility' disconnect circuit breaker rating (utility OCPD) [_____]

Your design submittal Solar or Wind power source circuit breaker(s) rating (Solar-Wind OCPD) [_____]

**Calculate:** (Max Allowed Solar-Wind source OCPD) [_____] = [(Max source(s) OCPD) [_____] – [(utility OCPD) (_____)].

**Qualifying Calculation:** [Your Solar-Wind OCPD (_____)] <= [Max Solar-Wind source OCPD (_____)] then design is code compliant, if not redesign submittal.

## Maximum Voltage Calculation

Solar panels produce their maximum voltage at cold temperatures. The solar PV system needs to have the Max Voc system voltage calculated to ensure system components (wires, fuses, connectors, inverters, etc) are not subject to voltages that can harm them or cause fires or electrocution.

Max Voc is calculated by multiplying the specific solar panels Voc (open circuit voltage) by a correction factor. The Washoe County minimum ambient temperature to use is minus 16° F (-27 C°) 'ASHRAE data' Your solar panels specification sheet provides the Voc at 25°C, (77° F). The specification sheet also provides a temperature coefficient Voc. This factor is given as a percentage [example (-0.351%/°C)].

Thus the calculation is as follows: Take the temperature difference 25°C to (-27°C) which equals 52°C. 52 times the specific panels Voc coefficient will give the PERCENTAGE increase in voltage that can be added to the normal Voc. Then the Maximum VOC can be figured. Note your string of panels will have their voltages added up. Example; a specific panel has a Voc of 37 volts. This

panel has a Voc temperature coefficient of (-0.351%/°C). Washoe County coldest ambient temperature delta factor use 52°C

52°C x (-0.351%/°C) = 18%
37 x (0.18) = 6.67 volts
37 + 6.67 = 43.7 Voc (Maximum Volts open circuit for one panel)

For example assume there are 12 panels in the string circuit feeding the combiner box or feeding the inverter. So; 12 x 43.7 = 524 volts. This is the system maximum voltage which is less than the rated 600 volt limitation of the equipment and wires. If it was greater than 600 a reduction in panels or redesign is necessary.

Or prescriptive method uses 2011 NEC table 690.7 row [-21to-40°C] factor is 1.25.

37 x 1.25 = 46.25
46.25 x 12 = 555 Max Voc.