

## **4.2 Installation and Equipment Specifications**

Systems receiving incentives under this program must be installed according to manufacturers' recommendations and generally accepted industry standards. Installation of the system must be completed by an installer meeting the requirements described in Section 5.1 "Installer Qualifications." The dealer for the system must meet the requirements described in Section 5.2 "Dealer Qualifications." Requirements not specified in this Plan, but which are applicable under this Plan, include, but are not limited to, the following:

- The project must comply with all applicable local, state, and federal regulations.
- Installations must meet applicable governmental statutes, codes, ordinances, and accepted engineering and installation practices.
- Systems must be permitted with and pass inspection by the Authority Having Jurisdiction (AHJ) over construction projects in the Participant's locale, or, if the site is not governed by an AHJ, the Participant must provide a certification in lieu of AHJ clearance.
- If the inverter of the DE system is interconnected or in any way connected to the APS grid – a "Grid-Tied System" – the system must meet all applicable APS Interconnection Requirements.
- APS may request copies of any documents to assure compliance with government, institutional, or DE program requirements that are either explicitly or implicitly described by this Plan.

If any of the requirements described in this Plan conflict with APS approved rate schedules, or government or other institutional requirements listed above, the conflicting requirements in this Plan may not be imposed.

All major components of the DE system must be new and must not have been previously placed in service in any other location or for any other application. A DE system purchased more than 180 days before the date that APS receives the reservation request will not be considered "new" under this Plan. APS may consider exceptions to this timeframe when justified by the Participant in writing. The DE system must also comply with the technology specific criteria detailed below. When some technology-specific criteria reference third party standards, the requirements of those standards are fully applicable when referenced as part of technology specific criteria.

The rapid growth in national and international renewable energy programs is resulting in greater need for the development of standardization in design, performance measurement, system integrity/longevity/maintenance, and installation techniques. New standards are likely to develop in the near future for technologies included in the DE program, and APS reserves the right to incorporate new standards into plan requirements as necessary and appropriate. The following standards or standard development bodies are referenced as part of the technology specific criteria.

## APS Distributed Energy Administration Plan

- The Active Solar Heating Systems Design Manual developed by the American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc. (“ASHRAE”) in cooperation with the Solar Energy Industries Association (“SEIA”) and the ACES Research and Management Foundation (the “Design Manual”).
- Arizona state boiler regulations (A.A.C. R4-13-406).
- Select technology specific qualification requirements developed by the California Energy Commission (“CEC”).
- Solar Rating and Certification Corporation (“SRCC”). The SRCC criteria and ratings can be viewed at [www.solar-rating.org](http://www.solar-rating.org).
- The Underwriters Laboratory (“UL”).

The technology standards are relied upon, in part, to develop a clear understanding of the DE system capacity or the expected energy production. Incentives offered under this program are based on system capacity and energy production. Therefore, to encourage transparency in program transaction and clarity for Participants, current and accurate technology standards are fundamental to the program’s success.

Some technologies included as DE under the RES are less standardized from installation to installation, while other technologies are generally standardized, no technology standard has been published. If no technology specific standard is referenced, at a minimum, to qualify for DE incentives, an Energy Savings and Designed Output (“ES&D”) report shall be provided as part of the reservation.

The ES&D report must include either a testing certification for a substantially similar system prepared by a publicly funded laboratory, or an engineering report stamped by a registered professional engineer. The ES&D report shall provide a description of the system and major components, designed performance, system output and the report shall identify applicable standards and/or codes used in system design and a brief history of the components used in similar applications. If the system design differs from the recognized industry best practices, as described in the equipment qualifications listed in the Plan for the qualifying technology, the ES&D report must contain a certification that the system design is at least as effective as the specified requirements.

Where the equipment qualifications detailed below are required for program participation, the technology specific installation guidance is provided to program participants to convey information on installation and operation practices that are most likely to achieve the DE system’s designed output. The requirements described herein are not intended as engineering recommendations, services, or technical advice. Engineering recommendations, design, and performance data will be provided to the Participant by their supplier, installer, or professional advisor. Although installation guidance is not currently mandated for a project to receive an incentive, it does reflect both industry and utility concurrence on those practices that are important for a technology to best achieve the designed output. APS reserves the right to modify equipment qualifications and/or installation guidance if APS becomes aware that such qualifications or guidance results in unsafe conditions, provides inappropriate results for our customer, or is inconsistent with program objectives.

## APS Distributed Energy Administration Plan

### 4.2.1 Biomass/Biogas and CHP (Electric and Thermal) and Biomass/Biogas Cooling

#### Equipment Qualifications

- Systems must include a dedicated performance meter to allow for monitoring of the number of RECs produced.
- A complete ES&D report must be submitted. Biomass system installations involving a regulated boiler or pressure vessel are required to include in the ES&D report confirmation of conformance with all Arizona state boiler regulations; provide a qualifying boiler inspection identification number; and keep all applicable permits in good standing.

#### Installation Guidance

Because of the individual nature of biomass systems, care should be taken to make sure the system complies with all applicable permitting and regulatory requirements, including but not limited to, air emission standards and air permit regulations.

### 4.2.2 Non-residential Solar Daylighting

#### Equipment Qualifications

Energy savings and designed output for the system will be verified by submitting either a testing certification for a substantially similar system prepared by a publicly funded laboratory, or by submitting an engineering reporting stamped by a registered professional engineer or accredited AEE Measurement and Verification professional. The report shall describe the inclusion the following components as part of the daylighting system:

- A roof mounted skylight assembly with a dome having a minimum 70% solar transmittance.
- A reflective light well to the interior ceiling or a minimum 12” below roof deck in open bay areas.
- An interior diffusion lens.
- A minimum of one thermal break/dead air space in the system between the skylight dome and the interior diffuser.
- If artificial lighting systems remain a part of the installation, the system shall include automated lighting control(s) that are programmed to keep electric lights off during daylight hours.
- The system must provide a minimum of 70% of the light output of the artificial lighting system that would otherwise be used for all of the claimed period of energy savings, as measured in foot-candles.

#### Installation Guidance

## APS Distributed Energy Administration Plan

All systems should be installed such that the skylight dome is substantially unshaded and have substantially unobstructed exposure to direct sunlight between the hours of 9 a.m. and 3 p.m.

### 4.2.3 Small Wind Generator

A small wind generator is a system with a nameplate rating of 1 (one) MW or less. The technology criteria described below are intended for small wind generators with a nameplate rating of 100kW or less. Systems larger than 100 kW will be required to submit a detailed package describing site selection, expected energy production, and an engineered system design and installation as part of an ES&D report.

#### Equipment Qualifications

The technology criteria described below are intended for wind generators with a nameplate rating of 100kW or less.

- Eligible small wind systems must be certified and nameplate rated by the CEC or other qualified third party selected by APS to provide certification and a nameplate rating. See [www.consumerenergycenter.org/erprebate/equipment.html](http://www.consumerenergycenter.org/erprebate/equipment.html) for a list of certified generators. For grid-tied or off-grid wind generators where an inverter is used, the CEC listed nameplate rating of the wind generator will be multiplied by the CEC approved weighted efficiency percentage listed for the inverter in the “List of Eligible Inverters” at [www.consumerenergycenter.org/cgi-bin/eligible\\_inverters.cgi](http://www.consumerenergycenter.org/cgi-bin/eligible_inverters.cgi) to calculate the wind turbine nameplate rating for use in determining the UFI payment.
- Grid-tied inverters used as part of the system shall be listed to Underwriters Laboratory standard UL 1741.
- The tower used in the installation must be designed by a registered professional engineer and installed by individuals familiar with local geotechnical conditions.
- The wind generator and system must include a five year warranty and an operation and maintenance plan for the full operational life of the system.

In addition to the requirements for small wind generators outlined above, systems nameplate rating larger than 100 kW will be required to submit an ES&D Report.

#### Installation Guidance

*Location:* a wind turbine hub should be at least 20 feet above any surrounding object and at least 28 feet above the ground within a 250-foot radius. Wind generators should be installed in locations with an elevation at or above the general elevation of the surrounding terrain.

*Lot size:* should be at minimum one-half acre. Municipalities and public facilities, such as schools and libraries, may not need to meet the minimum lot size requirements.

The installed system should be demonstrated to obtain at least a 15% annual capacity factor. The following are readily available methods for helping to demonstrate the potential for a 15% capacity factor, but other methods may be used. The installation location should have a demonstrated average annual wind speed of at least 9 MPH as measured at a height of no more

## APS Distributed Energy Administration Plan

than 50 feet above the ground. Average annual wind speed can be demonstrated by wind speed records from an airport, weather station or university within 20 miles of the proposed wind generator location, or by a 50 meter wind power density classification of Class 2 “Marginal” or higher on the “State of Arizona Average Annual Wind Resource” map, dated July 16, 2005 or later, as published by Sustainable Energy Solutions of Northern Arizona University. Northern Arizona University provides detailed wind resource maps as well as other resource services. For more information contact Northern Arizona University at <http://wind.nau.edu/maps/>.

### 4.2.4 Photovoltaic Systems

- All systems shall be installed with a horizontal tilt angle between 0 degrees and 60 degrees, and azimuth angle of +/- 110 degrees of due south. Since some installation alternates are less than ideal for energy production, some installation configurations for some systems receiving a UFI will not be eligible for the full incentive applicable to that system. APS will apply the PV off-angle and shading factor adjustment for the PV installation (Section 6.5).
- Photovoltaic modules must be covered by a manufacturer’s warranty of at least 20 years.
- Inverters must be covered by a manufacturer’s warranty of at least five years. The remaining operational life must be supported by a planned maintenance or equipment replacement schedule.

### Grid-Tied Systems Equipment Qualifications

- The minimum PV array size shall be 1,000 W-DC.
- All photovoltaic modules must be certified by a nationally recognized testing laboratory as meeting the requirements of UL Standard 1703.
- All other electrical components used in the installation must be UL listed.
- The inverter must be listed to Underwriters Laboratories UL 1741

### Off-Grid Systems Equipment Qualifications

- The minimum, single-system PV array size shall be 200 W-DC.
- All photovoltaic modules must be certified by a nationally recognized testing laboratory as meeting the requirements of the UL Standard 1703.
- All other electrical components used in the installation must be UL listed.
- “As-built” drawings shall be submitted to APS upon completion of the project and shall include: an electrical three-line diagram, a site plan, and a plant location map.

### 4.2.5 Solar Space Cooling

#### Equipment Qualifications

- Submittal of a complete ES&D Report certifying:

## APS Distributed Energy Administration Plan

- The minimum cooling capacity of the system will be 120,000 BTU per hour (10 tons).
- Solar collector panels used will have a SRCC OG-100 rating or laboratory documentation showing the panel energy output under controlled and replicable test conditions.

### Installation Guidance

- The horizontal tilt angle of the collector panels should be between 20 and 60 degrees and the panel orientation should be between +/- 45 degrees of south.
- All systems should be installed such that the energy collection system is substantially unshaded and should have substantially unobstructed exposure to direct sunlight between the hours of 9 a.m. and 3 p.m.

#### 4.2.6 Non-residential Solar Water Heating and Space Heating

##### Equipment Qualifications

Submittal of a complete ES&D Report that includes certification that solar collector panels used shall have a SRCC OG-100 certification or laboratory documentation showing the panel energy output under controlled and replicable test conditions.

### Installation Guidance

- The horizontal tilt angle of the collector panels should be between 20 and 60 degrees and the panel orientation should be between +/- 45 degrees of south.
- All systems should be installed such that the energy collection system is substantially unshaded and should have substantially unobstructed exposure to direct sunlight between the hours of 9 am and 3 pm.

#### 4.2.7 Small Domestic Solar Water Heating

##### Equipment Qualifications

- Domestic Solar Water Heating systems must be rated by the SRCC and meet the OG-300 system standard.
- The 'high' limit shall be set at a maximum of 160 degrees Fahrenheit.
- Contractors must provide minimum of a five year equipment warranty as provided by the system manufacturer, including a minimum warranty period of two years for repair/replacement service to the Participant. The remaining operational life must be supported by a planned maintenance or equipment replacement schedule.
- Systems shall be selected and sized according to the geographic location and hot water needs of the specific application. Reservation requests must include a manufacturer's verification disclosing that the system size and collector type proposed is appropriate for the specific application. The manufacturer's

## APS Distributed Energy Administration Plan

verification may be presented as a manufacturer's product specification sheet and must be included in the reservation request.

- Active, open-loop systems are not eligible for incentives except for active, open-loop systems that have a proven technology or design that limits scaling and internal corrosion of system piping, and includes appropriate automatic methods for freeze protection. Details disclosing conformance with this exception shall be submitted as part of the manufacturer's verification documentation.
- ICS systems shall have a minimum collector piping wall thickness of 0.058 inches. Details disclosing conformance with this requirement shall be submitted as part of the manufacturer's verification documentation.

### Installation Guidance

- All systems should be installed such that the energy collection system is substantially unshaded and should have substantially unobstructed exposure to direct sunlight between the hours of 9 am and 3 pm.

#### 4.2.8 Small Domestic Solar Space Heating

### Equipment Qualifications

- The system must be supported by a five year equipment warranty including a minimum warranty period of two years for repair/replacement service to the Participant. The remaining operational life must be supported by a planned maintenance or equipment replacement schedule.
- Submittal of a report verifying that:
  - The system will be sized and the incentive calculated based on a Solar Space Heating Incentive Calculation Procedure. The input sheet and description calculation procedure is attached provided as Exhibit 2 (APS will make the calculation procedure publicly available upon program implementation);
  - The system will utilize OG-100 certified collectors; and
  - Any active thermal storage used for the solar space heating system will utilize only water as the storage element.
- The solar space heating incentive calculation does not suggest or imply that a full energy audit is required to qualify for the solar space heating incentive. The intent is that industry professionals can utilize the calculation tool to aid in facilitating sound system design.

### Installation Guidance

- The system should be installed with a horizontal tilt angle between 20 degrees and 60 degrees, and azimuth angle of +/- 60 degrees of due south. It is recommended that collectors be positioned for optimum winter heating conditions at a minimum tilt angle of 45 degrees above horizontal, or as

## APS Distributed Energy Administration Plan

recommended by the manufacturer for the specific collector type and geographic location of installation.

- All systems should be installed such that the energy collection system is substantially unshaded and should have substantially unobstructed exposure to direct sunlight between the hours of 9 a.m. and 3 p.m.
- Heat exchange fluid in glycol systems should be tested and flushed and refilled with new fluid as necessary, every five years, or per the manufacturer's recommendations.
- It is recommended that the anode rod be checked and replaced per manufacturer's recommendations, but no less frequently than every five years.
- It is recommended that the system design include a timer, switch, or other control device on the backup element of the storage tank.
- The collectors and storage tank should be in close proximity to the backup system and house distribution system to avoid excessive pressure or temperature losses.
- It is recommended that in areas where water quality problems are reported to have reduced expected life of a solar water heater, that a water quality test is performed for each residence to screen for materials that, through interaction with the materials of the proposed system, may reduce the expected operational life of the system components. The Participant should consider contacting the manufacturer to determine if warranty or operational life will be affected.
- In areas subject to snow accumulation, sufficient clearance should be provided to allow a 12" snowfall to be shed from a solar collector without shadowing any part of the collector.
- Each system should have an operation and maintenance manual at the Participant's site, and each Participant must complete an initial start up and operation training review with the contractor at the time of system start up.

### 4.2.9 Non-Residential Pool Heating

#### Equipment Qualifications

- Submittal of a complete ES&D Report.