

## **PROCEDURES FOR SOLAR ELECTRIC (PHOTOVOLTAIC abbreviated as PV) SYSTEM DESIGN AND INSTALLATION**

### **SECTION 1: INTRODUCTION**

**The goal for a solar electric, or photovoltaic (PV), system is to provide high-quality, reliable renewable electrical power to a home.** The following sections contain detailed information on system design, fabrication, installation, and performance testing.

Photovoltaic (PV) power systems convert sunlight directly into electricity. A residential PV power system enables a homeowner to generate some or all of their daily electrical energy demand at their own home, exchanging daytime excess power for future energy needs (i.e. nighttime usage). The house remains connected to the utility at all times, so any power needed above what the solar system can produce is simply drawn from the utility as normal. PV systems can also include battery backup, or uninterruptible power supply (UPS), capability to operate selected circuits in the residence for hours or days during a utility outage.

The purpose of this document is to provide tools and guidelines for the new home builder and developer to help ensure that residential photovoltaic power systems are properly specified and installed, resulting in a system that operates to its design potential. This document sets out key criteria that describe a quality system, and key design and installation considerations that should be met to achieve this goal. This document deals with systems located on residences that are connected to utility power. Homes that are remote from utility power are not addressed in this protocol.

Recent studies have found that 10-20% of new PV installations have serious installation problems that will result in significantly decreased performance. All of these problems can lead to defect litigation. These cost-effective procedures will improve performance and reduce potential defect liability exposure.

This document focuses on pre-engineered and pre-designed packaged systems installed on new homes. In this early stage of marketing solar electric systems to the residential market, it is advisable that a builder work with established firms that have complete pre-engineered package solutions that accommodate variations in models, rather than custom design different systems for individual models and homeowners.

**Builder:** Include section 3 of this document in your bidding and contracting documents. It is meant to form the basis of a scope of work for both bidding and contracting. Its use will help ensure consistent bids and quality installations. The Scope of Work is to be followed by the PV contractors, and the PV System Installation Checklist should be used to verify installation quality.

**Contractor:** Follow the Scope of Work; use the PV System Installation Checklist to check installation quality.

**Field Superintendent:** Work with installing contractor to complete the portions of the checklist identified for verification by the field superintendent to check installation quality and send completed copy to the project manager or general superintendent.

#### **1.1. Criteria for a Quality PV System**

*A PV system should:*

1. Be properly sized and oriented to provide the expected electrical power and energy;
2. Use sunlight and weather resistant materials for all outdoor equipment;
3. Have any roof penetrations properly sealed with roofing-industry approved sealing methods;
4. Be installed with a minimum of shading from objects like foliage, vent pipes, or adjacent structures;
5. Be installed in compliance with all applicable building and electrical codes;
6. Be installed with a minimum of electrical losses due to wiring, overcurrent protection, switches, and inverters;
7. Be properly grounded to reduce the threat of shock hazards and induced surges;

8. Properly house and manage the battery system, should batteries be part of the system;
9. Interconnect with the utility company following accepted procedures.
10. Produce utility quality electrical output.

### **1.2. General Procedural Steps To Specify and Install A Residential PV Power System**

*The following steps should be followed in the design and installation of the PV system to ensure maximum performance:*

1. If PV is being considered as a standard feature or option in the early stages of project design, consider orienting homes so that there is unobstructed southern exposure to at least one large roof area (at least 120 sq ft) on most or all of the home sites, to allow maximum energy production from the rooftop solar array. Also consider installing PV systems on common buildings (e.g. community center), over covered walkways, for shading in common parking areas, and in other common areas.
2. Select a packaged system or systems that meets both customer desires and builder constraints, including:
  - a. Customer criteria for a system may include price stability for utility costs, reduction in monthly electricity bill, environmental benefits, and desire for backup power.
  - b. Builder considerations may include subdivision image, initial cost constraints, roof area constraints, visibility and aesthetic concerns.
  - c. Actual performance varies based on size of system and exposure to the sun (orientation of homes in a subdivision, and shading).
3. Develop site layouts for each system option to ensure the properties are capable of handling the desired system size. For roof-mounting options, each house plan should have at least two roof mounting options to address variations in the orientation of the house.
4. If roof mounted, verify that roof is capable of handling additional weight of PV system. Augment roof structure as necessary.
5. Install equipment according to manufacturers specifications, using installation requirements and procedures from the manufacturers' specifications.
6. Check for proper PV system operation by following the checkout procedures on the PV System Installation Checklist.