California Solar Permitting Guidebook

Improving Permit Review and Approval for Small Solar Photovoltaic (PV) Systems

June 2012
First Edition

Developed by:
Solar Permitting Work Group
The Governor's Office of Planning and Research
Office of Governor Edmund G. Brown Jr.

California Solar Permitting Guidebook

Improving Permit Review and Approval for Small Solar Photovoltaic (PV) Systems

Published June 2012

First Version

Governor's Office of Planning and Research

Office of Governor Edmund G. Brown Jr.

Electronic version available: www.opr.ca.gov

Lead Developers of the Statewide Solar Permitting Guidebook:
California Building Standards Commission
California Department of Housing and Community Development
California State Fire Marshal

Layout and production of this guidebook was made possible by
the California Center for Sustainable Energy

TABLE OF CONTENTS

PREFACE 4

ACKNOWLEDGMENTS 5

PURPOSE AND USE OF THIS GUIDE 6

Part 1 **CURRENT LAWS, REGULATIONS AND CODES 7**

- State Code Requirements 7
- Limits On Local Modifications 7
- Permit Fees 9

Part 2 **THE PROJECT APPROVAL PROCESS 10**

- Permit Application And Plan Review 10
- Site Inspection 13
- Local Utility Approval 13

Part 3 **RECOMMENDATIONS TO IMPROVE LOCAL SOLAR PERMITTING 15**

- Streamlined Permitting For Small, Simple PV Systems 15
- Toolkit For Local Governments 16

GLOSSARY 53

ADDITIONAL RESOURCES 55

PREFACE

California is a world leader in renewable energy generation. Solar and wind power, as well as emerging technologies such as biomass and fuel cells, are transforming California. Renewable energy is helping to power the state's economy, reducing our state's reliance on imported energy sources, and decreasing air pollution.

California's state and local governments have set aggressive goals to expand renewable energy. In 2011, California adopted a Renewable Portfolio Standard (RPS) requiring that at least one-third of the state's electricity come from clean energy sources by 2020. Many local governments also have their own targets for renewable energy. Additionally, Governor Brown has set a specific goal of developing 12,000 megawatts of small-scale, localized renewable electrical power (often called "Distributed Generation") in California by 2020.

Small-scale renewable energy benefits California communities. It increases energy reliability for residents and businesses by generating electricity near where it is consumed. This type of energy can also provide stable electricity prices for consumers and creates thousands of jobs across California.

In order to expand small-scale renewable energy across California, Governor Brown instructed the Governor's Office of Planning and Research (OPR) to help remove barriers to its development. One such barrier is the confusing variety of permitting requirements for small solar photovoltaic (PV) installations throughout the state. Solar PV systems, which use solar panels to convert sunlight into electricity, have been installed in California for decades. The technology of solar PV systems and the methods to install and maintain these systems are well established. As a result, permitting for these small and simple solar PV projects should be as simple and standardized as possible.

Currently, local permitting agencies maintain differing permit processes for small solar PV installations. These differences have created a confusing patchwork of requirements, which has made installing solar PV more expensive and slowed the expansion of this technology in California.

OPR has convened stakeholders from local government, the building industry, professional associations, solar companies, utility providers, and state regulatory agencies to tackle this problem. One result of this collective effort is this solar permitting guidebook, which provides local governments and solar contractors information and strategies to improve the permitting process. These improvements to local permitting will enable more solar energy generation in California communities and expand the many benefits provided by this form of renewable energy.

ACKNOWLEDGMENTS

This guidebook was developed in collaboration with the following individuals and organizations.

George Apple	Nor-Cal Fire Prevention Officers
Misha Balmer	Sungevity
Fouad Barakat	County of Los Angeles, Department of Public Works, Building & Safety Division
Bill Brooks	Brooks Engineering
Steven Burger	City of Folsom
Florentino Castellon	California Governor's Office of Business and Economic Development (GO-Biz)
Gary Craft	Craft Consulting Group
Wade Crowfoot	Governor's Office of Planning and Research
Carla Din	East Bay Economic Development Alliance
Benjamin Foster	Optony, Inc.
Ajay Friesen	SunPower
Tamara Gishri	California Center for Sustainable Energy
Pete Guisasola	Bureau Veritas North America
Peter Hamilton	California Center for Sustainable Energy
Eli Harland	California Energy Commission
Alison Healy	Solar Sonoma County
Doug Hensel	California Department of Housing and Community Development
Tonya Hoover	California State Fire Marshal
Nabil Kazerouni	East Bay Green Corridor
Bob Latz	CALBO
Sheila Lee	City of Santa Clara
Jim McGowan	California Building Standards Commission
Michael Nearman	California Building Standards Commission
Susan Oto	Sacramento Municipal Utility District
Doug Payne	Solar Tech
Hilary Pearson	Sungevity
Bill Pfanner	California Energy Commission
Michael Quiroz	3rd Wave Consulting, representing the Laborers International Union of North America
Bob Raymer	California Building Industry Association
Patrick Redgate	Ameco Solar, Inc., CALSEIA
Kevin Reinertson	CAL FIRE-Office of the State Fire Marshal
Richard S. Renfro	City of Elk Grove
Mike Richwine	CAL FIRE-Office of the State Fire Marshal
Enrique M. Rodriguez	California Building Standards Commission
Kelly M. Sherfey	California Building Officials
Terry Shoaff	Contra Costa Economic Partnership
Tim Snellings	Butte County
Ethan Sprague	Sun Run
Nancy Springer	Butte County
Kevin Stichter	Craft Consulting Group
Kim Strange	California Department of Housing and Community Development
John K. Taecker, P.E.	Underwriters Laboratories
Thomas Tansy	Solar 3.0- Solar Tech
Jane Taylor	California Building Standards Commission
Mike Tooke	California Building Officials
Theresa Townsend, AIA, LEED AP	Department of General Services, Division of the State Architect
Timothy Treadwell	California Center for Sustainable Energy
Tim Wegner	Placer County
Osama Younan	City of Los Angeles, Department of Building and Safety
Thomas Yurysta	Optony, Inc.

PURPOSE AND USE OF THIS GUIDE

This guidebook is designed to help local governments and their permitting agencies improve permitting of small solar PV systems. It is also designed to help building owners and solar installers navigate permitting as efficiently as possible. Practices recommended in this guidebook apply to permitting agencies of all sizes. The guidebook is also written for permit applicants with all levels of expertise.

The guidebook is organized into three main sections:

Part 1 **CURRENT LAWS, REGULATIONS AND CODES**: This section explains current legal requirements for solar PV installations in California.

Part 2 **THE PROJECT APPROVAL PROCESS**: This section describes important aspects of permit review and project inspection.

Part 3 **RECOMMENDATIONS TO IMPROVE LOCAL SOLAR PERMITTING**: This section recommends a streamlined local permitting process for small, simple PV installations and provides standard forms that can be used to streamline permitting. The section also provides materials that can help local governments clarify current state requirements for solar PV installations of all sizes.

The guidebook concludes with a glossary of terms and a list of helpful information sources for local governments and permit applicants.

This guidebook only addresses solar photovoltaic (PV) technology. While other promising forms of solar technology exist, this guidebook focuses exclusively on solar PV technology due its common application across California and because its technology and installation standards are well established.

This guidebook focuses on the permit review and approval to install a solar PV system. It does not address zoning, land use approvals, or environmental review that may be required for larger solar projects.

In the course of the guidebook, several types of solar PV installation are discussed, including systems on residential and commercial building rooftops, in parking lots and on parking structures, and mounted on the ground. It is important to note that each of these types of installations has a certain set of installation requirements. Also, rooftop installations have some differing requirements depending whether they are installed on a commercial or residential building.

The Toolkit section of this guidebook recommends streamlined permitting for small, simple PV systems. While there is no simple way to define a "small and simple" solar PV system, permit streamlining recommendations in this guidebook are suggested for solar systems under 10 kilowatts (KW) in size. This 10-kilowatt threshold captures approximately 90% of the solar PV systems that are currently installed. Above this size threshold, a system's design considerations become more complex.

An electronic version of this guidebook, that includes clickable links to Internet resources, can be found on the websites of several California state entities: **The Building Standards Commission**, the **State Fire Marshall**, and the **Department of Housing and Community Development**.

Part 1 CURRENT LAWS, REGULATIONS, AND CODES

State Code Requirements

California's state building codes provide uniform requirements for buildings throughout the state. These requirements are contained in Title 24 of the California Code of Regulations (CCR). The CCR is divided into 28 separate titles based on subject matter or state agency authority. Title 24 is the twenty-fourth title within the CCR and is reserved for state regulations that govern the design and construction of buildings, associated facilities, and equipment. These regulations are also known as the state's "building standards."

Title 24 applies to all building occupancies and related features and equipment throughout the state. It contains requirements for a building's structural, mechanical, electrical, and plumbing systems, in addition to measures for energy conservation, sustainable construction, maintenance, fire and life safety, and accessibility. A common misunderstanding is that Title 24 relates only to energy conservation. In fact, it covers a much wider range of requirements for buildings. Specific areas within Title 24 identify certain requirements for solar PV installations such as the California Electrical Code, the California Building Code, and the California Residential Code (which applies to residential buildings of one or two units).

State regulations should not be confused with state laws enacted through the legislative process. State regulations are adopted by state agencies where necessary to implement, clarify, and specify requirements of state law. The California Building Standards Commission and the other state adopting agencies review the codes, and update Title 24 as appropriate. Title 24 is updated every three years.

Several portions of Title 24 govern installation of a solar PV system:

California Building Code, Title 24, Part 2
California Residential Code, Title 24, Part 2.5 (One- and Two-family dwellings)
California Electrical Code, Title 24, Part 3
California Energy Code, Title 24, Part 6
California Fire Code, Title 24, Part 9

The intent of this guidebook is to provide consistent interpretation of these Title 24 requirements throughout the state. This guidebook is not intended to create, explicitly or implicitly, any new requirements.

While current Title 24 requirements establish several legal standards for installation of solar PV installations, Title 24 may be amended through the state's code update process to further clarify requirements for solar PV installations. Updated information regarding new code requirements, as well as the code updating process, is available on the **California Building Standards** website.

Limits on Local Modifications

BUILDING CODES

Cities and counties in California are required by state law to enforce Title 24 building standards. However, cities and counties may adopt local laws (also called "ordinances") to modify these state building standards under limited circumstances because of local climatic, geological, or topographical conditions. This limited allowance means that a city or county may have local ordinances that modify or add to the provisions of Title 24 for solar PV systems. The **California Building Code (Sections 1.1.8 and 1.1.8.1)** outlines the specific findings that a city or county must make for each amendment, addition, or deletion to the state building codes.

Cities, counties, and local fire departments file these local amendments to the state building code with the California Building Standards Commission. Findings that are prepared by fire protection districts must be ratified by the local government and are then filed with the California Department of Housing and Community Development.

PLANNING AND ZONING REQUIREMENTS

California's cities and counties have authority to adopt laws that govern local land use. Local governments typically enforce their own General Plans and other comprehensive plans that guide development in their communities, and then adopt local ordinances and zoning regulations to enforce these plans.

Local governments generally can adopt local laws regarding where certain land uses, such as large commercial energy generation, can be located within their communities. A more detailed conversation regarding land use and zoning for solar projects is addressed in a 2012 guide produced by the **California Planning Directors Association (CPDA)**, which is referenced in the Resources section of this guidebook. This guide recommends several steps to streamline land use decisions regarding solar energy.

RESTRICTIONS TO LOCAL LIMITS ON SOLAR ENERGY

Where solar energy is generated for on-site use, state law clearly limits local governments' ability to unreasonably prohibit solar systems. The following state laws place limits on local regulation of solar energy systems.

California Solar Rights Act

The California Solar Rights Act is a state law, passed in 1979, that elevates the timely and cost-effective installation of solar energy systems as a matter of statewide importance. The law establishes the right of homeowners and businesses to access sunlight in order to generate solar energy, limits the ability of local governments and homeowners associations (HOAs) to prevent the installation of solar systems, and prohibits a public entity from receiving state funding for solar energy programs if it unreasonably restricts the installation of solar energy systems.

The act's preamble provides the overarching intent of the act by stating:

> *It is the intent of the Legislature that local agencies not adopt ordinances that create unreasonable barriers to the installation of solar energy systems, including, but not limited to, design review for aesthetic purposes, and not unreasonably restrict the ability of homeowners and agricultural and business concerns to install solar energy systems. It is the policy of the state to promote and encourage the use of solar energy systems and to limit obstacles to their use. It is the intent of the Legislature that local agencies comply not only with the language of this section, but also the legislative intent to encourage the installation of solar energy systems by removing obstacles to, and minimizing costs of, permitting for such systems.*

The Solar Rights Act also requires that local governments use an administrative, nondiscretionary review process for on-site solar energy systems. As indicated above, no restrictions related to visual or aesthetic concerns are permitted. Section 65850.5 (c) of the act also prohibits local governments from denying a use permit for a solar energy system ". . . unless it makes written findings based upon substantial evidence in the record that the proposed installation would have a specific, adverse impact upon the public health or safety, and there is no feasible method to satisfactorily mitigate or avoid the specific, adverse impact. The findings shall include the basis for the rejection of potential feasible alternatives of preventing the adverse impact."

Specific requirements of the Solar Rights Act have been refined through a series of court cases in recent decades. For a more detailed understanding of specific legal requirements of this act, please consult a **report** completed by the Energy Policy Initiatives Center at the University of San Diego School of Law, which is detailed in the Resources section at the end of this guidebook.

Requirements of the Solar Rights Act are contained in the following sections of California law: California Civil Code, Sections 714 and 714.1, California Civil Code, Sections 801 and 801.5, California Government Code, Section 65850.5, California Health and Safety Code Section 17959.1, California Government Code, Sections 66473.1 and 66475.3.

California's Solar Shade Control Act

California's Solar Shade Control Act, enacted in 1978, is a state law intended to protect solar systems from being shaded from sunlight by neighboring trees or buildings. A 2008 amendment of this act limits the application of this law to situations in which a neighbor receives a notice that a solar energy system will be installed that they might shade if they plant trees or remodel their building.

Requirements of the act are contained in California Public Resources Code, Sections 25980 through 25986.

CEQA Exemption for Certain Solar Installations

Senate Bill 226, passed in 2011, is a state law establishing that certain solar energy systems are exempt from environmental review under the California Environmental Quality Act (CEQA). To qualify under this statutory exemption, a solar energy project must be located on the roof of either an existing building or on an existing parking lot. SB 226 makes clear the legislative intent that rooftop and parking lot solar projects do not require in-depth environmental review.

This CEQA exemption is contained in Section 21080.35 of the Public Resources Code.

Permit Fees

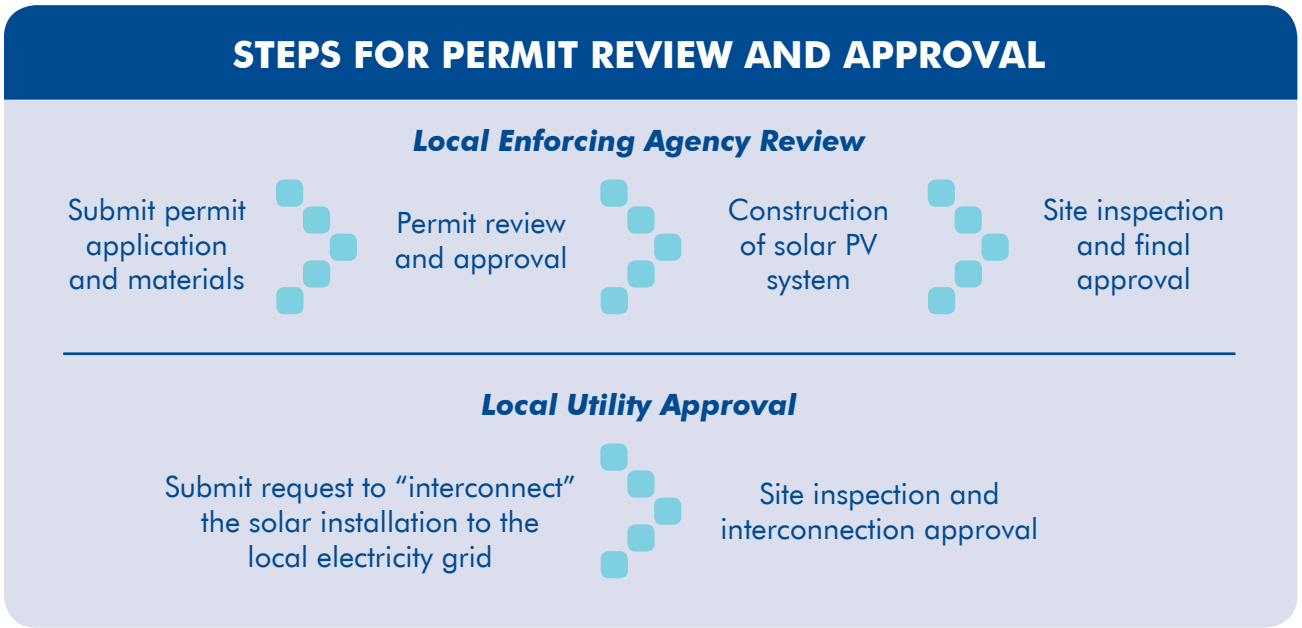
Current state law requires that fees charged by a local enforcing agency for permit processing and inspection cannot exceed the reasonable cost of providing the service for which the fee is charged. In other words, fee revenue must only be used to defray the cost of permit processing and enforcement and cannot be used for general revenue purposes. These requirements are contained in **Government Code Section 66016** and **State Health and Safety Code Section 17951**.

Many local governments across the state have reduced solar permit fees in recent years to ensure compliance with this law. Some local governments have also discontinued use of a "valuation method" of setting fees, which determines fees for a project simply based on the project's value. This method of setting solar permitting fees has no correlation to the costs of permit processing and enforcement and is therefore inconsistent with state law.

Some local governments have fully waived fees to install solar systems, recognizing the many benefits created by expansion of solar energy in their communities.

Part 2 THE PROJECT APPROVAL PROCESS

Securing approval for a solar PV project involves several basic steps. First a permit application is submitted to a local permitting agency, known within government as the "enforcing agency," and reviewed by that agency. Typically, a permit is submitted on behalf of a building owner by the contractor installing the solar PV system. Once the permit application is approved, the applicant has permission to build the solar installation. After the solar installation is constructed, it is inspected by the enforcing agency to ensure it complies with applicable building codes and local ordinances. Each of these steps is described in more detail below.



While securing project approval from the local agency, the permit applicant should contact the local utility provider to request permission to connect the solar installation to the local distribution grid. The solar system cannot be "turned on" until approval is granted by both the local agency and the local utility.

Well-informed solar installers and knowledgeable, well-trained local agency staff are critical to achieve an efficient permit approval process. Please consult the Resources section of this guidebook for information on training available to both solar contractors and agency staff. Effective training is one of the most important steps that local governments and the solar industry can take to ensure efficient permitting.

Permit Application and Plan Review

This section explains the permit review process for solar PV installations and common issues that must be addressed to minimize unexpected delays in the permit review process.

Enforcing Agency Review

The first step to build a solar installation requires applying for a permit to construct the installation from the local enforcing agency, which is most often the local building department. Each local enforcing agency is organized slightly differently, but all have an established process for receiving, reviewing, and approving permits.

The local agency enforces all Title 24 requirements from the state as well as any local requirements on solar PV installations. In many cases, the local agency must interpret how state requirements apply to certain buildings. For solar PV installations, the enforcing agency must verify that the installation complies with structural and electrical requirements and meets legal fire safety ratings. Each of these areas is discussed in more detail.

Structural Requirements

Installation of solar systems on the roof of a structure adds weight to the structure commonly referred to as "dead load." This additional weight must be accounted for to ensure that the building can safely bear the weight of the solar installation. In new construction, these additional loads are usually addressed easily and at very little cost. Where solar PV is added to existing buildings, the cost and complexity of adding weight to the roof vary depending on the structure of the building and roof.

Solar panels also may impose loads generated by seismic forces, and in some areas, by snow accumulation. Solar panels must also resist wind forces.

The California Building Code and California Residential Code contain specific tables that determine the required size and spacing of structural support for a roof according to assumed design loads based on roof covering, roof slope and snow loads. These specific tables do not address structural support that is required for additional equipment on rooftops such as PV systems.

Building codes do provide design criteria that an engineer or architect can use to calculate the required structural support required for additional loads on rooftops, such as solar PV system. Many enforcing agencies have policies or procedures in place to identify when a licensed engineer or architect must be consulted when adding loads to a roof structure. Permit applicants should learn if the local enforcing agency specifically requires the services of a licensed engineer or architect to verify proposed plans for a solar PV system. \

Electrical Requirements

Individual components of solar PV systems must comply with the California Electrical Code (CEC). This requirement applies to several system components, including but not limited to the installation's panels, modules, wire, inverters, connectors, and disconnects. The CEC requires these components in the solar PV system to be "identified and listed for the application." It is important to ensure that the solar system's components are listed within a product standard that covers the proposed use.

Requirements for electrical components of solar PV installations are no different than requirements for individual components of other types of installations, such as a swimming pool. In the case of swimming pools, pumps, chlorinator, heater, controls, and other components must be listed, identified, and properly installed to constitute a code-compliant system. Currently, no complete system listings exist for solar installations, but rather system listings exist for a solar PV installation's individual components.

Components that are identified and listed for solar PV installation application must be installed in accordance with both the California Electrical Code and the manufacturers' installation instructions. Solar PV systems that use components listed for the application and are properly designed and installed constitute a code-compliant system from an electrical standpoint.

In some circumstances, a professional electrical engineer may be required to design the electrical portion of the proposed solar PV system. The enforcing agency determines if this is necessary based on the complexity of the system. In many cases, an electrical engineer is not required, as licensed contractors are capable of completing the necessary sizing calculations and can specify the components needed to make smaller systems work safely and properly.

The California Electrical Code requires that portions of electrical systems, including solar PV systems, should only be accessed by qualified persons. This rule is intended to ensure that only people who have training or understand relevant hazards are allowed in certain areas of an electrical installation.

Fire Classification Requirements

Buildings in California may be required to have a fire resistant roof covering, depending on the type of construction, occupancy, or geographical location of the building. The California Building Code and California Residential Code recognize three fire resistant roof ratings; Class A, Class B, and Class C. These ratings are established through specific testing methods based on the ability of the roof covering to withstand fire that comes from a source on top of the roof structure. Roof materials with Class A fire resistance rating can withstand a high exposure to fire without allowing penetration or ignition of the structure. Class B materials have a moderate resistance to fire exposure while Class C materials have a lesser ability to withstand fire.

California statutorily requires all roof materials installed on buildings throughout state to have a minimum Class C rating. This means that if solar panels are used as roof covering, they must meet this rating. However, it is not uncommon for local government to amend the minimum code requirement to mandate a higher fire rating based on local conditions such as location in a high fire hazard severity zone.

Planning and Zoning

As noted earlier in this guide, California cities and counties have authority to adopt laws that govern local land use, but are limited from restricting solar energy systems where energy is being generated for use on-site. Local governments have more latitude to determine where large, commercial energy generation can be located within their communities. For commercial solar PV projects, developers should determine what if any local plans, laws, or regulations govern where the project can be located.

Fire Service Approval

Permits for solar PV installations must also be reviewed to ensure that they comply with fire safety requirements. In many communities, the local fire department ensures fire safety of PV projects in coordination with the main enforcement agency that provides final permit approval. In these situations, the enforcing agency will coordinate directly with the fire department and the permit applicant does not have any direct contact with the fire department.

In some areas, the local fire authority is a fire district or special service district organized to provide fire services. Unlike a fire department, which is typically part of a city or county government, a fire district operates independently under the direction of a locally elected board. In these circumstances, the permit applicant may need to contact the fire district for fire safety approval for the solar PV installation. Some jurisdictions have established a memorandum of understanding between the local fire authority and the building official that allows the building official to determine and approve fire safety requirements.

In circumstances where the fire authority is separate from city or county government, applicants should contact the local fire authority early in the planning stages of a PV installation to determine if there are any unique requirements or approval process within the specific jurisdiction.

In 2008, the California Office of the State Fire Marshal released a **final draft guideline** related to solar PV roof installations. This document was developed through collaboration with local fire departments and the solar industry with safety as the principal objective. The guideline's intent was to provide the solar industry with information to aid in designing, building, and installing PV systems to meet this objective.

Portions of the 2008 State Fire Marshal guideline will be included in the California State Fire Code in the current code update process that will take effect in 2014. Permit applicants should contact the local fire

authority to determine if specific fire safety requirements beyond current state regulations have been adopted in the local jurisdiction.

Site Inspection

After the solar PV system is installed, an inspector from the local enforcing agency physically inspects the installation. This field inspection is the last step before final project approval is granted by the local enforcing agency. (Note that the system cannot begin operating until it has received approval from both the local enforcing agency and the local utility.) The field inspection ensures the solar PV system has been installed properly and according to the approved plans.

Inspections focus on verifying that an installation is code compliant with electrical, building code, and fire safety requirements. Inspection of the installation's electrical system often focuses on wiring methods, circuit protection, grounding, and safety signage. To ensure building code compliance, an inspection will verify proper material selection, soundness of structural attachment to the roof or ground, and ensuring all components are securely fastened. To ensure fire safety of the installation, the inspection verifies labeling of equipment to limit firefighter exposure to electrical voltage, space for firefighters to access the building or structure, and limitations in roof installations due to firefighting suppression techniques.

Currently, inspection standards for PV solar systems can differ among jurisdictions due to differing interpretations of code standards and inconsistent expertise among field inspectors. Permit applicants should ask the local enforcing agency to provide a clear explanation of what the on-site inspection will entail, including what elements of the system the inspector will examine.

Local enforcing agencies also schedule and execute site inspections differently. Many jurisdictions are able to complete a site inspection within one or two days of notice that construction of the solar installation is completed, while others may take longer. Similarly, some enforcing agencies are able to predict a narrow window of time within which an inspector will visit a property, which saves the permit applicants time and money, while other agencies are less precise. Enforcing agencies should work to minimize the delay between the permit approval and site inspection and to minimize the inspection window.

Local Utility Approval

All solar installations need the local utility's approval to link into the electricity grid, a process commonly referred to as "interconnection." This interconnection approval must be granted before a solar PV installation is allowed to operate and is completely separate from local government approval for the solar installation. Interconnection approval ensures that a solar installation will safely connect and operate on the electricity grid.

Understanding the utility's requirements and process is very important. Permit applicants should contact the local electric utility at the beginning of the project planning stage. Utilities provide information about required interconnection agreements and can also provide information about available financial rebates or incentives. A permit applicant may also apply to the local utility for incentives available for new solar systems under the California Solar Initiative. To qualify for rebates or other incentives, property owners may be required to complete an energy audit before installing a PV system.

California's local utilities differ regarding when they require or allow filing an interconnection application during the local enforcing agency review process. Electric utilities may require or request that a contractor submit their application to the utility for review before a building permit is issued by the local city or county. Also, utilities may require one or more on-site inspections of the project before approving the interconnection agreement. This inspection process is completely different from an inspection performed by the local permitting agency.

The **Public Utilities Code** requires that all electric utilities respond within 30 working days after receiving a complete application for interconnection. To help ensure an application is considered complete when first submitted, permit applicants should contact their electric utility to learn the specific information and forms that must be included in the application.

Each utility provides information on its process for interconnection approval for solar PV installations on its website. The Resources section of this guidebook provides weblinks to this information for the state's largest utilities.

QUICK TIPS FOR CONTRACTORS & PROPERTY OWNERS WHEN APPLYING FOR A PERMIT

Permit applicants can save time and money by following these tips:

- **Take time to review permit requirements of the local jurisdiction**. Permitting rules and processes differ among different cities and counties. Understanding all local requirements will allow permit applicants to submit a complete and accurate permit application packet the first time.
- **Contact the local electric utility early in the permitting process**. Local electric utilities have a completely separate approval process from the local jurisdiction's permitting process. Some electric utilities may require that the solar project be reviewed before the local jurisdiction issues a building permit. Pursuing utility approval early in the permit process enables the solar PV system to become operational as soon as possible.
- **Make sure that the solar installation that is built matches the submitted plans**. The on-site inspector will verify that the installation matches proposed plans, and any changes may require corrections and additional inspections.

QUICK TIPS FOR LOCAL PERMITTING AGENCIES

Local agencies can save valuable staff time and resources by following these tips:

- **Provide clear written instructions on the permitting process and provide a checklist of required application materials**. Making this information available on the Internet and at the department's counter are low-cost ways to reduce errors by permit applicants.
- **Use standardized forms**. Use of standard forms that permit applicants simply fill out simplifies review for staff and reduces the possibility of omitted information.
- **Consider contractor trainings**. Partnering with the solar contractor community to train contractors on proper permit submittals represents a small investment of time that may avoid hours of staff work processing flawed permitting applications.
- **Standardize requirements across jurisdictions**. Using common permit materials, such as checklists and standard plans, across city and county lines reduces permit submittal errors among contractors working throughout a region.

Part 3 RECOMMENDATIONS FOR IMPROVING LOCAL SOLAR PERMITTING

This section recommends streamlining the permitting of small, simple solar PV installations and provides materials to help local governments make their solar permit process as efficient and cost-effective as possible.

Many local governments in California have already taken steps to streamline solar permitting. Also, several regional efforts among local governments are under way across the state to standardize solar permitting across jurisdictional lines. These existing efforts have helped to inform the recommendations made below.

Streamlined Permitting for Small, Simple PV Systems

A streamlined permit process for small solar PV systems simplifies the structural and electrical review of the PV system, can minimize the need for detailed engineering studies, and avoids unnecessary delays.

The model permit process outlined below is based on "Expedited Permit Process for PV Systems," prepared by Bill Brooks, P.E. in 2011 for the **Solar America Board for Codes and Standards** (also called the Solar ABCs). More information on this report is available in the Resources section of this guidebook.

The model streamlined permit process recommended is not intended to apply to all PV systems, but rather to PV systems under 10 KW maximum power output. As PV systems increase in size and complexity, the ability to handle these projects via a standard framework diminishes. However, it should be noted that larger PV systems can still be approved in a timely manner through a clear and efficient permit review process.

It is not the intent of an expedited process to circumvent the engineering process. Rather, the intent of a streamlined process is to recognize the similarities among these smaller systems and establish guidelines to determine when a PV project is within the boundaries of typical, well-engineered systems.

A streamlined permit process for solar PV projects under 10KW includes, but is not limited to, the following elements:

- Use of a concise submittal checklist for solar PV permit applications. The checklist provides permit applicants a clear understanding of the written materials that must be provided with the permit applications.
- Use of a standard plan to describe the proposed solar PV project in the permit application. A standard plan that applicants complete for solar PV systems can simplify the review of the permit application.
- Permit application materials and paperwork are made available through the Internet.
- Electronic submittals and permit issuance are completed using the Internet.
- When a submittal checklist and standard plan are used, plan review and permit issuance are completed "over the counter" for walk-in applications. If over the counter approval is not offered, a maximum timeframe in which to review the permit application is provided.
- If the capability exists for a local enforcing agency, permit payments are completed electronically.

A streamlined inspection process for solar PV systems should include the following:

- Coordinated inspection among the various agencies to allow for a single inspection or inspections by

the agencies to occur at the same time. This step typically involves coordination between the main local enforcing agency and the local fire authority.

- Use of concise inspection checklist that provides permit applicants a clear understanding of what elements of the solar installation will be inspected before final approval of the installation.
- Enable inspection requests to be submitted online.
- Provide for on-site inspection during the next business day after being notified that the solar system has been installed.
- Provide a scheduling time window for on-site inspection of no more than two hours, and utilize phone and/or e-mail communication to provide information on anticipated inspection time.
- The most streamlined permit process also ensures close coordination between the local enforcing agency and the local utility to coordinate on-site inspections in the most time efficient manner possible.

Efficient permitting requires cooperation among local permitting staff and solar contractors. Many local enforcing agencies have provided informational trainings for solar contractors to explain local requirements. These trainings have resulted in more educated contractors, reducing permit application errors and saving time and resources for the local permitting agency.

Toolkit for Local Governments

Several template documents are provided in this section that local enforcing agencies can customize for their own use in order to improve their permitting processes. These materials form an optional toolkit that local governments can utilize to reduce their costs of permit review and approval and ensure a predictable and efficient process for permit applicants.

Use of these materials is optional for local governments. However, local governments are encouraged to give substantial weight to the statewide goals and benefits that a streamlined permit process offers to their own agencies, local contractors, businesses, and residents. Enforcing agencies are encouraged to use these standardized plans and processes whenever possible to provide uniformity across jurisdictional lines.

Materials for streamlining permitting of small systems under 10kw on single family homes:

- **Local information bulletin** that outlines the necessary steps to secure permits for solar PV installations under 10kw. This information bulletin details what materials must be submitted in the permit application and key points of the on-site inspection. Several local permitting agencies have successfully issued similar bulletins to clarify their permit processes.
- **Standard plans** that enable applicants to "fill in the blanks" to explain the electrical configuration of a solar PV system. By doing so, these standard plans reduce omissions and errors within permit applications. This toolkit offers two standard plans that can be used for small solar PV installations: one for systems using a central inverter and the other for systems utilizing micro-inverters. Enforcing agencies are encouraged to use these plans as a base document to develop other standard plans and procedures that cover other types of PV installations.

Materials to further improve permitting of solar PV systems of all sizes:

- **Example MOU (memorandum of understanding)** that provides a template agreement between two local agencies to coordinate permit review and approval. It can be used, for example, to streamline review between a local building department and a local fire service.

- **Technical information bulletin for solar PV installations on single-family residences** that provides consistent and comprehensive information regarding current state requirements for solar PV systems on single-family residences. It could be issued as a departmental advisory or as an informational handout and can be used by solar installers as a reference document. Enforcing agencies can modify the information bulletin based on local needs or policies.
- **Technical information bulletin for solar PV systems on all types of buildings, including commercial buildings**, that provides information regarding current state requirements for solar PV systems on all buildings, including commercial buildings, in a local jurisdiction.

TOOLKIT DOCUMENT

City/County of [NAME OF CITY]
Department of [NAME OF DEPARTMENT]

Submittal Requirements for Permit Application Solar Photovoltaic Installations under 10KW in Single-Family Dwellings

Departmental Information Bulletin [IDENTIFYING NUMBER]
Effective: [DATE]

This information bulletin is published to guide applicants through a streamlined permitting process for solar photovoltaic (PV) projects under 10 KW in size. This bulletin provides information about submittal requirements for plan review, required fees, and inspections.

Note: Language in **BOLD FONT** *below indicates where local jurisdiction needs to provide information specific to the jurisdiction.*

1. Approval Requirements

The following permits are required to install a solar PV system under 10KW:

a) [LIST TYPE OF PERMIT(S) REQUIRED BY THE LOCAL JURISDICTION, i.e. ELECTRICAL OR BUILDING PERMIT].

Planning review [IS/IS NOT] required for solar PV installations of this size.
Fire Department approval [IS/IS NOT] required for solar PV installations of this size.

2. Submittal Requirements

a) Completed permit application form. This permit application form can be downloaded at [WEBSITE ADDRESS]

b) A completed Standard Electrical Plan [THIS GUIDEBOOK RECOMMENDS DEVELOPMENT OF A STANDARD PLAN THAT ALLOWS PERMIT APPLICANTS TO SIMPLY FILL IN INFORMATION REGARDING A SOLAR SYSTEM'S ELECTRICAL CONFIGURATION. A TEMPLATE STANDARD PLAN IS PROVIDED IN THIS GUIDEBOOK]. The standard plan may be used for proposed solar installations under 10KW in size and can be downloaded at [WEBSITE ADDRESS].

If a standard electrical plan is not available for use, an electrical plan shall be submitted that includes the following:

- Locations of main service or utility disconnect
- Total number of modules, number of modules per string, and the total number of strings
- Make and model of inverter(s) and/or combiner box if used
- One-line diagram of system
- Specify grounding/bonding, conductor type and size, conduit type and size, and number of conductors in each section of conduit
- If batteries are to be installed, include them in the diagram and show their locations and venting

- Equipment cut sheets including inverters, modules, AC and DC disconnects, combiners, and wind generators
- Labeling of equipment as required by CEC, Sections 690 and 705
- Site diagram showing the arrangement of panels on the roof or ground, north arrow, lot dimensions, and EXISTED SHADING ELEMENTS the distance from property lines to adjacent buildings/structures (existing and proposed)

c) Demonstrate compliance with structural requirements. [THIS GUIDEBOOK RECOMMENDS THAT LOCAL JURSDICTION ADOPT PRESCRIPTIVE APPROACH TO ESTABLISHING MINIMAL STRUCTURAL REQUIREMENTS THAT AVOIDS THE NEED FOR STRUCTURAL CALCULATIONS.]

If a prescriptive approach has not been developed to ensure structural requirements, structural support information for roof-mounted systems including the following SHOULD INCLUDE:

- The type of roof covering and the number of roof coverings installed
- Type of roof framing, size of members, and spacing
- Weight of panels, support locations, and method of attachment
- Framing plan and details for any work necessary to strengthen the existing roof structure
- Any relevant calculations (if required)
- Where an approved racking system is used, provide documentation showing manufacturer of the rack system, maximum allowable weight the system can support, attachment method to the roof or ground, and product evaluation information or structural design for the rack system

3. Plan Review

Permit applications can be submitted to [DEPARTMENT NAME] in person at [ADDRESS] and [IF APPLICABLE] online through the following website: [WEBSITE].

Permit applications utilizing standard plan may be approved over the counter at [ADDRESS]. Permit applications can also be submitted electronically [IF APPLICABLE] at the following website: [WEBSITE]. Permits not approved over the counter are typically reviewed in [NUMBER OF] days.

4. Fees

[PROVIDE CLEAR FEE SCHEDULE]

5. Inspections

Once all permits to construct the solar installation have been issued and the system has been installed, it must be inspected before final approval is granted for the solar system. On-site inspections can be scheduled by contacting [DEPARTMENT] by telephone at [PHONE NUMBER] or electronically at [WEBSITE OR E-MAIL ADDRESS]

Permit holders must be prepared to show conformance with all technical requirements in the field at the time of inspection. The inspector will verify that the installation is in conformance with applicable code requirements and with the approved plans.

Below are common points of inspection with which the applicant should be prepared to show compliance:

- Number of PV modules and model number matches plans, and specification sheets number matches plans and specification sheets
- Array conductors and components are installed in a neat and workman-like manner.
- PV array is properly grounded
- Electrical boxes are accessible and connections are suitable for environment

- Array is fastened and sealed according to attachment detail
- Conductors ratings and sizes match plans
- Appropriate signs are property constructed, installed, and displayed, including:
  - Sign identifying PV power source system attributes at DC disconnect
  - Sign identifying AC point of connection
  - Sign identifying switch for alternative power system
- Equipment ratings are consistent with application and installed signs on the installation, including:
  - Inverter has a rating as high as max voltage on PV power source sign
  - DC-side overcurrent circuit protection devices (OCPDs) are DC rated at least as high as max voltage on sign
  - Switches and OCPDs are installed according to the manufacturer's specifications (i.e. many 600VDC switches require passing through the switch poles twice in a specific way)
  - Inverter is rated for the site AC voltage supplied and shown on the AC point of connection sign
  - OCPD connected to the AC output of the inverter is rated at least 125% of maximum current on sign, and is no larger than the maximum OCPD on the inverter listing label
  - Sum of the main OCPD and the inverter OCPD is rated for not more than 120% of the bus bar rating

6. Departmental Contact information

For additional information regarding this permit process, please consult our departmental website at [WEBSITE] or contact [DIVISION NAME] at [PHONE NUMBER].

TOOLKIT DOCUMENT

City/County of [NAME OF CITY]
Department of [NAME OF DEPARTMENT]

Solar PV Standard Plan
Central Inverter Systems for Single-Family Dwellings

LOGO

SOLAR PV STANDARD ELECTRICAL PLAN

Central Inverter Systems for Single Family Dwellings

***** Provide this document to the inspector along with ALL system installation instructions *****

Project Address: _____

Permit Number: _____

Scope: **Standard plan for installation of solar PV systems utilizing 2 wire multiple string central inverters, not exceeding a total AC output of 10kW, in single family dwellings having a 3 wire electrical service not larger than 225 amps at a voltage of 120/240. This plan covers Crystalline and Multi-Crystalline type modules where all the modules are mounted on the roof of the single family dwelling. For installations exceeding this scope, Electrical Plan review is required.**

NOTE: This plan is intended for use with standard DC to AC inverters containing an isolation transformer. This plan is NOT intended to be used with micro inverters or transformer-less inverters and is limited to installations where the DC system voltage does not exceed 600 volts. This plan is not intended for systems containing batteries or power optimizer. This document addresses only the requirements of the 2010 California Electrical Code (CEC), refer to other toolkit documents for California Residential code (CRC) requirements.

Installer information:

Name:	Phone Number: ( ) -
Address: _____ City: _____ State: _____ Zip _____	Homeowner: ☐ Contractor: ☐ Contractor License # _____ License type _____

Required information for DC wiring:

1. Total number of solar modules being installed: ☐	2. Number of modules per string: ☐
3. How many strings total? ☐	4. Are any strings wired in parallel? ☐ Yes ☐ No If "Yes", how many are paralleled together? ☐ Two _____ ☐ Other (specify) _____
5. Are you installing a combiner box with fuses? ☐ Yes ☐ No (If Yes, include calculation in Step # 13)	
6. Module Voc (from module nameplate): ☐	7. Module Isc (from module nameplate): ☐
8. Module maximum fuse or circuit breaker size (from module nameplate): ☐	9. Temperature correction factor from **Table 690.7** of the 2010 CEC. Varies by location. (Check with the local building department for this figure) _____

Project Address: _____

Permit Number: _____

10. Calculate the maximum DC system voltage (Shall not exceed the inverter maximum DC input voltage and shall not exceed 600 volts):

Maximum number of modules per string _____ x Voc _____ x temperature correction factor _____ = _____ volts

Note: This formula is intended to provide a close approximation of the maximum DC system voltage possible at the job location under the lowest ambient temperature condition. This result will always be slightly higher than when using the module manufacturer supplied temperature coefficient. The intent is to alert the installer that the 600 volt limit is close to being exceeded and is not intended to provide as accurate a result as the calculation employing the manufacturer supplied coefficient. Where the installer chooses to use the manufacturer's supplied coefficient, approval by the local enforcing agency is required.

11. Calculate the maximum DC current per string to allow for peak sunlight conditions and continuous operation in excess of three hours:

Module Isc _____ x 1.56 = _____ **Max amps carried by the conductor.**

12. **Choosing a conductor size for the DC source circuits & output circuit:**
Where Type USE-2 or other listed PV conductors are run in free air from the module locations to a junction box or combiner box, the minimum size permitted shall be #12 AWG per the module manufacturers' installation instructions and the conductor material shall be copper.

If any part of the wiring from the modules to the combiner box or inverter is to be installed in a raceway, reductions in the amount of current the conductors can carry may have to be made. Conductors to be installed in a raceway shall be Type THWN-2 or equivalent and the conductor material shall be copper.

To select the correct conductor size for the PV source circuits from the modules to the combiner box or to the inverter, go to Table A on page 4. Select how many conductors you will have in the raceway and how high above the roof surface the raceway will be mounted. Using the appropriate "Ambient Temperature" section for the job location, select the number from the column in Table A that matches the result you entered in item #11. (The number in Table A may be the same or larger than the number in item #11, **but it shall not be less**). Move to the top of the column to see the minimum size conductor needed for this part of the installation. Enter the number here for the **Source Circuit conductor size**: # _____ **AWG.**

Note: Per Section 338.12(B)(1), USE-2 shall not be used for interior wiring.

Project Address: _____

Permit Number: _____

13. If a combiner box is to be installed to connect the string circuits together, then the size of the "Output circuit" conductors from the combiner to the inverter must be determined.
    To do this, multiply the number of strings that are to be combined (from item #3) with the "Max amps" (from item #11) _____ x _____ = _____ Amps. Using Table A, repeat the process used to select the conductor size for the source circuits and enter the number here for **Output Circuit conductor size:** # _____ **AWG.** (If no combiner box, enter N/A)

14. Where a combiner box is installed, or where more than two strings of modules are electrically connected together in "parallel", each individual string shall be protected by its own over current protection or feeders to be sized for sum of all short circuit current of all strings. The fuse or breaker shall be listed as being suitable for use in a DC circuit and shall meet or exceed the maximum voltage of the circuit. The rating of the fuse or circuit breaker shall not be larger than the maximum size specified on the lowest rated module in the string. All combiner boxes shall be listed by a recognized listting agency and labeled as such.
    Max fuse / breaker size permitted (from step #8) _____ **A.** **Fuse / breaker size installed** _____ **A.**

    Note: Where the module specifies "Max fuse size" a circuit breaker shall not be substituted. Where the module specifies "Max overcurrent protective device" (Max OCPD), then either a fuse or DC rated circuit breaker may be used.

NOTE: Per **Section 690.31 (E),** DC wiring can only be run inside of the house if it is installed in a listed **metallic raceway or enclosure**.

Project Address: _____

Permit Number: _____

Table A

Table A is based on the following:

A. Table 310.16 - Allowable Ampacity of Insulated Conductors, 90 C rated conductors.
B. Table 310.16 - Correction Factors based on temperature ranges.
C. Table 310.15(B)(2)(c) - Ambient Temperature Adjustments for Conduits Exposed to Sunlight On or Above Rooftops.
D. Table 310.15(B)(2)(a) Adjustment Factors for More Than Three Current-Carrying Conductors in a Raceway or Cable.
E. Sections 240.4(D)(5) and 240.4(D)(7) for 10 AWG and 12 AWG conductors

Table A: Maximum Allowable Ampacity of Conductors Installed in a Circular Raceway, Exposed to Sunlight, On or Above Rooftops

Number of Current Carrying Conductors in a Raceway	Height Above Rooftop	Highest Ambient Temp									
		Less than 30˚C					30˚C to 35˚C				
		12 AWG	10 AWG	8 AWG	6 AWG	4 AWG	12 AWG	10 AWG	8 AWG	6 AWG	4 AWG
Up to 3 Conductors	0 to 0.5"	17	23	32	44	55	17	23	32	44	55
	above 0.5" to 3.5"	20	30	42	57	72	20	28	39	53	67
	above 3.5" to 12"	20	30	45	62	78	20	30	42	57	72
	above 12"	20	30	48	65	83	20	30	45	62	78
4 to 6 Conductors	0 to 0.5"	14	19	26	35	44	14	19	26	35	44
	above 0.5" to 3.5"	18	24	33	46	58	17	23	31	43	54
	above 3.5" to 12"	20	26	36	49	62	18	24	33	46	58
	above 12"	20	28	38	52	66	20	26	36	49	62
7 to 9 Conductors	0 to 0.5"	12	16	22	30	39	12	16	22	30	39
	above 0.5" to 3.5"	16	21	29	40	51	15	20	27	37	47
	above 3.5" to 12"	17	23	32	43	55	16	21	29	40	51
	above 12"	18	24	33	46	58	17	23	32	43	55
10 to 20 Conductors	0 to 0.5"	9	12	16	22	28	9	12	16	22	28
	above 0.5" to 3.5"	11	15	21	29	36	11	14	20	27	34
	above 3.5" to 12"	12	16	23	31	39	11	15	21	29	36
	above 12"	13	17	24	33	41	12	16	23	31	39
		35˚C to 40˚C					40˚C to 45˚C				
Up to 3 Conductors	0 to 0.5"	12	16	23	31	39	12	16	23	31	39
	above 0.5" to 3.5"	17	23	32	44	55	17	23	32	44	55
	above 3.5" to 12"	20	28	39	53	67	17	23	32	44	55
	above 12"	20	30	42	57	72	20	28	39	53	67
4 to 6 Conductors	0 to 0.5"	10	13	18	25	31	10	13	18	25	31
	above 0.5" to 3.5"	14	19	26	35	44	14	19	26	35	44
	above 3.5" to 12"	17	23	31	43	54	14	19	26	35	44
	above 12"	18	24	33	46	58	17	23	31	43	54
7 to 9 Conductors	0 to 0.5"	9	11	16	22	27	9	11	16	22	27
	above 0.5" to 3.5"	12	16	22	30	39	12	16	22	30	39
	above 3.5" to 12"	15	20	27	37	47	12	16	22	30	39
	above 12"	16	21	29	40	51	15	20	27	37	47
10 to 20 Conductors	0 to 0.5"	6	8	11	15	19	6	8	11	15	19
	above 0.5" to 3.5"	9	12	16	22	28	9	12	16	22	28
	above 3.5" to 12"	11	14	20	27	34	9	12	16	22	28
	above 12"	11	15	21	29	36	11	14	20	27	34
		45˚C to 50˚C					50˚C to 55˚C				
Up to 3 Conductors	0 to 0.5"	0	0	0	0	0	0	0	0	0	0
	above 0.5" to 3.5"	12	16	23	31	39	12	16	23	31	39
	above 3.5" to 12"	17	23	32	44	55	12	16	23	31	39
	above 12"	17	23	32	44	55	17	23	32	44	55
4 to 6 Conductors	0 to 0.5"	0	0	0	0	0	0	0	0	0	0
	above 0.5" to 3.5"	10	13	18	25	31	10	13	18	25	31
	above 3.5" to 12"	14	19	26	35	44	10	13	18	25	31
	above 12"	14	19	26	35	44	14	19	26	35	44
7 to 9 Conductors	0 to 0.5"	0	0	0	0	0	0	0	0	0	0
	above 0.5" to 3.5"	9	11	16	22	27	9	11	16	22	27
	above 3.5" to 12"	12	16	22	30	39	9	11	16	22	27
	above 12"	12	16	22	30	39	12	16	22	30	39
10 to 20 Conductors	0 to 0.5"	0	0	0	0	0	0	0	0	0	0
	above 0.5" to 3.5"	6	8	11	15	19	6	8	11	15	19
	above 3.5" to 12"	9	12	16	22	28	6	8	11	15	19
	above 12"	9	12	16	22	28	9	12	16	22	28

Project Address: _____

Permit Number: _____

Grounding the DC side of the inverter:

A minimum #8 copper Grounding Electrode conductor must be run un-spliced from the factory identified system grounding terminal of the inverter to the grounding electrode system of the house. The grounding electrode system may consist of one or more of the following: Ground rod(s), Ufer ground, or metallic water pipe with a minimum of 10 feet in the ground. (**Section 690.47)**

AC wiring information:

15. The inverter shall be listed and labeled by a recognized testing agency and be identified as "Utility interactive". Ground fault protection (GFP) shall comply with **Section 690.5** 2010 CEC.

    Specify inverter: Make _____ Model # _____ Elec rating _____ kW

16. Per **Section 690.9** 2010 CEC, each inverter shall be protected by an overcurrent device on the AC output side of the inverter. This can be a fuse or a circuit breaker. To correctly size the overcurrent device, locate the maximum AC output of the inverter (in amps) on the inverter nameplate, and multiply by 1.25 (This is required because the unit will be in continuous use for more than three hours).
    Maximum AC output current _____ x **1.25 = _____ Amps.** (This number will also be used to size the inverter output circuit conductors.)
    Where the "Maximum AC output" is shown only in Watts, divide that number by 240 and then multiply by 1.25 to get the correct size breaker or fuse.
    If the maximum AC output is between standard breaker or fuse sizes, the next higher size can be used so long as the inverter output conductors are sized sufficiently large enough for the amount of current produced by the inverter. **Important note:** Where a fused disconnect switch is installed, the output conductors from the inverter will connect to the **"LOAD"** side (**bottom**) terminals of the switch and the wiring from the utility will connect to the **"LINE"** side (**top**) terminals. This meets the requirement of **Section 404.6(C)** and will reduce the risk of electrical shock hazards when changing a fuse with the system still energized by the utility electrical supply.

17. Many utility providers require a performance meter and a safety disconnect switch to be installed between the PV power source and their equipment. This means that the AC power output from the inverter(s) may not connect directly into the electrical panel of the house. For a single inverter, the output from the inverter disconnect switch will connect to the performance meter (if required). Where multiple central inverters are installed, they will usually go first to a solar load center. This is just a standard circuit breaker panel that collects together the output circuits from the individual inverters. Each inverter will have its own circuit breaker. The size of each circuit breaker will be determined from step #16. From this panel one feeder will go to the performance meter, then to the safety disconnect switch and lastly to the point of interconnection at the house electrical panel. No electrical loads shall be connected between the output of the inverter and the connection to the house electrical panel. Contact your local utilities for performance meter and AC utility disconnect switch requirements.

18. Where a performance meter is required by the local utility to record the power produced by the PV system, the output wiring from the inverter shall always connect to the **"LINE"** side terminals of the meter.

19. Where disconnect switches (with or without fuses) are installed in the circuit from the inverter output terminals to the house electrical panel, the wiring originating at the inverter(s) shall always connect to the **"LOAD"** side terminals of **ANY** disconnect that has been installed

Project Address: _____

Permit Number: _____

20. The connection to the breaker panel **shall** be through a dedicated circuit breaker that connects to the panel bus bars in an approved manner. "Load Side Taps" where the inverter AC wiring does not terminate using a dedicated breaker or set of fuses are prohibited under **ANY** condition by **Section 690.64 (B)**.

21. Per Section 690.64(B)(2), the sum of all overcurrent protective devices supplying power to the busbar or conductor shall not exceed 120% of their rating. In most PV installations, the breakers feeding the busbar are the main breaker and the backfed PV breaker. Per Section 690.64(B)(7), to utilize the 120% rule, the PV backfed breaker must be at the opposite end of the main breaker location. For a 100 amp rated bus, this means that the main breaker and the PV backfed breaker shall not add up to more than 120 amps. For a 200 amp rated bus, the combined ampacity of the two breakers (the main breaker and the PV breaker) shall not exceed 240 amps and so on. The location of the PV backfed breaker must be identified per 690.64(B)(7) with the following verbiage: "WARNING INVERTER OUTPUT CONNECTION. DO NOT RELOCATE THE OVERCURRENT DEVICE."

    Where it is not possible to locate the breakers at opposite ends of the panel bus, the sum of the two breakers is not permitted to exceed 100% of the bus rating.

    Note: In some cases it may be possible to reduce the size of the main circuit breaker to accommodate the addition of a PV breaker and still not exceed the bus bar rating. This requires that a "load calculation" of the house electrical power consumption be made in order to see if this is an acceptable solution.

22. Per **Section 690.53**, a permanent label for the DC power source shall be installed at the PV DC disconnecting means. This label shall show the following: (a) Rated maximum power-point current, (b) Rated maximum power-point voltage, (c) Maximum system voltage, (d) Short circuit current of the PV system.

    (a) **Rated maximum power-point current (mppA)** (this is the actual current in amps produced by the PV system). Multiply the **Imax** value from the module nameplate by the number of strings in the system.
    Imax _____ x **# of strings** _____ = _____ **Amps**.

    (b) **Rated maximum power-point voltage (mppV)** (this is the highest operating voltage of the PV system). Multiply the **Vmax** value from the module nameplate by the number of modules in the **largest** string.
    Vmax _____ x **# of modules** _____ **=** _____ **Volts.**

    (c) **Maximum system voltage** (see step #10) _____ **Volts**

    (d) **Short circuit current** of the PV system (module Isc from step #7 x 1.25). **Isc** _____ x **1.25** = _____ **Amps**.

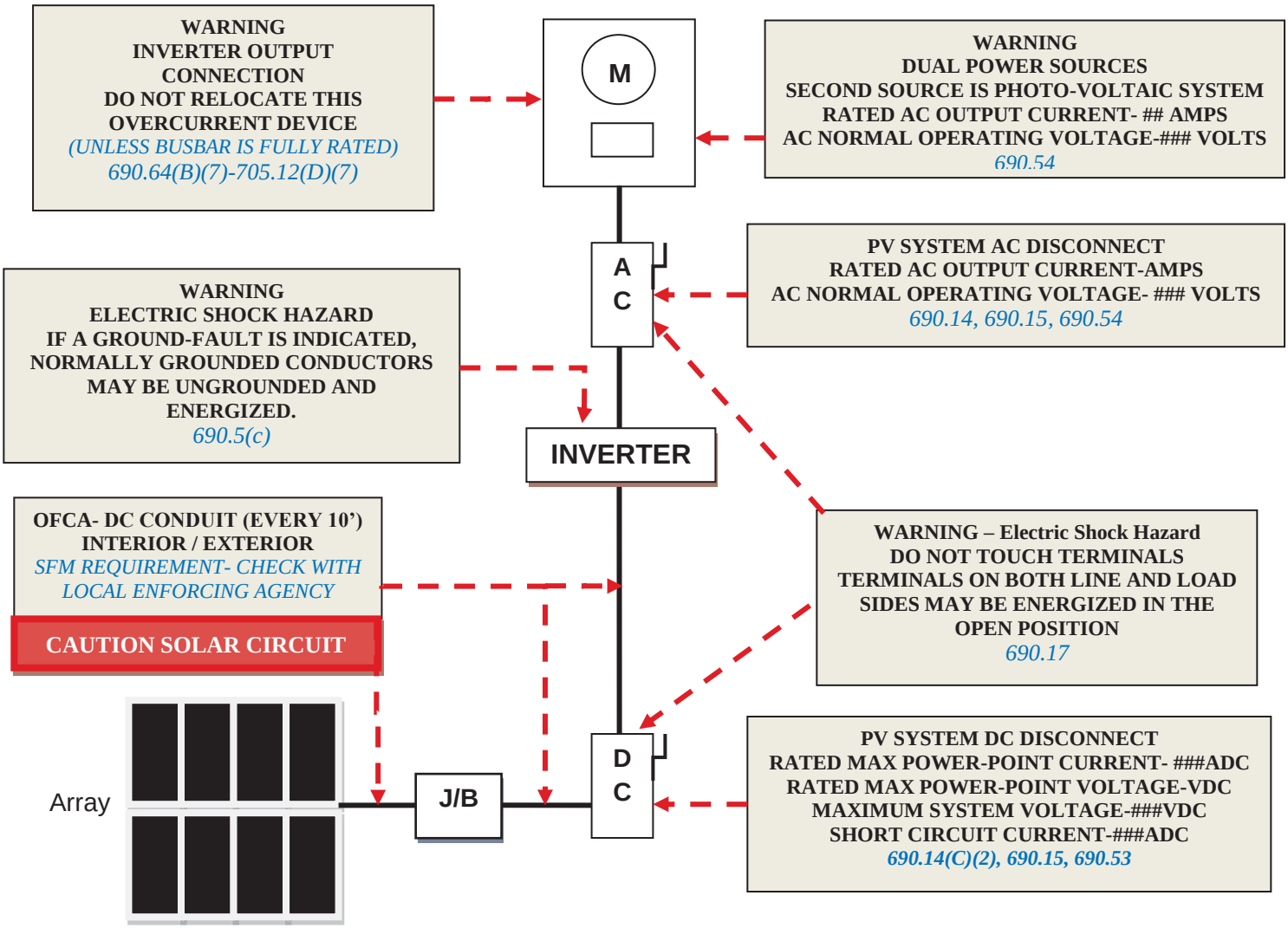
    Note: A phenolic plaque with contrasting colors between the text and background would meet the intent of the code for permanency. No type size is specified, but 20 point (3/8") should be considered the minimum.

Project Address: _____

Permit Number: _____

23. The following signage is required to be installed:

(a) Per **Section 690.17** 2010 CEC, where both the line and load side terminals of any disconnect may be live in the "OFF" position the following warning shall be placed on the front of the disconnect "WARNING LINE AND LOAD TERMINALS MAY BE ENERGIZED IN THE OPEN POSITION".



Note: Italicized text shown inside the boxes is not required to be part of the sign, it is only for reference.

Project Address: _____

Permit Number: _____

LOGO

SOLAR PV STANDARD PLAN

Central Inverter Systems for Single Family Dwellings

TAG	DESCRIPTION
1	SOLAR PV MODULE
2	DC PV SOURCE CIRCUIT
3	COMBINER BOX (if installed), refer to item 14 on page 3
4	DC PV OUTPUT CIRCUIT
5	DC EQUIPMENT GROUNDING CONDUCTOR per 690.43 NEC
6	INVERTER DC DISCONNECT
7	DC TO AC INVERTER WITH ISOLATION TRANSFORMER
8	GROUND FAULT DETECTION INTERRUPTER
9	AC DISCONNECT
10	SOLAR LOAD CENTER (If installed)
11	UTILITY PERFORMANCE METER (If installed)
12	UTILITY SAFETY SWITCH (If installed)
13	INVERTER DC GROUNDING ELECTRODE CONDUCTOR (MIN #8 AWG COPPER)
14	ELECTRICAL SERVICE PANEL

STANDARD PV PLAN FOR SINGLE FAMILY DWELLING
CENTRAL INVERTER

MAXIMUM 10 KW
MAXIMUM 225 AMP SERVICE

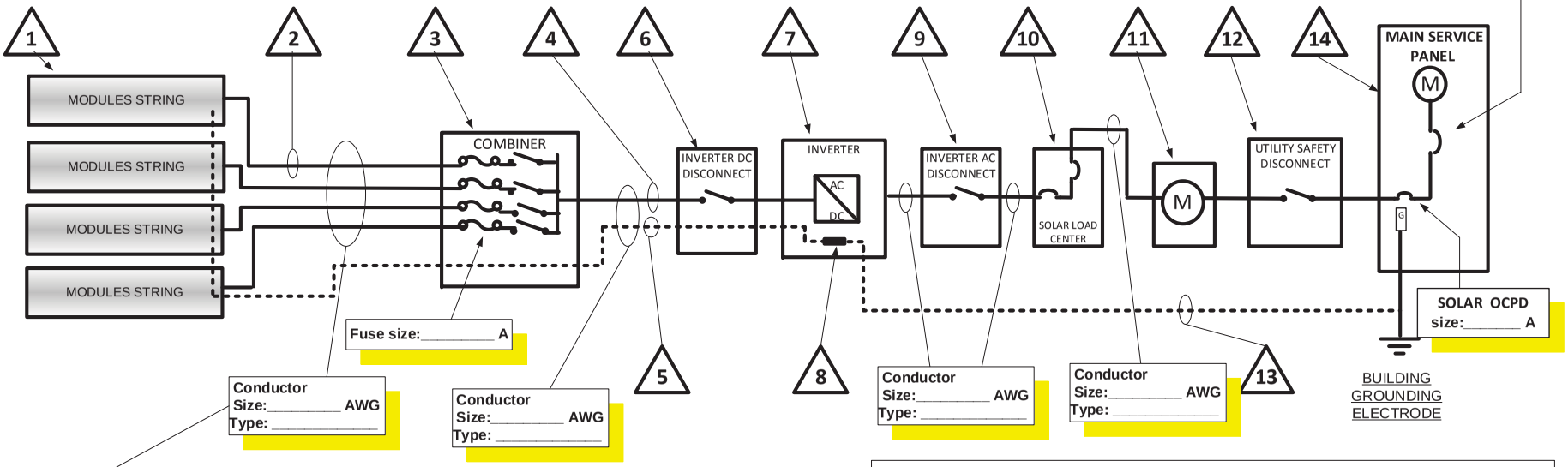
THIS PLAN MUST BE PROVIDED TO THE FIELD INSPECTOR

MAIN BREAKER / FUSE Size:_____A

SOLAR BREAKER/ FUSE Size:_____A

MAIN PANEL BUS Size:_____ A

MAIN OVERCURRENT PROTECTIVE DEVICE size:_____ A



Fuse size:_____ A

Conductor Size:_____ AWG Type: _____

Conductor Size:_____ AWG Type: _____

Conductor Size:_____ AWG Type: _____

Conductor Size:_____ AWG Type: _____

Provide required information in these boxes

Note: This plan is **Not** intended to be used with micro inverters or transformer-less inverters. Permitted DC conductor types are USE-2, PV Wire or equivalent listed cables. Conductors for DC and AC circuits, where installed in raceways outdoors, shall be "W" rated and have an insulation rating of 90 degrees Centigrade.

Project Address: _____

Permit Number: _____

LOGO

SOLAR PV STANDARD PLAN

Central Inverter Systems for Single Family Dwellings

ROOF PLAN

PROVIDE A ROOF PLAN SHOWING LOCATION OF ALL EQUIPMENT, DISCONNECTING MEANS AND REQUIRED CLEARANCES.

Project Address: _____

Permit Number: _____

TOOLKIT DOCUMENT

City/County of [NAME OF CITY]
Department of [NAME OF DEPARTMENT]

Solar PV Standard Plan
Microinverter Systems for Single-Family Dwellings

LOGO

SOLAR PV STANDARD ELECTRICAL PLAN
Microinverter Systems for Single Family Dwellings

***** Provide this document to the inspector along with ALL system installation instructions *****

Project Address:_____

Permit Number: _____

Scope: **Standard plan for the installation of microinverter solar PV systems, not exceeding a total AC output of 10kW, in single family dwellings having a 3 wire electrical service not larger than 225 amps at a voltage of 120/240. This plan covers crystalline and multicrystalline type modules where all the modules and microinverters are mounted on the roof of the single family dwelling. For installations exceeding this scope, Electrical Plan review is required.**

Note: **This plan is not intended for systems containing batteries. This document addresses only the requirements of the 2010 California Electrical Code (CEC), refer to other toolkit documents for California Residential Code (CRC) requirements.**

NOTE: **Calculate the total AC output of the system.**

# of microinverters ____ x Inverter AC Output Current ____amps x 240 volts = _____ watts divided by 1,000 = _____ kW.

Installer information:

Name:	Phone Number: ( ) -
Address: _____ City: _____ State: _____ Zip _____	Homeowner: ☐ Contractor: ☐ Contractor License # _____ License type _____

A) Module information:

1) Manufacturer _____

2) Model number _____

3) Total number of modules being installed _____

4) Maximum DC output voltage (Voc) _____ **Volts**

5) Maximum DC current output (Isc) _____ **Amps**

Important: **Not all modules are suitable for use with microinverter systems. Review the microinverter installation manual prior to beginning any installation to avoid costly errors.**

Project Address: _____

Permit Number: _____

B) Microinverter information:

Each microinverter shall be listed by a recognized listing agency, have factory installed Ground Fault protection and be identified as "Utility-Iinteractive".

Provide the following information from the microinverter installation manual. If any information is not provided by the manufacturer write "not given" in the appropriate box

6) Manufacturer _____

7) Model number _____

8) Minimum mounting height above the roof surface _____ **inches**

9) Maximum DC input voltage _____ **Volts**

10) Maximum DC input current _____ **Amps**

11) Maximum AC output current _____ **Amps**

12) Maximum size branch circuit breaker permitted _____ **Amps**

13) Maximum number of inverters permitted per branch circuit _____

Note: The number of microinverters installed per branch circuit may be less than the maximum number permitted by the manufacturer, but it shall not be more.

C) Manufacturer "Trunk" cable (if supplied):

Some microinverter manufacturers include as part of their installation kit a "Trunk" cable that each microinverter of the branch circuit plugs into. These cables must be listed by a recognized listing agency, have a wet insulation temperature rating of at least 90 degrees celsius, be provided with an equipment grounding conductor inside of the overall cable sheath and contain no more than three current carrying conductors. Cables that will be exposed to sunlight must be listed as such. This cable will typically be run underneath the array where it will not be subject to physical damage. This cable, if provided, must be used. Non-manufacturer supplied cables or installer fabricated assemblies are not approved. Where the cable is exposed to physical damage, the cable shall be protected.

14) Provide the conductor size of the manufacturer supplied "Trunk" cable _____ **AWG (From cable jacket)**

15) Provide the **MINIMUM INSTALLATION** spacing above the roof surface to the bottom of the "Trunk" cable per the installation instructions _____ **inches** (If no dimension specified, write "None given").

16) Provide the **MINIMUM INSTALLATION** spacing below the array modules to the top of the "Trunk" cable per the installation instructions _____ **inches** (If no dimension specified write "None given").

Project Address: _____

Permit Number: _____

D) Temperature compensation for roof mounted cables under the array:

17) Temperatures under the array may be higher than the surrounding ambient air. Where cables are installed close to the roof surface or to the modules, local jurisdictions may require the ambient air temperature to be higher based on local conditions. Some local enforcing agencies use ASHRAE to determine the local ambient temperature. Below are the temperatures for the local jurisdiction.

(i) The Ambient Air Temperature for this jurisdiction is: _____°C

Note: Some local jurisdictions may require this temperature to be increased when sizing conductors beneath the module or array

E) Sizing the conductors for the microinverter branch circuit:

The amount of current that will be carried by the conductors shall be calculated as follows:

18) Maximum # of inverters installed per branch circuit _____ **x** Maximum inverter AC output (Step #11) _____ **A x 1.25** (for long continuous load) **= _____ Amps.**

Where the manufacturer supplied cable transitions to regular building wire installed inside of a raceway, a reduction in the amount of current these conductors can carry may be required based on the exposed ambient air temperature and number of conductors in the raceway.

Note how many conductors will be in the raceway and how high above the roof surface the raceway will be mounted. Using **Table A** on page 4, select the appropriate "Ambient Temperature" section for your project location from (Step #17**(i)**) and choose a conductor size that will meet or exceed the result from Step #18. Your selected conductor size is permitted to have a higher ampacity than the number in step #18, **but it shall not be less.**

Selected conductor size for branch circuit wiring in raceway _____ AWG.

Project Address: _____

Permit Number: _____

Table A

Table A is based on the following:

A. Table 310.16 - Allowable Ampacity of Insulated Conductors, 90 C rated conductors.
B. Table 310.16 - Correction Factors based on temperature ranges.
C. Table 310.15(B)(2)(c) - Ambient Temperature Adjustments for Conduits Exposed to Sunlight On or Above Rooftops.
D. Table 310.15(B)(2)(a) Adjustment Factors for More Than Three Current-Carrying Conductors in a Raceway or Cable.
E. Sections 240.4(D)(5) and 240.4(D)(7) for 10 AWG and 12 AWG conductors.

Table A: Maximum Allowable Ampacity of Conductors Installed in a Circular Raceway, Exposed to Sunlight, On or Above Rooftops

Number of Current Carrying Conductors in a Raceway	Height Above Rooftop	Highest Ambient Temp									
		Less than 30˚C					30˚C to 35˚C				
		12 AWG	10 AWG	8 AWG	6 AWG	4 AWG	12 AWG	10 AWG	8 AWG	6 AWG	4 AWG
Up to 3 Conductors	0 to 0.5"	17	23	32	44	55	17	23	32	44	55
	above 0.5" to 3.5"	20	30	42	57	72	20	28	39	53	67
	above 3.5" to 12"	20	30	45	62	78	20	30	42	57	72
	above 12"	20	30	48	65	83	20	30	45	62	78
4 to 6 Conductors	0 to 0.5"	14	19	26	35	44	14	19	26	35	44
	above 0.5" to 3.5"	18	24	33	46	58	17	23	31	43	54
	above 3.5" to 12"	20	26	36	49	62	18	24	33	46	58
	above 12"	20	28	38	52	66	20	26	36	49	62
7 to 9 Conductors	0 to 0.5"	12	16	22	30	39	12	16	22	30	39
	above 0.5" to 3.5"	16	21	29	40	51	15	20	27	37	47
	above 3.5" to 12"	17	23	32	43	55	16	21	29	40	51
	above 12"	18	24	33	46	58	17	23	32	43	55
10 to 20 Conductors	0 to 0.5"	9	12	16	22	28	9	12	16	22	28
	above 0.5" to 3.5"	11	15	21	29	36	11	14	20	27	34
	above 3.5" to 12"	12	16	23	31	39	11	15	21	29	36
	above 12"	13	17	24	33	41	12	16	23	31	39
		35˚C to 40˚C					40˚C to 45˚C				
Up to 3 Conductors	0 to 0.5"	12	16	23	31	39	12	16	23	31	39
	above 0.5" to 3.5"	17	23	32	44	55	17	23	32	44	55
	above 3.5" to 12"	20	28	39	53	67	17	23	32	44	55
	above 12"	20	30	42	57	72	20	28	39	53	67
4 to 6 Conductors	0 to 0.5"	10	13	18	25	31	10	13	18	25	31
	above 0.5" to 3.5"	14	19	26	35	44	14	19	26	35	44
	above 3.5" to 12"	17	23	31	43	54	14	19	26	35	44
	above 12"	18	24	33	46	58	17	23	31	43	54
7 to 9 Conductors	0 to 0.5"	9	11	16	22	27	9	11	16	22	27
	above 0.5" to 3.5"	12	16	22	30	39	12	16	22	30	39
	above 3.5" to 12"	15	20	27	37	47	12	16	22	30	39
	above 12"	16	21	29	40	51	15	20	27	37	47
10 to 20 Conductors	0 to 0.5"	6	8	11	15	19	6	8	11	15	19
	above 0.5" to 3.5"	9	12	16	22	28	9	12	16	22	28
	above 3.5" to 12"	11	14	20	27	34	9	12	16	22	28
	above 12"	11	15	21	29	36	11	14	20	27	34
		45˚C to 50˚C					50˚C to 55˚C				
Up to 3 Conductors	0 to 0.5"	0	0	0	0	0	0	0	0	0	0
	above 0.5" to 3.5"	12	16	23	31	39	12	16	23	31	39
	above 3.5" to 12"	17	23	32	44	55	12	16	23	31	39
	above 12"	17	23	32	44	55	17	23	32	44	55
4 to 6 Conductors	0 to 0.5"	0	0	0	0	0	0	0	0	0	0
	above 0.5" to 3.5"	10	13	18	25	31	10	13	18	25	31
	above 3.5" to 12"	14	19	26	35	44	10	13	18	25	31
	above 12"	14	19	26	35	44	14	19	26	35	44
7 to 9 Conductors	0 to 0.5"	0	0	0	0	0	0	0	0	0	0
	above 0.5" to 3.5"	9	11	16	22	27	9	11	16	22	27
	above 3.5" to 12"	12	16	22	30	39	9	11	16	22	27
	above 12"	12	16	22	30	39	12	16	22	30	39
10 to 20 Conductors	0 to 0.5"	0	0	0	0	0	0	0	0	0	0
	above 0.5" to 3.5"	6	8	11	15	19	6	8	11	15	19
	above 3.5" to 12"	9	12	16	22	28	6	8	11	15	19
	above 12"	9	12	16	22	28	9	12	16	22	28

Project Address: _____

Permit Number: _____

F) Solar Load Center and circuit breakers, sizing information:

Many utility providers require a performance meter and a safety disconnect switch to be installed between the PV power source and their equipment. This means that the microinverter branch circuits may not connect directly into the electrical panel of the house. They may go first to a solar load center. This is just a standard circuit breaker panel that collects together the individual branch circuits from the microinverters. Each branch circuit **shall** have its own dedicated circuit breaker. From this panel one feeder will go to the performance meter (if required), then to the safety disconnect switch (if required), and finally to the point of interconnection at the house electrical panel. Only PV system monitoring equipment/devices are permitted to be connected between the output of the inverter and the house electrical panel. Contact your local utilities for performance meter and AC utility disconnect switch requirements.

19) Total number of microinverter branch circuits installed in the solar load center _____

20) List the current in Amps (from step 18) for each individual branch circuit in the solar load center.

Circuit #1 output _____ **Amps,** Circuit #2 output _____ **Amps,** Circuit #3 _____ **Amps,** Circuit #4 _____ **Amps.**

21) Total PV current in Amps connected to the panel (sum of the individual branch circuits from step 20) = _____ **Amps**

22) Panel bus bar rating (from panel label) _____ **Amps.** This figure must be larger than the number at step #21 or the panel will be undersized.

23) Size of Main breaker if installed (If no main write NONE) _____ **Amps**

24) To size the feeder conductors leaving the solar load center use the result from step #21 and go to table 310.16, using the 75°C column, to select the correct size conductor for your installation.

G) Utility "Performance" meter (if required):

Where an additional meter is required by the local Utility to record the power produced by the PV system the output wiring from the microinverters shall always connect to the **"LINE"** side terminals at the top of the meter. The wiring from the meter to the electrical panel will connect to the **"LOAD"** side terminals at the bottom. Not all utility providers have the same requirements for connecting solar power systems to their electrical systems. Contact the local utility for specific requirements in the local jurisdiction.

H) Utility "Safety Disconnect Switch" (if required):

Where disconnect switches (with or without fuses) are installed in the circuit(s) from the microinverters to the house electrical panel, the wiring originating at the microinverters shall always connect to the **"LOAD"** side **(bottom)** terminals of **ANY** disconnect switch that has been installed. The wiring originating at the electric service panel shall always connect to the **"LINE"** side **(top)** terminals. Check with the local utility for specific requirements.

I) Connection to the house electrical panel:

The connection to the service panel **shall** be through a dedicated circuit breaker that connects to the panel bus bars in an approved manner. "Load Side Taps" where the inverter AC wiring does not terminate using a dedicated breaker or set of fuses are prohibited under **ANY** condition by **Section 690.64 (B)**.

Project Address: _____

Permit Number: _____

Where the main breaker of the electrical panel that the PV system will interconnect to is located at either the top or bottom of the panel distribution bus bars and the PV interconnect breaker is located at the opposite end, the code permits the sum of the ratings of the main breaker and the PV breaker to exceed the rating of the panel bus bars. Per **Section 690.64 (B)(2)**, the sum of the electrical panel main breaker and the microinverter PV interconnect breaker shall not add up to more than 120% of the rating of the panel bus bars. For a 100 amp rated bus this means that both breakers together shall not add up to more than **120 amps.** For a 200 amp rated bus, not more than **240 amps** and for 225 amps, not more than **270 amps.** In order to qualify for this additional allowance, the PV breaker **must** be located at the opposite end of the breaker panel from the main breaker and shall have the warning label installed next to it per **Section 690.64 (B)(7)**. "WARNING INVERTER OUTPUT CONNECTION. DO NOT RELOCATE THIS OVERCURRENT DEVICE".

Note:
Certain "All-in-One" service panels have the factory installed main breaker in the center of the distribution section. Because of the possibility of overloading the bus bars, this type of service is not able to take advantage of the 120% overage permitted for top or bottom fed bussing. For this type of installation the sum of the main circuit breaker and the PV breaker may not exceed 100% of the rating of the factory bussing. For example, if the service panel label states that the bus bars are rated for 200 amps you cannot exceed that figure. In some cases it may be possible to reduce the size of the main circuit breaker to accommodate the addition of a PV breaker and still not exceed the bus bar rating. This requires that a "load calculation" of the house electrical power consumption be made in order to see if this is an acceptable solution. Where it is necessary to install the PV interconnection as a "Line Side Tap" and where the electrical service panel at the dwelling is an "All-in-One" type, the service shall be provided with factory installed terminals designed specifically to accommodate this type of connection. Where these terminals are not provided there shall be **NO** PV connection between the load side of the meter and the line side of the main circuit breaker.

J) Grounding the photovoltaic system:

A **Grounding Electrode Conductor** sized per the manufacturer's installation instructions, (minimum #8 AWG solid copper), shall be run **UNSPLICED** from the factory identified grounding terminal of each microinverter to the grounding electrode system of the house, (i.e. ground rod, Ufer ground, or metallic water pipe with a minimum of 10 feet in the ground).

Note: The Grounding Electrode Conductor is permitted to be spliced per **Section 250.64 (C)** using an irreversible means or by the installation of a "Ground Plate". (A Ground Plate is defined as a copper bus bar ¼" thick by 2" wide by whatever length is needed to terminate the conductors). This conductor may also be used as the required equipment grounding conductor for the modules and the frame rails of the array. (Equipment grounding conductors may be connected to the Grounding Electrode Conductor by non-irreversible means such as listed split bolts).

K) Disconnection of photovoltaic equipment:

Section 690.15 requires that means are provided to disconnect equipment from all ungrounded conductors of all sources. Such disconnecting means shall comply with Sections 690.16 and 690.17.

Note: Section 690.17 contains an exception which states "A connector shall be permitted to be used as an ac or a dc disconnecting means, provided that it complies with the requirements of 690.33 and is listed and identified for the use."

L) Signage:

Per Section 690.54, a permanent label for the microinverter AC power source shall be installed at the point of interconnection at an accessible location. This label shall show that it is a PV source and additionally, the rated AC output current and the nominal operating AC voltage.

Project Address: _____

Permit Number: _____

LOGO

SOLAR PV STANDARD PLAN

Microinverter Systems for Single Family Dwellings

Array (Modules and Microinverters)

J/B

Collector Panel / Solar Load Center

PV SYSTEM AC DISCONNECT
RATED AC OUTPUT CURRENT-AMPS
AC NORMAL OPERATING
VOLTAGE- ### VOLTS
690.54

M

UTILITY PERFORMANCE METER (IF REQUIRED)

A
C

PHOTOVOLTAIC SYSTEM UTILITY SAFETY DISCONNECT SWITCH (IF REQUIRED)

M

WARNING
DUAL POWER SOURCES
SECOND SOURCE IS PHOTO-VOLTAIC SYSTEM
RATED AC OUTPUT CURRENT- ## AMPS
AC NORMAL OPERATING
VOLTAGE-### VOLTS
690.54

INTALL PERMANENT PLAQUE OR DIRECTORY PROVIDING THE LOCATION OF THE SERVICE DISCONNECTING MEANS, AND PHOTOVOLTAIC SYSTEM DISCONNECTING MEANS IF NOT INSTALLED AT THE SAME LOCATION. PLAQUE SHALL BE MOUNTED ON THE EXTERIOR OF THE BUILDING

Minimum 20 point type on a sharply contrasting background

690.56-(B), 705.10

WARNING
PV OUTPUT CONNECTION
DO NOT RELOCATE THIS OVERCURRENT DEVICE
(UNLESS BUSBAR IS FULLY RATED)
690.64(B)(7), 705.12(D)(7)

Note: Italicized text shown inside the boxes is not required to be part of the sign, it is only for reference

Project Address: _____

Permit Number: _____

LOGO

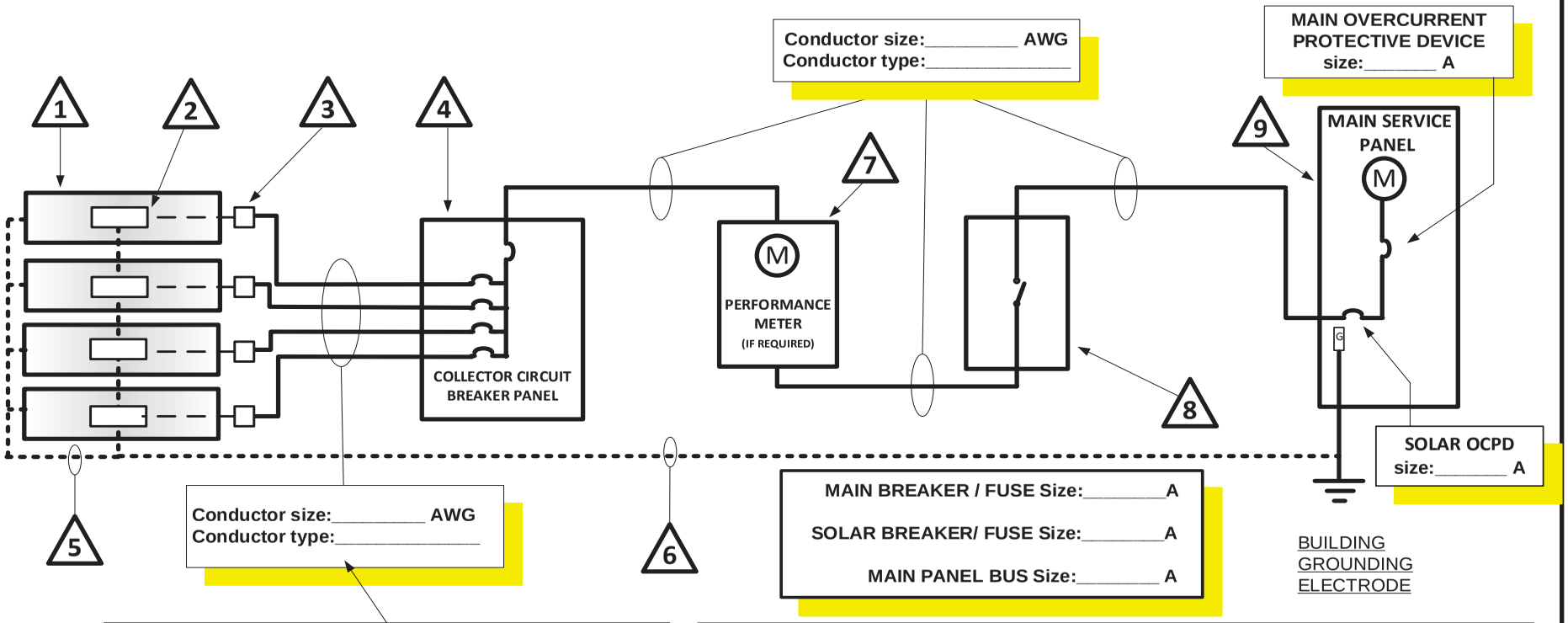
SOLAR PV STANDARD PLAN

Microinverter Systems for Single Family Dwellings

TAG	DESCRIPTION
1	SOLAR PV MODULE
2	MICROINVERTER
3	JUNCTION BOX FOR THE MANUFACTURER SUPPLIED CABLE TO RACEWAY TRANSITION
4	“COLLECTOR” CIRCUIT BREAKER PANEL
5	ARRAY EQUIPMENT GROUNDING CONDUCTOR
6	MICROINVERTER GROUNDING ELECTRODE CONDUCTOR (MIN #8 AWG COPPER)
7	PERFORMANCE METER (IF REQUIRED BY THE UTILITY COMPANY)
8	UTILITY SAFETY DISCONNECT SWITCH (IF REQUIRED BY THE UTILITY COMPANY)
9	ELECTRICAL SERVICE PANEL

MAXIMUM 10 KW OUTPUT
MAXIMUM 225 AMP SERVICE
120/240 SINGLE PHASE

THIS PLAN MUST BE PROVIDED TO THE FIELD INSPECTOR



Provide required information in these boxes

Note: This plan is intended to be used ONLY with Microinverter Systems.

Project Address: _____

Permit Number: _____

LOGO

SOLAR PV STANDARD PLAN

Microinverter Systems for Single Family Dwellings

ROOF PLAN

PROVIDE A ROOF PLAN SHOWING ALL EQUIPMENT, DISCONNECTING MEANS AND REQUIRED CLEARANCES

Project Address: _____

Permit Number: _____

TOOLKIT DOCUMENT

MOU (MEMORANDUM OF UNDERSTANDING) REGARDING SOLAR PHOTOVOLTAIC PLAN REVIEW AND INSPECTION SERVICES

Administering Agencies
Agreement Number:

This memorandum of understanding (MOU) formalizes coordination by local agencies regarding plan review and inspection services for solar photovoltaic installations.

Note: Language in **BOLD FONT** *below indicates where local jurisdiction needs to provide information specific to the jurisdiction.*

This agreement is made at [LOCATION], California, by and between [FIRE AUTHORITY] and [BUILDING AUTHORITY].

RECITALS

WHEREAS, Sections 1.8.2.1 and 1.11.2 of the currently adopted version of the California Residential Code charges the local building authority and local fire authority with the responsibility of enforcement of residential building standards within the jurisdictions boundaries; and

WHEREAS, the [FIRE AUTHORITY] desires the [BUILDING AUTHORITY] to perform these services on its behalf subject to the following terms and conditions; and

WHEREAS, the [BUILDING AUTHORITY] is willing to perform said services provided it can charge and collect all fees for services rendered subject to the following terms and conditions.

SERVICES AGREEMENT

1. **Services** The [BUILDING AUTHORITY] shall conduct the services outlined in Exhibit A for the review of plans and inspection of solar photo voltaic systems within the [JURISDICTION] boundaries during the term of this agreement.

2. **Term** The term of this agreement shall commence on _____, and shall be for _____. The term of this agreement may be extended upon agreement of [FIRE AUTHORITY] and the [BUILDING AUTHORITY].

3. **Plan Review and Inspection Fees/Charges** The [BUILDING AUTHORITY] shall charge and collect its standard fees for plan review and inspection. The [FIRE AUTHORITY] shall receive no portion of said fees.

4. **Facilities, Equipment and Other Materials** The [BUILDING AUTHORITY] shall, at its cost and expense, furnish all facilities, equipment, and other materials that may be required for furnishing services pursuant to this agreement.

5. **No Agency** No agency relationship is created by this agreement.

6. **Records** The [BUILDING AUTHORITY] shall maintain, at all times, complete detailed records with

regard to work performed under this agreement. The [FIRE AUTHORITY] shall have the right to inspect said records with reasonable notice to the county. All such records shall be maintained by the [BUILDING AUTHORITY] in its [OFFICE LOCATION] offices.

7. **Insurance** It is agreed that each party shall maintain at all times during the performance of this agreement insurance coverage or self-insurance in the amount of not less than [DOLLAR AMOUNT] to cover all of its operations, including general liability, automobile liability, and workers' compensation.

8. **Indemnification** The [BUILDING AUTHORITY] shall indemnify, defend, and hold harmless the [FIRE AUTHORITY] and its elected and appointed officials, employees, agents, and contractors (collectively, "indemnities") from and against any and all loss, liability, cost, claim, cause of action, demand, judgment, expense, (including reasonable attorneys' fees), or damage (collectively "claims") arising from or related to [BUILDING AUTHORITY] performance or failure to perform its obligations pursuant to this agreement, except to the extent the same are attributable to the gross negligence or willful misconduct of the Indemnities. The [FIRE AUTHORITY] shall indemnify, defend, and hold harmless the [BUILDING AUTHORITY] and its elected and appointed officials, employees, agents, and contractors (collectively, "building indemnities") from and against any and all claims arising from or related to the [BUILDING AUTHORITY] performance or failure to perform its obligations pursuant to this agreement, except to the extent the same are attributable to the gross negligence or willful misconduct of building indemnities.

9. **Entirety of Agreement – Modifications** This agreement contains the entire agreement of the [FIRE AUTHORITY] and the [BUILDING AUTHORITY] with respect to the subject matter hereof, and no other agreement, statement, or promise made by any party, or to any employee, officer, or agent of any party, which is not contained in this agreement, shall be binding or valid.

10. **Early Termination** Either party may serve notice of early termination of this agreement pursuant to Section 11 below. Upon termination of this agreement, the [FIRE AUTHORITY] shall take over all plan review and inspections covered by this agreement. For plan review and/or inspections that are in process at the time of termination, the county shall complete these.

11. **Notice** Any notice or demand desired or required to be given hereunder shall be in writing and deemed given when personally delivered or deposited in the mail, postage prepaid, and addressed to the parties as follows:

[BUILDING AUTHORITY ADDRESS]	**[FIRE AUTHORITY ADDRESS]**
_____	_____
_____	_____
_____	_____
_____	_____
Phone: _____	Phone: _____
Fax: _____	Fax: _____

Any notice so delivered personally shall be deemed to be received on the date of delivery, and any notice mailed shall be deemed to be received five (5) days after the date on which it was mailed.

[BUILDING AUTHORITY ADDRESS]	**[FIRE AUTHORITY ADDRESS]**
By: _____	By: _____
Date: _____	Date: _____

Exhibit A – Scope of Work

TOOLKIT DOCUMENT

City/County of [NAME OF CITY]
Department of [NAME OF DEPARTMENT]

Code Requirements for Solar Photovoltaic (PV) Systems Single-Family Dwellings

Based on the 2010 California Building Code (CBC)
and the 2010 California Residential Code (CRC)

PURPOSE

The purpose of this information bulletin is to clarify requirements of the State Building Standards Codes (Title 24) that pertain to solar PV installations. This bulletin can serve as a reference guide for permit applicants and enforcing agencies to clarify how state code requirements are practically applied in the local jurisdiction. It is intended to minimize permitting uncertainty and differing interpretation regarding specific code requirements for solar PV installations. This information bulletin primarily clarifies requirements pertaining to the California Building Code and the California Residential Code, since these codes in their current form require significant local interpretation. This information bulletin does not address local regulations.

The implementation of uniform standards to achieve the timely and cost-effective installation is consistent with the California Solar Rights Act that views solar installation as a matter of statewide concern and prohibits local jurisdictions from adopting unreasonable barriers to the installation of solar energy systems (CA Government Code Section 65850.5).

PART I: BUILDING AND RESIDENTIAL CODE REQUIREMENTS

1. Definitions

1.1 Solar photovoltaic (PV) system: The total components and subsystems that, in combination, convert solar energy into electric energy suitable for connection to utilization load (CEC Article 690.2)

1.2 Solar photovoltaic module: A complete, environmentally protected unit consisting of solar cells, optics, and other components, exclusive of tracker, designed to generate DC power when exposed to sunlight (CEC Article 690.2)

1.3 Solar photovoltaic (PV) panel: A collection of modules mechanically fastened together, wired, and designed to provide a field-installable unit (CEC Article 690.2)

1.4 Building integrated photovoltaic (BIPV) system: Photovoltaic cells, devices, modules, or modular materials that are integrated into the outer surface or structure of a building and serve as the outer protective surface of the building (CEC Article 690.2)

2. Structural Requirements

2.1 PV systems positively anchored to the building:

2.1.1 Exemption from structural calculations: The building official may waive the requirement for structural calculations for solar PV installations on top of existing roofs if the official can readily

determine that the additional weight of the new solar PV system on the roof does not affect the structural integrity of the building. Some jurisdictions may have a prescriptive approach for when structural calculations can be waived, however, that varies by the enforcing agency.

To help streamline and simplify the permitting process for roof-mounted solar PV systems, it is highly recommended that local jurisdictions develop a prescriptive approach to meeting the structural requirements so that structural calculations are not always required. Here are some parameters to consider under such prescriptive approach:

- Maximum distributed weight of the solar PV system in psf
- Maximum perpendicular distance between the solar PV system and the roof below
- Maximum concentrated load imposed by the PV panel support onto the building's roof
- Minimum size and spacing of rafters or joists for portion of the roof that is supporting the solar PV system
- Maximum span of rafters or joists for portion of the roof that is supporting the solar PV system
- Anchoring requirements such as type of fasteners, minimum fastener size, minimum embedment, and minimum number of attachment points
- Any limitation on the type of building construction

2.1.2 Structural calculations: When structural calculations are required, calculations shall demonstrate that the primary structure will support the additional vertical and lateral loads from the panels and related equipment.

2.1.2.1 Roof dead Load: The weight of solar PV systems shall be considered in the design of the structure. (CBC Section 1606, CRC Section R301.4)

For installation of conventional (not BIPV) solar PV panels on existing roofs, the building official may allow a certain percent of the code required live load to be reduced to accommodate the additional weight of the solar PV panels provided the roof design is adequate for the concentrated loads from the solar PV panel support frames. This allowance may vary by jurisdiction and is generally based on the assumption that solar PV panels will not be stepped on or used by anyone to support any live load.

When the roof live load is allowed to be reduced, consideration should be given to the possibility that a roof may have more than one layer of existing roofing and the possibility of having smaller size rafters in older buildings.

2.1.2.2 Roof live load: The building official may allow the live load to be reduced in the area covered by each solar PV panel when such area is inaccessible as determined by the enforcing agency and as discussed in Section 2.1.2.1 of this information bulletin. Roof surfaces not covered by solar PV panels shall be designed for the roof live load. (CBC Section 1607, CRC R301.6)

The building official may determine that live load need not be considered for solar PV panels and associated supporting members that are built on grade. Such interpretation is generally based on the assumption that the solar PV panels will not be stepped on or used by anyone to support any live load

2.1.2.3 Wind design: Calculations shall demonstrate that the solar PV panels and associated supporting members are designed to resist wind loads. For ballasted PV systems, see Section 2.2 of this information bulletin (CBC Section 1609, CRC R301.2.1)

2.1.2.4 Seismic design: Calculations shall demonstrate that the solar PV panels and associated supporting members are designed to resist earthquake loads. (CRC 301.2.2)

2.1.2.5 For wood construction, supports shall be attached with fasteners of sufficient length and size to achieve minimum required embedment into solid wood taking into consideration the plywood and multiple layers of roofing that may exist, unless otherwise approved by the enforcing agency. (CRC Section R301.1.3)

2.1.2.6 Snow load: When applicable, include snow loads and loads from snow drift. (CBC Section 1608, CRC R301.2.3)

2.1.2.7 Requirements for load combinations: The applicable load combinations in CBC 1605 may be applied to all loading conditions, including evaluating the effects of dead load to counteract wind uplift. (CRC Section R301.1.3)

2.2 Structural strength of PV panels: The structural strength of solar PV panels is not addressed in the code.

UL 1703, Third Edition, published March 15, 2002, requires that solar PV panels are tested to withstand a superimposed load of 30lb/ft2. Therefore, all solar PV panels that are listed per UL 1703 are considered to meet this requirement.

When used as a building component and depending on the load values that the solar PV panels are subjected to, the enforcing agency may require a test report from an agency recognized by the enforcing agency showing the strength of the solar PV panels.

2.3 Condition of existing roof: Solar PV systems shall not be installed on an existing roof that is deteriorated to the point where it is not adequate as a base (this interpretation is based on CRC R907)

2.4 Premanufactured support systems: Premanufactured support systems must support the PV system and allow the system to stay attached to the structure when exposed to wind or seismic activity. Compliance of the PV support system with appropriate building codes is accomplished through a design specified by a licensed engineer or architect or through research reports from approved sources as defined in CBC Section 1703.4.2. Additional requirements may be imposed by the enforcing agency. (CRC Section R301.1.3)

3. Fire Safety Provisions

3.1 Fire/roof classification of photovoltaic (PV) panels

3.1.1 Solar PV panels installed on top of a building's roof structure:

3.1.1.1 Solar PV systems installed on top of a roof where the space between the solar PV panels and the roof has no use and no potential use are generally considered to be equipment. Currently, the State's Building Standards Code maintains fire/roof classification requirements for roof structures, but does not maintain specific requirements regarding fire/roof classification of solar PV panels.

Since no specific requirements or guidance are provided by the State Building Standards Code, local enforcing agencies currently determine whether any fire/roof classification of solar PV panels is required and if so, what fire/roof classification is required. The State Fire Marshal is leading an effort to consider specific state code requirements for fire/roof classification of solar panels in the current code adoption process. Until any requirements in this area are standardized on a state basis, agencies generally consider the following when determining any appropriate fire/roof classification to enforce:

- UL 1703, Standard for Flat-Plate Photovoltaic Modules and Panels, is often used for determining the fire/roof classification and listing/certification of solar PV panels. This standard is not currently listed in the CRC but is being considered for adoption in the 2013 State Building Standards Code. UL 1703 is subject to change until approved as part of state code. Enforcing agencies may consider this standard as an alternate to UL 790, subject to approval by the building official. (CRC Section R902)

- Local enforcing agencies have used different approaches to determine any appropriate fire/roof classification for solar PV panels. When PV systems cover a significant portion of the roof, some enforcing agencies have determined that the solar PV panels mounted above the roof should match the classification of the roof while others have determined that the panel may be of a lesser classification based on local conditions, panel installation configuration listing/certification, and/or alternate testing information.

- For installations in State Responsibility Areas (SRA) or High Fire Hazard Severity Zones, additional provisions adopted by the local enforcing agency may be applicable. Check with the enforcing agency for any additional requirements.

3.1.1.2 **Solar PV panels used as roofing on an independent (stand-alone) structure:** Solar PV panels/modules that are designed to be on the roof, and span to structural supports, and have a use or occupancy underneath, shall comply with the minimum fire/roof classification requirements for roof covering as required by CRC Section R902. An example of this type of installation is a carport structure having solar PV panels as the roof.

3.1.1.3 **Solar PV panels installed as a part of a building's roof structure:** Solar PV panels installed as integrated roofing material shall comply with the minimum fire/roof classification requirements for roof covering as required by the current CRC Section R902. An example of this type of installation is PV modules integrated into the roofing shingles (BIPV systems).

3.1.2 **Solar PV systems installed on grade:** Solar PV panels that are part of a stand-alone, ground-mounted solar PV panel structure, with no use and no potential use underneath are generally considered equipment and therefore the fire/roof classification requirements would not apply. (Based on the definition of a roof assembly in CRC Section R202)

3.2 Area, height, and story limitations: Where there is a use between the solar PV panels and the roof/grade underneath, adding such solar PV structures may constitute additional floor area, story, and/or height. Solar PV panels supported by framing that has sufficient uniformly distributed and unobstructed openings throughout the top of the array (horizontal plane) to allow heat and gases to escape, as determined by the enforcing agency, are generally considered equipment. (CRC Section 1.1.3, definition of a roof assembly in CRC Section R202)

3.3 Location from property line and adjacent buildings: Solar PV panels and associated framing, with no use and no potential use between the panels and the grade underneath, are generally treated as equipment; when not considered equipment, they may be considered a structure and shall be located and protected based upon the code required fire separation distance to property lines and adjacent buildings. (CRC Section R302.1)

3.4 Other fire safety requirements or guidelines: The installation of solar PV systems may be subject to additional provisions adopted by the local enforcing agency that may include the State Fire Marshal Solar Photovoltaic Installation Guideline. Check with the enforcing agency for

additional requirements. The guideline can be obtained at http://osfm.fire.ca.gov/pdf/reports/solarphotovoltaicguideline.pdf.

4. **Roof drainage:** Roof-mounted solar PV systems shall not cause excessive sagging of the roof that results in water ponding. They shall also not block or impede drainage flows to roof drains and scuppers. (CRC Section R903.4)

5. **Roof penetrations:** All roof penetrations shall be sealed using approved methods and products to prevent water leakage. Such methods include but not limited to caulking, roof jacks, and sheet metal flashing. (CRC Section R903.2)

6. **Skylights:** Solar PV panels shall maintain a minimum clearance around the perimeter of skylights as not to interfere with the function of the skylight, as determined by the enforcing agency (CRC Section R303)

7. **Plumbing vent, mechanical equipment, and mechanical exhaust terminations:** Solar PV panels shall not obstruct or interfere with the function of plumbing vents or mechanical equipment. (CPC Sections 901.1 & 906, CMC Section 304)

PART II: ELECTRICAL CODE REQUIREMENTS

1. **Product listing (certification):** The solar PV panel/module and other equipment used in the PV system shall be listed/certified by a nationally recognized listing/certification agency in accordance with the applicable standards.

2. **Installation:** The installation of the solar PV system must conform to the requirements of the California Electrical Code (CEC).

3. **Signage:** Signage must conform to the requirements of the (CEC). Signage requirements and location of certain equipment for solar PV systems may be subject to additional provisions adopted by the enforcing agency that may include requirements from the State Fire Marshal Solar Photovoltaic Installation Guideline.

PART III: LOCAL ELECTRIC UTILITY REQUIREMENTS

Check with the local utility for any incentives, interconnection, operating, and metering requirements.

TOOLKIT DOCUMENT

City/County of [NAME OF CITY]
Department of [NAME OF DEPARTMENT]

Code Requirements for Solar Photovoltaic (PV) Systems – General

Based on the 2010 California Building Code (CBC)
and the 2010 California Residential Code (CRC)

PURPOSE

The purpose of this information bulletin is to clarify requirements of the State Building Standards Codes (Title 24) that pertain to solar PV installations. This bulletin can serve as a reference guide for permit applicants and enforcing agencies to clarify how state code requirements are practically applied in the local jurisdiction. It is intended to minimize permitting uncertainty and differing interpretation regarding specific code requirements for solar PV installations. This information bulletin primarily clarifies requirements pertaining to the California Building Code and the California Residential Code, since these codes in their current form require significant local interpretation. This information bulletin does not address local regulations.

The implementation of uniform standards to achieve the timely and cost-effective installation is consistent with the California Solar Rights Act that views solar installation as a matter of statewide concern and prohibits local jurisdictions from adopting unreasonable barriers to the installation of solar energy systems (CA Government Code Section 65850.5).

PART I: BUILDING AND RESIDENTIAL CODE REQUIREMENTS

1. Definitions

1.1 Solar photovoltaic (PV) system: The total components and subsystems that, in combination, convert solar energy into electric energy suitable for connection to utilization load (CEC Article 690.2)

1.2 Solar photovoltaic module: A complete, environmentally protected unit consisting of solar cells, optics, and other components, exclusive of tracker, designed to generate DC power when exposed to sunlight (CEC Article 690.2)

1.3 Solar photovoltaic (PV) panel: A collection of modules mechanically fastened together, wired, and designed to provide a field-installable unit (CEC Article 690.2)

1.4 Building integrated photovoltaic (BIPV) system: Photovoltaic cells, devices, modules, or modular materials that are integrated into the outer surface or structure of a building and serve as the outer protective surface of the building (CEC Article 690.2)

2. Structural Requirements

2.1 PV systems positively anchored to the building:

2.1.1 Exemption from structural calculations: The building official may waive the requirement for structural calculations for solar PV installations on top of existing roofs if the official can readily

determine that the additional weight of the new solar PV system on the roof does not affect the structural integrity of the building. Some jurisdictions may have a prescriptive approach for when structural calculations can be waived, however, that varies by the enforcing agency.

To help streamline and simplify the permitting process for roof-mounted solar PV systems, it is highly recommended that local jurisdictions develop a prescriptive approach to meeting the structural requirements so that structural calculations are not always required. Here are some parameters to consider under such prescriptive approach:

- Maximum distributed weight of the solar PV system in psf
- Maximum perpendicular distance between the solar PV system and the roof below
- Maximum concentrated load imposed by the PV panel support onto the building's roof
- Minimum size and spacing of rafters or joists for portion of the roof that is supporting the solar PV system
- Maximum span of rafters or joists for portion of the roof that is supporting the solar PV system
- Anchoring requirements such as type of fasteners, minimum fastener size, minimum embedment, and minimum number of attachment points
- Any limitation on the type of building construction

2.1.2 Structural calculations: When structural calculations are required, calculations shall demonstrate that the primary structure will support the additional vertical and lateral loads from the panels and related equipment.

2.1.2.1 Roof dead Load: The weight of solar PV systems shall be considered in the design of the structure. (CBC Section 1606, CRC Section R301.4)

For installation of conventional (not BIPV) solar PV panels on existing roofs, the building official may allow a certain percent of the code required live load to be reduced to accommodate the additional weight of the solar PV panels provided the roof design is adequate for the concentrated loads from the solar PV panel support frames. This allowance may vary by jurisdiction and is generally based on the assumption that solar PV panels will not be stepped on or used by anyone to support any live load.

When the roof live load is allowed to be reduced, consideration should be given to the possibility that a roof may have more than one layer of existing roofing and the possibility of having smaller size rafters in older buildings.

Section 3403 of the CBC states, in part, that: "Any existing gravity load-carrying structural element for which an addition and its related alterations cause an increase in design gravity load of more than 5 percent shall be strengthened, supplemented, replaced, or otherwise altered as needed to carry the increased load required by this code for new structures."

2.1.2.2 Roof live load: The building official may allow the live load to be reduced in the area covered by each solar PV panel when such area is inaccessible as determined by the enforcing agency and as discussed in Section 2.1.2.1 of this information bulletin. Roof surfaces not covered by solar PV panels shall be designed for the roof live load. (CBC Section 1607, CRC R301.6)

The building official may determine that live load need not be considered for solar PV panels and associated supporting members that are built on grade. Such interpretation

is generally based on the assumption that the solar PV panels will not be stepped on or used by anyone to support any live load

2.1.2.3 Wind design: Calculations shall demonstrate that the solar PV panels and associated supporting members are designed to resist wind loads. For ballasted PV systems, see Section 2.2 of this information bulletin (CBC Section 1609, CRC R301.2.1)

Note 1: The Structural Engineering Association of California is in the process of developing a white paper titled "Wind Loads on Low-Profile Solar Photovoltaic Systems on Flat Roofs." Once available, a link to the white paper will be included in this document.

2.1.2.4 Seismic design: Calculations shall demonstrate that the solar PV panels and associated supporting members are designed to resist earthquake loads. For ballasted PV systems, see Section 2.2 of this information bulletin. (CBC Section 1613, CRC 301.2.2)

Note that Section 3404 of the CBC states, in part, that "Any existing lateral load-carrying structural element whose demand-capacity ratios with alteration considered is no more than 10 percent greater than its demand-capacity ratio with the alteration ignored shall be permitted to remain unaltered. . . ."

2.1.2.5 For wood construction, supports shall be attached with fasteners of sufficient length and size to achieve minimum required embedment into solid wood taking into consideration the plywood and multiple layers of roofing that may exist, unless otherwise approved by the enforcing agency. (ASCE/SEI 7 Section 13.4, CRC Section R301.1.3)

2.1.2.6 Snow load: When applicable, include snow loads and loads from snow drift. (CBC Section 1608, CRC R301.2.3)

2.1.2.7 Requirements for load combinations: The applicable load combinations in CBC 1605 shall be applied to all loading conditions, including evaluating the effects of dead load to counteract wind uplift for ballasted and anchored systems. (CBC Section 1605, CRC Section R301.1.3)

2.1.2.8 Alterations, additions, and repairs: Sections 3403, 3404, and 3405 of the CBC shall apply to additions, alterations, and repairs associated with PV systems. Roof structural components, their connections, additions, alterations, and repairs shall be designed to support the loads from the PV panel support frames

2.2 Ballasted PV system: PV panels in a ballasted system are typically not attached to the roof and rely on their weight, aerodynamics, and friction to counter the effect of wind and seismic forces. In some cases, ballasted systems have few attachment points to supplement the friction forces. Ballasted systems have low ratios of height-to-base width or length, which makes them inherently stable against overturning.

Section 13.4 of ASCE/SEI 7-05 requires that nonstructural components and their supports be attached (or anchored) to the structure. Ballasted solar PV systems are not addressed in the ASCE/SEI 7 or in the building code. When approved by the enforcing agency as an alternative material, design or method of construction pursuant to CBC Sections 12.2, 1.8.7, or 1.11.2.4 as applicable, these systems may be unrestrained or partially restrained subject to conditions of approval set by the enforcing agency.

Note 1: Electrical connections and wiring in a ballasted system should be designed to accommodate movements within the system.

Note 2: The Structural Engineering Association of California is in the process of developing a white paper, titled "Structural Seismic Requirements and Commentary for Rooftop Solar Photovoltaic Systems," addressing the seismic design of ballasted systems. Once available, a link to the white paper will be included in this document.

2.3 Structural strength of PV panels: The structural strength of solar PV panels is not addressed in the code.

UL 1703, Third Edition, published March 15, 2002, requires that solar PV panels are tested to withstand a superimposed load of 30lb/ft2. Therefore, all solar PV panels that are listed per UL 1703 are considered to meet this requirement.

When used as a building component and depending on the load values that the solar PV panels are subjected to, the enforcing agency may require a test report from an agency recognized by the enforcing agency showing the strength of the solar PV panels.

2.4 Condition of existing roof: Solar PV systems shall not be installed on an existing roof that is deteriorated to the point where it is not adequate as a base. (this interpretation is based on CBC Section 1510 and CRC R907)

2.5 Premanufactured support systems: Premanufactured support systems must support the PV system and allow the system to stay attached to the structure when exposed to wind or seismic activity. Compliance of the PV support system with appropriate building codes is accomplished through a design specified by a licensed engineer or architect, or through research reports from approved sources as defined in CBC Section 1703.4.2. Additional requirements may be imposed by the enforcing agency. (CRC Section R301.1.3, CBC Section 1703.4.2)

3. Fire Safety Provisions

3.1 Fire/roof classification of photovoltaic (PV) panels

3.1.1 Solar PV panels installed on top of a building's roof structure:

3.1.1.1 Solar PV systems installed on top of a roof where the space between the solar PV panels and the roof has no use and no potential use are generally considered to be equipment. Currently, the State's Building Standards Code maintains fire/roof classification requirements for roof structures, but does not maintain specific requirements regarding fire/roof classification of solar PV panels.

Since no specific requirements or guidance are provided by the State Building Standards Code, local enforcing agencies currently determine whether any fire/roof classification of solar PV panels is required and if so, what fire/roof classification is required. The State Fire Marshal is leading an effort to consider specific state code requirements for fire/roof classification of solar panels in the current code adoption process. Until any requirements in this area are standardized on a state basis, agencies generally consider the following when determining any appropriate fire/roof classification to enforce:

- UL 1703, Standard for Flat-Plate Photovoltaic Modules and Panels, is often used for determining the fire/roof classification and listing/certification of solar PV panels. This standard is not currently listed in the CRC or the CBC but is being considered for adoption in the 2013 State Building Standards Code. UL 1703 is subject to change until approved as part of state code. Enforcing agencies may consider this standard as an alternate to UL 790, subject to approval by the building official. (CRC Section R902, CBC Section 1505)

- Local enforcing agencies have used different approaches to determine any appropriate fire/roof classification for solar PV panels. When PV systems cover a significant portion of the roof, some enforcing agencies have determined that the solar PV panels mounted above the roof should match the classification of the roof while others have determined that the panel may be of a lesser classification based on local conditions, panel installation configuration listing/certification, and/or alternate testing information.

- For installations in State Responsibility Areas (SRA) or High Fire Hazard Severity Zones, additional provisions adopted by the local enforcing agency may be applicable. Check with the enforcing agency for any additional requirements.

3.1.1.2 **Solar PV panels used as roofing on an independent (stand-alone) structure:** Solar PV panels/modules that are designed to be on the roof, and span to structural supports, and have a use or occupancy underneath, shall comply with the minimum fire/roof classification requirements for roof covering as required by CRC Section R902. An example of this type of installation is a carport structure having solar PV panels as the roof.

3.1.1.3 **Solar PV panels installed as a part of a building's roof structure:** Solar PV panels installed as integrated roofing material shall comply with the minimum fire/roof classification requirements for roof covering as required by the current CRC Section R902. An example of this type of installation is PV modules integrated into the roofing shingles (BIPV systems).

3.1.2 **Solar PV systems installed on grade:** Solar PV panels that are part of a stand-alone, ground-mounted solar PV panel structures, with no use and no potential use underneath are generally considered equipment and therefore the fire/roof classification requirements would not apply. (Based on the definition of a roof assembly in CRC Section R202/CBC Section 1502)

3.2 Area, height, and story limitations: Where there is a use between the solar PV panels and the roof/grade underneath, adding such solar PV structures may constitute additional floor area, story, and/or height. Solar PV panels supported by framing that has sufficient uniformly distributed and unobstructed openings throughout the top of the array (horizontal plane) to allow heat and gases to escape, as determined by the enforcing agency, are generally considered equipment. (CBC Section 503 and Table 503, CRC Section 1.1.3, definition of a roof assembly in CBC Section 1502 and CRC Section R202)

3.3 Location from property line and adjacent buildings: Solar PV panels and associated framing, with no use and no potential use between the panels and the grade underneath, are generally treated as equipment; when not considered equipment, they may be considered a structure and shall be located and protected based upon the code required fire separation distance to property lines and adjacent buildings. (CRC Section R302.1, CBC Section 602).

3.4 Fire proofing of structural support: Depending on the type of building, support structures of solar PV systems that have a use or have potential for use underneath (such as carports) may be required to be fire proofed in accordance with CBC Section 602.

3.4.1 The following installations are generally considered equipment and are not subject to this requirement provided that the structural members are noncombustible.

A. Stand-alone PV panel structures with no use and no potential use underneath. (Based on definition of a roof assembly in CBC Section 1502)

B. Solar PV panels supported by framing that has sufficient uniformly distributed and

unobstructed openings throughout the top of the array (horizontal plane) to allow heat and gases to escape, as determined by the enforcing agency. (Based on definition of a roof assembly in CBC Section 1502)

3.4.2 Alternate designs can be considered when approved by the enforcing agency as an alternative material, design, or method of construction pursuant to CBC Sections 1.2.2, 1.8.7, or 1.11.2.4 as applicable.

3.5 Rooftop structures: Unenclosed rooftop structures supporting solar PV systems with no use underneath are generally not subject to CBC Section 1509.2.

3.6 Fire sprinklers: In buildings that are required to be provided with fire sprinklers, the CBC requires that all parts of the building have sprinkler coverage except where an exemption is specifically required. Current code has no exemption for solar PV structures but here are some guidelines (CBC 903.3):

3.6.1 Existing exemptions in the code may be used for a solar PV installation if it meets the intent of the exemption. This will be subject to approval by the enforcing agency.

3.6.2 Solar photovoltaic (PV) panels supported by framing that have sufficient uniformly distributed and unobstructed openings throughout the top of the array (horizontal plane) to allow heat and gases to escape, as determined by the enforcing agency, are generally not subject to this requirement. (CBC Section 903.3.3)

3.6.3 Solar PV panels placed above the roof, with no use and no potential use between the panels and the roof, are generally not subject to this requirement. (Based on definition of a roof assembly in CBC Section 1502 and CRC Section R202)

3.7 Other fire safety requirements or guidelines: The installation of solar PV systems may be subject to additional provisions adopted by the local enforcing agency that may include the State Fire Marshal Solar Photovoltaic Installation Guideline. Check with the enforcing agency for additional requirements. The guideline can be obtained at http://osfm.fire.ca.gov/pdf/reports/solarphotovoltaicguideline.pdf

4. **Roof drainage:** Roof-mounted solar PV systems shall not cause excessive sagging of the roof that results in water ponding. They shall also not block or impede drainage flows to roof drains and scuppers. (CBC Section 1611, CRC Section R903.4)

5. **Roof penetrations:** All roof penetrations shall be sealed using approved methods and products to prevent water leakage. Such methods include but not limited to caulking, roof jacks, and sheet metal flashing. (CBC Section 1503.2, CRC Section R903.2)

6. **Skylights:** Solar PV panels shall maintain a minimum clearance around the perimeter of skylights as not to interfere with the function of the skylight, as determined by the enforcing agency. (CBC Section 1205, CRC Section R303)

7. **Plumbing vent, mechanical equipment, and mechanical exhaust terminations:** Solar PV panels shall not obstruct or interfere with the function of plumbing vents or mechanical equipment. (CPC Sections 901.1 & 906, CMC Section 304)

8. **Guard rails:** When required by the enforcing agency, guard rails may apply to solar PV systems. (CBC 1013.5).

9. **Disabled access requirements**

9.1 Nonresidential, hotel, motel buildings, facilities, or structures (See CBC Chapter 11B)

9.1.1 Scope: Accessibility to solar PV support structures that create a use or occupancy shall be provided for all occupancy classifications in accordance with Chapter 11B.

9.1.2 General: When alterations, structural repairs, or additions are made to existing buildings or facilities, for the purpose of installing a solar PV system, they shall comply with Chapter 11B

Note: New solar PV systems that do not create or expand a use or occupancy and consist only of installation of the solar PV system, and related electrical work, that does not affect disabled access requirements for existing buildings regulated by Chapter 11B are not considered alterations for the purpose of accessibility and should not be subject to accessibility upgrades.

9.2 Residential buildings, facilities, or structures

9.2.1 Scope: New solar PV systems serving covered multifamily dwellings that create a use or occupancy shall comply with the provisions of Chapter 11A.

9.2.2 Existing buildings: The building standards contained in Chapter 11A do not apply to the installation of solar PV systems serving privately funded multifamily dwellings constructed for first occupancy prior to March 13, 1991.

9.3 Parking

Required accessible parking spaces shall be provided and maintained in accordance with the applicable provisions of Sections 1109A and Chapter 11B.

Note: Alterations: Where parking lots, parking structures, or parking facilities are re-striped or otherwise altered to accommodate solar PV systems, required accessible parking spaces shall be maintained or shall be provided in accordance with the applicable provisions of Sections 1109A and 11B.

PART II: ELECTRICAL CODE REQUIREMENTS

1. **Product listing (certification):** The solar PV panel/module and other equipment used in the PV system shall be listed/certified by a nationally recognized listing/certification agency in accordance with the applicable standards.

2. **Installation:** The installation of the solar PV system must conform to the requirements of the California Electrical Code (CEC).

3. **Signage:** Signage must conform to the requirements of the (CEC). Signage requirements and location of certain equipment for solar PV systems may be subject to additional provisions adopted by the enforcing agency that may include requirements from the State Fire Marshal Solar Photovoltaic Installation Guideline.

PART III: LOCAL ELECTRIC UTILITY REQUIREMENTS

Check with the local utility for any incentives, interconnection, operating, and metering requirements.

GLOSSARY

AHJ: Acronym that stands for authority having jurisdiction. AHJ is often used to describe the designated department or agency that enforces certain laws or regulations. It is often used interchangeably with the term enforcing agency.

BIPV: Acronym that stands for Building Integrated Photovoltaics, which is a form of photovoltaic solar energy technology that is integrated into the building envelope to become a part of the roof, skylight, or façade.

California Building Standards Commission: State entity that administers California's building codes, including the adoption, approval, and publication. They follow a triennial code adoption cycle in which state agencies submit their proposals for code changes.

California Department of Housing and Community Development (HCD): State department responsible for preserving and expanding safe and affordable housing opportunities. HCD develops the building standards that govern construction and maintenance on all forms of housing and ensures that the standards are properly enforced, identifies California's housing needs, and develops policies to meet those needs.

California State Fire Marshal: State office that supports CAL FIRE by focusing on fire prevention through fire prevention engineering, training, and education, and enforcement.

Contractor: A contractor licensed by the State of California performing work within the scope of their license.

Dead load: The weight of materials of construction incorporated into the building, including but not limited to walls, floors, roofs, ceilings, stairways, built-in partitions, finishes, cladding, and other similarly incorporated architectural and structural items, and the weight of fixed service equipment, such as cranes, plumbing stacks, and risers; electrical feeders; heating, ventilating and air-conditioning systems; and automatic sprinkler systems.

Enforcement: (As defined in Title 24) A diligent effort to secure compliance, including review of plans and permit applications, response to complaints, citation of violations, and other legal process. Except as otherwise provided in this part, "enforcement" may, but need not, include inspections of existing buildings on which no complaint or permit application has been filed, and effort to secure compliance as to these existing buildings.

Enforcing agency: The designated department or agency that enforces certain laws or regulations, as specified by statute or regulation. In regard to solar PV installations, this entity is can also be referred to as the "permitting agency," since it is often the entity that issues a permit to allow for solar installations to be constructed.

General plan: A document adopted by a city or county to create a long-term vision to guide the jurisdictions future growth and land use. It includes a statement of development policies and implementing actions to achieve its development objectives.

Live load: Those loads produced by the use and occupancy of the building or other structure and do not include construction or environmental loads such as wind load, snow load, rain load, earthquake load, flood load, or dead load.

Photovoltaic: A method of generating electrical power by converting solar radiation (sunlight) into direct current electricity using semiconductors.

Qualified person: One who has the required state license and has proper skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved.

Solar photovoltaic system: The total components and subsystems that, in combination, convert solar energy into electric energy suitable for connection to utilization load.

Title 24: The section of the California Code of Regulations that governs the design and construction of all buildings and associated facilities and equipment in California.

ADDITIONAL RESOURCES

Alternative Energy Equipment and Systems Marking and Application Guide

Underwriters Laboratories (UL) has recently published the ***Alternative Energy Equipment and Systems Marking and Application Guide***. The guide is similar to the seven electrical equipment marking guides that UL publishes in Appendix A of the UL White Book. The guide provides application and UL product category information for photovoltaic systems, thermal solar systems, fuel cells and hydrogen generators, engine generators, microturbines, and wind turbine generating systems. This guide is available online and will be included in the 2010 UL White Book in Appendix A.

Energy Aware Planning Guide

Developed by the California Energy Commission, the ***Energy Aware Planning Guide*** is a comprehensive resource for local governments seeking to reduce energy use, improve energy efficiency, and increase usage of renewable energy across all sectors. The guide presents a menu of strategies and best management practices to help local governments improve energy efficiency, reduce energy consumption through transportation and land use, and enhance renewable sources of energy.

Energy Aware Facility Siting and Permitting Guide

Developed by the California Energy Commission, the ***Energy Aware Facility Siting and Permitting Guide*** assists local governments with developing general plan energy and transmission elements and provides guidance on utility-scale electricity generation and transmission planning and permitting. The guide discusses the increasing role of local governments in energy planning and permitting; describes the energy regulations and policies (both federal and state) and planning processes that define future electricity generation and transmission needs; and identifies opportunities for local government involvement in electricity infrastructure planning and permitting.

Expedited Permit Process for PV System

Recommendations developed for the Solar American Board for Codes and Standards (Solar ABCs) by Brooks Engineering. This **document** outlines a standardized review process for small-scale PV systems.

Incentive and Interconnection Information

Weblinks to information on major utilities' interconnection rules and procedures is provided below:

Los Angeles Department of Water and Power (LADWP)

Pacific Gas and Electric (PG&E)

- **Generator Interconnection Website** (includes link to Interconnection Request Form)
- **FAQs for Small Generation Interconnection Procedures**

Sacramento Municipal Utility District (SMUD)

- **Project Interconnection Process**

San Diego Gas and Electric (SDG&E)

- **Generation Interconnection Handbook**

Southern California Edison (SCE)

- **Net Metering FAQs**
- **Net Energy Metering Interconnection Handbook**

Sharing Success — Emerging Approaches to Efficient Rooftop Solar Permitting

Published by the Interstate Renewable Energy Council (IREC) in May 2012. This **report** outlines innovative

strategies being implemented across the US to help increase the efficiency of permitting procedures for rooftop solar systems.

Solar America Board for Codes and Standards (Solar ABCs)

Solar ABCs is a collaborative effort funded by the U.S. Department of Energy. This entity publishes several helpful reports and recommendations, including a permit streamlining guideline.

Solar Energy Facilities Permit Streamlining Guide

A **guide** produced by the California County Planning Directors Association (CCPDA) to help counties facilitate development of solar energy facilities. The guide describes the laws and regulations applying to solar energy facilities, points to consider regarding solar energy development, and lists current procurement and incentive programs for renewable energy. The guide also provides a model ordinance regarding solar energy facilities and further outlines policy options and guidance for counties regarding solar energy.

Solar Instructor Training Network

The **Solar Instructor Training Network** (SITN) promotes high-quality training in the installation of solar technologies. Nine regional resource and training providers support the professional development of trainers and instructors of solar PV and solar heating and cooling technologies across the country. The Interstate Renewable Energy Council (IREC) became the national administrator of the Solar Instructor Training Network in 2010.

California Solar Rights Act: A Review of the Statutes and Relevant Cases

The Energy Policy Initiatives Center at the University of San Diego School of Law has produced this detailed analysis of the California Solar Rights Act. This review details the evolution of the act since its passage in the late 1970s. A series of court cases, detailed in this **document**, have shaped how the act is practically applied throughout the state.

Solar 3.0

Solar 3.0 is a national initiative to promote process innovation in U.S. cities through the standardization of local land use, zoning code ordinances, permitting processes, and interconnection rules for distributed solar PV. Funded by the U.S. Department of Energy, Solar 3.0 aims to increase the competitiveness of solar PV as an energy source by reducing nonhardware balance-of-system costs by 50% in identified U.S. solar communities by 2014.