Solar Water Heating and Solar Electric Generators Installed on One or Two Family Dwellings

Category: Residential Construction

Revised: August 15, 2016 [Paul L. Scarlett], Director

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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 Program Guide also describes what system siting or design elements may trigger the need for additional 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.
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 (DC) electricity produced by the panels into alternating current (AC) electricity that can be used by the home.

C. Residential Solar Pool Heating
A residential solar pool heating system consists of light-weight unglazed polymer (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. This type of system is not subject to the requirements of this Program Guide, and may be installed by obtaining a mechanical permit. In some cases an electrical permit may also be necessary to install the control system for the solar collectors.

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 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. The Bureau of Development Services (BDS) may require additional information be submitted to ensure proper compliance with relevant code requirements.

IV. INSTALLATION AND DESIGN REQUIREMENTS
For a typical residential installation the following requirements apply. For installations that do not comply with this program guide, contact BDS for installation requirements.

A. Land Use
Solar installations must comply with the Zoning Code. Specific Zoning information regarding a site can be obtained from the BDS Planning and Zoning Section by calling 503-823-7526.

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

   Roof-mounted solar panels may exceed the maximum building height of the zone if the following are met:
a. For flat roofs or the horizontal portion of mansard roofs, the panels may extend up to 5 feet above the highest point of the roof.

b. For pitched, hipped, or gambrel roofs, the panels must be mounted no more than 12 inches from the surface of the roof at any point, and may not extend above the ridgeline of the roof. The 12 inches is measured from the upper side of the solar panel.

2. Setbacks for Ground Mounted Solar Installations

a. Ground mounted solar installations than 3 feet in width, depth or diameter and not exceeding 8 feet in height are allowed in required building setbacks.

b. In R7-IR, C, E, and I zones only, installations that do not meet the above dimensions in IV.A.2.a. are allowed in side and rear setbacks if all of the following are met:

   (1) The structure is at least 40 feet from a front lot line, and if on a corner lot, at least 20 feet from a side street lot line;

   (2) The structure has dimensions that do not exceed 24 feet by 24 feet;

   (3) No part of the finished structure exceeds 10 feet above finished grade;

   (4) The portion of the structure within the setback must be screened from adjoining lots by a fence or landscaping, unless it is enclosed within the setback by a wall. Screening is not required for enclosed structures. Screening must comply with the L3 or F2 standards of Chapter 33.248, Landscaping and Screening; and

   (5) The structure does not have a rooftop deck.

Installations that exceed the above allowances are not in a required setback unless they are approved through a land use review adjustment process.

3. Design and Historic Resource Review

Installations in design overlay zones, historic districts, conservation districts, or individual historic or conservation landmarks are subject to additional requirements. A proposal may meet exemptions, may be eligible to meet non-discretionary development standards, the Community Design Standards, or may require a land use review-either design review or historic resource review.

a. Exemptions: If a proposal meets specific requirements, it may be exempt from the regulations of the Design Overlay Zone or Historic Resource Overlay Zone chapters.
(1) In design overlay zones, roof-mounted solar systems are exempt from
design review if specified requirements of Zoning Code Section
33.420.045.Y are met.
(2) In historic districts or conservation districts roof-mounted solar systems
are exempt from historic resource review if specified requirements of
Zoning Code Section 33.445.320.B.11 or 33.445.420.B.11, respectively,
are met.

b. **Community Design Standards**: If exemptions to design or historic
resource review are not met, the proposal may be eligible to meet specific
development standards called Community Design Standards.

(1) In some design overlay zones, a design review will not be required if
the project is eligible to use the Community Design Standards. See
Zoning Code Sections 33.420.055-60 for when Community Design
Standards may be used.
(2) In conservation districts and for some conservation landmarks, historic
resource review will not be required if the project is eligible to use the
Community Design Standards. See Zoning Code Sections
33.445.710-720 for when Community Design Standards may be used.

The Community Design Standards for solar energy systems are found in
Zoning Code Chapter 33.218.

c. **Design and Historic Resource Review**: If a proposal is not exempt and
is not eligible or does not meet the Community Design Standards, design
review or historic resource review is required. Design review and historic
resource review are discretionary land use reviews that analyze the
aesthetics of a project in order to conserve or enhance special scenic,
architectural or cultural areas of the City.

(1) Design review and historic resource review are reviews that require
public notice and generally take about 8-10 weeks to complete.
(2) The design review or historic resource review fee for a solar
installation will be based on the current Land Use Services Fee
Schedule for a ‘Minor C’ review.

Contact BDS Planning and Zoning Section at 503-823-7526 if you are unsure if
the project is exempt from design review or historic resource review, or is
eligible to use the Community Design Standards.

B. **Structural**
The solar collectors and underlying substructure (mounts, rails, etc.) must be
designed and installed in accordance with the requirements of the latest version of
the Oregon Structural Specialty Code (OSSC). A solar installation that meets the
prescriptive requirements as described in section 3111.5.3 of the OSSC will not require the system be designed by a registered Oregon engineer. Use the checklist attached to the back of this code guide to determine if your system would qualify for the prescriptive path. All other systems that do not meet the prescriptive requirements are required to be designed by an engineer registered in Oregon. The roof framing supporting the solar installation must be designed for all load combinations specified in the OSSC.

1. **Requirements for Snow and Dead Loads for Solar Installations not Meeting the Prescriptive Requirements**
   
a. The weight of solar installation, their support system, and any ballast must be considered as dead load;

b. The design snow load for solar photovoltaic arrays must be based on the requirements of the latest edition of the Oregon Structural Specialty code. When applicable, snow drift loads created by the PV panels or modules shall be included; and

c. Roof systems that provide support for the solar installation must be designed or their adequacy verified considering concentrated loads from support frames for dead, snow and wind loads. In addition, roof systems that provide support for solar installations shall be designed for uniform and concentrated roof live and snow loads assuming that the PV panels or modules are not present.

2. **Requirements for Solar Installations Designed Utilizing Wind Tunnel Tests and Peer Review**

Where wind tunnel tests are used to determine wind loads on a solar installation on one or two family dwellings, peer review of the wind tunnel test are required. Please see program guide for “Solar Water Heating and Photovoltaic Electric Generators Installed on Commercial Buildings” for requirements for wind tunnel testing and peer review requirements.

3. **Requirements for Seismic Design**

Rooftop solar installation must be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity, except that solar photovoltaic arrays without attachment to the roof structure are permitted for ballasted system. See program guide for “Solar Water Heating and Photovoltaic Electric Generators Installed on Commercial Buildings” for additional requirements for ballasted systems.
C. Plumbing and Electrical

All portions of the installation of solar systems governed by the plumbing or electrical portions of the ORSC 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.

V. PERMITS

A. General Requirements

1. Alterations

When a solar system is added to an existing one or two family dwelling, the installation is considered an “alteration”. Under the provisions of the ORSC, all alterations must meet the code requirements for new construction. Permits for solar installations qualifying as alterations may be processed in one of two ways:

   a. Through the traditional permitting system; or

   b. Through the Field Issuance Remodel (FIR) program.

The specific requirements of each of these two processes are described in detail under B. Application Process.

2. New Construction

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

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

All solar installations shall be submitted for permit review.

1. Traditional Permitting System: For New Construction and Alterations

All permits for new construction and alterations are required to be processed through the Development Services Center (DSC) located at 1900 SW 4th Avenue, Portland Oregon on the first floor. All solar panels that are installed as a part of a new construction project will be processed in conjunction with the other work being permitted.
A building permit and any necessary plumbing and electrical permits will be created at the Second Screen station at the time of visit. A permit technician will evaluate the plans for completeness, and if complete, a building permit folder will be created to document all necessary reviews and approvals. Typically, the permit technician will combine the building permit and the plumbing/electrical permit into a single permit application, called a combination residential permit for convenience and ease of inspections. The applicant may apply for each of the permits separately; however, if the plumbing or electrical permits are obtained separately, they will not be issued until the associated building permit has been approved.

After the initial permits have been created, the applicant will proceed through the various review stations (Planning & Zoning and Plan Review) to verify that the design meets all of the necessary requirements. If the project is shown to comply with all requirements and all permit fees are paid, the permit will be issued to the applicant the same day.

In some cases, depending upon the complexity of the project, 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 within 7 days. The applicant will be notified of any additional questions via a “checksheet”, or the reviews will be approved. After all necessary reviews have been completed the applicant will be notified when the permit is “Approved to Issue”. The permit will be issued after all permit fees have been paid.

2. Field Issuance Remodel (FIR) Program: (Available only for alterations)
The FIR program application process differs from the traditional application process and requires contractor registration. After the registration process is completed, the designated FIR inspector works with the contractor in the field to issue all necessary permits and advise the contractor of potential issues associated with the project, such as Planning and Zoning issues. The FIR inspector will also conduct all necessary inspections for the project. All solar system permits that are processed through the FIR program will be subject to FIR registration and inspection fees. For additional information on the FIR program, consult the BDS FIR Program Guide available online at http://www.portlandoregon.gov/bds or contact the FIR program directly at 503-823-7784.

C. Permit Submittal Requirements
Regardless of the permit application process, the following information must be submitted for each permit.

1. Site Plan
A site plan is required showing building footprints, property lines, location and dimensions of solar collectors, ridgeline of roof, fire fighter access and a description of the solar system. The system must be shown in sufficient detail to assess whether requirements of section 304.9 or one of the exceptions of OSISC have been met. See attached Figure #1. For ground mounted solar installations, the site plan must also show the size, species and location of all existing trees with a diameter of 12” or greater.

2. Elevation Drawings
A simple building elevation will be required to measure the height of the installation above 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 or historic resource review is required. See attached Figure #2.

3. Structural Plans

a. Prescriptive system
If the system meets all the prescriptive requirements of the OSSC, no structural calculations will be required. However, structural plans showing the roof framing, building sections that verify that the roof and attic framing meets the prescriptive requirements of the OSSC, and system racking attachment details are required. See Figures 1 through 5 for sample drawings. In addition, complete and attach the checklist for prescriptive installations found at the end of this document; or

b. Designed system
(1) If the system does not qualify for the prescriptive path, then structural calculations prepared by an Oregon registered engineer are required. At a minimum, structural calculations verifying adequacy of the structure’s roof framing, strut or frame supporting the rails (where used), attachment of the rail to the support /strut frame and the attachment to the building’s roof framing are required. Calculations must be based on the latest version of the OSSC. In some cases, manufacturer’s information and installation details may be substituted for required calculation and details;

(2) Drawings must include a roof framing plan (member size, type, span and spacing) and any additional framing required to reinforce the existing framing. Provide a building section in sufficient detail to show how the roof framing supports the solar installation and distributes the roof and solar loads to the building walls. The plans must include the layout of the module system and its mounting, overlaid on the roof framing plan. Drawings must also provide information on any support strut or frame that supports the rails including frame member sizes, lateral bracing where required and their attachments. Details
and information on the attachment of the system to the building structure are also required.

(3) Refer to program guide “Solar Water Heating and Photovoltaic Electric Generators Installed on Commercial Buildings” for requirements when ballasted systems or wind tunnel procedures are used for solar installations on one or two family dwellings.

When S5 clips or similar clips are used at standing seam metal roof decks the capacity and spacing of the clips, the size and thickness of the standing seam roofing panels and attachment of the standing seam metal panel to the roof, shall be per section 3115.3 of the OSSC.

Submittal Requirements
In addition to requirements for standard installations, solar installation permits utilizing S-5-U Mini Clips shall contain the following additional information:

(a) Roof framing plan indicating framing member size and spacing, type of roofing, roofing attachment of metal roofing to framing, location and spacing of S-5-U Mini Clips.

(B) Structural calculations demonstrating that uplift demand on the S-5-U Mini Clip is less than allowable uplift load.

VI. INSPECTIONS
The following inspections are required for the installation of the solar system:

A. Building
Building inspections are required to verify that the solar support system is properly installed. For alterations, two building inspections, listed in order, are required to verify that the system has been installed properly:

1. IVR Code 299: Final Structural; and

2. IVR Code 999: Final Building.

For new construction or for permits that include additional work beyond the installation of the solar system additional inspections may be required.

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. Two plumbing inspections, listed in order, are required to verify that the system has been installed properly:
C. Electrical
An electrical inspection is required in all instances where the solar system provides power to the dwelling’s electrical system. The inspection will verify that the circuits and feeders have been installed properly and the system has been connected properly. Three electrical inspections, listed in order, are required to verify that the system has been installed properly:

1. IVR Code 145: Circuits/Feeders;
2. IVR Code 120: Permanent Electrical Service/Reconnect; and
3. IVR Code 199: Final Electrical.

VII. FEES
Fees for all required building, plumbing or electrical permits will be calculated using the current applicable BDS fee schedule available online at http://www.portlandoregon.gov/bds or in the BDS Development Services Center at 1900 SW 4th Avenue, Portland Oregon. If a design review or historic resource review is required, the fee will be for a ‘Minor C’ review, based on the current Land Use Services Fee Schedule.

VIII. ENFORCEMENT
All code requirements shall be in accordance with the applicable permitting and inspection procedures established by BDS.

Updates April 3, 2015 edition
Updates December 1, 2010 edition
Updates April 26, 2010 edition
Updates April 24, 2009 edition
New May 1, 2008
Figure 1

SAMPLE SITE PLAN

PROPERTY LINE DIMENSION

DESCRIPTION AND SIZE OF SOLAR PANEL

1' FT RIDGE PATHWAY

PV ARRAY LESS THAN 25% OF TOTAL ROOF

STREET NAME

Figure 2

SAMPLE ELEVATION

PROPERTY LINE DIMENSION

HEIGHT FROM ROOF SURFACE TO TOP OF PANEL

NEW SOLAR PANEL

BUILDING HEIGHT
Please refer to the following information when using Span Tables, table 2308.7.2(5) of the OSSC or table R802.5.1(5) of the ORSC to determine if your project follows the prescriptive path:

**Allowable rafter spans.** Spans for rafters shall be in accordance with Tables 2308.7.2(5) of the OSSC or table 802.5.1(5) of the ORSC. For other grades and species and for other loading conditions, refer to the AF&PA Span Tables for Joists and Rafters. The span of each rafter shall be measured along the horizontal projection of the rafter.

**Purlins.** Installation of purlins to reduce the span of rafters is permitted, as shown in the figure below. Purlins shall be sized no less than the required size of the rafters that they support. Purlins shall be continuous and shall be supported by 2-inch by 4-inch (51 mm by 102 mm) braces installed to bearing walls at a slope not less than 45 degrees from the horizontal. The braces shall be spaced not more than 4 feet (1219 mm) on center and the unbraced length of braces shall not exceed 8 feet (2438 mm).

**Bearing.** The ends of each rafter or ceiling joist shall have not less than 1 1/2 inches (38 mm) of bearing on wood or metal and not less than 3 inches (76 mm) on masonry or concrete.

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**SAMPLE BUILDING SECTION**

Figure 3
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Figure 4

PLAN VIEW

CONNECT SOLAR PANEL TO RAILS WITH 1 CONNECTOR FOR EACH 8 SQ. FT. OR LESS OF PANEL SURFACE

CORROSION RESISTANT METAL RAIL, ANCHOR TO ALTERNATE ROOF FRAMING 4'-0" MAX. ON CENTER PER SECTION A-A TYPICAL. PROVIDE A MINIMUM OF 2 RAILS PER PANEL

2X ROOF FRAMING @ 24" MAX. ON CENTER
To meet design and historic resource review exemptions, max height is 12" from top of roof to the top of panel.
Appendix – Solar Permits: Prescriptive Installations Checklist

Checklist and Submittal Requirements for Prescriptive Installations of Solar Photovoltaic in accordance with Oregon Solar Installation Specialty Code (OSISC) and Solar Water Heating Systems

Instructions
Complete the following with all the information requested. This form must be submitted along with the application for installation.

Property Owner Information
Property Owner Name: __________________________ Installation Address: __________________________
Day Phone: __________________________ Evening Phone: __________________________ Email: __________________________
Contractor: __________________________ CCB#: __________________________
Day Phone: __________________________ Evening Phone: __________________________ Email: __________________________

PV Modules or Solar Water Heating Collectors
Manufacturer: __________________________ Model Number: __________________________ Listing Agency: __________________________

Site Plan and Structural Plan
• Attach a simple site plan showing the location of the PV or solar water heating system in relation to buildings, structures, property lines, and, as applicable, flood hazard areas.
• Attach a simple structural plan showing the roof framing (rafter size, type and spacing) and PV module system racking attachment. Plans must be shown in sufficient detail to assess whether the requirements of section 304.9 of OSISC or one of the exceptions have been met.
• Attach simple building elevation.
• The plans must be 8.5 x 11 or larger paper.

Structural Information

Roof Design and Attachment
• Roof rafter size: _____ x _____ inches OR Manufactured Trusses
• Rafter or manufactured roof truss spacing _____ inches o.c.
• For roof rafters, maximum rafter span allowed per table 305.4.1 (Appendix "B") of the Oregon Solar Installation Specialty Code (OSISC) (www.oregonbdc.org/programs/solar/solar_code/100110_OSISC.pdf) for the size and spacing of roof rafters is _____ ft _____ inches.

Checklist to determine if your installation qualifies for prescriptive path

☐ Yes ☐ No  Is this conventional light framed wood construction?

☐ Yes ☐ No  Does the structure have pre-engineered trusses?

OR

Does structure have roof framing members spaced at 24" o.c. maximum AND comply with the applicable allowable span in table 305.4.1 (Appendix "B") of the Oregon Solar Installation Specialty Code (OSISC)?
<p>| | | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>□ Yes □ No</td>
<td>Is the roofing material metal, single layer wood shingle, or not more than two layers of composition shingle?</td>
<td></td>
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<td>□ Yes □ No</td>
<td>Is the weight of the modules and racking less than 4.5 pounds per square foot?</td>
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<tr>
<td>□ Yes □ No</td>
<td>Is the module height less than 18 inches above the roof in accordance with section 305.4?</td>
<td></td>
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For Standing Seam Metal Roofs Only (If not applicable please skip this section)

|  □ Yes □ No | Is the metal gauge 26 or heavier? |
|  □ Yes □ No | Clamp design: Are clamps designed to withstand uplift of at least 115 pounds for clamps spaced at 60 inches on center or less or at least 75 pounds for clamps spaced at 48 inches on center or less? |
|  □ Yes □ No | Is the spacing of the clamps as measured along the seam greater than or equal to 24” o.c. and less than 60” o.c. AND the spacing perpendicular to the seam not greater than 24” o.c.? |
|  □ Yes □ No | Is the roofing panel width 18-inches or less? |
|  □ Yes □ No | Is the roofing panel attached with at least #10 screws at 24” o.c.? |
|  □ Yes □ No | Is the roofing panels installed over minimum 1/2-inch nominal wood structural panels attached to framing with 8d nails at 6” o.c. at panel edges and 12” o.c. field nailing? |

If you have indicated “No” on any of these requirements above, the project may not be submitted using the prescriptive path.

**Fire Fighter Access and Escape**

Access and escape pathways are not required when the array is located on a non-occupied accessory structures that is separated from occupied structures by a 6 foot minimum separation distance or by a minimum two-hour fire rated assembly.

**General Requirements:** For all other roof mounted systems, a minimum 36” wide pathway is required along three sides of the solar roof, located over a structurally supported area. Any roof with a slope greater than 2:12 can not use the bottom roof edge as a pathway. Pathways and solar panels shall be located outside 12” of the low point of a valley.

If the array is greater than 150 feet in length or width, additional 36” wide intermediate pathways and cutouts are required. See code for details.

If the roof has smoke and/or heat vents, a 36” pathway shall be provided to and around each vent.

**Exceptions to General Requirements:**

|  □ Yes □ No | Is the roof slope greater than 2:12? |
|  □ Yes □ No | Is the array area 1,000 sq ft or less? |
|  □ Yes □ No | Is the array 150 feet or less in length or width? |

If you have indicated “No” to any of the items above, exceptions do not apply, provide a simple plan conforming with the general requirements.

If you have indicated “Yes” to all of the items above, see below for reduced access and escape pathway requirements.

Is the array 25% or less of the roof area?  □ Yes □ No

- If Yes, a 12” pathway along each side of any horizontal ridge is required.
- If No, a 12” pathway along each side of any horizontal ridge is required and a minimum of one 36” pathway is required from ridge to eave over a structurally supported area.

Provide a simple plan showing conformance to the reduced access pathway requirements.

As the property owner or authorized representative of the above listed property, I certify that I have verified the information provided above and that the roof rafter (if applicable to the project), meet the span requirements of Table 305.4.1 (Appendix B) of the Oregon Solar Installation Specialty Code.

**Applicant name (please print)_____________________________**

**Signature_____________________________**

**Date_____________________________**