

Solar Water Heating and Photovoltaic Electrical Systems Installed on One or Two Family Dwellings

I. BACKGROUND

As awareness of renewable energy and green building options increases, solar energy systems are becoming a more common energy choice for Oregon homeowners. Energy from the sun can be harnessed using a solar water heating or solar electric system.

This Program Guide outlines the application and review procedures for obtaining the necessary permit(s) to install a solar energy system for a new or existing residential building. The guide also describes what system design elements may trigger the need for additional plan review.

II. SOLAR ENERGY SYSTEM DESCRIPTION

A solar energy system is defined, for the purpose of this Program Guide, as a solar water heating or solar electric (also known as a photovoltaic or PV) system.

A. Solar Water Heating

A solar water heating system reduces household energy consumption by preheating water so that the residence's water heater does less work. It consists of two, primary components:

1. Solar collectors, which are commonly installed on the roof; and
2. A storage tank, which is typically co-located with the residence's water heater and in which potable water is preheated by the solar collectors via a heat exchanger.

A residential solar pool heating system consists of plastic solar collectors, typically mounted on a roof, through which swimming pool water is circulated during the summer months to capture the sun's heat.

B. Solar Electric

A solar electric system produces electricity that is distributed to the home via the residence's main electrical panel, offsetting electric energy that would otherwise be purchased from the utility. It consists of two, primary components:

1. Photovoltaic panels, which are commonly installed on the roof; and
2. An inverter, which converts direct current electricity produced by the panels into alternating current electricity that can be used by the home.

III. SCOPE

This Program Guide is designed to provide guidelines and permitting requirements to those interested in solar hot water heaters or photovoltaic solar electric panels on residential construction. This may include adding a solar system on to an existing structure as an addition or an alteration, or incorporating a solar system into a new building. The intent of these guidelines is to streamline the permitting process for solar

energy systems. Authority Having Jurisdiction (AHJ) reserves the right to require additional information for any reason they deem necessary to ensure proper compliance with code requirements.

IV. INSTALLATION REQUIREMENTS

For a typical residential installation the following rules apply. For installations not complying with this guide contact the AHJ for installation requirements.

A. Land Use

Solar installations must comply with the local Zoning Code. Specific Zoning information regarding a site can be obtained from the AHJ Planning and Zoning Section.

1. Height

In all instances, installations of solar equipment, including the rails and panels, are subject to the height limitations of the specific zone where they are being installed.

For installations mounted flush with a pitched roof, the height of the panels will not be calculated, unless the panels will extend above the highest ridge of the roof.

2. Setbacks

Installations that are 6 feet or less in height are allowed to be placed in the setbacks of the individual lot. Installations taller than 6 feet are not allowed in this area. Check with the AHJ.

3. Design and Historic Review:

- a. **General.** Design review analyzes the aesthetics of a project, in order to conserve or enhance special scenic, architectural or cultural areas of the City. Projects in historic districts may require design review. Please contact the AHJ Planning and Zoning department if you are unsure if the project is located in a design or historic zone or is eligible to use the Community Design Standards.
- b. **Notice requirements.** Historic design review is a discretionary review that requires a public notice and generally takes about 8 weeks to complete. Check with the AHJ.
- c. **Historic plan review fees.** Contact the AHJ Planning Department.

B. Structural

The solar collectors and underlying substructure (mounts, rails, etc.) must be designed to meet the loading requirements of the Oregon Residential Specialty Code. The prescriptive requirements as described in this section are assumed to meet the residential code requirements and therefore will not require the system be design by a registered Oregon engineer. *An engineer registered in Oregon must*

complete the design and details of all other systems not meeting the prescriptive requirements provided in this guide.

A project will qualify as a prescriptive installation with an acceptable supporting roof structure if all of the following criteria are met:

1. **Roof structure:** The supporting roof framing shall be of typical residential construction, with multiple parallel wood roof rafters or trusses. Minimum rafter or truss chord size is 2x4 and maximum spacing is 2 ft. on center. See attached diagram #1A. Provide existing roof rafter/truss size, spacing and span for review.
2. **Roof materials:** Roofing material must be either standing seam metal, single layer wood shingle or shake, or not more than two layers of composition shingle. Concrete or tile roofs will require structural review.
 - a. **Loading:** Collectors are either directly attached to the roof framing or are mounted to continuous rails that are attached directly to the roof framing. These attachments must be anchored to roof framing at a spacing no greater than 4 ft. on center maximum or per manufacturer's instructions. Collector and mounting hardware (rails, frame, etc) weight shall not exceed 4.5 pounds per square foot (psf). Solar thermal collector weight shall include the weight of the working fluid inside the collector. See attached diagram #1A.
3. **Height:** Maximum panel height above roof shall be 18" from top of panel to roof surface. See attached diagram #1B.

For additional information regarding the structural requirements for solar panel installations, please contact the AHJ local building department at (insert your jurisdiction here).

C. Plumbing and Electrical

All portions of the installation of solar systems governed by the plumbing or electrical portions of the residential code shall comply with the respective requirements of each code section at the time of completion of the project. In general, plumbing or electrical plan review is not required for the installation of residential solar systems, but electrical and plumbing permits must be obtained either as separate permits, or combined with the residential building permit. In all instances, field inspection is required to verify code compliance. A PV 1 Line Drawing must accompany the permit application. See Example attached.

V. PERMITS

A. General Requirements

1. Alterations.

If solar systems are added to an existing one or two family dwelling, the installation of these components are considered an alteration. Under the provisions of the residential code, all alterations must meet the code requirements for new construction. Permits for solar panel qualifying as alterations may be processed in one of two ways:

- a. Online or Faxed – If the AHJ has this program available; or
- b. Through the traditional permitting system (over the counter).

1) Permits processed through the traditional permitting system. Permits that are processed through the traditional permitting system will follow the same general application process that is used for new construction described in the next section and will be processed through the AHJ.

2. New Construction

Solar panels that are part of new construction will be processed in conjunction with the new construction permit for the one or two family dwelling.

In all instances, the type of solar system to be installed shall be clearly indicated with the application documents and all necessary permits shall be obtained before installation of the system.

B. Application Process

1. New Construction and Alterations

All solar panels that are installed as a part of a new construction project or as part of an alteration will be processed in conjunction with the other work being permitted.

If the project is shown to comply with all necessary requirements, and all permit fees are paid, the permit will be issued to the applicant the same day.

In some cases, it may be necessary for a particular project to be reviewed more closely and the permit will be taken in for review. In these instances, the necessary reviews will be completed and the permit will be issued after all necessary reviews are completed and all necessary fees have been paid.

C. Permit Submittal Requirements

Regardless of the permit application process, the following information shall be submitted for each permit.

1. Structural Plans

a. Prescriptive system. If the system meets all of the prescriptive requirements of the structural section of this program guide, no structural plans and calculations will be required. Data showing that the solar installation meets the prescriptive requirements must be included with the site plan.

b. Designed elements.

- 1) If any of the prescriptive requirements for roof structure, roof materials, loading or height are not met, then structural calculations by an Oregon engineer showing complete details for the rails, support struts and roof attachments must be provided. In addition, stamped calculations verifying adequacy of the roof construction are required.

- 2) In the case where the support struts raise the panel height greater than 18" above the roof but all other prescriptive requirements of this program guide are met, then structural calculations by an Oregon engineer and details only for the support struts and its connections are required. In some cases, manufacturer's information and installation details may be substituted for the required engineering.

2. Elevation Drawings

For installations where the panels will not be mounted flush with the roof, a simple building elevation will be required to measure the height of the installation. The elevation must show the height of the building, and the height of the solar installation, but does not need to show other building details, unless a Design Review will be required.

3. Electrical 1-Line Drawing (attached)

VI. INSPECTIONS

The following inspections may be required for the installation of the solar system. Approved permits must be posted at job location.

- A. **Building:** Building inspections are required to verify that the solar support system is properly installed.
- B. **Plumbing:** A plumbing inspection is required where the solar apparatus attaches to the potable water system, usually a water heater. The inspection will verify that the collection system is properly attached so that no contamination of the potable system can occur.
- C. **Electrical:** An electrical inspection is required in all instances where the solar system provides power to the dwelling electrical system. The inspection will verify that the circuits and feeders have been installed properly and the system has been connected properly.

VII. FEES

Fees for all required building, plumbing or electrical permits will be calculated using the current and applicable AHJ fee schedule available with the Authority Having Jurisdiction.

In general, building permit fees will be based on the valuation of the structural elements for the solar panels, including the mounting brackets and rails and the cost of labor to install them. Excluded from the permit valuation is the cost of the solar equipment, including the solar collector panels, inverters and preheat tanks.

$$\text{Valuation of Project} = \text{Total Project Price} - \text{Solar Equipment Value}$$

Building Permit Fees: Based on valuation.

Electrical Fees: 5kva or less = \$79.00; 5.01 to 15kva = \$94.00; 15.01 to 25kva = \$156.00; 26kva and above = \$156.00 + \$2 per each kva above 25.

Plumbing Fees: Water Heater permit = \$40.00

VIII. INSPECTIONS

One-line diagram comparison

Is a one-line diagram available at the site?

- PV module model number matches plans and cut sheets
- PV modules are properly grounded with lugs on each module or equivalent grounding method.
- PV array wiring is consistent with plans (# of modules)
- Check that cable and conduit is properly supported
- Where plug connectors are used for module wiring, inspect a sample to make sure that connectors are fully engaged.
- Inverter model number matches plans and cut sheets.

Structural Attachment of Array

Confirm that footings and support structure match the supplied detail.

Confirm that module attachment matches the supplied detail.

PV System Signs

Signs shall be permanent and have sufficient durability to withstand the environment.

Sign Identifying Photovoltaic Power Source (at DC disconnect)

- Rated maximum power-point current (690.53)
- Rated maximum power-point voltage
- Maximum system voltage
- Short-circuit current
- Maximum rated output current of the charge controller (if installed)

Sign identifying AC point of connection

- Maximum operating current (provided in initial plan review)
- Operating AC voltage (provided in initial plan review)

Sign identifying switch for alternative power system

Sign at the main service disconnect (702.8) notifying the type and location of the optional standby system

Plumbing

Refer to the Oregon Plumbing Specialty Code

IX. ENFORCEMENT

All code enforcement shall be in accordance with the applicable permitting and inspection procedures.

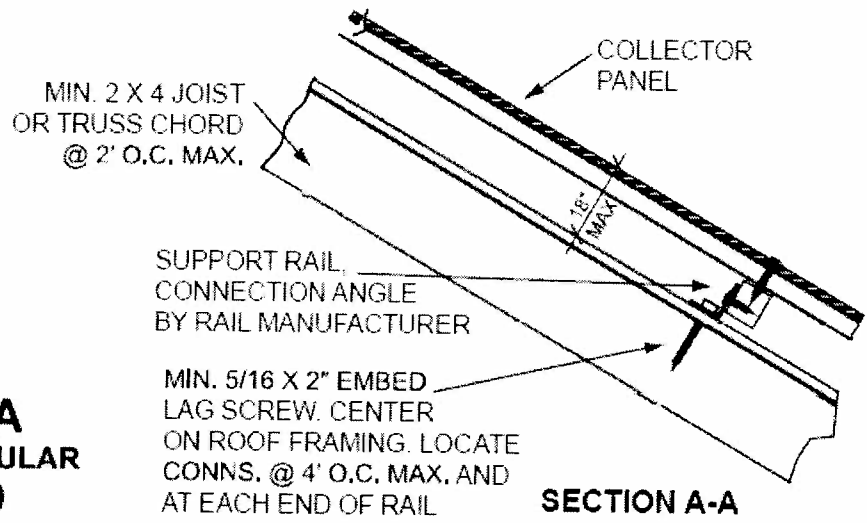
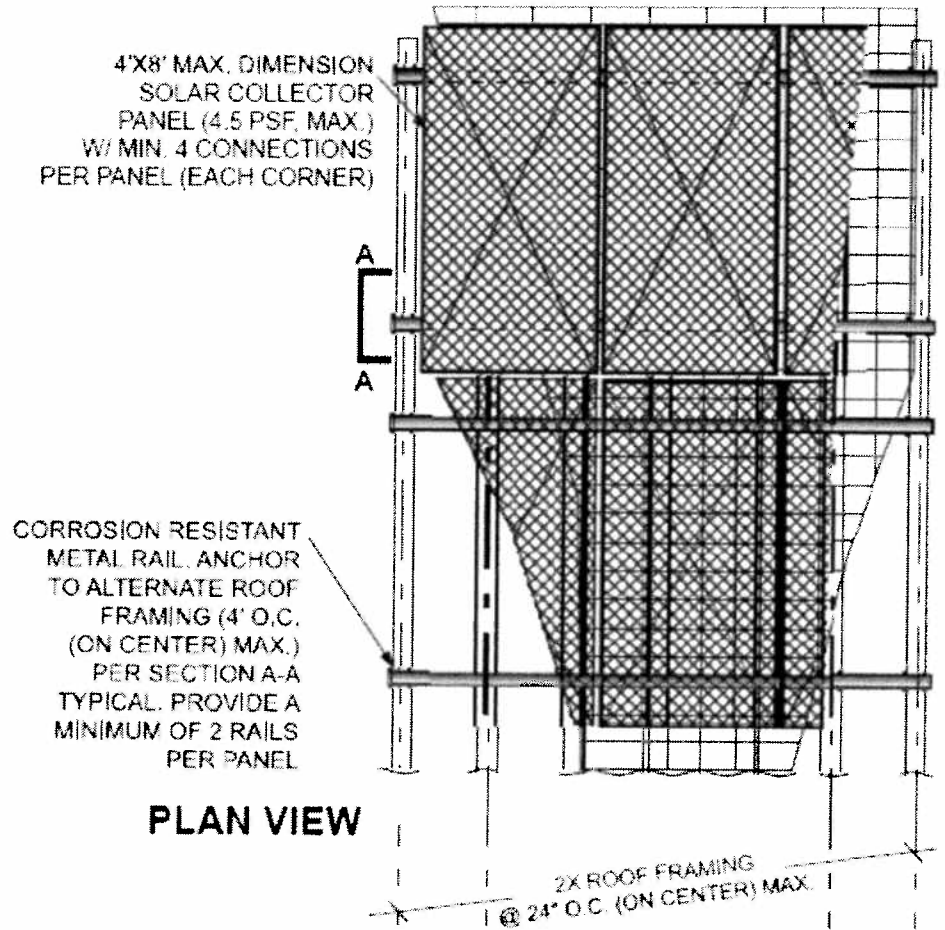
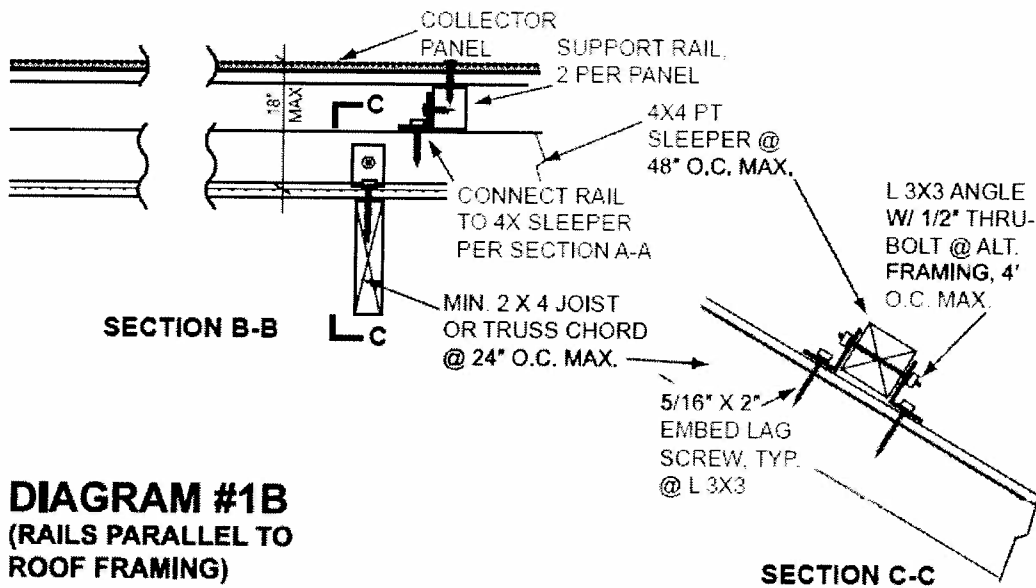
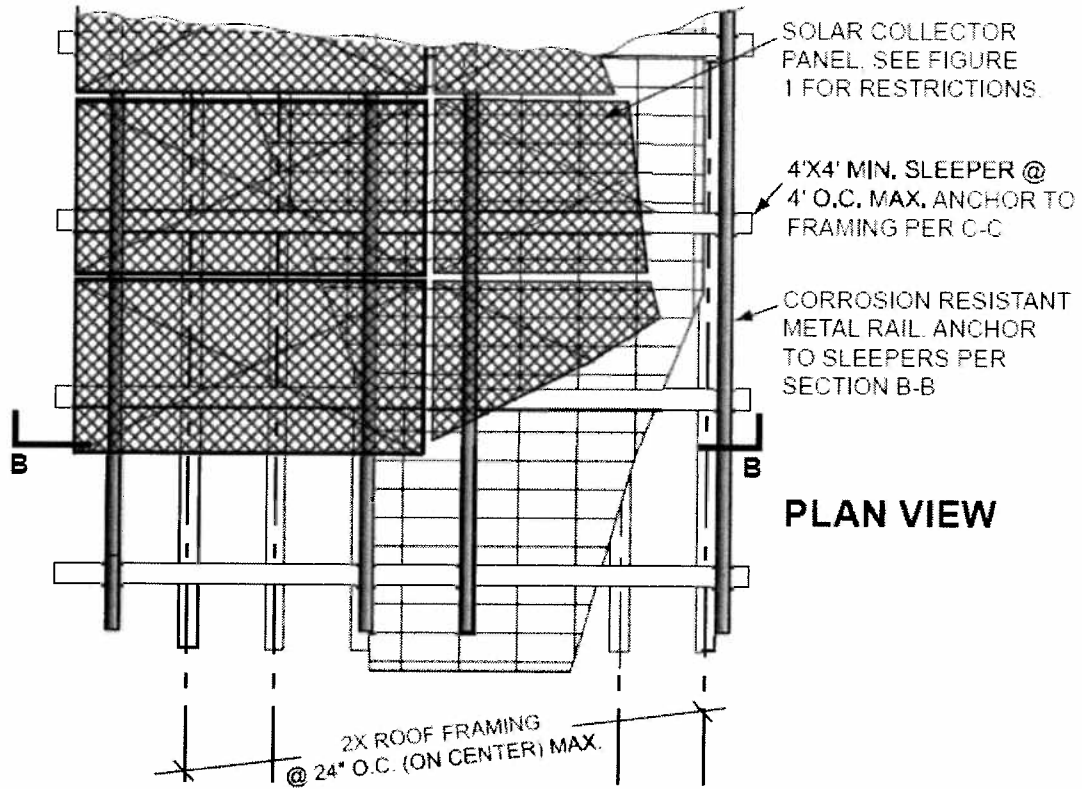


DIAGRAM #1A
(RAILS PERPENDICULAR TO ROOF FRAMING)

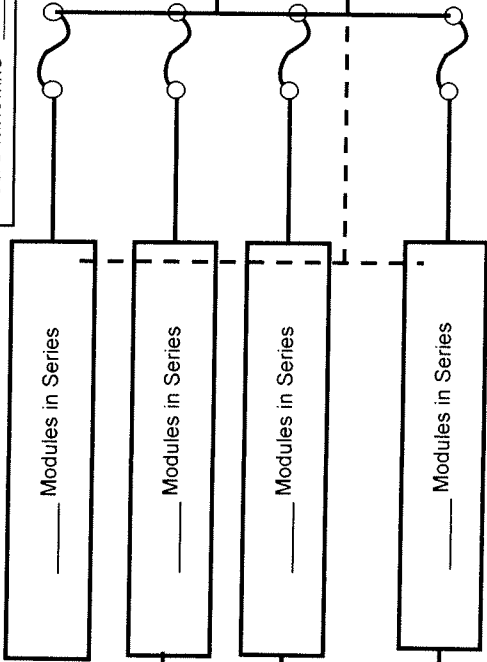


**OCPD = OVERCURRENT PROTECTION
DEVICE (IF NO OCPD-LEAVE ITEM BLANK)**

INVERTER RATINGS
 MAX DC VOLT RATING = _____ V
 MAX POWER @ 40°C = _____ W
 NOMINAL AC VOLTAGE = _____ V
 MAX AC CURRENT = _____ A
 MAX OCPD RATING = _____ A

SOURCE COMBINER RATINGS
 MAX OCPD RATING = _____ A
 OCPD AMP RATING = _____ A
 OCPD volt RATING = _____ V

**UNUSED SERIES STRINGS
LEAVE BLANK BELOW**



PV MODULE RATINGS @ STC
 MODULE MANUFACTURER _____
 MODULE MODEL # _____
 OPEN-CIRCUIT VOLTAGE = _____ V
 OPERATING VOLTAGE = _____ V
 MAX SYSTEM VOLTAGE = _____ V
 OPERATING CURRENT = _____ A
 SHORT-CIRCUIT CURRENT = _____ A
 MAXIMUM POWER = _____ W
 Voc TEMP COEFF = _____ mV or %/°C
 (if supplied)

PV ARRAY INFORMATION
 # OF MODULES IN SERIES _____
 # OF PARALLEL CIRCUITS _____
 LOWEST EXPECTED TEMP _____ °C
 HIGHEST EXPECTED TEMP _____ °C

**690.53 PHOTOVOLTAIC POWER
SOURCE SIGN ON DC DISCO**
 RATED CURRENT = _____ A
 RATED VOLTAGE = _____ V
 MAX SYS VOLTAGE = _____ V
 MAX CIRC CURRENT = _____ A

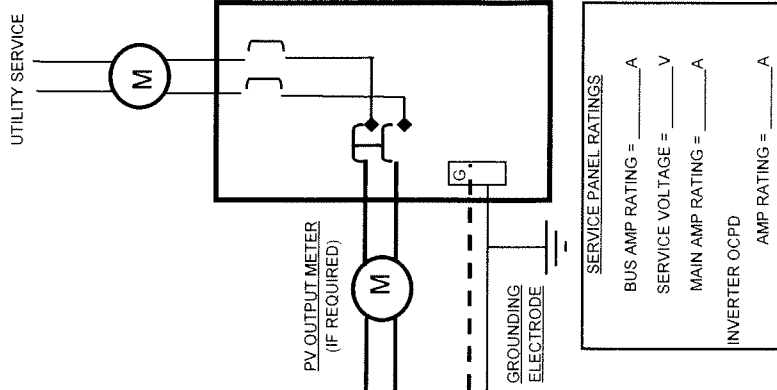
SOURCE CIRCUIT WIRE TYPE (OUTSIDE CONDUIT-CIRCLE ONE)
 USE-2 WIRE _____

SOURCE CIRCUIT WIRE TYPE (INSIDE CONDUIT-CIRCLE ONE)
 THWN-2, XHHW-2, RHW-2, USE-2 _____

SOURCE CIRCUIT WIRE SIZE (SEE NOTE BELOW) _____

NOTES:

- ASHRAE FUNDAMENTALS OUTDOOR DESIGN TEMPERATURES DO NOT EXCEED 47°C IN THE UNITED STATES (PHOENIX, AZ, PALM SPRINGS, CA)
- FOR LESS THAN 9 CURRENT-CARRYING CONDUCTORS IN ROOF-MOUNTED SUNLIT CONDUIT AND USING THE OUTDOOR DESIGN TEMPERATURE OF 47°C:
 - 12 AWG CONDUCTORS ARE GENERALLY ACCEPTABLE FOR MODULES WITH ISC OF 6.4 AMPS OR LESS WHEN PROTECTED BY A 10-AMP FUSE.
 - 10 AWG CONDUCTORS ARE GENERALLY ACCEPTABLE FOR MODULES WITH ISC OF 9.6 AMPS OR LESS WHEN PROTECTED BY A 15-AMP FUSE.



DC DISCONNECT RATINGS
 DISCO AMP RATING = _____ A
 DISCO VOLT RATING = _____ V
 OCPD AMP RATING = _____ A
 OCPD VOLT RATING = _____ V

AC DISCONNECT RATINGS
 DISCO AMP RATING = _____ A
 DISCO VOLT RATING = _____ V
 OCPD AMP RATING = _____ A
 OCPD VOLT RATING = _____ V

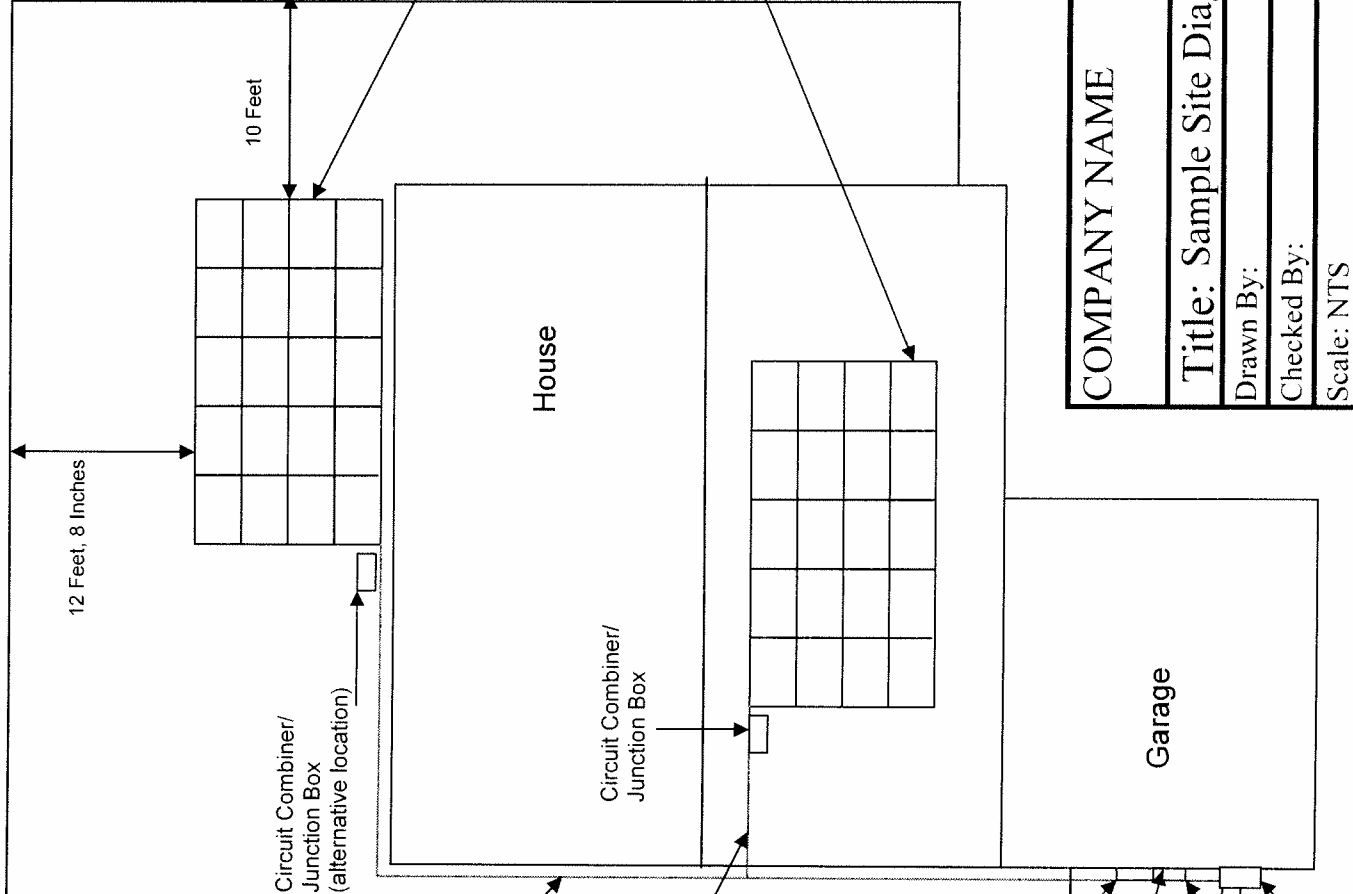
SERVICE PANEL RATINGS
 BUS AMP RATING = _____ A
 SERVICE VOLTAGE = _____ V
 MAIN AMP RATING = _____ A
 INVERTER OCPD AMP RATING = _____ A

NOTES:

- IF UTILITY REQUIRES VISIBLE-BREAK SWITCH, DOES THE AC DISCONNECT SATISFY THE UTILITY REQUIREMENTS OR IS AN ADDITIONAL SWITCH NECESSARY?
- IF INCENTIVE PROGRAM REQUIRES PV OUTPUT METER, ADD METERBASE THAT MEETS REQUIREMENTS

SCALE: NTS

**Generic Photovoltaic System Electrical Diagram
for PV Systems of 10 kW or less**



3/4" EMT conduit with 3, #10 AWG THWN conductors, (plus, minus, and ground) Conduit run is 75 feet land current is 10 amps. Conduit fastened to exposed slab. (alternative location)

3/4" EMT conduit with 3, #10 AWG THWN conductors, (plus, minus, and ground) Conduit run is 35 feet and current is 10 amps. Conduit fastened to exterior wall and exposed slab.

Inverter with DC and AC disconnects

1/2" LFNC conduit with 2, #12 AWG THWN conductors (240V, two conductors), a #12 AWG THWN equipment grounding conductor, and a #8 DC circuit grounding conductor. Conduit run is less than 10 feet to panel and current is 10 amps

New Utility Disconnect

Existing Main Service Panel

20, 140-Watt PV Modules mounted on attached patio cover shade structure (alternative location)
 #10 AWG USE-2 conductors, (#6 ground wire lugged to each module) Conduit run is 25 feet to combiner and current is 5 amps per circuit.

20, 140-Watt PV Modules mounted on 5:12 pitch roof with comp shingles. House constructed in 1989.
 #10 AWG USE-2 conductors, (#12 ground wire attached with ground screw to each module) Conduit run is 25 feet to combiner and current is 5 amps per circuit.

COMPANY NAME

Title: Sample Site Diagram

Drawn By: _____ Date: _____

Checked By: _____

Scale: NTS

Material: _____

DWG NO. **EX-2**
 Related Drawings: EX-1

Your Logo Here
 Jurisdiction Building Safety Department
 Address City OR Zip
 Phone (541) , Fax (541)
 Internet address: www.

Photovoltaic & Solar Water Heater Application

Permit Number: _____

TYPE OF WORK	
<input type="checkbox"/> RESIDENTIAL <input type="checkbox"/> COMMERCIAL	
JOB SITE INFORMATION AND LOCATION	
Job address:	
City/State/ZIP:	
Subdivision:	Lot:
DESCRIPTION OF WORK	
<input type="checkbox"/> PROPERTY OWNER <input type="checkbox"/> BUSINESS NAME	
Name:	
Owner installation: This installation is being made on property that I own, which is not intended for sale, lease, rent, or exchange.	
Owner signature: _____	Date: _____
OWNER INSTALLATION	
Name:	
Address:	
City/State/ZIP:	
Phone: ()	Fax: ()
CONTRACTOR	
Business name:	
Address:	
City/State/ZIP:	
Phone: ()	Fax: ()
CCB lic. no.:	BCD lic. no.:
Signing Supervisor's license no.:	
Print Name of signing supervisor:	
Signature of signing supervisor: _____	Date: _____
Plumbing Contractor: _____	Phone: _____

REQUIRED DATA: 1- AND 2-FAMILY DWELLING
All criteria must be met as a prescriptive installation:
Roof Structure: Is Minimum rafter or truss chord size 2x4 or more? Yes <input type="checkbox"/> No <input type="checkbox"/> Is spacing 24" o.c. or less? Yes <input type="checkbox"/> No <input type="checkbox"/> (If No, plan review required)
Roofing Material: Standing seam metal, composition, single layer wood shingle or shake? Yes <input type="checkbox"/> No <input type="checkbox"/> If No what type? _____ Concrete or tile Yes <input type="checkbox"/> No <input type="checkbox"/> (If Yes, will require a structural review)
Loading: Are collectors directly attached to roof framing OR mounted to continuous rails directly attached to roof framing? Yes <input type="checkbox"/> No <input type="checkbox"/> Does collector and mounting hardware (rails, frame, etc.) weight exceed 4.5 pounds per square foot (psf)? Yes <input type="checkbox"/> No <input type="checkbox"/> Does maximum panel height above roof exceed 18" from top of panel to roof surface? Yes <input type="checkbox"/> No <input type="checkbox"/> (If Yes on either of these two, plan review required)
REQUIRED DATA: PLANNING & LAND USE
Check with the local planning/development department:
Land Use - Zoning Code <input type="checkbox"/> _____ Setbacks <input type="checkbox"/> _____ ft. Height Restrictions vary per local jurisdictions. Check with the Authority Having Jurisdiction for restrictions. Solar Shade Restrictions <input type="checkbox"/> Is property in the Historic District? Yes <input type="checkbox"/> No <input type="checkbox"/> (If Yes, Historic Review may be required)
DOCUMENTS REQUIRED FOR SUBMITTAL
Application <input type="checkbox"/> Site Plan <input type="checkbox"/> Elevations <input type="checkbox"/> Structural plans needed if the system does not meet all of the prescriptive requirements above. Include data showing that the solar installation meets the prescriptive requirements. Elevation Drawings (required if system not flush with the roof). The elevation must show the height of the building, and the height of the solar installation, but does not need to show other building details, unless a Design Review will be required.

PERMITS ARE NON-TRANSFERABLE, NON-REFUNDABLE AND EXPIRED IF WORK IS NOT STARTED WITHIN 180 DAYS OF ISSUANCE OR IF WORK IS SUSPENDED FOR 180 DAYS.

It is the responsibility of the owner or contractor to call for inspections. 541-774-2350 by 7:00 am for same day inspection.

CREDIT CARD INFORMATION
Name of Cardholder as shown on credit card:
Cardholder Signature: (need on every permit appl.)
<input type="checkbox"/> Visa <input type="checkbox"/> Master Card Credit card number: _____ Expiration Date: _____

PERMIT FEES																													
Valuation of Project = Total Project Price - Solar Equipment Value (structural elements for the solar panels, including the mounting brackets and rails and the cost of labor to install them)	\$ _____																												
Solar Equipment Value (including the solar collector panels, inverters and preheat tanks).	\$ _____																												
<table> <tr> <td>Building Permit (Based on valuation above)</td> <td>\$ _____</td> <td>Electrical Permit:</td> <td></td> </tr> <tr> <td>Electrical Permit</td> <td>\$ _____</td> <td>5kva or less</td> <td>\$79.00 <input type="checkbox"/> \$ _____</td> </tr> <tr> <td>Plumbing Permit</td> <td>\$ _____</td> <td>5.01 to 15 kva</td> <td>\$94.00 <input type="checkbox"/> \$ _____</td> </tr> <tr> <td>12% state surcharge</td> <td>\$ _____</td> <td>15.01 to 25kva</td> <td>\$156.00 <input type="checkbox"/> \$ _____</td> </tr> <tr> <td>Total Fees Due:</td> <td>\$ _____</td> <td>25.01kva and above</td> <td>\$156 + \$2 x _____ kva = <input type="checkbox"/> \$ _____</td> </tr> <tr> <td></td> <td></td> <td>Plumbing Permit:</td> <td></td> </tr> <tr> <td></td> <td></td> <td>Water Heater Permit</td> <td>\$40.00 <input type="checkbox"/> \$ _____</td> </tr> </table>	Building Permit (Based on valuation above)	\$ _____	Electrical Permit:		Electrical Permit	\$ _____	5kva or less	\$79.00 <input type="checkbox"/> \$ _____	Plumbing Permit	\$ _____	5.01 to 15 kva	\$94.00 <input type="checkbox"/> \$ _____	12% state surcharge	\$ _____	15.01 to 25kva	\$156.00 <input type="checkbox"/> \$ _____	Total Fees Due:	\$ _____	25.01kva and above	\$156 + \$2 x _____ kva = <input type="checkbox"/> \$ _____			Plumbing Permit:				Water Heater Permit	\$40.00 <input type="checkbox"/> \$ _____	<p>*Inspections that may be required by the AHJ of the solar system:</p> <p>Building - To verify that the solar support system is properly installed. Electrical - Required in all instances where the solar system provides power to the dwelling electrical system. To verify that the circuits and feeders have been installed properly & the system has been connected properly. Plumbing - Req'd when the solar apparatus attaches to the potable water system, usually water heater. Inspection verifies that the collection system is properly attached so that no contamination of the potable system can occur.</p>
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		Water Heater Permit	\$40.00 <input type="checkbox"/> \$ _____																										

Worksheet for PV System Field Inspection

One-line diagram comparison

- _____ Is a one-line diagram available at the site?
- _____ PV module model number matches plans and cut sheets
- _____ PV modules are properly grounded with lugs on each module or equivalent grounding method
- _____ PV array wiring is consistent with plans (#of modules)
- _____ Check that cable and conduit is properly supported
- _____ Where plug connectors are used for module wiring, inspect a sample to make sure that connectors are fully engaged
- _____ Inverter model number matches plans and cut sheets

Structural Attachment of Array

- _____ Confirm that footings and support structure match the supplied detail.
- _____ Confirm that module attachment matches the supplied detail.

PV System Signs

- _____ Do signs have sufficient durability to withstand the environment?
- _____ Sign Identifying Photovoltaic Power Source (at DC disconnect)
 - _____ Rated maximum power-point current (690.53)
 - _____ Rated maximum power-point voltage
 - _____ Maximum system voltage
 - _____ Short-circuit current
 - _____ Maximum rated output current of the charge controller (if installed)
- _____ Sign Identifying AC point of connection
 - _____ Maximum operating current (provided in initial plan review)
 - _____ Operating AC voltage (provided in initial plan review)
- _____ Sign Identifying switch for alternative power system
- _____ Sign at the main service disconnect (702.8) notifying the type and location of the optional standby system