Single Combination Building Inspection Process

"Small Solar Photovoltaic Electrical Systems"

California Building Officials Training Institute proudly presents:

Small Solar Photovoltaic Systems

"Single-Combination Inspection Process"

Are you an AHJ interested in proven effective methods for a "single-inspection process of small PV systems" eligible for State mandated expedited permitting?

Are you an AHJ interested in a point by point interpretation and opinion regarding the 19 point checklist from the California Solar Permitting Guidebook?

Are you a PV installer and want transparency and understanding of the single-inspection process?

If you answered yes to any of the above, this presentation will be beneficial for you and or your entire staff. This presentation will help all parties understand a sound:

"Single-Combination Inspection Process" to avoid "Re-inspections."

This training will address related California Electrical Code Article 690 and 705 requirements as well as the 19 point inspection checklist of the Solar Permitting Guidebook. It will benefit building officials, plan check staff, and inspection staff as it will highlight "bigger picture code requirements and intent" and sound "single inspection methodologies" proven to be practical for compliance with new law. The training will also benefit solar energy system contractors, installers, manufactures and project design entities as failed inspections create more work for both AHJ's and all other solar community stake holders.

Instructor: Sparky Cohen, CBO

Sparky Cohen is a fourth generation finish carpenter from a family of woodworkers and California B Licensed Contractors.

Sparky started working for a building department in 1989 as a Combination Building Inspector. He is currently the Building Official for the Building and Safety Division and he is the Chief Code Enforcement Officer for the Code Enforcement Section of the City of Calabasas.

Sparky has secured the following certifications:

- Building Official
- Building Plans Examiner
- Electrical Plans Examiner
- Electrical Inspector
- Septic System Inspector
- Plumbing Inspector

A word about training …

The views and opinions expressed in this presentation by the instructors are based upon their own experiences and understanding of the topic. They do not necessarily reflect the position of CALBO, local ICC Chapters, US DOE, CESA, or SEAC. Examples based on experiences are only examples.

Instructor: Don Hughes

Don Hughes is the Codes and Standards Specialist for the Center for Sustainable Energy, he is a leading expert regarding solar photovoltaic system permitting, inspecting and codes and standards. With over 30 years combined experience as an Electrician, Electrical Inspector and Chief Electrical Inspector he has served as the President, Vice President and Treasurer for the IAEI Northern California Chapter and has provided AHJ perspective to the United States Department of Energy, The California State Governor's Office of Planning and Research, The Interstate Renewable Energy Council, and Underwriter's Laboratories. He currently serves on all U.L. Standards Technical Panels for Solar PV, and is an IAEI/ IASET Trained Solar PV instructor.

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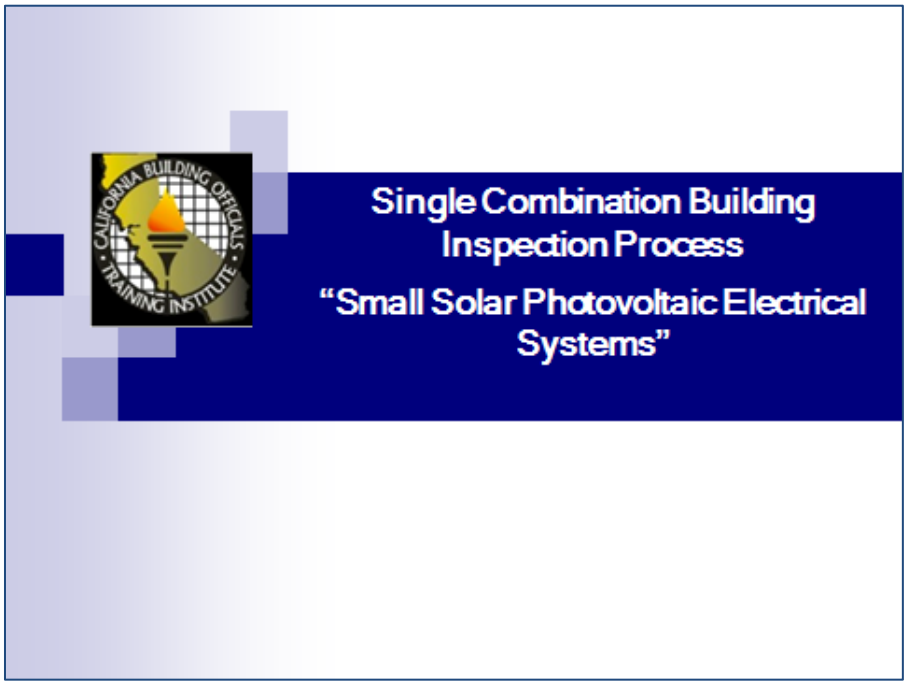
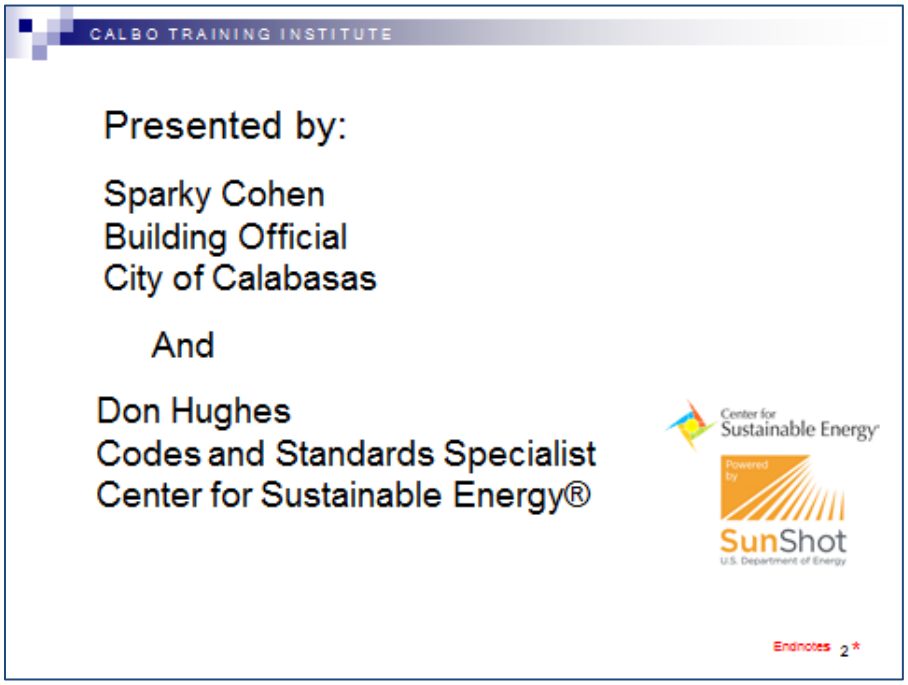
Power Point


Single Combination Building Inspection Process
"Small Solar Photovoltaic Electrical Systems"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Presented by:
Sparky Cohen
Building Official
City of Calabasas
And
Don Hughes
Codes and Standards Specialist
Center for Sustainable Energy®
Center for Sustainable Energy
SunShot
U.S. Department of Energy
Endnotes 2 *

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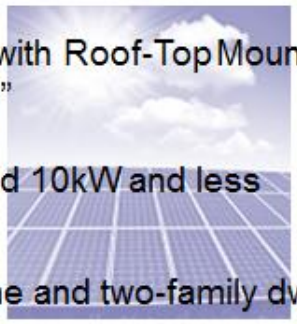
What Is Considered A Small Solar Photovoltaic Electrical System?



Installations with Roof-Top Mounted Photovoltaic "PV" "Panels"

System Rated 10kW and less

Limited to one and two-family dwellings

3

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Genesis of Subject:

1978 California Solar Rights Act
Bars unreasonable restrictions on solar installations

January 1, 2007 - California Solar Initiative
One Million Residential Roof Tops with Solar Systems

September 25, 2012 Assembly Bill 1801-Campos
Permit fee limitations - Fee can only be related to solar work

September 27, 2012 Senate Bill 1222 – Leno
Fees capped

September 21, 2014 Assembly Bill 2188 – Muratshuchi
Expedited Solar Permits

4

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"Assembly Bill 2188"
California Government Code Section 65850.5 (h)

"For a small residential rooftop solar energy system eligible for expedited review, **only one inspection shall be required**, which shall be done in a timely manner and may include a consolidated inspection, except that a separate fire safety inspection may be performed in a city, county, or city and county that does not have an agreement with a local fire authority to conduct a fire safety inspection on behalf of the fire authority. If a small residential rooftop solar energy system fails inspection, a subsequent inspection is authorized, however the subsequent inspection need not conform to the requirements of this subdivision."

5

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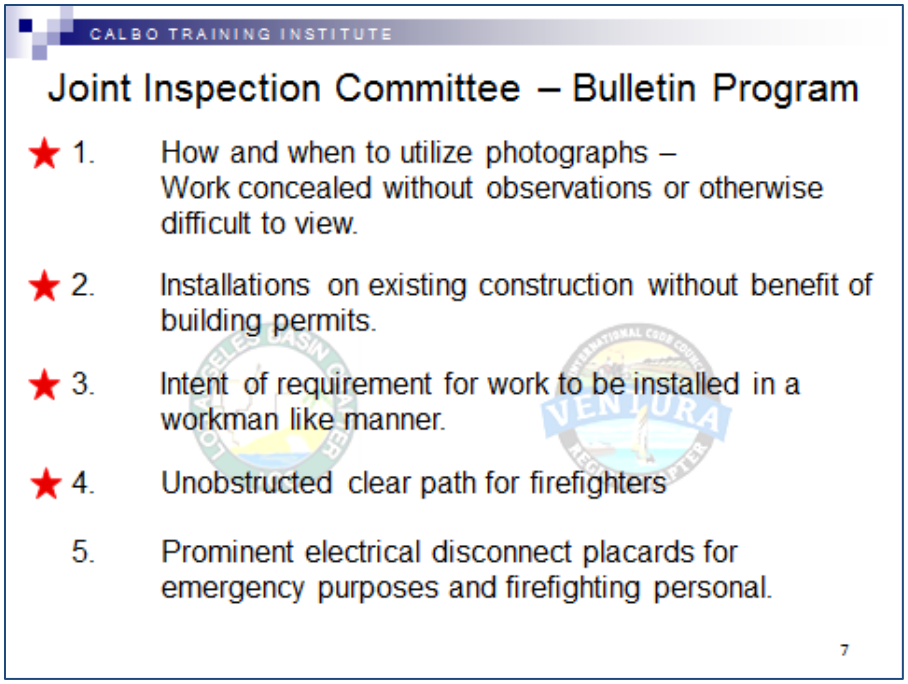
Joint Inspection Committee
Small PV Bulletin Program
Based upon Survey of AHJ Inspectors

Inspection Committee

Inspection Committee

6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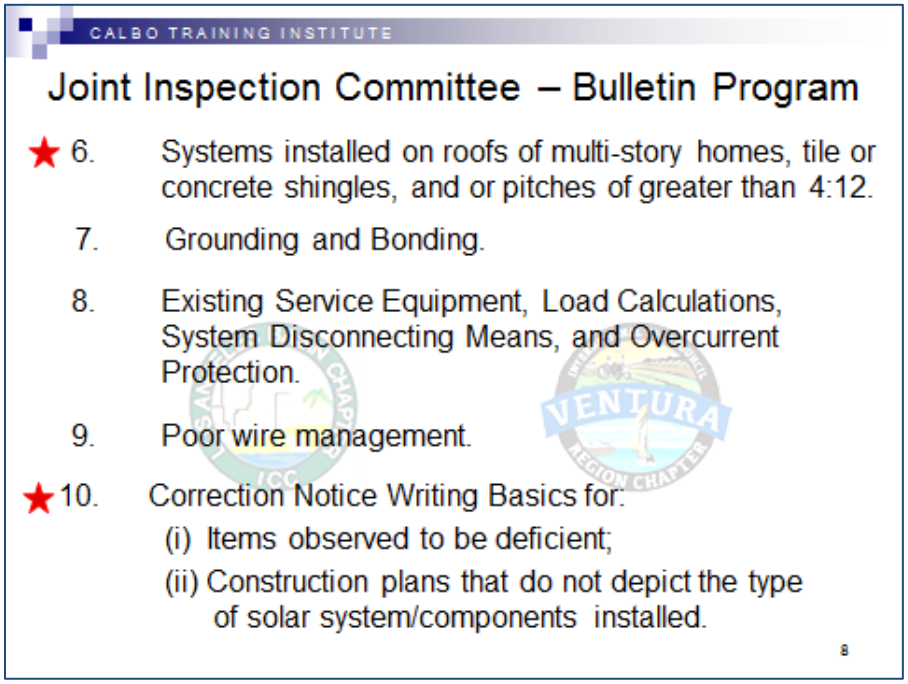
Joint Inspection Committee – Bulletin Program
★ 1. How and when to utilize photographs – Work concealed without observations or otherwise difficult to view.
★ 2. Installations on existing construction without benefit of building permits.
★ 3. Intent of requirement for work to be installed in a workman like manner.
★ 4. Unobstructed clear path for firefighters
5. Prominent electrical disconnect placards for emergency purposes and firefighting personal.
7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Joint Inspection Committee – Bulletin Program
★ 6. Systems installed on roofs of multi-story homes, tile or concrete shingles, and or pitches of greater than 4:12.
7. Grounding and Bonding.
8. Existing Service Equipment, Load Calculations, System Disconnecting Means, and Overcurrent Protection.
9. Poor wire management.
★ 10. Correction Notice Writing Basics for:
(i) Items observed to be deficient;
(ii) Construction plans that do not depict the type of solar system/components installed.
8

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Typical Southern California "Tract Home" With Small PV System

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Typical Southern California "Tract Home" With Small PV System

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How a Typical Small PV System Works

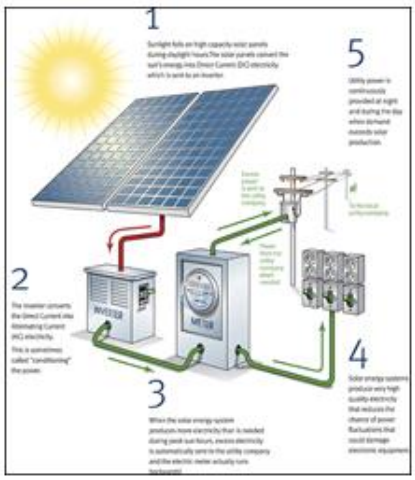

Illustration credit - http://solarcraft.com

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This Presentation Does Not Address:
Small Solar Water Heating Systems

Typically 2-6 panels
Insulated piping coming from panels (as opposed to wiring) – typically copper

Solar thermal systems do not pose the same risk as solar photovoltaic systems.
They typically contain a loop of water/glycol in the rooftop collectors, however there may be a scalding hazard.

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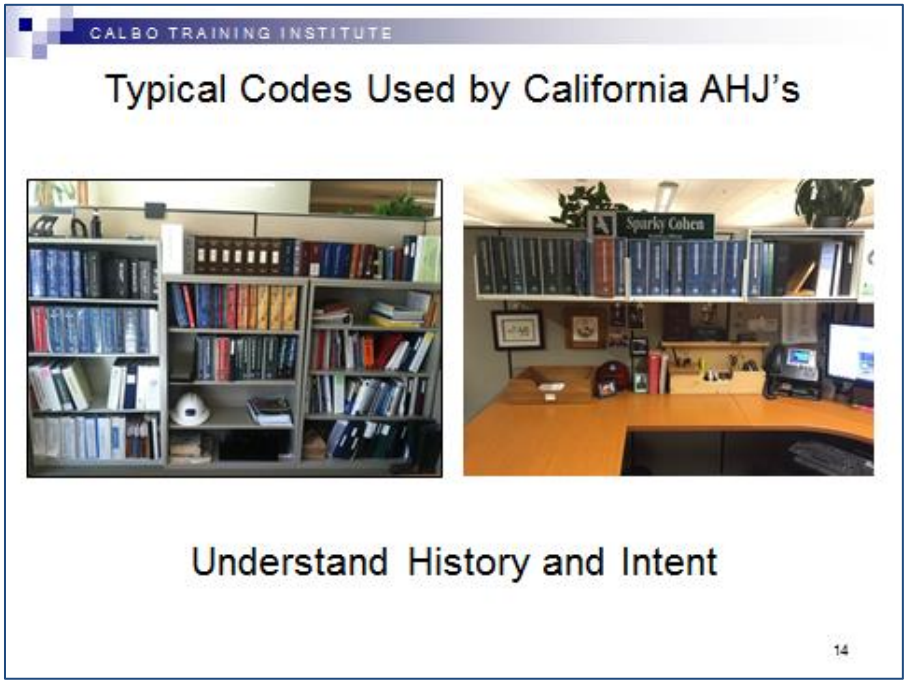
California Law's
California Code of Regulations
29 California Codes
Business and Professions Code
Code of Civil Procedure
Corporations Code
Elections Code
Family Code
Fish and Game Code
Government Code
Health and Safety Code
Labor Code
Penal Code
Public Contract Code
Public Utilities Code
Streets and Highways Code
Vehicle Code
Welfare and Institutions Code
Civil Code
Commercial Code
Education Code
Evidence Code
Financial Code
Food and Agricultural Code
Harbors and Navigation Code
Insurance Code
Military and Veterans Code
Probate Code
Public Resources Code
Revenue and Taxation Code
Unemployment Insurance Code
Water Code
All
13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Typical Codes Used by California AHJ's
Spurky Cohen
Understand History and Intent
14

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CCR Title 24 – Current Mandatory Codes For Projects Post January 1, 2014

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First
Uniform Building Code

First
County of Los Angeles
Building Code

The Primary Goals and Administrative Processes of the Historic Building Codes Are Still Consistent Today

16 *

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Required Inspections

1927 Uniform Building Code

Sec. 204

work. This permit card shall be maintained in such position by the permit holder until the Certificate of Occupancy has been issued by the Building Inspector.

The Building Inspector upon notification from the permit holder or his agent shall make the following inspections of Type V buildings and shall either approve that portion of the construction as completed or shall notify the permit holder or his agent wherein the same fails to comply with the law.

Foundation Inspection: To be made after trenches are excavated and the necessary forms erected and when all materials for the foundation are delivered on the job.

Frame Inspection: To be made after the roof, all framing, fire-blocking and bracing is in place and all pipes, chimneys and vents are complete.

Stucco Inspection: To be made after all lathing and backing is in place and all plastering and stucco materials are delivered on the job, but before any stucco is applied.

Final Inspection: To be made after building is completed and is ready for occupancy.

No work shall be done on any part of the building and/or structure beyond the point indicated in each successive inspection without first obtaining the written approval of the Building Inspector. Such written approval shall be given only after an inspection shall have been made of each successive step in the construction as indicated by each of the above four inspections. (See Appendix).

No reinforcing steel or structural framework of any part of any building or structure shall be covered or concealed in any manner whatsoever without first obtaining the approval of the Building Inspector.

In all buildings where plaster is used for fire protection purposes the permit holder or his agent shall notify the Building Inspector after all lathing and backing is in place and all plastering materials are delivered on the job and no plaster shall be applied until the approval of the Building Inspector has been received.

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Required Inspections

CRC Section 905.3.3 – Is Underlayment Inspection Required?

No

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Required Inspections

CRC Section 905.3.8 – Is Roof Flashing Inspection Required ?

No

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Required Inspections

CRC 109.4 – Frame Inspection

Roof Sheathing And All Penetrations Should Be Complete For Frame Inspection - Specific Roof Sheathing Inspection Is Typically A "Courtesy Inspection."

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Required Inspections

Do Not

Encourage Contractor To Provide An In Process Inspection

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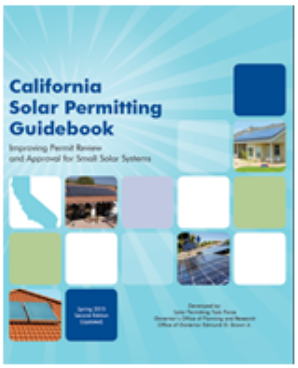
What Are The Primary Goals Of The California Solar Permitting Guidebook?



Transparency of AHJ Criteria

Consistency of AHJ Criteria

Shortening the "Critical Path" of the construction time-line due to AHJ building permit processes.

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Customer Service

23

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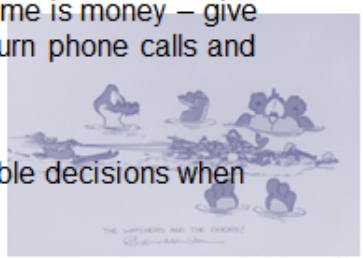
Customer Service

Courteous – have a smile in your voice – are you approachable?

Supportive – can do attitude – understand the customers goals and make them a reality.

Receptive and responsive – time is money – give inspection times; promptly return phone calls and emails.

Be flexible – facilitate practicable decisions when code intent is achieved.



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Customer Service and AB2188
Understand Law Intent

"… The **people of the State of California** do enact as follows … The **Legislature finds and declares**…

…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 … permitting … such systems…"

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"Photographs" Utilized As An Inspection Aid
Highly Encouraged By:

Inspection Committee

Inspection Committee

SEAC
Solar Energy Action Committee

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Photographs Utilized As An Inspection Aid

Substitution For AHJ Inspection

(Quality control process of contractor should already include use of photographs.)

27

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"Access To Work"
Invasive or Destructive Inspections

Invasive Inspection – Should inspection require the removal of electrical components?

Destructive Inspection - Should inspection require the removal of building material?

Alternative - Use Photographs – Both the contractors quality control photos and on the spot photos as directed by the inspector.

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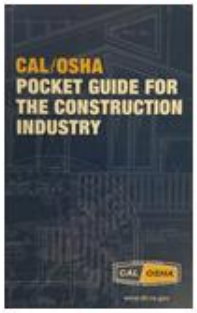
Inspector's Access To Work – Is it Safe?

Title 8 – Division 1
California Department of Industrial Relations



Alternative - Use Photographs – Both the contractors quality control photos and on the spot photos as directed by the inspector.

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When Access To Work is Safe Can The Roof Material Still Be Damaged?

Alternative - Use Photographs – Both the contractors quality control photos and on the spot photos as directed by the inspector.

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Smoke Detector and Carbon Monoxide Alarm

Affidavits Are Highly Encouraged

Inspection Committees

SEAC Solar Energy Action Committee

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Correction Notice Writing Basics

Clearly describe "observations."

Clearly describe corrective actions necessary.

Cite accurate applicable Code Section.

If your signature is not plainly legible - legibly print your name.

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Correction Notice Writing Basics
"Methods of Construction"

"All conduit shall be fastened"

"EMT conduit on roof adjacent photovoltaic array on south facing roof is not fastened within 3 feet of each termination point and horizontal runs are not supported and fastened every 10 feet." Please see CEC Article 358.50 for further information.

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Correction Notice Writing Basics
"Inaccurate Construction Plans"

PV system installation does not match construction plans

The expedited permit was issued based upon standard plan information that is not accurate in comparison to the proposed as built installation. Please reconcile via plan check the wiring methods, make, model and rating of the inverter, as well as the number of modules and their location on the roof of the structure. (Plans depict a 5000W SolarEdge SEP4000A-US inverter with integrated disconnect and 2 strings of 9 modules not a 7000W Sunpower inverter with 3 strings of 12 modules.)

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Correction Notice Writing Basics
"Unlawful Existing Structure"

Room addition does not have permit

≠

"A cursory review of permit records reveals the "flat roof" room addition approximately 20 feet x 10 feet in size and located at the North-East part of the dwelling, appears to have been constructed without the benefit of building permits and inspection approvals. Approval for the installation of the small PV system will require reconciliation of the permit records or retroactive permits for the work not benefit of permits.

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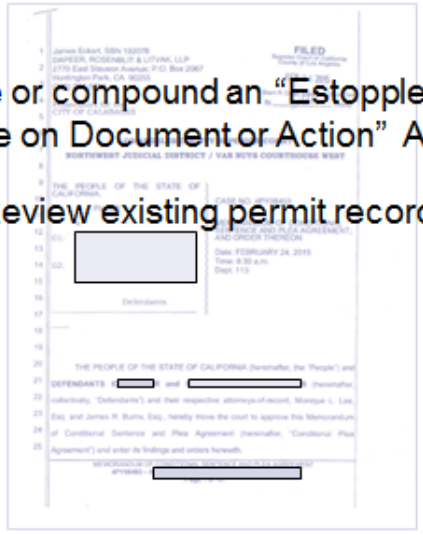
Is Existing Construction Lawful ?

Do not create or compound an "Estopple – Detrimental Reliance on Document or Action" Argument

Review existing permit records



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What Is The Primary Goal Of All Building Codes?

Bullseye – Protection of Human Life

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What Is The Primary Goal of the Fire Code?

To protect fire fighters and occupants of structures from perishing due to a structure fire.

38

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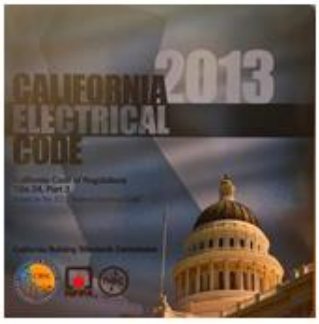
What Is The Primary Goal of the Electrical Code?



To protect occupants of structures from perishing due to electrocution or structure fire due to electrical ignition.

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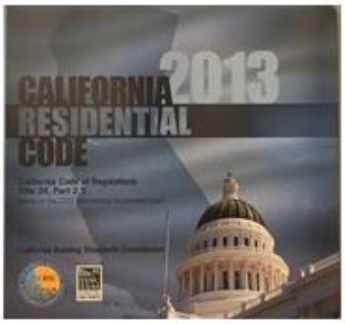
What Is The Primary Goal of the Residential Code?



To protect occupants of structures from perishing due to building collapse or fire.

40

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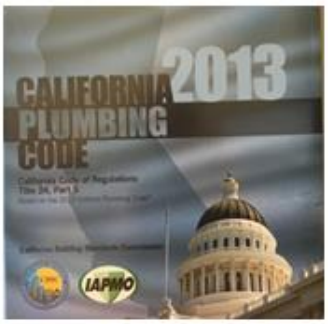
What Is The Primary Goal of the Plumbing Code?



To protect occupants of structures from perishing due to poisoning.

41

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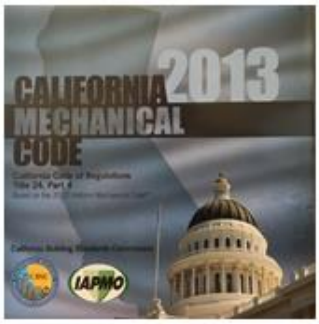
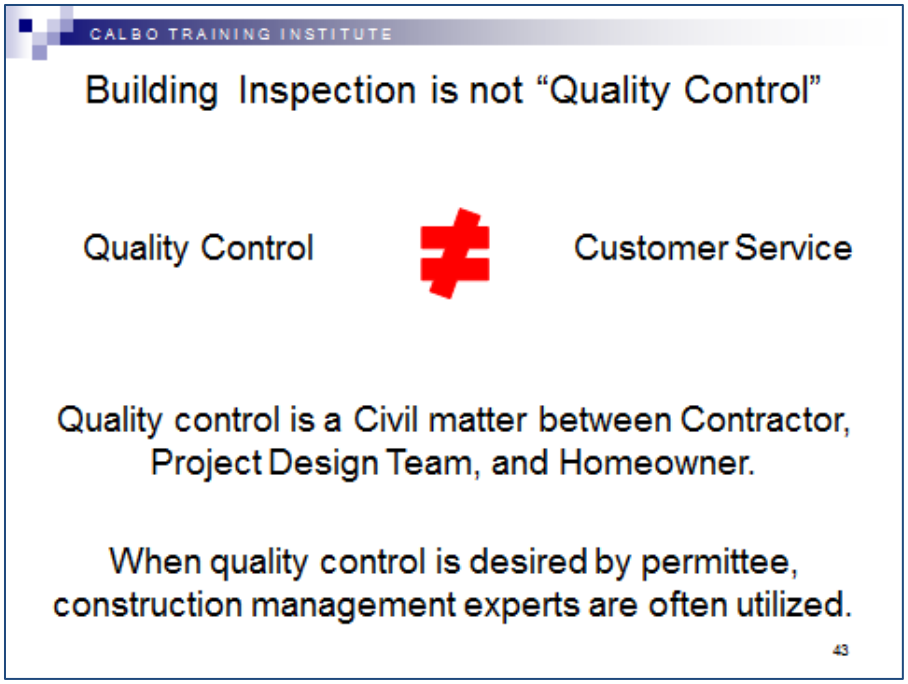
What Is The Primary Goal of the Mechanical Code?



To protect occupants of structures from perishing due to asphyxiation.

42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Building Inspection is not "Quality Control"
Quality Control
≠
Customer Service
Quality control is a Civil matter between Contractor, Project Design Team, and Homeowner.
When quality control is desired by permittee, construction management experts are often utilized.
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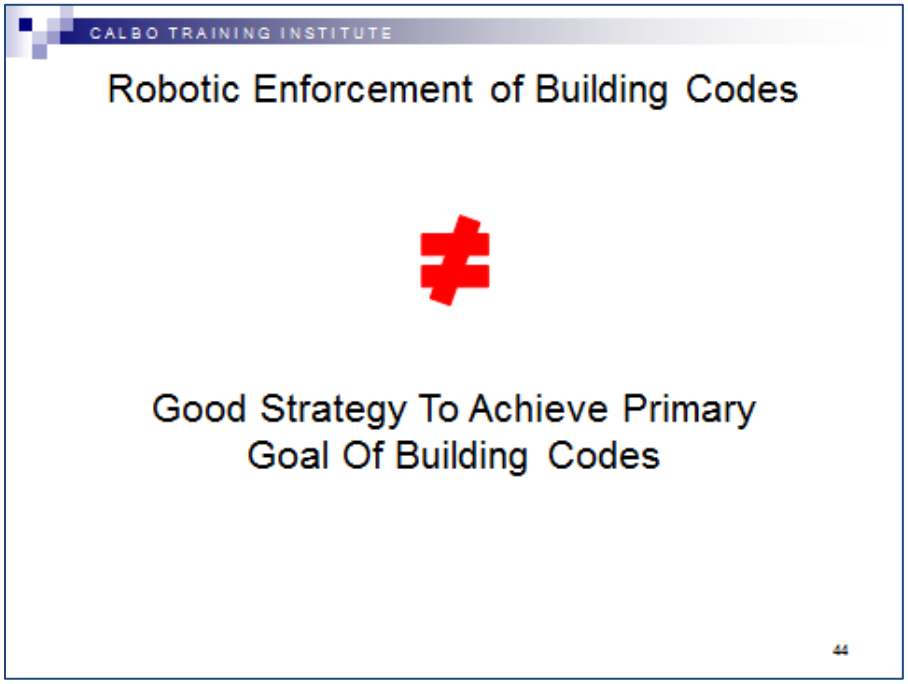
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Robotic Enforcement of Building Codes
≠
Good Strategy To Achieve Primary Goal Of Building Codes
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Inspection Checklists

Inspectors Common Sense

Checklists are a "Tool in the Tool Box"

All Inspectors should have a "Routine." A Checklist should be used to make sure they did not inadvertently miss a step in that routine.

Checklists also help AHJ "Transparency"

45

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Inspection Checklists

The installers responsibility to have the approved standard plans at the project site.

- OR -

The installer and the inspectors familiarity with fundamental requirements detailed in the California Electrical Code Chapters 1 through 4.

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Other very helpful "checklists and documents"

- Single line diagram prominently part of construction plan (*both installer and inspector should have clear understanding of how to read diagram.*)
- California Solar Permitting Guidebook standard plan "Markings" document (*for all warning labels*)
- Contractors checklists
- Contractors quality control documents

47*

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The Indisputable Threat To Human Life Due Installation Of A Small PV System

Fire Fighters Are At Risk Due To The Presence Of The System

48*

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A Firefighters Life Is Not Replaceable
A Dwelling Is Replaceable

49

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DC Circuit from PV Panel to Disconnect

D.C. Circuits between PV panels and D.C. disconnecting means are energized during daylight conditions – regardless if disconnect is "Open" (off position)

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Fire Fighting and Roof Ventilating

Conduits in attics must be in metal raceways and kept at least 10 inches below roof framing

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Clear Path Obstructed by Solar Panels

Fire Fighter performing "Horizontal Ventilation"

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Hazards and Electricity

53

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Do In Action Processes Cause Injury
- or -
Does After Effect Of Code Violation Cause Injury

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In Action Human Processes Usually Cause Injury

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In Action Process Caused Ground Fault

In Action Process Caused Serious Injury

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Electrical Equipment Shall Be Installed In A Neat and Workmanlike Manner

Good or Poor Workmanship
Should set the tone of the inspection

Good workmanship should result in an inspection that is shorter in time than that of an inspection with poor workmanship

Good workmanship, good access, and good photographs, should result in an inspection with a very short duration of time.

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Workmanlike Manner

58

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Workmanlike Manner

59

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Workmanlike Manner

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Workmanlike Manner

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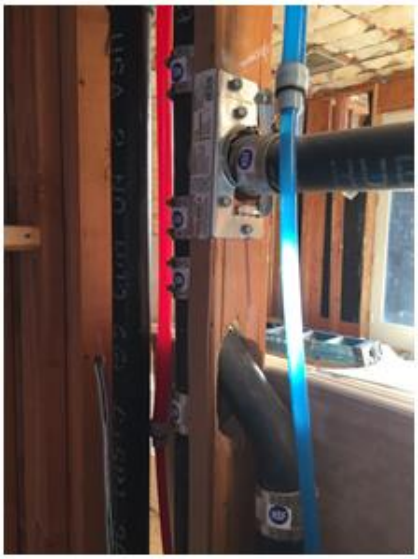
Poor Workmanship



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Poor
Workmanship

63

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Poor Workmanship*

Workmanlike Manner

*Poor wire management

64

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Poor Workmanship*

*Poor wire management

Workmanlike Manner

65

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Poor Workmanship

Non-approved bending equipment

Workmanlike Manner

Approved bending equipment

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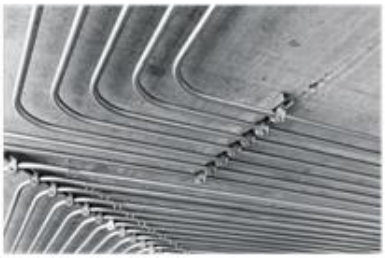
Poor Workmanship

Workmanlike Manner



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Poor Workmanship

Workmanlike Manner

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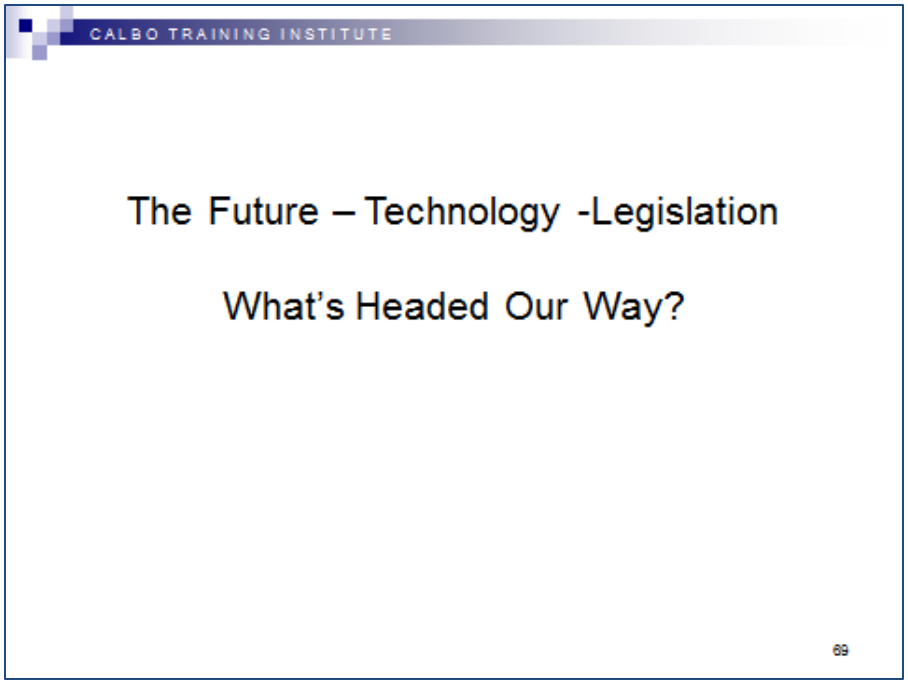
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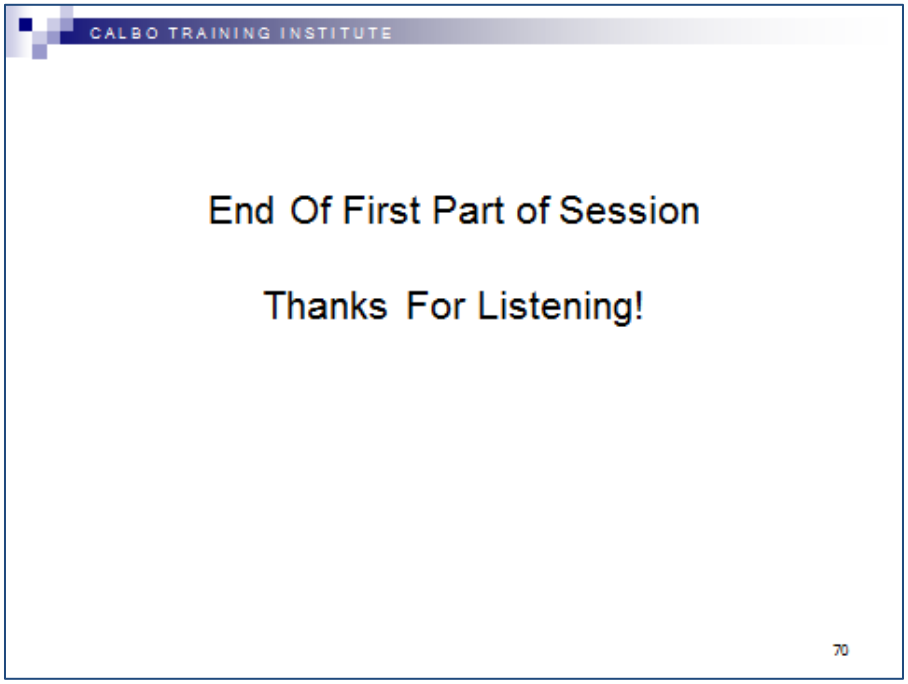
The Future – Technology -Legislation
What's Headed Our Way?
69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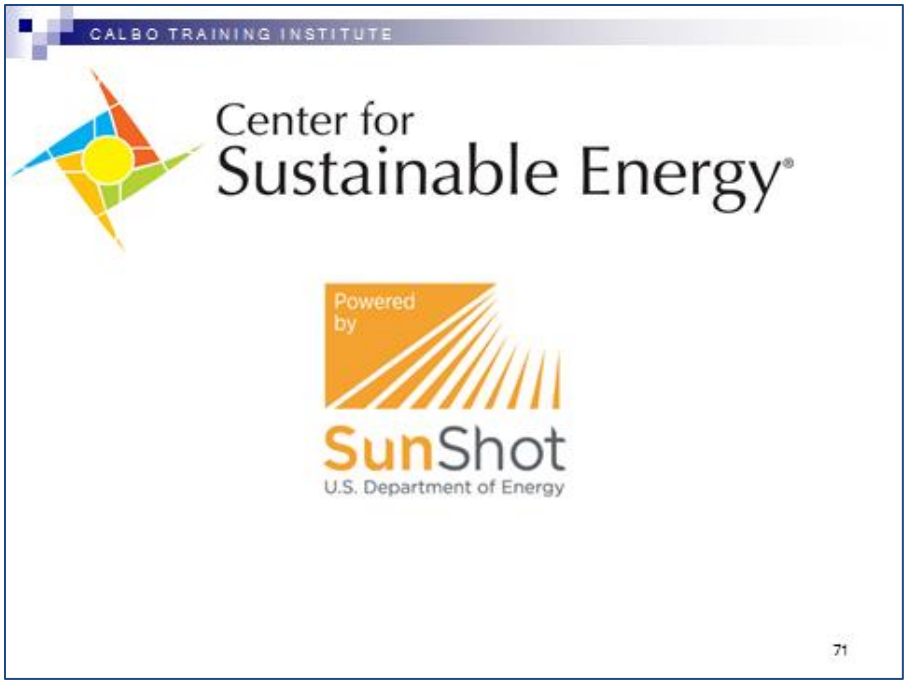
End Of First Part of Session
Thanks For Listening!
70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Center for
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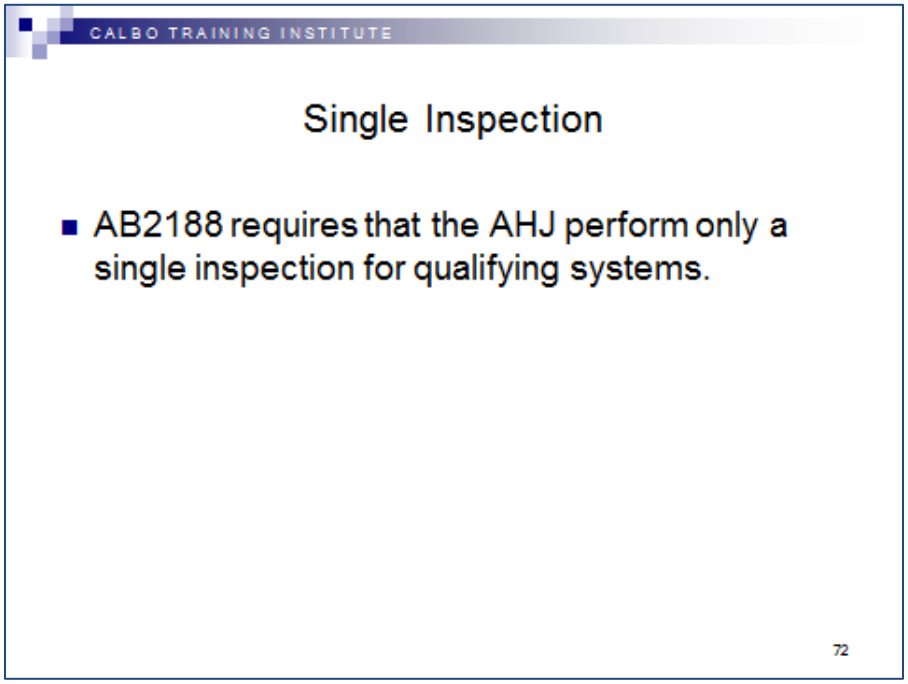
71


CALBO TRAINING INSTITUTE
Single Inspection
AB2188 requires that the AHJ perform only a single inspection for qualifying systems.
72

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Single inspection

- PV & SHW
- Less than 10 kW or 30 kWth (SHW)
- Rooftop installations
- String inverter, microinverter, or DC converter (PV)
- Complies with eligibility checklist

73

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Single Inspection

- The bill states that if correction items are observed then it is acceptable for the inspector to write a correction notice, and follow up inspections may take place until the items have been corrected.

74

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Single Inspection

- The intent of the single inspection requirement in AB2188 is for the local jurisdiction to go out of their office with the intent to perform only a single inspection on the PV system. Not that the jurisdiction is only permitted, or allowed, to perform only one inspection. But it should be their intent.

75

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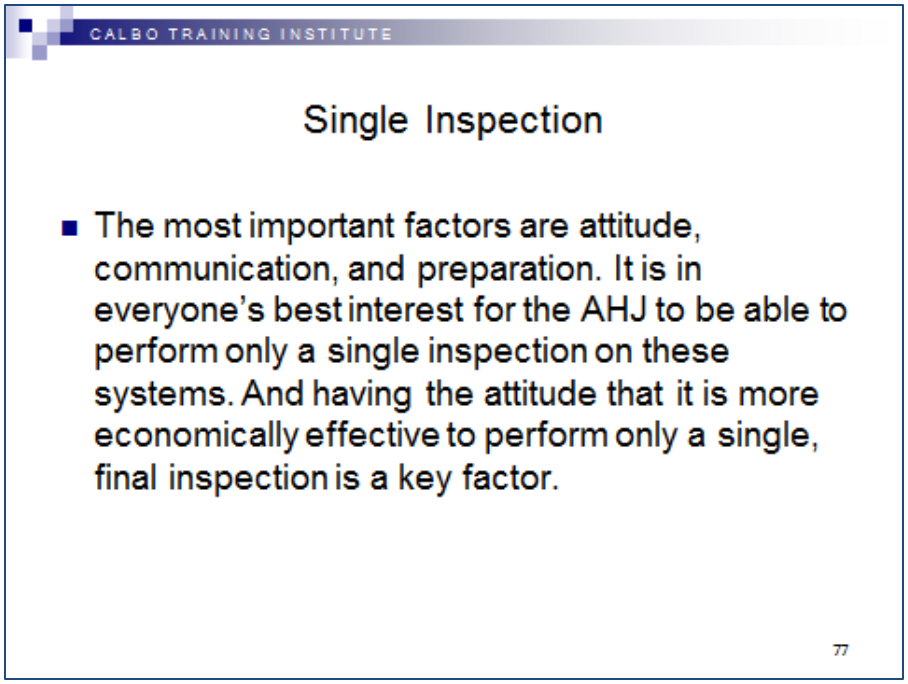
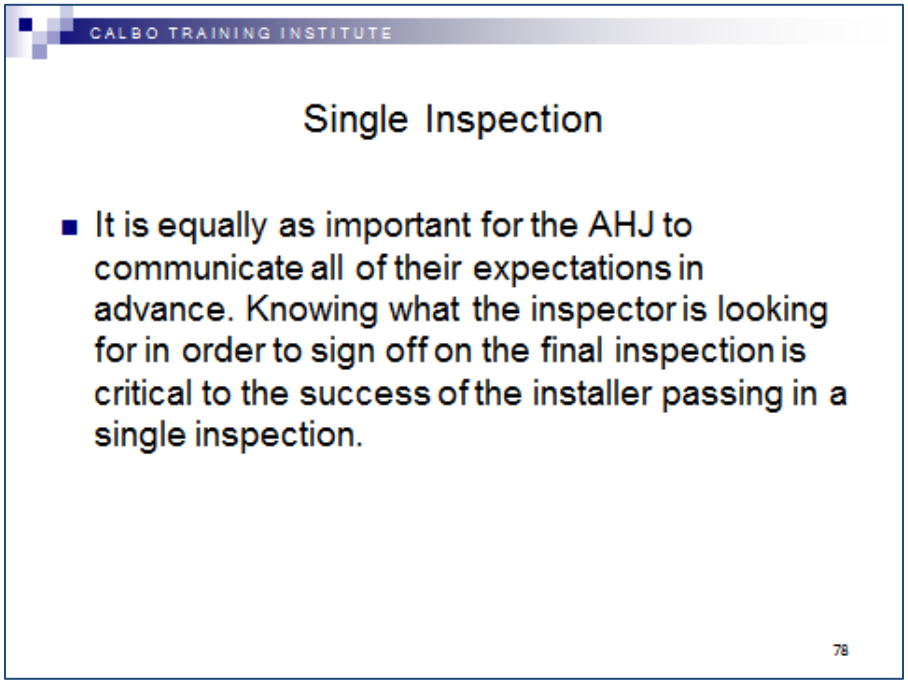
Single Inspection

The best single inspection process:

- There is no best process, each AHJ needs to determine what works best for them, based on varying conditions and circumstances.

76


CALBO TRAINING INSTITUTE
Single Inspection
The most important factors are attitude, communication, and preparation. It is in everyone's best interest for the AHJ to be able to perform only a single inspection on these systems. And having the attitude that it is more economically effective to perform only a single, final inspection is a key factor.
77


CALBO TRAINING INSTITUTE
Single Inspection
It is equally as important for the AHJ to communicate all of their expectations in advance. Knowing what the inspector is looking for in order to sign off on the final inspection is critical to the success of the installer passing in a single inspection.
78

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Single Inspection

- The installers should be prepared for the inspection, a properly trained individual at the site at time of inspection with the necessary tools and qualifications to be able to access equipment and answer any questions the inspector may have will greatly increase the chances of a successful first inspection.

79

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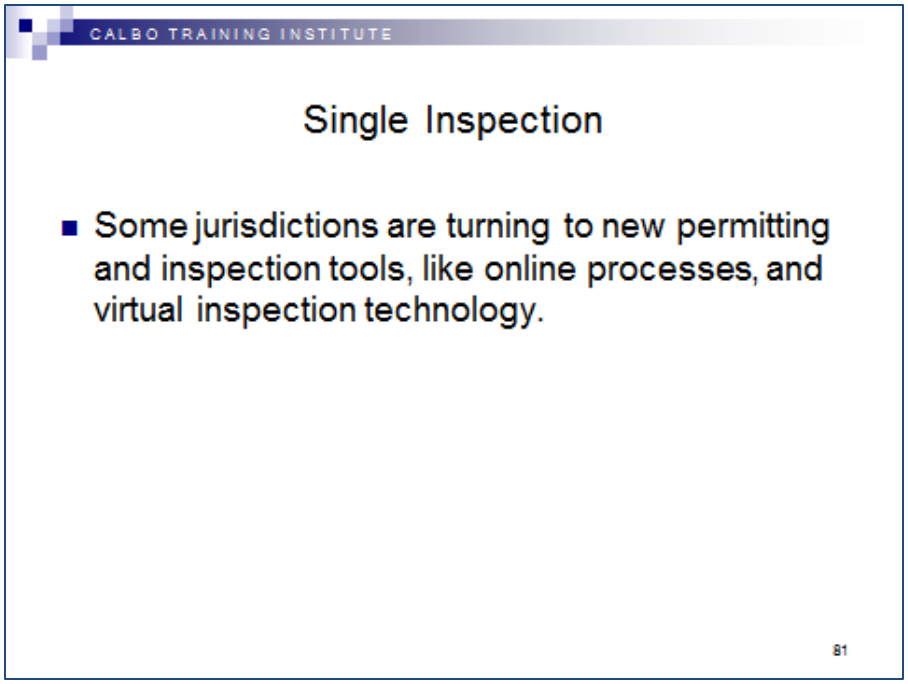
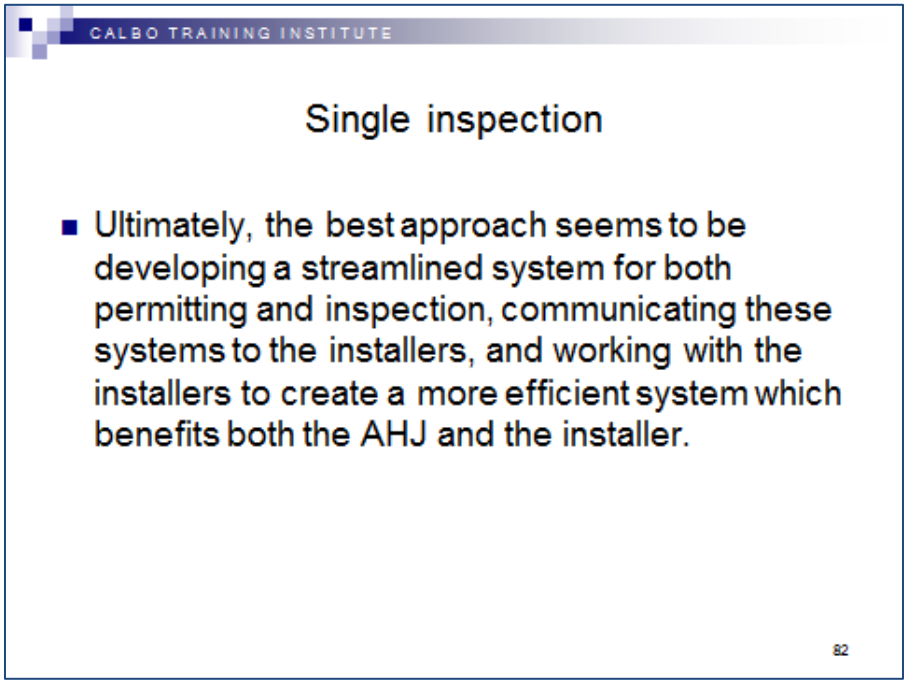
Single Inspection

- Considering the added workload created by new technology, and new and recently adopted codes, such as the Energy Code, WUI, Green Building etc. the inspection staff is having to develop new ways to be efficient.

80


CALBO TRAINING INSTITUTE
Single Inspection
Some jurisdictions are turning to new permitting and inspection tools, like online processes, and virtual inspection technology.
81


CALBO TRAINING INSTITUTE
Single inspection
Ultimately, the best approach seems to be developing a streamlined system for both permitting and inspection, communicating these systems to the installers, and working with the installers to create a more efficient system which benefits both the AHJ and the installer.
82

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Single Inspection

- If an inspection reveals only few, or minor corrections, it is far better to allow the person standing inspection five or ten minutes to make the corrections versus - having to write a correction notice and scheduling a re-inspection (which adds to the following days workload, requires additional travel time, and starting the inspection over in many cases.)

83

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Single Inspection

- As new product safety standards like UL 1703 for modules, or 2703 for racking, and bonding and grounding are developed, some of the concerns of the AHJ are mitigated, like “What is this thing?” or “what if a wire comes loose” or a “What if a fire fighter needs to go on the roof”?
- Tests have been done, we know these systems are much safer than we did ten years ago.

84

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Single Inspection

- By creating checklists and processes for performing a single inspection and communicating them to the local installers, the AHJ will benefit from not needing to return for follow up inspections, which in turn, will free up the inspection staff to be able to keep up with the advancing workload.

85

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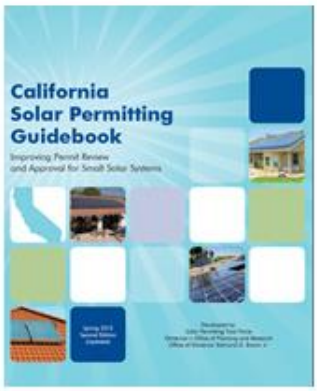
California Solar Permitting Guidebook 19 Point Inspection Checklist



86

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Toolkit Document 7
Inspection Guide for PV Systems

- Section 1 - Field Inspection Guide: Single-page reminder of the most important items in a field inspection. **"19 Point Inspection Checklist."**
- Section 2 - Comprehensive Reference: Reference document details items that may be relevant in the plan check and field inspection of rooftop PV systems. Not all items outlined are relevant to each PV system.

87

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Toolkit Document 7—
Inspection Guide for PV Systems—Field Guide

Make sure all PV system ac/dc disconnects and circuit breakers are in the open position and verify the following:

SHOULD BE "OFF" TO START THE INSPECTION

88

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1. All work done in a neat and workmanlike manner (CEC 110.12)

89

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1. All work done in a neat and workmanlike manner (CEC 110.12)

NO CONDUCTORS HANGING DOWN ATTRACTING ATTENTION OR DEBRIS

90

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1. All work done in a neat and workmanlike manner (CEC 110.12)

91

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1. All work done in a neat and workmanlike manner (CEC 110.12)

92

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2. PV module model number, quantity and location according to the approved plan

93

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2. PV module model number, quantity and location according to the approved plan

94

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2. Correct type and quantity of modules

95

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3. Array mounting system and structural connections according to the approved plan.

96

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3. Array mounting system and structural connections according to the approved plan.

97

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3. Array mounting system and structural connections according to the approved plan.

"Before" – Maximum cantilever of rack system exceeded

98

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3. Array mounting system and structural connections according to the approved plan.

"After" – Supported per installation instructions

99

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4. Roof penetrations flashed/sealed according to the approved plan.

100

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4. Roof penetrations flashed/sealed according to the approved plan.

101

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4. Roof penetrations flashed/sealed according to the approved plan.

102

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4. Roof penetrations flashed/sealed according to the approved plan.



103

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5. Array exposed cables are properly secured, supported and routed to prevent physical damage


POORLY ROUTED AND UNSECURED – "LAYING ON ROOF SURFACE AND VENT"

104

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5. Array exposed cables are properly secured, supported and routed to prevent physical damage

105

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6. Conduit correctly installed and according to CRC R331.3 and CEC 690.4(F)

106

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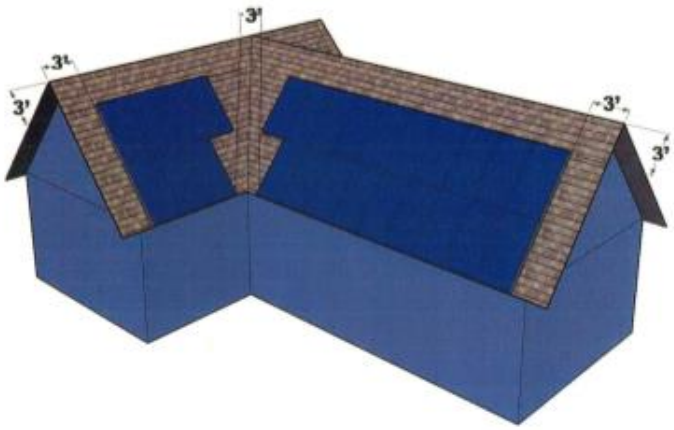
7. Firefighter access according to approved plan



107

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7. Firefighter access according to approved plan

FIRE FIGHTERS HAD PLENTY OF ROOM TO FIGHT THE FIRE AT THIS RESIDENCE

108

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7. Firefighter access according to approved plan

109

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8. Roof-mounted PV systems have the required fire classification

110

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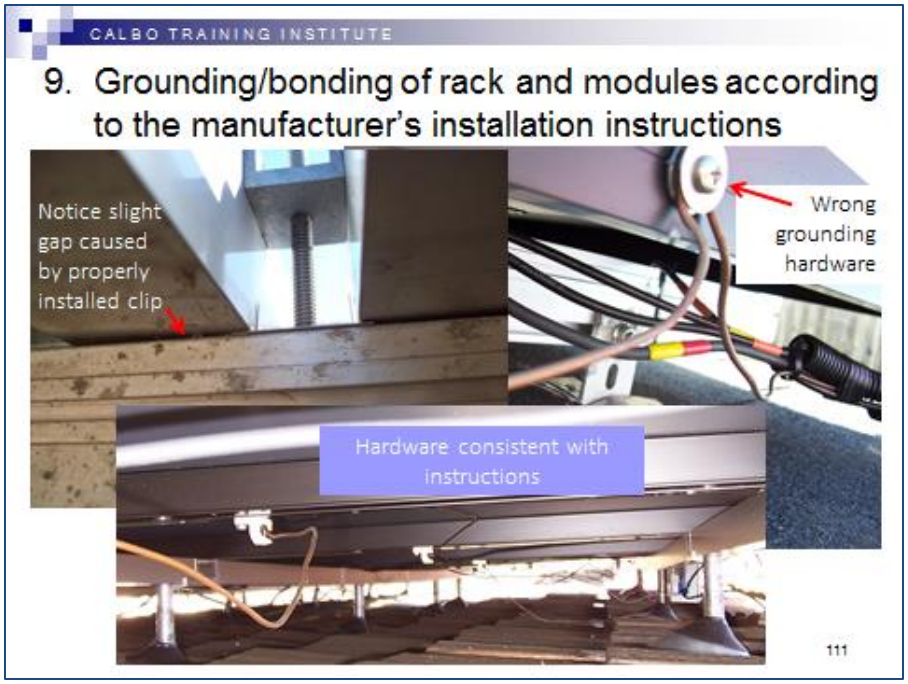
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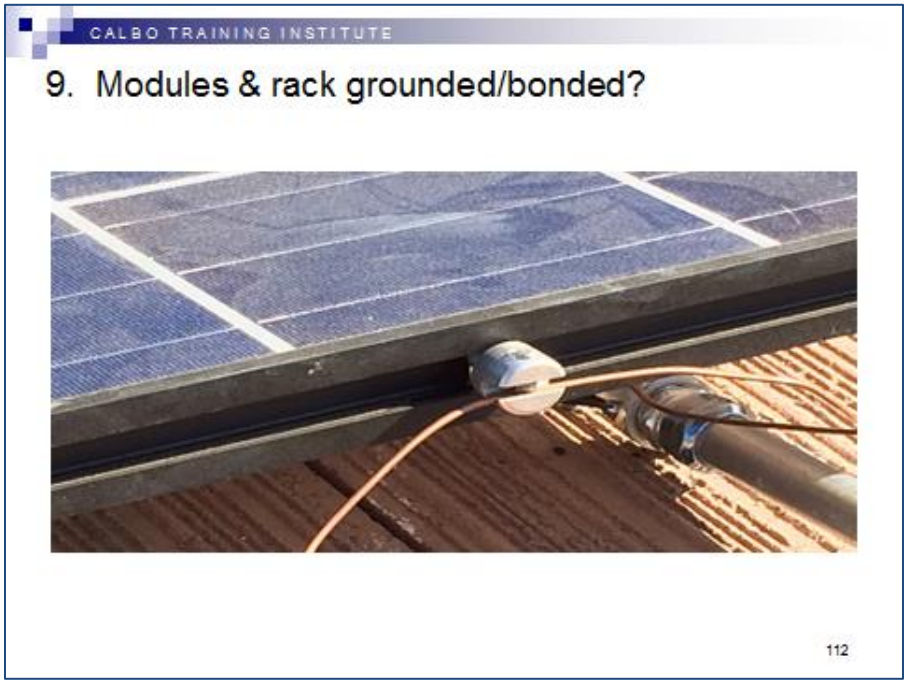
9. Grounding/bonding of rack and modules according to the manufacturer's installation instructions
Notice slight gap caused by properly installed clip
Wrong grounding hardware
Hardware consistent with instructions
111


CALBO TRAINING INSTITUTE
9. Modules & rack grounded/bonded?
112

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9. Listed system – mounting clamp bonds modules

113

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9. Equipment grounding conductor connection to rack/modules

114

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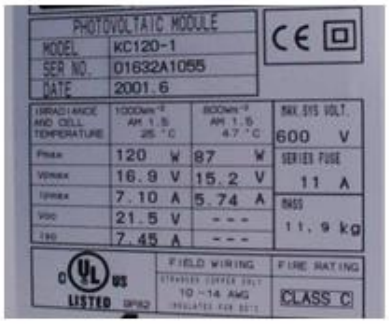
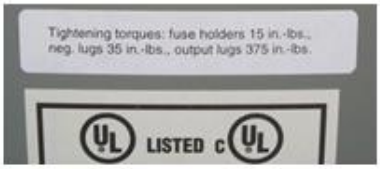
10. Equipment listed and installed according to the approved plan





115

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11. Inverter is marked "utility interactive"

116

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12.Complies with 690.35 for ungrounded inverters – type PV for exposed conductors (D)

117

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12.Complies with 690.35 for ungrounded inverters – fuses & dc color code (A) & 200.6

118

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12. Complies with 690.35 for ungrounded inverters – dc colors & disconnect (B) & 200.6

119

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12. Complies with 690.35 for ungrounded inverters – additional label (F)

120

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13. Conductors, cable and conduit types, sizes and markings according to the approved plan

SJO CORD USED ON ROOF IN SUNLIGHT-NOT ALLOWED

THWN WIRE USED OUTSIDE CONDUIT IN SUNLIGHT-NOT ALLOWED

121

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13. Conductor & conduit type & size according to approved plan…conductor color per CEC.

122

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14. Overcurrent device type and size according to the approved plan

123

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14. Main breaker/overcurrent device type and size according to the approved plan

124

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15. Disconnects according to the approved plan

125

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15. Inverter ac/dc disconnect type, rating and location according to the approved plan and CEC

126

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15. Inverter with integrated dc disconnect and circuit breaker as ac disconnect




127

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16. Load Center or service panel Inverter output circuit breaker located at opposite end of bus from the utility supply

128

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17. Labeling of conduit and junction box covers

129

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17.PV system markings, labels and signs according to the approved plan

OWNER HAD ALL THE EQUIPMENT STUCCOED— INCLUDING ALL THE SIGNS

130

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18. Connection of the PV system to the grounding electrode system according to the approved plan

131

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19. Access and working space for operation and maintenance of PV equipment

132

End of Second Part of Session

133

SEAC
Solar Energy Action Committee

www.seacgroup.org

134

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Solar Energy Action Committee (SEAC)

- Formulated to identify solutions in regards to solar industry challenges, promote transparency and consistency of solar regulations.
- Recommendations provided by focus groups/committee members
- Recommendations transcribed into "Issue Statements" to disseminate to any interested stakeholder

135

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SEAC Committee Members

Hector Bordes	Assistant Deputy Director – Building and Safety	County of Los Angeles
Paula Melton	Project Administrator	OpSite
Don Hughes	Retired Electrical Inspector - Santa Clara County	Center for Sustainable Energy
Sparky Colton	Building Official	City of Calabasas
Alan Fields	AHJ & Utility Specialist	Sungevity
Andrew Henning	Deputy State Fire Marshal III (Specialist)	CalFire - Office of the State Fire Marshal
Behzad Eghtesady	Chief Electrical Inspector	City of Los Angeles
Craig Carnl	Chief Technology Officer and Founder	IronRidge
Gilbert Aceves	Technical Specialist Scientist	SCE
Jason Rondou	Solar Programs Manager	City of Los Angeles DWP
Jeff Spies	Sr. Director of Policy	CalSEIA / QuickMount PV
Jim Cahill	Regional Vice President	SolarCity
John Taecker	Sr. Regulatory Engineer	Underwriters Laboratory
Kevin Reinertson	Deputy Fire Marshal	Riverside County Fire Department
Mark Baldassari	Director, Codes and Standards	Enphase
Mostafa Kache	Chief Electrical Inspector	County of Los Angeles
Patrick Healy	Chief EPM Inspector	County of San Diego
Pete Jackson	Chief Electrical Inspector	City of Bakersfield
Robert Vinje	Vice Pres of Utility and Commercial EPC	SunPower Corporation
Ron Mullok	Chairman of CALSEIA LA Chapter - Pres/CEO of Solartronics	Solartronics
Roy Allen	Technical Sales Support Engineer	AEG Inc.
Shai Bergerfreund	Director of Operations Velocity, Operations	Verengo Solar
Steve Jones	Assistant Building Official	City of Oceanside
Stuart Tom	Fire Marshal	City of Glendale Fire Department
Sunny Rai	Vice President, Global Business Line Leader	Intertek, ETL
Tiffany Maycumber	Technical Advisor	San Diego Gas & Electric

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SEAC Issue Statement No.1

- What should be considered sufficient to the Authority Having Jurisdiction (AHJ) in order to comply with the single inspection requirements of AB 2188?

137

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Background

- All California jurisdictions are mandated by the State to adopt an expedited PV permitting process in accordance with Assembly Bill 2188. The Solar Energy Action Committee (SEAC) has identified practical methods of compliance with the AB 2188 requirements in an effort to assist local building officials.

138

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AB2188

- Section 65850.5 of the Government Code is amended to read:
- 65850.5. (h) For a small residential rooftop solar energy system eligible for expedited review, only one inspection shall be required, which shall be done in a timely manner and may include a consolidated inspection, except that a separate fire safety inspection may be performed in a city, county, or city and county that does not have an agreement with a local fire authority to conduct a fire safety inspection on behalf of the fire authority. If a small residential rooftop solar energy system fails inspection, a subsequent inspection is authorized, however the subsequent inspection need not conform to the requirements of this subdivision.

139

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Current Status

- SEAC has identified successful single inspection procedures currently in use by several jurisdictions. In addition, SEAC is providing innovative recommendations that can be used to develop AB 2188 compliant single inspection procedures.

140

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Key considerations

- The objective of this briefing is to facilitate system approval in one inspection. Many of the solutions simply require a greater education, relationship, and communication of expectations between the AHJ and the installer.

141

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Recommendations

- 1) The installer should ensure that a qualified individual who is familiar with the applicable codes and installation procedures be onsite at time of inspection to provide access to the system and all components and to answer any questions from the inspector.

142

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Recommendations

- 2) Access to the roof should be provided in accordance with the latest CAL/OSHA guidelines.

143

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Recommendations

- 3) Approved construction documents and installation instructions shall be available onsite at time of inspection for major system components, including: Inverters, Modules, Power Optimizers, and Racking and Mounting systems.

144

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Recommendations

- 4) Affidavits,

signed by the installer and homeowner, may be considered by the AHJ as verification of installation of the smoke and carbon monoxide alarms required by the California Residential Code.

145

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Recommendations

- 5) Ongoing training by qualified organizations regarding the one inspection process and installation procedures should be encouraged on a regional basis.

146

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Recommendations

- 6) The AHJ may adopt specific details on photographic documentation that is required at time of inspection, as an aid of the inspection process and as a tool to be used in lieu of removal of specific components.

147

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Recommendations

- SEAC recommends that the AHJ accept photographic documentation for inspection of items not readily accessible to the inspector at the time of inspection.

148

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Photo Documentation Guidance

- Photo guidelines:
  - Photographs shall be of sufficient clarity to clearly demonstrate the elements being inspected, and shall include evidence that the photograph is connected to the property of the inspection site.

149

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Photo guidelines - Components to be photographed

- 1) PV module label.

If more than one module type is used on a project, there must be a photo for each different module, including the micro-inverter if used.

150

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Photo guidelines - Components to be photographed

- 2) Method of flashings at attachments and penetrations, including the sub flashing beneath tiles.



151

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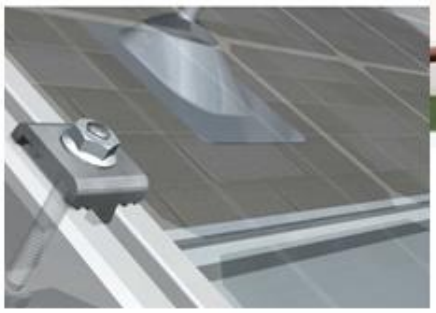
Photo guidelines - Components to be photographed

- 3) Method of grounding and bonding PV modules and racking systems.




152

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Photo guidelines - Components to be photographed

- 4) Wire management under PV modules.

153

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Photo guidelines - Components to be photographed

- 5) Conduit penetrations of the roof and inaccessible portions of the structure.

154

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Photo guidelines - Components to be photographed

- 6) Proof of height of conduit above the roofing material to verify temperature de-rate calculations.

155

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Photo guidelines - Components to be photographed

- 7) Attic-run conduit and fastening methods.

156

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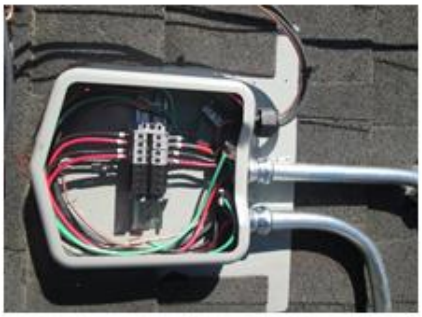
Photo guidelines - Components to be photographed

- 8) All junction and/or combiner boxes with the cover removed.



157

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Photo guidelines - Components to be photographed

- 9) Any required labels or markings not readily accessible at time of inspection.

158

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SEAC Issue Statement 1 – Applicable to whom?

- AHJs, Contractors, Homeowners and Fire Departments

159

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End of Presentation

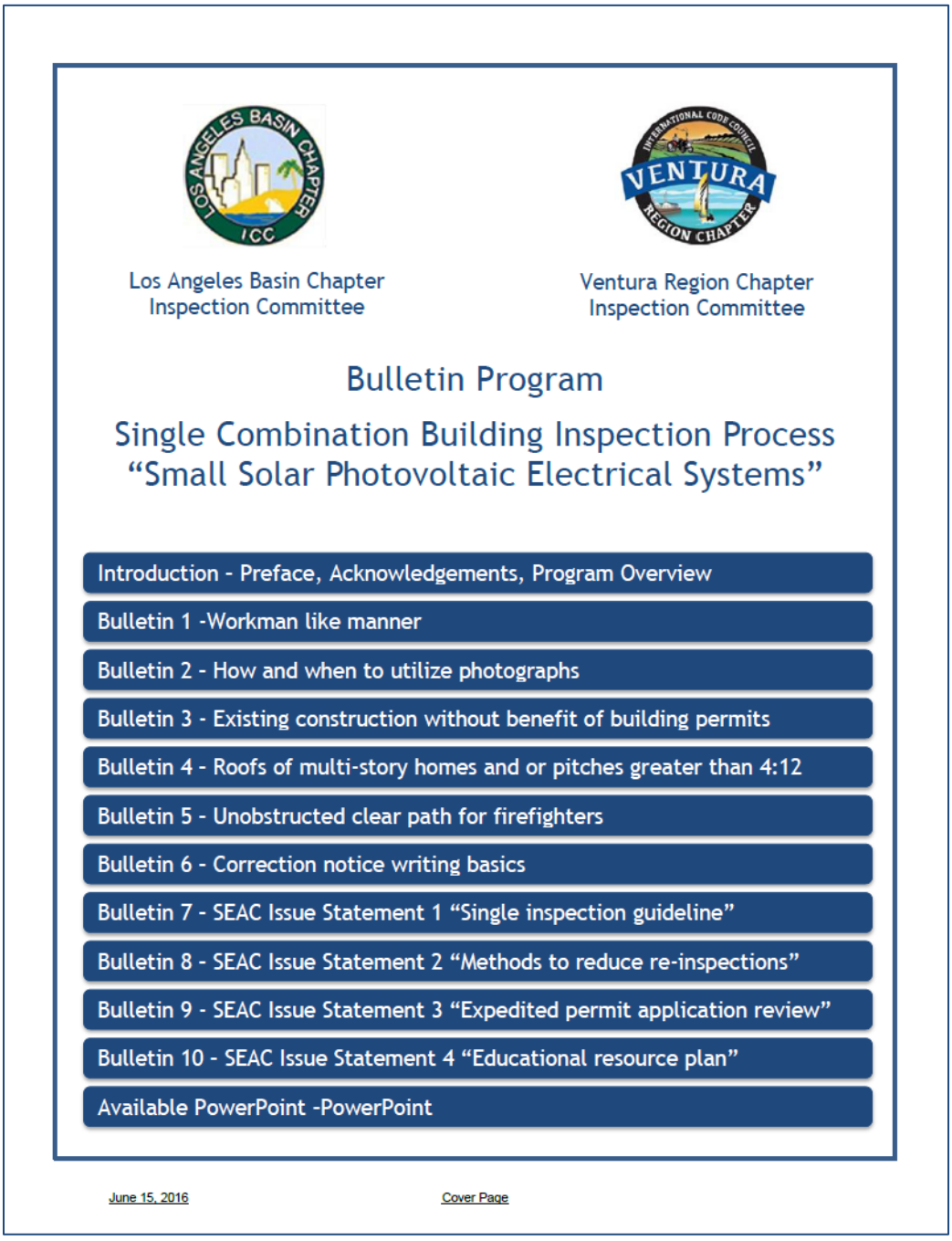
THANK YOU FOR ATTENDING!

160

Power Point Endnotes

(Slide 2) This presentation and the implementation of AB2188 in Ventura County and Los Angeles County would not be a success without the generous support of Don Hughes, Bill Brooks, Mustafa Kashe, John Wiles, Stuart Tom, Pete Jackson, Steven Jones, Pat Healy, Jason Reithoffer, Dan Chavin, and Steve Berry.

(Slide 6) ICC Ventura Region Chapter and ICC Los Angeles Basin Chapter
Joint Inspection Committee
Single Combination Inspection Process - "Small PV Bulletin Program."



Preface

Solar photovoltaic electrical technology and legislative laws are transcending current building codes. In January of 2015 in response to California Assembly Bill 2188, the Board of Directors of the Los Angeles Basin Chapter and the Ventura Region Chapter of ICC directed their respective Inspection Committees ("Joint Inspection Committee") to analyze the inspection challenges known to be looming. In response to the direction the Committee created the "Small Solar System One-Inspection Process Bulletin Program." The program is a series of documents related to proven successful practices and useful information regarding the single inspection process of small solar photovoltaic electrical systems.

The Joint Inspection Committee recommends that the Board of Directors recognize the program and make the document/s available on the Chapters websites. Building Departments within the Los Angeles Basin and Ventura Region should also be encouraged to support the program and post the documents on their websites as well.

Acknowledgements

Each and every joint inspection committee member should be commended for their review of the draft and final documents. In addition, the tremendous efforts and contributions of the Solar Energy Action Committee (SEAC), which was formulated by the County of Los Angeles Department of Public Works Building and Safety Division, should be commended. The Chairman of the Joint Inspection Committee is an active member of SEAC and this bulletin program gleans much of their positive work. To date, four "issue statements" created by SEAC are supported by the Joint Inspection Committee and are part of this bulletin program. The Joint Inspection Committee also shares SEAC's message which is as follows:

> "The State of California has an aggressive solar energy growth plan. With these goals in mind, a diverse group of professionals has been gathered to form the Solar Energy Action Committee ("SEAC"). SEACs mission is to assist the solar industry by outlining available solutions to provide a transparent roadmap for achieving a code compliant and efficient solar installation."

Acknowledgements Continued

Joint Inspection Committee:

Sparky Cohen	Building Official – Committee Chairman	City of Calabasas
Steve Berry	Supervising Building Inspector	City of Simi Valley
Steve Stoltze	Building Inspection Supervisor	City of Thousand Oaks
Matt Wyatt	Supervising Building Inspector	County of Ventura
Sandi McCracken	Senior Manager-Metal Building and Fabrication Accreditation Programs	International Accreditation Service
Michael Pauly	Lead Combination Building Inspector	City of Santa Monica
Miguel Garcia	Supervising Building and Safety Engineering Specialist	County of Los Angeles
Dan Freleaux	District Building and Safety Engineering Associate	County of Los Angeles
Jesse DeAnda	E-Government Manager	City of Beverly Hills
Tim Griffith	Senior Building Inspector	City of Los Angeles
Ayla Jefferson	Building Official	City of Alhambra /Transtech Engineers
Scott Klepetar	Branch Operations Manager	North Hollywood Sunrun Inc.

SEAC:

Don Hughes	Retired Electrical Inspector - Santa Clara County	Center For Sustainable Energy
Hector Bordas	Assistant Deputy Director – Building and Safety	County of Los Angeles
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Stuart Tom	Fire Marshal	City of Glendale Fire Department
Sunny Rai	Vice President, Global Business Line Leader	Intertek, ETL
Tiffany Maycumber	Technical Advisor	San Diego Gas & Electric

Program Overview

The "Small Solar System - One Inspection Process - Bulletin Program" is a series of bulletins that describe proven recommended practices and useful information[1] in response to "Assembly Bill 2188" - California Government Code Section 65850.5 (h). The program is limited to expedited permitting for small solar photovoltaic "PV" electrical energy systems. The program is intended to benefit any stakeholder of the electrical solar photovoltaic industry.

What is considered a small solar photovoltaic electrical energy system (small PV system)? It's a system with an alternate current nameplate rating of 10 kilowatts or less and the solar panels are on the roof of a single or duplex family home. The passage of Government Code Section 65850.5 (h) which is the genesis of this program is as follows:

> "For a small residential rooftop solar energy system eligible for expedited review, **only one inspection shall be required**, which shall be done in a timely manner and may include a consolidated inspection, except that a separate fire safety inspection may be performed in a city, county, or city and county that does not have an agreement with a local fire authority to conduct a fire safety inspection on behalf of the fire authority. If a small residential rooftop solar energy system fails inspection, a subsequent inspection is authorized, however the subsequent inspection need not conform to the requirements of this subdivision."

For the "Single Combination Inspection" of a small PV system, if the inspector has a recognized standard plan, the California Solar Guidebook tool Kit No. 7 (19 point inspection checklist and comprehensive inspection reference), and most importantly, an understanding of the intent of the new law and the primary California Building Codes, the Joint Inspection Committee believes that to be the best strategy for the successful and efficient performance of the single inspection. These bulletins can be used in a variety of ways to build an inspectors confidence level related to the aforementioned. These bulletins can also stand alone as separate useful informational documents; however, the advantages of the program as a whole are most useful after attending a related training session.

[1] New bulletins may be added and existing bulletins may be updated from time to time. New or revised bulletins will be reflected with the word "revised" and new date in the footer of the impacted bulletin.

ICC Los Angeles Basin Chapter and Ventura Region Chapter
Joint Inspection Committee
"Small Solar System One-Inspection Process Bulletin Program"

Bulletin 1 – Intent of requirement for work to be installed in a workman like manner.

"Good or poor workmanship should set the tone of the inspection."

"Good workmanship should result in an inspection
that is shorter in time than that of an inspection with poor workmanship."

Good workmanship, good access, and good photographs, should result in an inspection
with a very short duration of time." (See Bulleting 2 regarding the effective use of photographs.)

Building inspectors are not agents for quality control, nor do they enforce requirements of the California State Constructors License Board. However, a project with an obvious lack of workmanship will frequently lead to close scrutiny/attention to detail of the project from the building inspector. A building inspector should avoid citing California Electrical Code Article 110.12 and the lack of workmanship or Article 690-3 (E)[1] as a "code violation." The specific sub article of the code pertaining to the specific non-compliant part of the proposed installation should be cited. In example, should a contractor utilize a length of Electrical Metallic Tubing that has not been bent with approved bending equipment, the inspector should cite Article 358.24 which states:

> "Bends – how made. Bends shall be made so that the tubing is not damaged and the internal diameter of the tubing is not effectively reduced. The radius of the curve of any field bend to the centerline of the tubing shall not be less than shown in Table 2, Chapter 9 for oneshot and full shoe benders."

Poor workmanship

Poor workmanship

Workmanlike manner

[1] Article 1100 and the definition of qualified person also has a Informational Note that references NFPA 70E-2009. The reference document is an OSHA recognized electrical worker safety document that general involves higher voltage/high ampacity 3 phase systems. It would not be appropriate to apply the training to small PV systems.

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"Small Solar System One-Inspection Process Bulletin Program"

Bulletin 2 – How and when to utilize photographs – work concealed without observations or otherwise difficult to view.

A very good alternative to confirm criteria within difficult to access areas or areas that are obscured for close viewing, is to utilize photographs. Photographs should be used as an inspection aid – they should not be used to substitute for an on-site inspection.

Many proactive contractors are photo documenting all aspects of their installations for their own quality control and protection against customer claims at a later date. These photographs, and or on the spot photographs requested to be taken by the building inspector, can prove a valuable time saver for both the building inspector and the contractor.

The law is clear - only one-single inspection shall be provided. An AHJ should not encourage the contractor to provide a "rough inspection" under any circumstance. A building inspector should not conveniently "drop in" on a project site while the contractor is in the process of installing a small PV system. The aforementioned introduces a potential allegation of misfeasance or malfeasance and allegations are tremendously uncomfortable.

> Malfeasance - the performance of an act that is legally unjustified, harmful, or contrary to law
> Misfeasance - the wrongful performance of a normally lawful act
> Nonfeasance - the omission of some act that ought to have been performed

Invasive or destructive methods requested by the inspector (such as removing PV panels or roofing tiles) are a disservice. Moreover, the California Building Codes do not mandate a building inspector confirm the installations to the extent of such detail. In example, requesting roofing tile and or a PV panel to be removed to confirm quality control of a roof penetration is not required by either by the California Electrical Code or the California Residential Code. More specifically:

"CRC Section 905.3.3 –Underlayment Inspection **Is Not** Required."

"CRC Section 905.3.8 –Roof Flashing Inspection **Is Not** Required."

Again, a very good alternative to confirm criteria within difficult to access areas, or areas that are obscured for close viewing, or areas concealed by construction is to utilize photographs. See Bulletin 7 section 6 for reasonable photo guidelines and Bulletin 4 regarding access to roofs.

Bulletin 3 – Installations on existing construction without benefit of building permits.

Is the existing structure lawful? Did the building inspector just inadvertently approve a room addition?

This bulletin assumes that in most cases the permit for the small PV system was issued on-line and did not have the benefit of a historic permit review process from a permit technician or a plans examiner. The building inspector in these cases, is the last and only line of defense as keeper of accurate permanent records. Reviewing existing permit records before the inspection is valuable - inadvertently approving existing work leads to substantial aggravation for AHJ's down the road.

A term that should be considered is an "Estopple - Detrimental Reliance on a Document or Action."

What is Estopple?

The complaining party is asking the AHJ to "Stop" an action.

What is Detrimental Reliance on a Document or Action?

Reliance on Document –
The recipient of an AHJ enforcement action is claiming that since they relied on the building department record/s as being accurate, it was assumed everything was legal and they purchased the property.

Reliance on actions –
An AHJ's permit/s allowed them to construct a project of a certain size or in a certain location. An AHJ representative at a later point in time states the square feet size of the structure is excessive and or is in a location that is not permissive. The property owner may use "reliance on actions" as their defensive allegation.

These arguments get dramatically stronger each time the property is sold.

Hypothetically assume the following:

The AHJ building permit records reflect that a single family dwelling is 1200 square feet in size with a 250 square feet detached garage are constructed in the year 1970. There are directly related Plumbing, Mechanical and Electrical permits issued in 1970 as well. Between the year 1970 and 2016 there are no other building permits issued that justify other physical improvements to the dwelling.

In 2016, a small PV permit is issued on-line and the application states the dwelling is 2500 square feet in size, with 500 square feet in size attached garage. There is also a 200 square feet solid roofed attached carport on the side yard depicted. The site plan proposes that PV panels are to be installed on both the attached garage roof and a portion of the dwelling that has been expanded. Conduit from the PV system is also fastened to the top of the carport.

The building inspector provides inspection approval of the small PV system, no corrective measures are requested during the single final inspection. Did the inspector just inadvertently approve the expansion of the dwelling? The attached garage? How about the carport?

Example 1 - compounded. The building inspector has not reviewed the existing permit records and does not notice that the home is significantly different than the original building permits. The inspector has entered the attached garage and is trying to verify an existing water bond connection on a water heater installed in that garage. The inspector does not see a water bond connection and the contractor does not know the location of an existing connection – if there is one somewhere else. The contractor inquires if it would be acceptable to simply install a new solid number 8 copper conductor from the service panel to the cold water piping at the water heater. The inspector agrees and leaves a correction notice to "install a water bond at the cold water piping of the water heater or verify the connection of an existing water bond at a different location." No other written or verbal direction is cited by the inspector, the contractor installs the new water bond to the water heater and the project receives a final inspection.

Example 1 – potential issue: At some point in time in the future, the home is sold. The property is subject of code enforcement actions and the AHJ demands the property owner secure building permits for the new attached garage. The new owner claims they relied on the building department records to be accurate and assumed the garage was lawful. The Estopple – detrimental reliance on actions and documents are both compelling and problematic for the AHJ. (The argument is substantially more problematic if the new homeowner has a copy of the correction notice that only addresses the water bond to the water heater in the garage and does not address the structure itself.)

Example 2 – The carport extends to within one foot of the side yard property line. The inspector is certain that the carport is not benefit of building permits and inspection approvals and leaves corrective measure direction in writing to either secure permits and or remove the carport. The Contractor and property owner choose to demolish the carport and in turn the PV system permit receives a final inspection one week later. At some point in time in the future, the home is sold. The property is subject of code enforcement actions and the AHJ demands the property owner secure building permits for the homes expansion and the attached garage. The Estopple – detrimental reliance on actions and documents are both compelling and problematic for the AHJ as it is claimed the AHJ did a code compliance inspection for the property during the first and final re-inspection of the PV system via the order to demolish the carport.

Affidavits or AHJ waiver statements/clause notes made part of an issued PV permit may be helpful during other code enforcement actions if the same person owns the property [emphasis added – may – the scenarios above can still cause aggravation for the AHJ]. However, Affidavits or AHJ waiver statements/clause notes made part of an issued PV permit do not lessen the arguments as stated above once a property is sold.

An inspectors review of the existing permit records is the first and foremost best line of defense for the AHJ. Moreover, if an inspector is going to cite existing conditions as code violations, they need to be diligent and not inadvertently approve other major non conformities on the property.

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Joint Inspection Committee
"Small Solar System One-Inspection Process Bulletin Program"

Bulletin 4 – Systems installed on roofs of: multi-story homes, tile of concrete shingles, and or of pitches greater than 4:12.

Building inspectors accessing roofs with tile, or concrete shingles, and or of pitches greater than 4:12, are highly discouraged. When damaging the finished surfaces of a roof is not of a concern, I.E. for roofs with asphalt shingles or rolled asphalt roofing, providing access to any roof is the contractors responsibility.

If an inspector proposes to access a roof via ladder, the inspector should make sure it is California Department of Industrial Relations - General Industry Safety Orders compliant (commonly referred to as "OSHA compliant"). Moreover, the inspector needs to be aware when fall protection is required due to the height and or steepness of the pitch of the roof.

Although it's the contractor's obligation to provide the safe access, it's the inspector's responsibility to understand what safe access is – it's the AHJ's responsibility to have safety training.

Avoid all potential issues – all the more reason for the inspector to stay on the ground and use photos (See bulletins 2 and 7.)

Inspection access to the roofs of the structures depicted below is highly discouraged.

See: California Department of Industrial Relations - General Industry Safety Orders:

https://www.dir.ca.gov/title8/3276.html

ICC Los Angeles Basin Chapter and Ventura Region Chapter
Joint Inspection Committee
"Small Solar System One-Inspection Process Bulletin Program"

Bulletin 5 – An unobstructed clear path on roof for firefighters.

The most common disaster that strikes a single family dwelling is fire. However, more fire fighters are injured due to the "in process action" of trying to extinguish a home on fire that "happens" to have a PV system on its roof, than are injured due to the PV system igniting a home on fire. The paramount goal of a building inspector should be to confirm code compliance with fire code related requirements, most important of all the fire code related requirements – a clear path around PV panels for fire fighter access.

PV panels can significantly impede roof ventilation efforts of firefighters despite a code compliant clear path, lessoning this path width only compounds those issues. A clear path for firefighters will also help maintain a safe emergency recuse path to bedroom windows.

In general a 3 feet clear path is required between panels and the edges/ridges of the roof surface.

Bulletin 6 – Correction notice writing basics.

Clearly describe "observations."

Clearly describe corrective actions necessary.

Cite accurate applicable Code Section.

Example 1 - "Methods of Construction"

"All conduit shall be fastened"

Does not equal

"EMT conduit on roof adjacent photovoltaic array on south facing roof is not fastened within 3 feet of each termination point and horizontal runs are not supported and fastened every 10 feet." Please see CEC Article 358.50 for further information.

Example 2 - "Inaccurate Construction Plans"

"PV system installation does not match construction plans"

Does not equal

"The expedited permit was issued based upon standard plan information that is not accurate in comparison to the proposed as built installation. Please reconcile via plan check the wiring methods, make, model and rating of the inverter, as well as the number of modules and their location on the roof of the structure. (Plans depict a 5000W SolarEdge SEP4000A-US inverter with integrated disconnect and 2 strings of 9 modules not a 7000W Sunpower inverter with 3 strings of 12 modules.)"

Example 3 - "Unlawful Existing Structure"

"Room addition does not have permit"

Does not equal

"A cursory review of permit records reveals the "flat roof" room addition approximately 20 feet x 10 feet in size and located at the North-East part of the dwelling, appears to have been constructed without the benefit of building permits and inspection approvals. Approval for the installation of the small PV system will require reconciliation of the permit records or retroactive permits for the work not benefit of permits."

RECOMMENDED PRACTICES

Series 1 – AB 2188 Requirements
Issue 1 – Single Inspection Guidelines for Small Residential Rooftop Solar Energy Systems

1. ***Issue Statement:***

   What should be considered sufficient to the Authority Having Jurisdiction (AHJ) in order to comply with the single inspection requirements of AB 2188?

2. **Background:**

   All California jurisdictions are mandated by the State to adopt an expedited PV permitting process in accordance with Assembly Bill 2188. The Solar Energy Action Committee (SEAC) has identified practical methods of compliance with the AB 2188 requirements in an effort to assist local building officials.

3. **Current Status:**

   SEAC has identified successful single inspection procedures currently in use by several jurisdictions. In addition, SEAC is providing innovative recommendations that can be used to develop AB 2188 compliant single inspection procedures.

4. **Key considerations:**

   The objective of these recommendations is to facilitate system approval in one inspection. Many of the solutions simply require a greater education, relationship, and communication of expectations between the AHJ and the installer.

5. **Recommendation(s):**

   1) The installer should ensure that a qualified individual who is familiar with the applicable codes and installation procedures be onsite at time of inspection to provide access to the system and all components and to answer any questions from the inspector.

   2) Access to the roof should be provided in accordance with the latest CAL/OSHA guidelines.

   3) Approved construction documents and installation instructions shall be available onsite at time of inspection for major system components, including: Inverters, Modules, Power Optimizers, and Racking and Mounting systems.

4) Affidavits, signed by the installer and homeowner, may be considered by the AHJ as verification of installation of the smoke and carbon monoxide alarms required by the California Residential Code.

5) Ongoing training by qualified organizations regarding the one inspection process and installation procedures should be encouraged on a regional basis.

6) The AHJ may adopt specific details on photographic documentation that is required at time of inspection as an aid of the inspection process and as a tool to be used in lieu of removal of specific components.

SEAC recommendations include the following photo guidelines that may be used for inspection of items not readily accessible to the inspector and should include, but not necessarily be limited to:

Photographs shall be of sufficient clarity to clearly demonstrate the elements being inspected, and shall include evidence that the photograph is connected to the property of the inspection site.

Include photo(s) of:

1) PV module label. If more than one module type is used on a project, there must be a photo for each different module, including the micro-inverter.

2) Method of flashings at attachments and penetrations, including the sub flashing beneath tiles.

3) Method of grounding and bonding PV modules and racking systems.

4) Wire management under PV modules.

5) Conduit penetrations of the roof and inaccessible portions of the structure.

6) Proof of height of conduit above the roofing material to verify temperature de-rate calculations.

7) Attic-run conduit and fastening methods.

8) All junction and/or combiner boxes with the cover removed.

9) Any required labels or markings not readily accessible at time of inspection.

6. Applicable to whom:

The recommendations would apply to all solar energy stakeholders.

Disclaimer: The Recommended Practices of SEAC are tools and information to benefit the solar energy industry. Recommended Practices published by SEAC are non-binding and/or regulatory.

Recommended Practices Number: SEACRP1/201511-v1
Revision: 1
Revision Date: November 15, 2015
Date of Conceptual Consensus: October 29, 2015
Date of Majority Committee Consensus: November 15, 2015

For the most recent version of the document, please refer to the SEAC website at www.SEACgroup.org
SEACRP1/201511-v1

Bulletin 7 - Page 3 of 3

SEAC
Solar Energy Action Committee

RECOMMENDED PRACTICES

Series 1 – AB 2188 Requirements
Issue 2 – Methods to reduce follow-up inspections for Small Residential Rooftop Solar Energy Systems

1. ***Issue Statement:***

   What methods should be considered in order to reduce follow-up inspections for roof mounted PV systems without compromising safety or quality?

2. **Background:**

   Failed inspections are creating more work for AHJs and installers adversely affecting the wide adoption of PV installations.

   Many inspections fail due to insufficient:

   - Understanding of codes and standards
   - Preparation for the inspection
   - Quality of work
   - Training
   - Communication of expectations between inspector and installer

3. **Key considerations:**

   - Economic factors such as financial incentive deadlines, state/local rebates, proposed tax credits, and utility rate changes could create an increase in the demand for solar and the number of PV installations. In light of this, installers and inspectors are encouraged to work together to find new solutions.

   - Some of the solutions simply require the effective use of resources through a consistent and efficient streamlined process. One way to practice efficiency and avoid a follow-up inspection would be for both the inspector and installer to be prepared, and to allow for minor corrections to be made during the inspection process.

4. Recommendation(s):

The Solar Energy Action Committee (SEAC) has identified the following practical methods to assist Installers and AHJs:

A. Persons involved in the installation and inspection of PV systems must be qualified and trained in the areas of electrical theory, the applicable parts of NEC/CEC Chapters 1 through 4 and NEC/CEC Articles 690 and 705. Qualification and training should also include applicable PV related fire and building codes. Training should be done on a regular basis.

B. Installers and inspectors should be familiar with the inspection related material of the California Solar Permitting Guidebook and the manufacturer's installation instructions.

C. The installer can expedite the inspection process by having a qualified representative on site to assist with the inspection. With the agreement of the installer and inspector minor corrections may be performed at time of inspection to avoid a re-inspection.

D. The California Solar Permitting Guidebook inspection checklist is encouraged to be used so that both the inspector and installer will know what to expect. However, if an AHJ develops a different inspection checklist, this checklist should be provided when an installation permit is issued. AHJs should be encouraged to post their inspection criteria and policies on their website.

E. The installer can expedite the inspection process by providing an applicable completed quality control and code based installation checklist to the inspector.

F. Both inspectors and installers should be encouraged to regularly attend local IAEI and ICC chapter meetings for training regarding the latest code requirements and installation practices. These forums provide an opportunity for continual dialog between the inspectors and installers to help foster better communication and stay updated on new technology from the manufacturers.

G. The installer can expedite the inspection process by providing the following equipment and documents for the inspection:

   1) OSHA approved ladder capable of providing access to roof.

   2) AHJ-approved plans and permit(s).

   3) Installation instructions at least for the following electrical equipment:
      a. PV modules
      b. PV inverter
      c. Mounting/racking system

d. Grounding and bonding

4) Tools for removal / reattachment of PV modules and equipment.

5) Extra labels (notably "WARNING: PHOTOVOLTAIC POWER SOURCE").

6) Any required AHJ affidavit.

7) Documentation as described in SEAC Recommended Practices #1.

5. Applicable to whom:

The recommendations would apply to all solar energy stakeholders.

Disclaimer: The Recommended Practices of SEAC are tools and information to benefit the solar energy industry. Recommended Practices published by SEAC are non-binding and/or regulatory.

Recommended Practices Number: SEACRP2/201511-v2
Revision: 1
Revision Date: November 23, 2015
Date of Conceptual Consensus: November 19, 2015
Date of Majority Committee Consensus: November 23, 2015

SEAC
Solar Energy Action Committee

RECOMMENDED PRACTICES

Series 1 – AB 2188 Requirements
Issue 3 – Expedited PV Permitting Process Guidelines for Small Residential Rooftop Solar Energy Systems

Objective: *To facilitate submission of uniform, correct, and complete expedited PV permitting applications and reviews in a timely manner.*

1. **Issue Statement:**

   Permit requirements and processing can be plagued with misunderstandings. Permit applications which are submitted incorrectly and/or incomplete, require resubmission creating delays in approval.

2. **Background:**

   Permitting processes vary widely across jurisdictions creating confusion for permit applicants; in addition, permitting processes which are not clearly defined or are overly complex create confusion and misunderstandings resulting in additional costs for both the applicants and reviewers in the processing of permit applications. Some permit applications require resubmission due to insufficient preparation or understanding of codes and standards.

3. **Current Status:**

   As of September 30, 2015 all California jurisdictions were mandated by the State to adopt an expedited PV permitting and inspection process in accordance with Assembly Bill 2188.

4. **Key considerations:**

   The State of California continues to set far-reaching climate and energy goals. SEAC has conducted research and identified the following important mandates, acts and facts to take into consideration:

   - AB 2188 requires all California jurisdictions to adopt an ordinance to create a streamlined permitting process for residential PV systems in substantial conformance with the California Solar Permitting Guidebook.
   - The California Solar Rights Act is intended to encourage timely and cost-effective installation of solar energy systems, promote the use of solar energy systems, and to limit obstacles to their use.

- Economic factors such as financial incentive deadlines, state/local rebates, proposed tax credits, and utility rate changes could create an increase in the demand for solar and the quantity of PV permit applications.

5. Recommendation(s):

Many of the solutions simply require a greater education, relationship, and communication of expectations between the AHJ and the Installer.

The following are practices to consider assisting permit applicants and jurisdictions:

1) Use of the California Solar Permitting Guidebook (CSPG) checklists and standard plan – refer to additional resources (3). Checklist and permitting documentation details should be clear and made available on the jurisdictions website.

2) Consider the use of PV permit application software which automates the toolkits provided in the CSPG. Refer to SEAC website for currently available PV permit software.

3) In accordance with AB2188, jurisdictions shall clearly inform applicants of all the documentation required and the method of submission.

4) Training for applicants and jurisdictions in the use of the CSPG Submittal Requirements Bulletin (Toolkit Document #1) and the Eligibility Checklist (Toolkit Document #2) is provided by the CSE – details can be found at: https://energycenter.org/

5) Use of the SEAC website as an information resource for the solar industry – SEAC publishes all Recommended Practices on its website to further assist the solar industry on common issues, these Recommended Practices can be found at: www.seacgroup.org

6) Increased communication between all industry stakeholders to decrease PV permit application inconsistencies through active participation in local organization meetings such as SEAC, CALBO, IAEI, ICC, CalSEIA and CSE.

6. Benefits:

The above recommendations will aid in achieving a successful implementation and adoption of AB 2188 permitting process. The recommendations will significantly simplify the process, reduce human error, reduce inconsistencies as well as standardize the permit application process, and decrease application review time. The successful adoption of expedited permitting will help the State of California reach its clean energy and environmental goals and in turn, improve our communities.

7. Applicable to whom:

The recommendations would apply to all solar energy stakeholders.

Disclaimer: The Recommended Practices of SEAC are tools and information to benefit the solar energy industry. Recommended Practices published by SEAC are non-binding and/or regulatory.

Additional Resources:

(1) Assembly Bill 2188 Muratsuchi
http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140AB2188

(2) California Government Code, ARTICLE 2. Adoption of Regulations [65850 - 65863.13]
http://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=GOV&sectionNum=65850.5

(3) California Solar Permitting Guidebook Spring 2015
https://www.opr.ca.gov/docs/California_Solar_Permitting_Guidebook_Spring_2015.pdf

(4) California Solar Rights Act
https://lib.sandiego.edu/law/documents/centers/epic/Solar%20Rights%20Act-A%20Review%20of%20Statutes%20and%20Relevant%20Cases.pdf

(5) Senate Bill 1222 Leno
http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201120120SB1222

Recommended Practices Number: SEACRP3/201601-v1
Revision: 1
Revision Date: January 28, 2015
Date of Committee Consensus: January 28, 2016

SEAC
Solar Energy Action Committee

RECOMMENDED PRACTICES

Series 1 – AB 2188 Requirements
Issue 4 – Educational Resources for Small Residential Rooftop Solar Energy Systems

Objective: *To provide educational resources to assist in achieving a safe and code-compliant PV installation in a timely and cost- effective manner.*

1. **Issue Statement:**

   The lack of appropriate information, education and training can hamper the successful transition and deployment of solar energy systems. An inadequately trained workforce can create unnecessary obstacles and delays resulting in an increased cost to industry.

2. **Background:**

   Information, education and training on solar energy systems are abundant and can prove overwhelming. PV training can vary greatly in regard to consistency, regulations, code content and quality. A poorly skilled workforce can potentially compromise industry standards, quality and safety.

3. **Current Status:**

   The adoption of AB 2188 drives the need to provide reliable and updated information and training.

4. **Key considerations:**

   Quality educational resources are critical to the development and maintenance of a skilled and knowledgeable workforce.

   The State of California continues to set far-reaching climate and energy goals. There is a constant evolution of PV system related technologies, product standards, code and utility requirements, permitting and inspection procedures for jurisdictions. This presents a challenge for all stakeholders.

5. **Recommendation(s):**

   Many of the solutions simply require better education, relationship, and communication of expectations between all stakeholders.

The following are practices and resources to consider

1) The California Solar Permitting Guidebook (CSPG) is a current resource based on the California codes that provides regulatory, design, installation guidance for designers, installers and inspectors of residential PV systems - refer to additional resources (1).

2) Increased communication between all industry stakeholders is essential and should be encouraged through active participation in local organization meetings such as SEAC, IAEI, CALBO, CalSEIA, SEIA, CSE and ICC.

3) Use of the SEAC website as an information resource for the solar industry - SEAC publishes all Recommended Practices on its website to further assist the solar industry on common issues, these Recommended Practices can be found at: www.seacgroup.org

For future assistance SEAC plans to develop the following:

4) An online interactive resource that provides consistent information trending in the solar industry and lists available solar training with website links should be developed

5) A research group to identify information and training gaps in the industry

6) A minimum criteria guideline for all available training programs

7) An online forum for all industry stakeholders to come together to share, collaborate and communicate

6. Benefits:

The above recommendations will aid in promoting consistent information, education and training on AB 2188 statewide standards, as well as other valuable solar training programs. This will result in creating a skilled and knowledgeable workforce. Studies show an improvement in productivity and the quality of work following training, thus resulting in a more efficient and effective workforce. Training is also one way of ensuring employees feel valued; it increases staff loyalty and decreases staff turnover.

In addition, a successfully skilled workforce is a strong workforce that will help achieve safe and compliant installation of solar energy systems.

7. Applicable to whom:

The recommendations would apply to all solar energy stakeholders.

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Additional Resources:

(1) California Solar Permitting Guidebook Spring 2015
https://www.opr.ca.gov/docs/California_Solar_Permitting_Guidebook_Spring_2015.pdf

Recommended Practices Number: SEACRP4/201601-v1
Revision: 1
Revision Date: January 28, 2015
Date of Committee Consensus: January 28, 2016

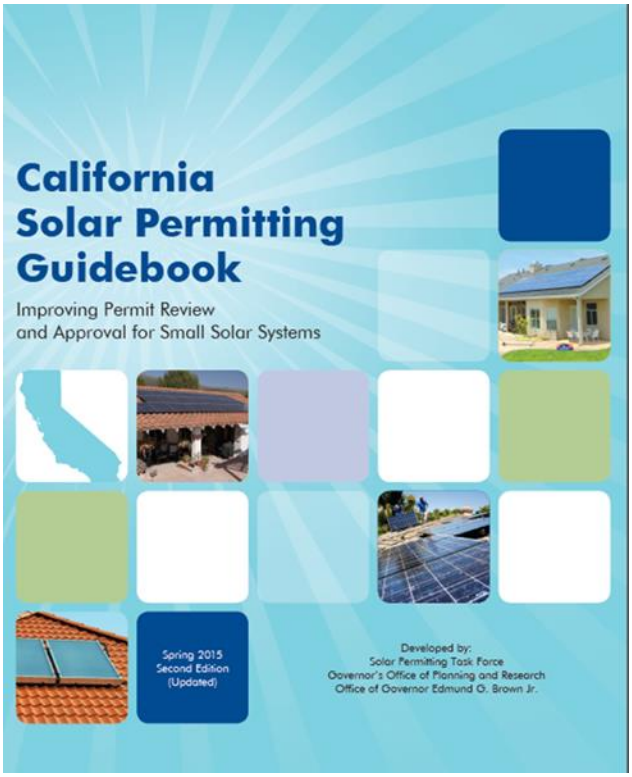
(Slide 13)
"Westlaw Next" California Code of Regulations: https://govt.westlaw.com/calregs

"Find Cal Law" California Law: http://leginfo.legislature.ca.gov

(Slide 16) The County Building and Safety Division was originally established as a department in March 1933 by the Los Angeles County Board of Supervisors. This action was taken in the wake of the Long Beach earthquake, which brought to focus the importance of maintaining and enforcing effective building laws.

(Slide 22) California Solar Permitting Guidebook
As of January 21, 2016, the most recent version of the California Solar Permitting Guidebook can be found online at:

https://www.opr.ca.gov/docs/California_Solar_Permitting_Guidebook_Spring_2015.pdf



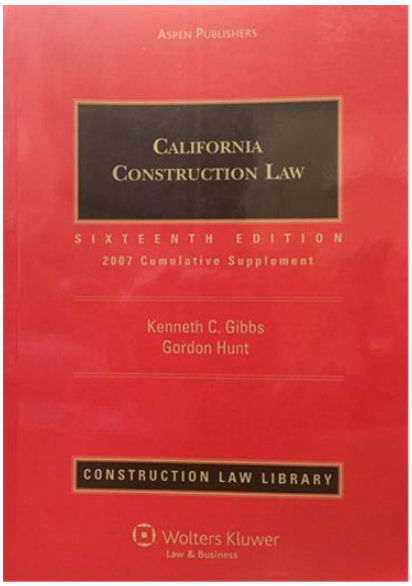
(Slide 22)

Critical Path or Critical Path Method (CPM)
Term used in California Construction law that denotes milestone markers/scheduling of the construction process. CPM is not a "Bar Chart" or "Gant Chart." CPM prevails in court. Just one of many recognized books on the subject has been produced by Kenneth C. Gibbs, Esq:

http://www.jamsadr.com/gibbs/

Mr. Gibbs body of work on the subject can be found online at:

http://www.wklawbusiness.com/store/products/california-construction-law-seventeenth-prod-0735592578/hardcover-item-1-0735592578

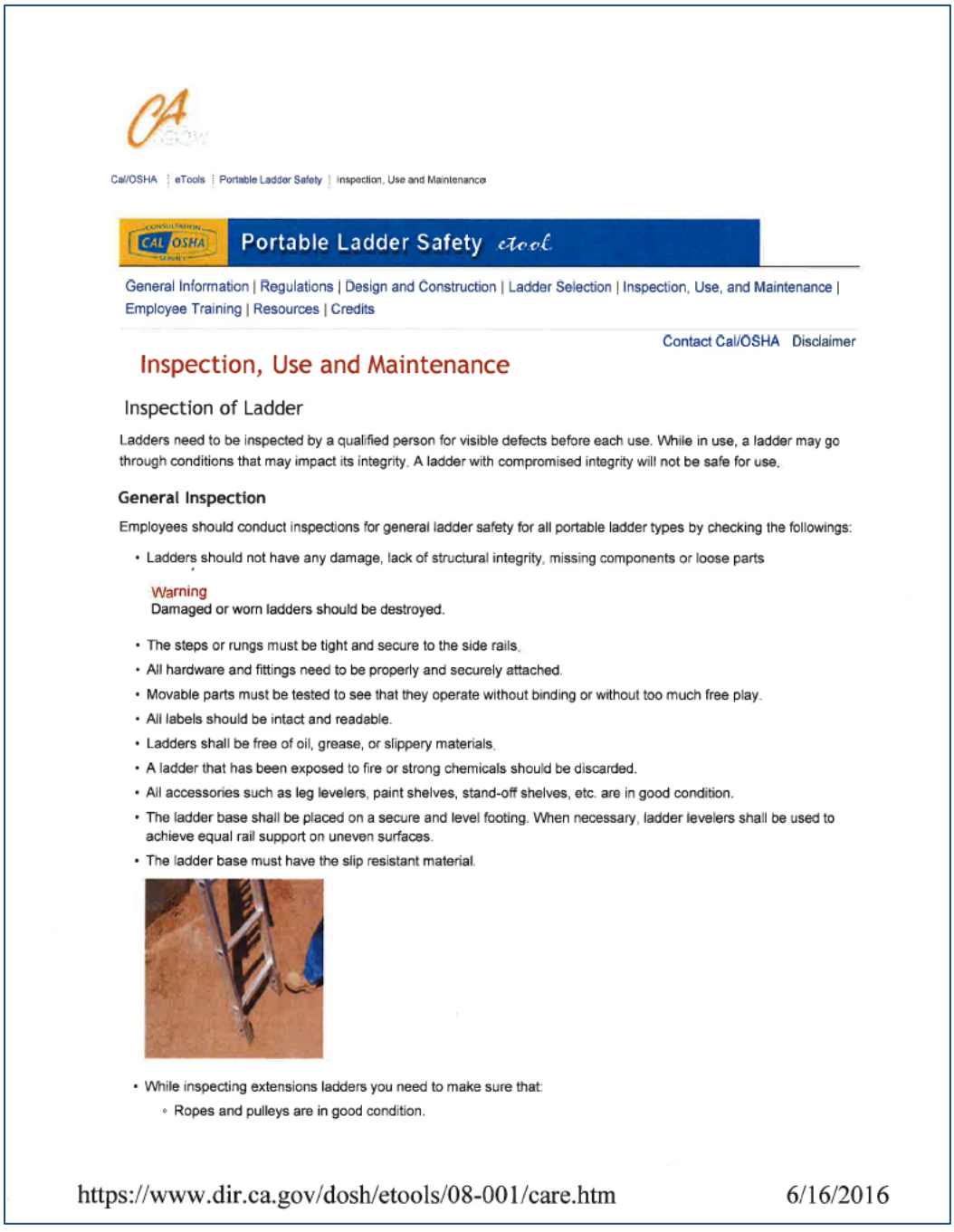


(Slide 29 and 30) Access to work – OSHA

"When in doubt - stop - ask questions"

CAL/OSHA – The most convenient and user friendly information regarding CAL/OSHA requirements as they pertain to the construction industry and ladder use may be found at the following web site:

https://www.dir.ca.gov/dosh/etools/08-001/care.htm



Cal/OSHA | eTools | Portable Ladder Safety | Inspection, Use and Maintenance

Portable Ladder Safety etool

General Information | Regulations | Design and Construction | Ladder Selection | Inspection, Use, and Maintenance | Employee Training | Resources | Credits

Contact Cal/OSHA Disclaimer

Inspection, Use and Maintenance

Inspection of Ladder

Ladders need to be inspected by a qualified person for visible defects before each use. While in use, a ladder may go through conditions that may impact its integrity. A ladder with compromised integrity will not be safe for use.

General Inspection

Employees should conduct inspections for general ladder safety for all portable ladder types by checking the followings:

- Ladders should not have any damage, lack of structural integrity, missing components or loose parts

  Warning
  Damaged or worn ladders should be destroyed.

- The steps or rungs must be tight and secure to the side rails.
- All hardware and fittings need to be properly and securely attached.
- Movable parts must be tested to see that they operate without binding or without too much free play.
- All labels should be intact and readable.
- Ladders shall be free of oil, grease, or slippery materials.
- A ladder that has been exposed to fire or strong chemicals should be discarded.
- All accessories such as leg levelers, paint shelves, stand-off shelves, etc. are in good condition.
- The ladder base shall be placed on a secure and level footing. When necessary, ladder levelers shall be used to achieve equal rail support on uneven surfaces.
- The ladder base must have the slip resistant material.

- While inspecting extensions ladders you need to make sure that:
  - Ropes and pulleys are in good condition.

https://www.dir.ca.gov/dosh/etools/08-001/care.htm 6/16/2016

(Slide 29 and 30) Access to work – OSHA (*continued*)

- Ladder extension locks move freely and lock correctly
- Rung locks are on the rails of the top section to ensure the top section will not fall.
- Extension guide brackets are secure and in place

Additional inspection

In addition to the general inspection elements mentioned above, there are ladder type specific elements that also need to be inspected. Do not use the ladder if you find any of the ladder-specific conditions listed below present in the type of ladder you are inspecting.

- For metal ladders, also check for the followings:
  - loose rungs, nails, bolts screws and other metal parts
  - dented rungs or rails
  - sharp edges, corners and burrs
  - damage from corrosion
  - bends and breaks
  - tags or stickers reading **"CAUTION-Do Not Use Around Electrical Equipment"** or similar wording.
- For wooden ladders also inspect the followings:
  - integrity of rungs and rails
  - chips, splits, cracks and splinters in the rails
  - holes and knots
  - loose / wiggly parts
  - painted wooden parts (transparent paint is OK)
- Fiberglass or plastic ladders should be inspected for the following elements as well:
  - cracks, chips and splinters
  - deformed rails or rungs from heat, chemical or environmental exposure
  - bends and breaks
- For self supporting step ladders, also inspect for the following:
  - the two front legs should be of the same length and the two hind legs should also be of the same length
  - spreaders are intact and lock correctly

Use of Ladder

Position Ladders Correctly

- Keep the area around the top and bottom of a ladder clear.

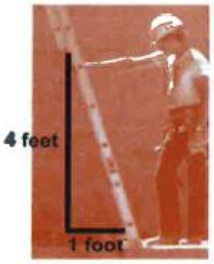
- When using a ladder in a crowded area, erect warning signs or barricades to guide traffic away from the foot of the ladder. If this is not possible, have someone hold and guard the bottom of the ladder.
- Rest the base of ladder on a spot away from hallways, passageways, doorways, driveways or heavy traffic areas. Never set up a ladder in front of a door unless the door is locked or a guard is posted.

(Slide 29 and 30) Access to work – OSHA (*continued*)

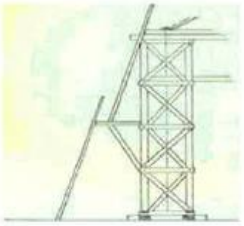
- Rest the base of ladders on firm, level, dry, non slippery surfaces. If one foot sits in a low spot, build up the surface with firm material or use leg levelers or mudsills when necessary to provide firm support.

- Make sure the ladder is sitting straight and secure before climbing it. Do not allow ladders to lean sideways. Level them before using.
- Position the extension ladder such that top section is above and resting on the bottom section with the rung locks engaged.
- To provide the correct angle so extension ladders won't slip, place the base of the ladder **one foot away** from whatever the top of the ladder leans against, **for every four feet in height of the ladder**.

  To check, put your feet at the base of the ladder and extend your arm straight out. If you can touch the closest part of the ladder without bending your arm, or bending over, the ladder is at the correct angle. If not, the ladder is not at a safe angle.



- Do not try to make a ladder reach farther by setting it on boxes, barrels, bricks, blocks or other unstable bases.
- Never set up or use a ladder in a high wind, especially a lightweight metal or fiberglass type. Wait until the air is calm enough to insure safety.
- Do not use ladders on ice or snow unless absolutely necessary. If they must be used on ice or snow, use spike or spur-type safety shoes on the ladder feet and be sure they are gripping properly before climbing.
- When two or more separate ladders are used to reach an elevated work area, make sure that the ladders are offset with a platform or landing between the ladders.



- Remember that the side rails shall extend 36 inches or more above the upper landing surface. When such an extension is not possible, then the ladder shall be secured at its top to a rigid support that will not deflect, and a

(Slide 29 and 30) Access to work – OSHA (*continued*)

grasping device, such as a grab-rail must be provided to assist employees in mounting and dismounting the ladder.

Secure Ladders Properly

- The ladder shall be so placed as to prevent slipping, or it shall be tied, blocked, held, or otherwise secured to prevent slipping. One way to prevent slipping is to use safety shoes on ladder feet.
- Brace the foot of the ladder with stakes or place stout boards against the feet if there is any danger of slipping.
- Tie, block or otherwise secure the ladder to prevent it from being displaced.
- Make sure that the top support is supported equally on the two rails, unless a single support attachment is provided and used.

- Top support for a ladder is as important as good footing. The top should rest evenly against a flat, firm surface. If a ladder is to be leaned against a surface, test the surface first for strength and stability.

Maintain Overlap in Extension Ladders

While using extension ladders, make sure that you are always maintaining at least the minimum required overlap between the sections of the ladder. The minimum overlap lengths are:

Ladder Size (Feet)	Minimum Overlap (Inches)
Up to and including 32	36
Over 32, up to and including 36	46
Over 36, up to and including 48	58
Over 48, up to and including 60	70

(Slide 29 and 30) Access to work – OSHA (*continued*)

Do Not Overload the Ladder

While using portable ladders, you also need to make sure that you are not overloading the ladder. The maximum working loads for different types of ladders are:

Duty Rating	Ladder Type	Working Load (Pounds)
Special Duty	IAA	375
Extra Heavy-Duty	IA	300
Heavy-Duty	I	250
Medium-Duty	II	225
Light-Duty	III	200

Climb and Work Safely on Ladders

- While climbing and working on ladders, you need to climb or work with the body near the middle of the step or rung to keep the load on the ladder centered.

  Make sure that you do not overreach from the center position. To avoid overreaching, you need to descend and reposition the ladder.

(Slide 29 and 30) Access to work – OSHA (*continued*)

- When it is not practical to work with the body near the middle of the step or rung, you need to secure the ladder at the top, and use a personal fall protection system.
- Always face the ladder and maintain contact with the ladder at three-points at all times. Contact with the ladder at three points means two feet and one hand, or two hands and one foot which is safely supporting the user's weight.

- Do not carry equipment or materials on ladders. Have coworkers hand up tools and equipment instead of carrying them when on a ladder.

- Make sure that you are not standing and working on the top 3 rungs of a single or extension ladder. If you have to work from the top 3 rungs, ensure that there are structures that provide you with a firm handhold or you use a personal fall protection system.
- Do not stand on the topcap or the step below the topcap of a step ladder.

- Do not use cross-bracing on the rear section of step ladders for climbing.
- Ladders shall not be moved, shifted, or extended while in use, unless permitted by the manufacturer.
- Always follow manufacturer's recommendations for proper use.

Follow Safe Work Practices

Following safe work practices like these given below can save your employees from the accidents and injuries while climbing and using ladders in workplace.

(Slide 29 and 30) Access to work – OSHA (*continued*)

- Get help when needed. DO NOT try to do alone if you can't do it safely by yourself.

- DO NOT take short cuts.
- Use ladder only for the purpose it is made for.
- Read and follow all labels/markings on the ladder.
- Never use a ladder when under the influence of alcohol, on drugs or medication, or in ill health.
- If you get sick, dizzy or panicky while on a ladder, do not try to climb down in a hurry. Wait. Drape your arms around the rungs and rest your head against the ladder until you feel better. Then climb down slowly and carefully.
- Allow only one person at a time on a ladder unless the ladder is specifically designed to hold more than one person at a time (e.g., double sided or mechanics ladders).

- Never use a ladder on a scaffold platform. If you need to reach higher, the scaffold should be higher.
- DO NOT use step ladders as single ladders or in a partially closed position.
- Be sure that all locks on an extension ladder are properly engaged.

(Slide 29 and 30) Access to work – OSHA (*continued*)

- Always open a stepladder completely and make sure the spreader is locked open before using the ladder.

- Never slide down a ladder.
- Never climb onto a ladder from the side, from above the top or from one ladder to another.
- Do not straddle the front and back of a stepladder.
- Ladders shall not be used in a horizontal position as platforms, runways, or scaffolds unless designed for such use.

- DO NOT use ladders as a brace, skid, guy or gin pole, gangway, or for uses other than they were intended.
- DO NOT use wooden ladders that are painted.
- Never tie or fasten ladders together to gain additional length/height.
- Avoid overhead electrical hazards. Look for overhead power lines before handling a ladder. Avoid using a metal ladder near power lines.
- Never use metal ladders around exposed electrical wiring. Metal ladders should be marked with tags or stickers reading "CAUTION-Do Not Use Around Electrical Equipment" or similar wording.
- Use only the non-conductive ladders in wet and damp locations where electrical work is anticipated.
- Wear shoes with slip resistant soles.
- Clean mud and other slippery substances off your shoes and ladder rungs before climbing the ladder.
- When moving an extension ladder always retract the "fly" section(s).
- When carrying an extension ladder keep the bottom section lower than the top. Use a ladder dolly to help you carry heavy ladders.
- When using extension ladders consider using fall protection systems

Maintenance of Ladder

- Keep all ladders and ladder accessories, especially safety shoes, maintained in good condition at all times.
- Withdraw damaged ladders immediately from service for repair or destruction.
- Treat all wood ladders, which are to be used outside, to protect from weather damage. A clear finish or transparent penetrating preservative should be used. Never paint a wood ladder.

(Slide 29 and 30) Access to work – OSHA (*continued*)

- Never store materials on a ladder.
- Store wood ladders where they will not be exposed to excessive heat or dampness. Store fiberglass ladders where they will not be exposed to sunlight or other ultraviolet light sources.
- Be sure that ladders are properly supported and secured when in transit. Vibration and bumping against other objects can damage them.
- Store ladders on racks, which give them proper support when not in use.
- Metal bearings of extension ladder rung locks and pulleys should be lubricated periodically, and between regular maintenance periods whenever necessary.
- Ropes on extension ladders should be in good condition. If they become frayed or badly worn, replace them.
- DO NOT use ladders with broken or missing steps, rungs, cleats, safety feet, side rails, or other defects.
- Keep the ladders free of oil, grease, or slippery materials all the time by cleaning frequently.

- Store all ladders to protect them from weathering effects.

Prohibited Uses

Listed below are the most common prohibited uses

Use of damaged or defective ladders

Use of ladders inappropriate for the specific job

Hand carry loads or equipment while on a ladder

Reach to the point where you lose your balance

Stand or work on the top cap or the step below the top cap of a stepladder

Stand or work on the top 3 rungs of an extension ladder

Place ladders on boxes, barrels, pick- up trucks or scaffolds or equipment

Use portable ladders in a horizontal position as a plank, platform, or scaffold etc.

Splice together short ladders to make longer ladders

Use ladders with only a single rail

Use ladders in high winds

Use extension ladders without maintaining minimum overlap

Using ladder that does not meet the required duty rating

Replace all frayed or badly worn ropes

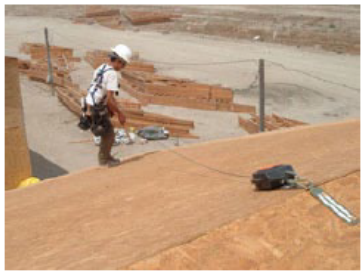
(Slide 29 and 30) Access to work – OSHA (*continued*)

Fall Protection

CONSULTATION CAL OSHA SERVICE

Stopping Falls

This fact sheet provides an overview of types of fall protection systems for **stopping falls** from the Cal/OSHA regulations. For details on the requirements on Fall Protection see **What is Required by Cal/OSHA** (www.dir.ca.gov/dosh/etools/08-010/TE_FallProtection.htm). The risk of falls can be reduced or eliminated by careful planning, *training prior to performing work,* providing appropriate safety equipment, enforcing safe work practices, following the Cal/OSHA regulations, and close supervision. ***Always follow all manufacturer's recommendations and specifications for the use, maintenance, inspection, and storage of Fall Protection Equipment.*** Check to make sure that students and young workers understand the training and can demonstrate how to work safely with Fall Protection Equipment.



Personal Fall Arrest Systems arrest falls from the working level and consist of a horizontal life line secured to the back and above the person's waist to a harness. The system prevents falling more that 6 ft. to avoid hitting lower surfaces. Each person must be attached to their own lifeline with only one person on each lifeline. The anchorage point must be able to support at least 5000 pounds per employee. Lanyards and lifelines should have a breaking strength of 5000 pounds. It must be designed, installed, and used under the supervision of a qualified person. Make sure and carefully inspect all parts of the system for damage, worn out sections, and parts to be replaced. Use only equipment that meets the American National Standard Institute safety requirements (ANSI/ASSE Z359.1 - 1992 R1999). ***You must develop and train students and young workers on a rescue plan in the event of a fall as per*** **T8CCR 1670(b)(14)** (www.dir.ca.gov/title8/1670.html).

Positioning Devices are a system of ropes and body harnesses that allow individuals to have free hands and be able to do work. They do not allow a fall of more than 2 feet. They limit the maximum force on the individual from the fall to 900 pounds. The anchorage point must be capable of supporting two times the intended load or 3000 pounds, whichever is greater. The system has to be inspected each time before it is used. Malfunctioning or damaged components must be replaced.

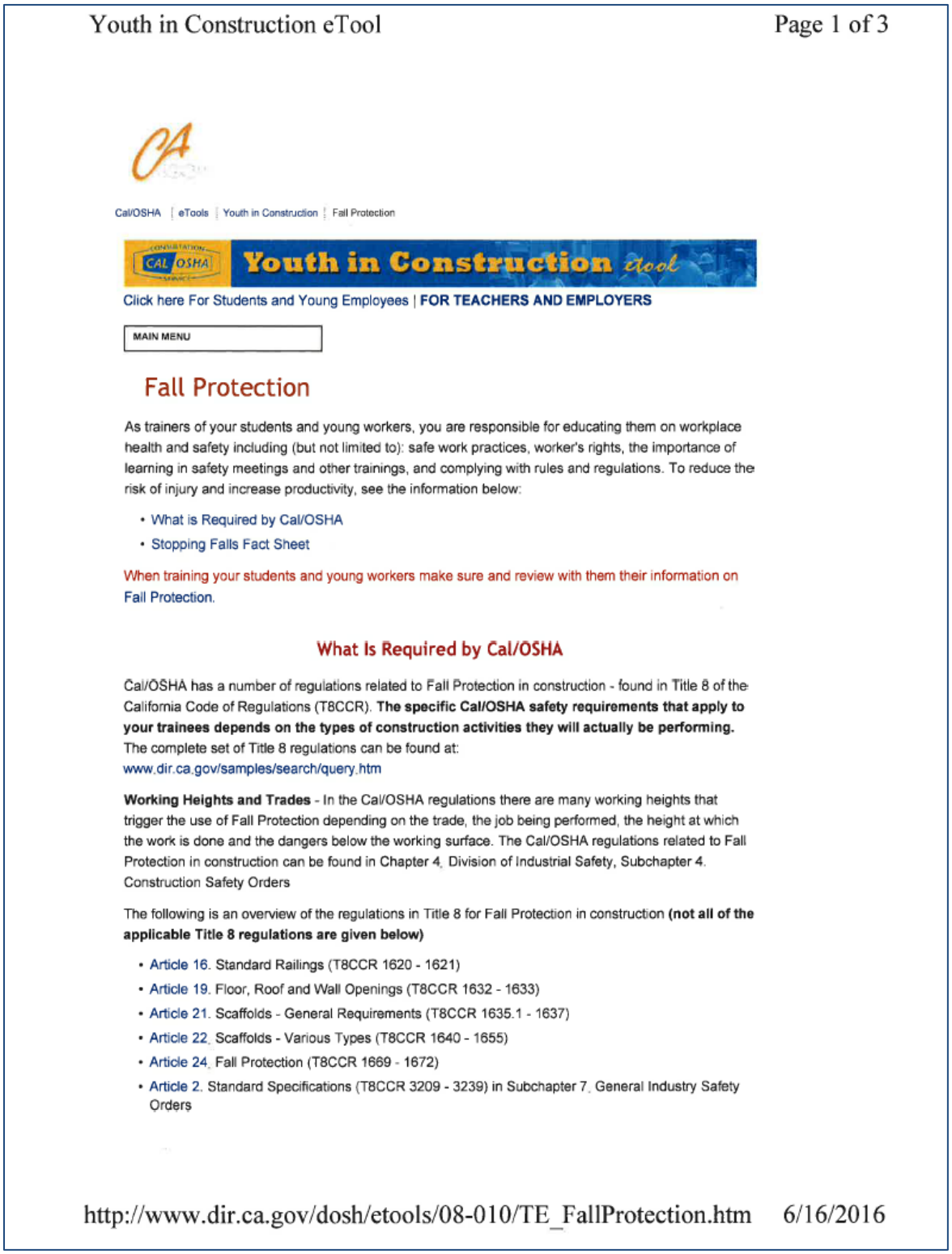
Personal Fall Restraint Systems are composed of body belts or harnesses attached to a life-line. The anchorage point base must support four times the intended load and be rigged to allow the movement of the employee only as far as the edges of the working area.

Use Approved Safety Nets on working heights of 25 feet or more, when the use of Personal Fall Protection or more conventional types of protection is not practical. The nets must be tested before use.

- The safety nets on the inside or outside of structures must extend at least 8 feet horizontally from the perimeter and be not further than 10 feet vertically below where the fall hazards exist , or
- Equivalent protection from safety nets shall extend outward from the outermost projection of the work surface from 8 to 13 ft. beyond the structure you are working depending on the height of the work being performed.

For more information call 1-800-963-9424 or go to www.dir.ca.gov/dosh 09-01001

(Slide 29 and 30) Access to work – OSHA (*continued*)



Youth in Construction eTool Page 1 of 3

Cal/OSHA | eTools | Youth in Construction | Fall Protection

Youth in Construction etool

Click here For Students and Young Employees | **FOR TEACHERS AND EMPLOYERS**

MAIN MENU

Fall Protection

As trainers of your students and young workers, you are responsible for educating them on workplace health and safety including (but not limited to): safe work practices, worker's rights, the importance of learning in safety meetings and other trainings, and complying with rules and regulations. To reduce the risk of injury and increase productivity, see the information below:

- What is Required by Cal/OSHA
- Stopping Falls Fact Sheet

When training your students and young workers make sure and review with them their information on Fall Protection.

What Is Required by Cal/OSHA

Cal/OSHA has a number of regulations related to Fall Protection in construction - found in Title 8 of the California Code of Regulations (T8CCR). **The specific Cal/OSHA safety requirements that apply to your trainees depends on the types of construction activities they will actually be performing.** The complete set of Title 8 regulations can be found at: www.dir.ca.gov/samples/search/query.htm

Working Heights and Trades - In the Cal/OSHA regulations there are many working heights that trigger the use of Fall Protection depending on the trade, the job being performed, the height at which the work is done and the dangers below the working surface. The Cal/OSHA regulations related to Fall Protection in construction can be found in Chapter 4, Division of Industrial Safety, Subchapter 4. Construction Safety Orders

The following is an overview of the regulations in Title 8 for Fall Protection in construction **(not all of the applicable Title 8 regulations are given below)**

- Article 16. Standard Railings (T8CCR 1620 - 1621)
- Article 19. Floor, Roof and Wall Openings (T8CCR 1632 - 1633)
- Article 21. Scaffolds - General Requirements (T8CCR 1635.1 - 1637)
- Article 22. Scaffolds - Various Types (T8CCR 1640 - 1655)
- Article 24. Fall Protection (T8CCR 1669 - 1672)
- Article 2. Standard Specifications (T8CCR 3209 - 3239) in Subchapter 7. General Industry Safety Orders

http://www.dir.ca.gov/dosh/etools/08-010/TE_FallProtection.htm 6/16/2016

(Slide 29 and 30) Access to work – OSHA *Continued*

Fall Protection Systems


Preventing Falls

- **Guard Rails and Toeboards** must be installed:
  - Where work is to be performed at **7.5 feet or higher above the ground**. (T8CCR 1620 and 1621) and
  - On **all open sides of unenclosed elevated work locations** like roof openings, landings, balconies or porches on working levels more than 30 inches above the floor, ground or other working areas (T8CCR 3210) and
  - **On floor, roof and wall openings** (only for wall openings from which there is a drop of more than 4 feet and the bottom of the opening is less than 3 feet above the working surface) (T8CCR 1632).The requirement is for guard rails with either a swinging gate or equivalent protection and floor or roof openings must be covered and painted **"OPENING: DO NOT REMOVE"**.
- **Scaffolds** (T8CCR 1635.1 - 1637 and 1640 - 1655)
  - Required when work can not be done safely by employees standing on permanent or solid construction at least 20 inches wide except when work can be done safely from ladders (T8CCR 1637)
    - *Exception 1 - Work of limited nature and short duration when the permanent or solid construction is less than 20 inches in width and fall distance does not exceed 15 feet in height and provided adequate risk control is recognized and maintained under competent supervision.*
    - *Exception 2 - Work of short duration from joists or similar members at 2 feet or closer centers, planks resting on these members forming a plank platform 12 inches wide or equivalent protection.*


Stopping Falls

If guard rails, toeboards and scaffolds are not provided or impractical above 7.5 feet to stop falls one or more of the following Fall Protection Systems must be used:

- **Approved Personal Fall Arrest, Personal Fall Restraint or Positioning Systems** (T8CCR 1670) shall be worn by those employees whose work exposes them to falling in excess of **7.5 feet** from the perimeter of a structure, unprotected sides and edges, leading edges, through shaft ways and openings,

(Slide 29 and 30) Access to work – OSHA *Continued*

sloped roof surfaces steeper than 7:12 or other sloped surfaces steeper than 40 degrees not otherwise adequately protected under the provisions of these orders.

- **Safety Nets** (T8CCR 1671) - requires safety nets where the elevation is **25 feet** or more above the ground, water surface, or continuous floor level below, **and when the use of personal fall arrest systems, personal fall restraint systems, positioning device systems or more conventional types of protection are clearly impractical**, the exterior and/or interior perimeter of the structure shall be provided with an approved safety net extending at least 8 feet horizontally from such perimeter and being positioned at a distance not to exceed 10 feet vertically below where such hazards exist, or equivalent protection provided safety nets shall extend outward from the outermost projection of the work surface as follows:

Vertical distance from working level to horizontal plane of net.	**Minimum required horizontal distance of outer edge of net from the edge of working surface.**
Up to 5 feet	8 feet
More than 5 feet up to 10 feet	10 feet
More than 10 feet but not to exceed 30 feet.	13 feet

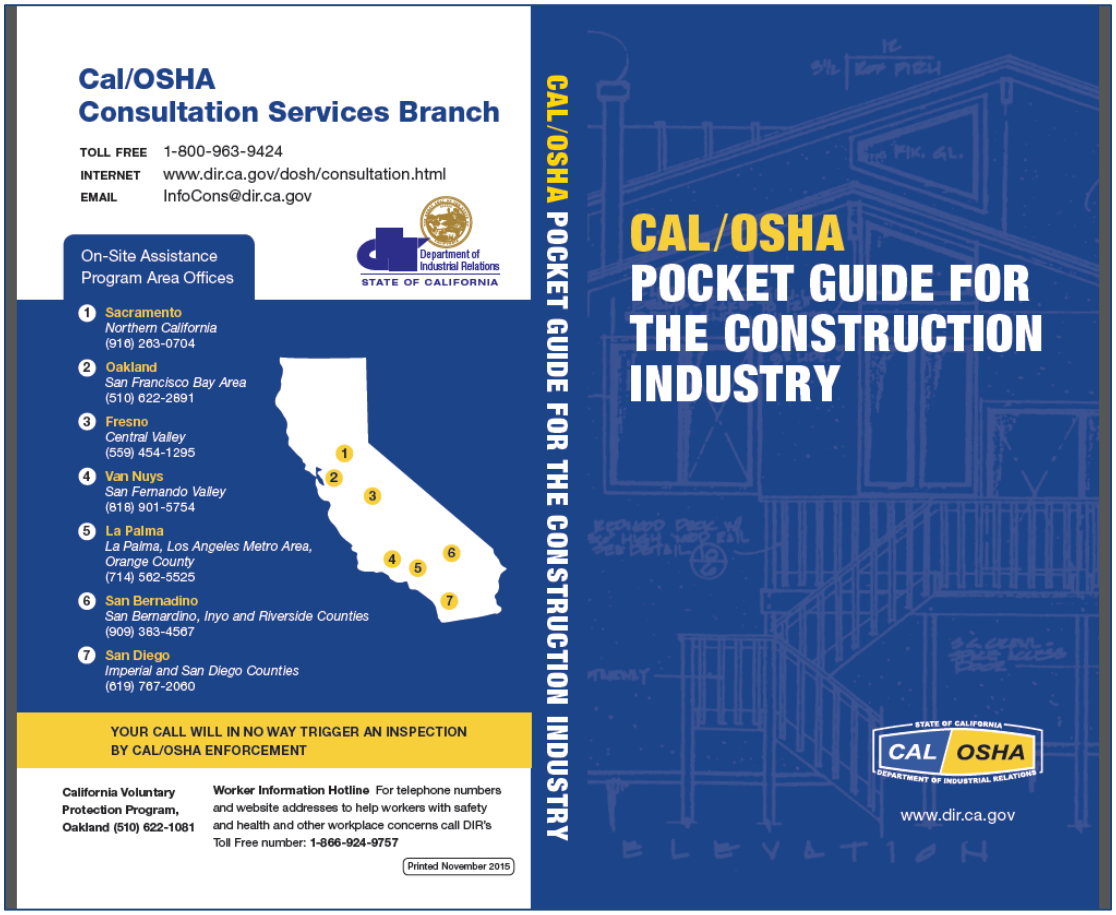
Fall Protection Plan

T8CCR 1671.1 - requires that if conventional fall protection systems are not practical for the work being performed, then a written fall protection plan must be developed and implemented by a qualified person. The plan permits work to be carried on in a designated area, without conventional fall protection, and requires alternate measures to be used to reduce any fall hazard. There must be constant observation by a safety monitor. The area of the work is known as an "controlled access zone" and only trained workers can enter.

(Slide 29 and 30) Access to work – OSHA *Continued*

For a more detailed view of CAL/OSHA requirements as they pertain to the construction industry, visit the following part of the CAL/OSHA website and download the "CAL/OSHA Pocket Guide For The Construction Industry."

https://www.dir.ca.gov/dosh/PubOrder.asp



(Slide 29 and 30) Access to work – OSHA *Continued*

For a comprehensive view of CAL/OSHA requirements as they pertain to the construction industry, see the California Code of Regulations Title 8 Division 1.

https://govt.westlaw.com/calregs/Index?transitionType=Default&contextData=(sc.Default)

Note – There are Construction Safety Orders (Subchapter 4) and General Industrial Safety Orders (Subchapter 7). The "outline" of the regulations are as follows:

California Code of Regulations - Title 8 Industrial Relations

Division 1. Department of Industrial Relations

Chapter 4. Department of Industrial Safety:

Subchapter 4. Construction Safety Orders

Subchapter 7. General Industry Safety Orders

(Slide 47) a. Typical Contractors Quality Control Checklist:
Curtesy SolarCity
www.solarcity.com/SolarCity

Rooftop to Inverter

- Ensure all equipment matches approved plans (modules, mounting hardware, J-box/combiner box, etc.)
- Mounting hardware is not altering roof in a manner that will cause the elements to enter building (Tiles are not lifted from tile hooks, Comp flashing installed properly under comp etc.)
- No loose connections with nuts, bolts, screws, clamps and interlocks at arrays
- Interlocks are installed in all necessary locations within the array
- Max spans between penetrations do not exceed approved plans
- No low hanging wires under array with properly spaced wire clips
- When ABS vents are re-routed under array, ensure the vent is always running up the roof, never horizontal or downhill.
- Fire setbacks are within NFPA requirements and CA Fire Code (req 96) and as shown on approved plans
- Array layout matches approved plans
- Structure of attic matches approved plans and when applicable rafter upgrade matches plans
- Conduit is installed per code (elevated from roof surface with supports no more than 10 feet apart, within 3 feet of all connections, fittings are rated for exterior use in a wet location, grounded and run in a good workmanship like manner, etc.)
- Conduit is run so that the opening is facing down the roof under array

- Wires in conduit do not exceed conduit fill for conduit
- Bond bushings are in place at every conduit termination with set screws tightened
- The conductors are sized according to the appropriate ampacity with correct Temp. derate and conduit fill calculations
- Inverter matches approved plans
- Inverter is installed with proper work clearance Per NEC 110.26
- All labeling is per code on conduit and equipment

Inverter to Utility

- Wires in conduit match approved plans and are appropriate for AC side amperage
- Conduit is installed per code (supports no more than 10 feet apart, within 3 feet of all connections, fittings are rated for exterior use in a wet location, grounded and run in a good workmanship like manner, etc.)
- Conduit is sized appropriately for number and size of wires in it
- Irreversible crimp is placed on the GEC for the house/main panel or two ground rods are placed for system grounding.
- Proper size and brand back feed breaker is installed
- Back feed breaker is placed at opposite end of bussing from main breaker
- Ensure the 120 percent rule is followed with End fed panels and 100 percent rule is followed with center fed panels
- Make sure Main Panel GEC connection is accessible(ufer or ground rods)
- All system labeling is in place and per code
- Site plan plaque is installed on main panel and accurately portrays equipment location

(Slide 47) a. Typical Contractor Quality Control/Commissioning Documentation
Courtesy Verengo Solar
http://www.verengosolar.com/

Verengo Solar
20285 South Western Ave
Suite # 200
Torrance, CA 90501

Verengo Quality Commissioning Date: 08/04/2015

PROJECT INFORMATION

A1. Project # (SO-xx-xx-xxx) so1505172
A2. Project Last Name:
A3. Foreman Name:
A4. Electrician Name:

Equipment List: Select all equipment shown on the approved plan set to be inspected per the 2014 NEC.

1.0 Array
2.0 Micro Inverters
3.0 Roof Conduit ☑
4.0 Junction / Combiner Box ☑
5.0 Roof Conduit Penetration ☑
6.0 Wall Conduit ☑
7.0 DC Disconnect ☑
8.0 String Inverter ☑
9.0 Load Center
10.0 Production Meter ☑
11.0 AC Disconnect ☑
12.0 Wall Conduit Penetration
13.0 Subpanel
14.0 Interconnection
15.0 Production & Monitoring

A5. Homeowner: Greet homeowner and confirm equipment location on plan set. ☑

Submitted by [redacted] at 08/03/2015 14:03 PDT, captured at 08/03/2015 13:47 PDT
Submission ID: d2147ec67887f257-1438634840993
Mobile Apps For How You Do Business - powered by Canvas (www.gocanvas.com)

(Slide 47) a. Contractor Quality Control/Commissioning Documentation (*continued*)

Verengo Solar
20285 South Western Ave
Suite # 200
Torrance, CA 90501

Verengo Quality Commissioning

Date: 08/04/2015

A6. Address: Clearly show a full view of the customers home from the street with Verengo sign present. (Address and module required in photo for Sunrun projects)

Submitted by [redacted] at 08/03/2015 14:03 PDT, captured at 08/03/2015 13:47 PDT

Page: 2

Submission ID: d2147ec67887f257-1438634840993

Mobile Apps For How You Do Business - powered by Canvas (www.gocanvas.com)

(Slide 47) a. Contractor Quality Control/Commissioning Documentation (*continued*)

Verengo Solar
20285 South Western Ave
Suite # 200
Torrance, CA 90501

Verengo Quality Commissioning — Date: 08/04/2015

A8. Safety Harness Anchor: Clearly show the location of the safety harness anchor in relation to the working area if applicable (Required for roof teams).

1.0 ARRAY

Array # 1

Submitted by [redacted] at 08/03/2015 14:03 PDT, captured at 08/03/2015 13:47 PDT
Submission ID: d2147ec67887f257-1438634840993
Mobile Apps For How You Do Business - powered by Canvas (www.gocanvas.com)

Page: 4

(Slide 47) a. Contractor Quality Control/Commissioning Documentation (*continued*)

Verengo Solar
20285 South Western Ave
Suite # 200
Torrance, CA 90501

Verengo Quality Commissioning — Date: 08/04/2015

1.1 Mounting System Penetration: Clearly show a screen fit picture of a properly installed mounting penetration with hardware and flashing.

1.2 Mounting System Splice: Splice or expansion joint properly installed with 1/2" gap.	☑
1.3 Mounting System Span: All mounting system penetrations within the maximum span of the mounting system specifications.	☑
1.4 Mounting System Cantilever: All rail cantilever is less than 33% of the max span for each penetration. (See Field Notes)	☑
1.5 Mounting System EGC: EGC is properly bonded to the mounting system.	☑
1.6 Mounting System Layout: Mountng system layout installed per plan.	☑
1.7(a) Array Layout: Array installed per plan without changes.	☑

Submitted by [redacted] at 08/03/2015 14:03 PDT, captured at 08/03/2015 13:47 PDT — Page: 5
Submission ID: d2147ec67887f257-1438634840993
Mobile Apps For How You Do Business - powered by Canvas (www.gocanvas.com)

(Slide 47) a. Contractor Quality Control/Commissioning Documentation (*continued*)

Verengo Solar
20285 South Western Ave
Suite # 200
Torrance, CA 90501

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1.7(b) Shading Measurements: Collected shading measurements. ☑
1.8 Array Clearance: Clearly show the array height off the roof surface.

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(Slide 47) a. Contractor Quality Control/Commissioning Documentation (*continued*)

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1.9(a) Array Module Count 1: Clearly show the entire array with each module easily distinguishable.

1.9(b) Array Module Count 2: Clearly show the entire array with each module easily distinguishable. (Only if all modules were not able to be capured in first photo)
1.10 Array Pitch: Clearly show the array pitch within +/- 2 degrees of approved plan set.

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(Slide 47) a. Contractor Quality Control/Commissioning Documentation (*continued*)

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1.11 Array Azimuth: Clearly show the array azimuth within +/- 5 degrees of the approved plan set.

1.12 Module Mid Clamp: Mid Clamps are properly installed.	☑
1.13 Module End Clamp: End clamps are properly mounted with rail exposure min of 2", max 3" past the module frame.	☑
1.14 Module Spacing: All modules are evenly spaced with a min 1/4 inch, max 1" between them.	☑
1.15 Module Cantilever: All modules are installed with a mimimum of 4" cantilever and maximum of 17" portrait / 10" landscape.	☑
1.16 Array Leveling: The array is level accross the roof surface and height between modules less than 1/4".	☑

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1.17(a) Array Wire Management: Clearly show underneath the array from the ridge down that all conductors are secure, protected from UV and not visibly hanging.

1.17(b) Array Wire Management: Clearly show underneath the array and between the rails that all conductors are secure, protected from UV and not visibly hanging.

1.18 Module EGC: ECG is properly bonded to the module.	☑
1.19 Module Damage: Modules are free of surface scratches and scrapes.	☑
1.20 Roof Damage: Roof is free of any Verengo caused damage.	☑

3.0 ROOF CONDUIT

Roof Conduit #	1

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(Slide 47) a. Contractor Quality Control/Commissioning Documentation (*continued*)

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3.1 Roof Conduit Conductors: Clearly show a screen fit picture of properly bonded conductors entering the conduit.

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3.2 Roof Conduit Support: Clearly show a srcreen fit picture of a properly installed roof conduit support.

3.3 Roof Conduit Paint: Roof conduit is evenly painted to match the roof surface without significant overspray.	☑
3.4 Roof Conduit Workmanship: Roof conduit runs well planned and installed in a neat and workmanlike manner.	☑
NEC 110.3(B) - Installation Listing	☑
NEC 110.12 - Workmanship	☑
NEC 310.10(D) - Direct Sunlight	☑
NEC 314.15 - Damp or Wet Locations	☑
NEC 344.14 - Dissimilar Metals	☑
NEC Article 358 - EMT	☑
NEC 690.43 - Equipment Grounding	☑
NEC 690.64 - Grounding Physical Damage	☑

4.0 JUNCTION / COMBINER BOX

Combiner Box #	1

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4.1 Junction / Combiner Box Installation: Clearly show a screen fit picture of the combiner box with the cover open and distance of 1" or less between array.

NEC 110.3(B) - Installation Listing	☑
NEC 110.12 - Workmanship	☑
NEC Article 200 - Identification of Grounded Conductors	☑
NEC 310.10(D) - Direct Sunlight	☑
NEC 690.16 - Fuses	☑
NEC 690.31 - Methods Permitted	☑
NEC 690.34 - Box Access	☑

5.0 ROOF CONDUIT PENETRATION

Roof Conduit Penetration #	1

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5.1 Roof Conduit Penetration Flashing: Clearly show a screen fit picture of the electrical roof penetration flashing or conduit decending from the roof.

5.2 Roof Conduit Penetration Bottom: Clearly show a screen fit picture of the sealed electrical roof penetration from below.

NEC 110.3(B) - Installation Listing ☑
NEC 110.12 - Workmanship ☑

6.0 WALL CONDUIT

Wall Conduit # 1

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6.1 Wall Conduit Support: Clearly show a wall mounted conduit run that is properly supported.

6.2 Wall Conduit Paint: Wall conduit is evenly painted to match the customers home.	☑
6.3 Wall Conduit Workmanship: Wall conduit runs well planned and installed in a neat and workmanlike manner.	☑
NEC Article 358 - EMT	☑
NEC 110.12 - Workmanship	☑

7.0 DC DISCONNECT

DC Disconnect #	1

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7.1 DC Disconnect Installation: Clearly show a screen fit picture of the DC disconnect with the cover open.

NEC 110.3(B) - Installation Listing	☑
NEC 250.96 - Bonding Enclosures	☑
NEC 690.31 - Methods Permitted	☑
NEC 690.47 - Grounding Electrode System	☑

8.0 STRING INVERTER

String Inverter #	1

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8.1 String Inverter Model: Clearly show a screen fit picture of the inverter label.

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(Slide 47) a. Contractor Quality Control/Commissioning Documentation (*continued*)

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8.2 String Inverter Installation: Clearly show a screen fit picture of the properly installed inverter with the cover open.

NEC 110.3(B) - Installation Listing	☑
NEC 110.12 - Workmanship	☑
NEC 690.31 - Methods Permitted	☑
NEC 690.47 - Grounding Electrode System	☑

10.0 PRODUCTION METER

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10.1 Production Meter: Clearly show a screen fit picture of the properly installed production meter with the cover open.

10.2 Production Meter Tag: Tag installed on production meter.	☐
NEC 110.3(B) - Installation Listing	☑
NEC 110.27 (A)(2) - Guarding of Live Parts	☑
NEC 300.3(B) - Conductors of Same Circuit	☑
NEC 690.31 - Methods Permitted	☑
NEC 250.96 - Bonding Enclosures	☑
NEC 690.47 - Grounding Electrode System	☑

11.0 AC DISCONNECT

AC Disconnect #	1

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11.1 AC Disconnect: Clearly show a screen fit picture of the properly installed AC disconnect with the cover open.

11.2 AC Disconnect Tag: Tag installed on AC disconnect.	☐
NEC 110.3(B) - Installation Listing	☑
NEC 110.12 - Workmanship	☑
NEC 110.27 (A)(2) - Guarding of Live Parts	☑
NEC 240.21(B)(1) - Location in Circuit, AKA - 10 ft. tap rule. (Tapped systems only)	☐
NEC 250.96 - Bonding Enclosures	☑
NEC 690.8(A) - Circuit Sizing	☑
NEC 690.9(A)(B)(C) - Overcurrent Protection (Next Fuse Size > Max inverter(s) continuous output x 1.25) (OCPD less than 50 amps in 5 amp increments) (OCPD greater than 50 amps in 10 amp increments)	☑
NEC 690.13(A) - Disconnect Location	☑
NEC 690.31 - Methods Permitted	☑
NEC 690.47 - Grounding Electrode System	☑

14.0 INTERCONNECTION

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14.1 Interconnection Equipment: Clearly show a screen fit picture of the MSP with the cover open.

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14.2 Interconnection Main Breaker: Clearly show a screen fit picture of the main service breaker with breaker sizes legible.

14.3 Interconnection Solar Breaker/Tap: Clearly show a screen fit picture of the solar breaker or tap with equipment sizes legible.

NEC 110.3(B) - Installation Listing ☑
NEC 110.12 - Workmanship ☑
NEC 250.52 - Grounding Electrode ☑
NEC 250.96 - Bonding Enclosures ☑
NEC 250.120 - EGC Installation ☑
NEC 250.122 - EGC Size ☑
NEC 250.166 - Grounding Electrode Size ☑

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(Slide 47) a. Contractor Quality Control/Commissioning Documentation (*continued*)

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NEC 690.31 - Methods Permitted	☑
NEC 690.47 - Grounding Electrode System	☑
NEC 705.12(D)(1) - Interconnection Breaker (Next Breaker Size greather than Max inverter(s) continuous output x 1.25)	☑
705.12(D)(5) - Fastening	☑
NEC 705.12(D)(2)(2) - Supply Side Tap (Next Tap > Max inverter output x 1.25)	☐
NEC 705.12(D)(2)(3) - 120% Rule Allowable Backfeed = ((Buss Rating x 1.20) - Main Breaker)	☑

15.0 PRODUCTION EQUIPMENT

15.1 Production Equipment: Select equipment displaying the system production.	String Inverter 1
15.2 Production Equipment Label: Clearly show the label of the equipment displaying system production with all #'s legible.	
15.3 Production Equipment Connection: Select internet connectivity method.	NONE - No internet connection
15.4 Production Equipment Location: Identify the location of the production monitoring equipment.	Exterior - Garage

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(Slide 47) a. Contractor Quality Control/Commissioning Documentation (*continued*)

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15.5 Production Equipment Power: Clearly show the total power (WATTS) being generated on the equipment display.

16.0 INSTALLATION COMPLETE

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16.1(a) Wall Equipment 1: Clearly show full view of all completed wall mounted equiment with covers closed.

16.1(b) Wall Equipment 2: Secondary photo if all wall mounted equipment was not able to be captured in first photo.
16.2 Production Meter Communication: Clearly show the production meter communication code or symbol, serial #'s and meter tag.

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16.4 Equipment ON (String Inverter): - MSP Solar Breaker - Subpanel Solar Breaker(s) - Load Center Breakers(s) - AC Disconnect(s) - DC Disconnect(s) (Non Inverter Integrated)	☐
16.5 Equipment OFF (String Inverter): - Inverter(s) - DC disconnect(s) (Inverter Integrated)	☑
16.6 Clean Up: Home has been cleaned of all installation debris from roof, yard and other working areas.	☑
16.7 Foreman Inspection: I have inspected this project to the best of my ability to meet the quality standards of Verengo Solar and this project is SUBSTANTIALLY COMPLETE.	☑
REDLINES:	
16.8 Layout Redlines: Clearly show a screen fit photo of the plan set identifying all layout changes WITH new shade measurement locations marked.	
16.9 Electrical Redlines: Clearly show a screen fit photo of the single line diagram identifying all electrical changes made.	
FINISH WORK:	
Finish Work Item 1:	Panel Upgrade
Finish Work Photo 1:	
Finish Work Item 2:	
Finish Work Photo 2:	
Finish Work Item 3:	
Finish Work Photo 3:	
16.10 Foreman Comments: Describe finish work required and customer comments if any. panel upgrade still required and tie in of solar.	
Submission Location:	

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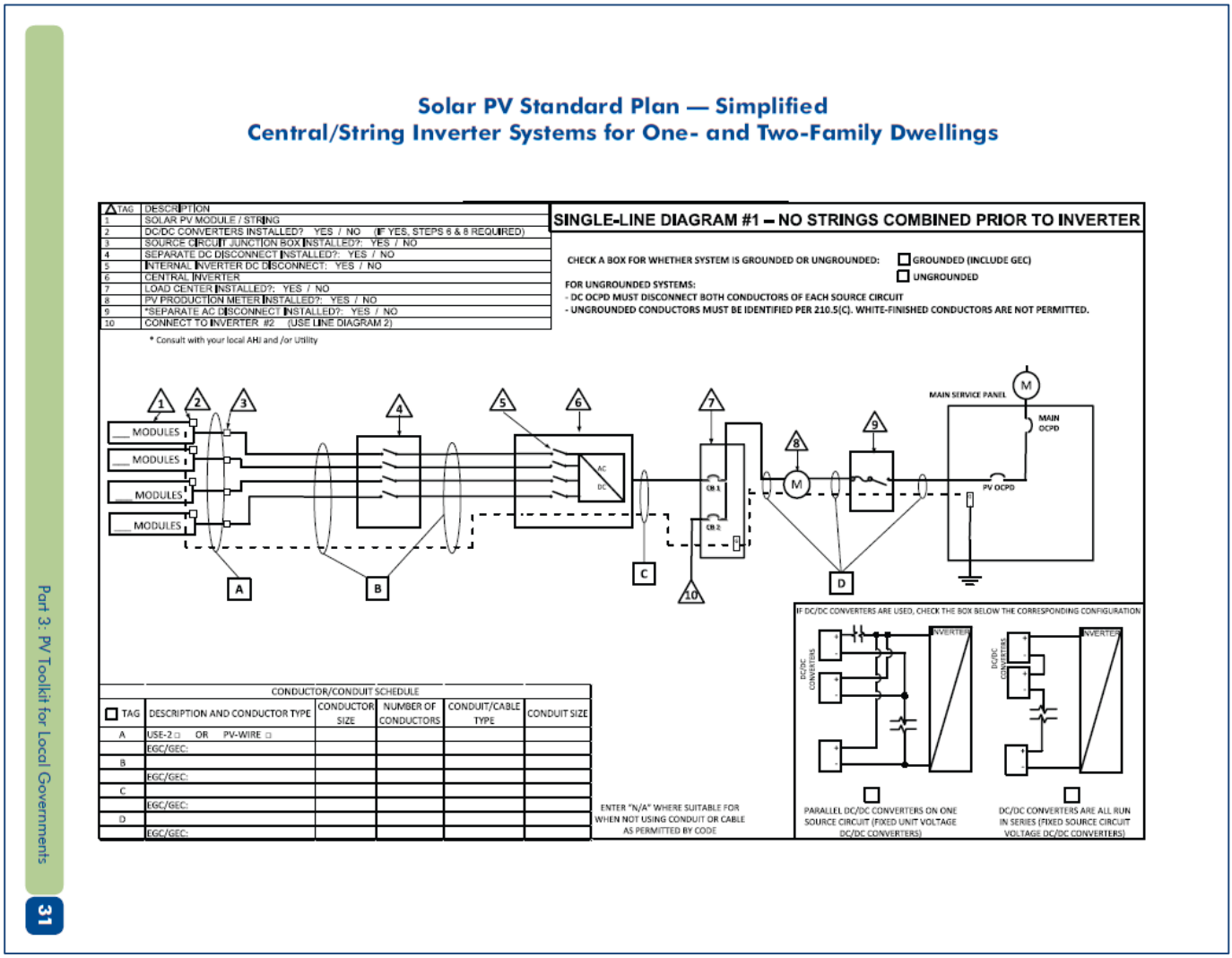
(Slide 47) c. Single Line Diagram

CEC 215.5 Diagram of Feeders. If required by the authority having jurisdiction, a diagram showing feeder details shall be provided prior to the installation of the feeders. Such a diagram shall show the area in square feet of the building or other structure supplied by the feeder, the total calculated load before applying the demand factors, the demand factors used, the calculated load after applying demand factors, and the size and the type of conductors to be used.

Example - Single Line Diagram (*From California Solar Permitting Guidebook*)

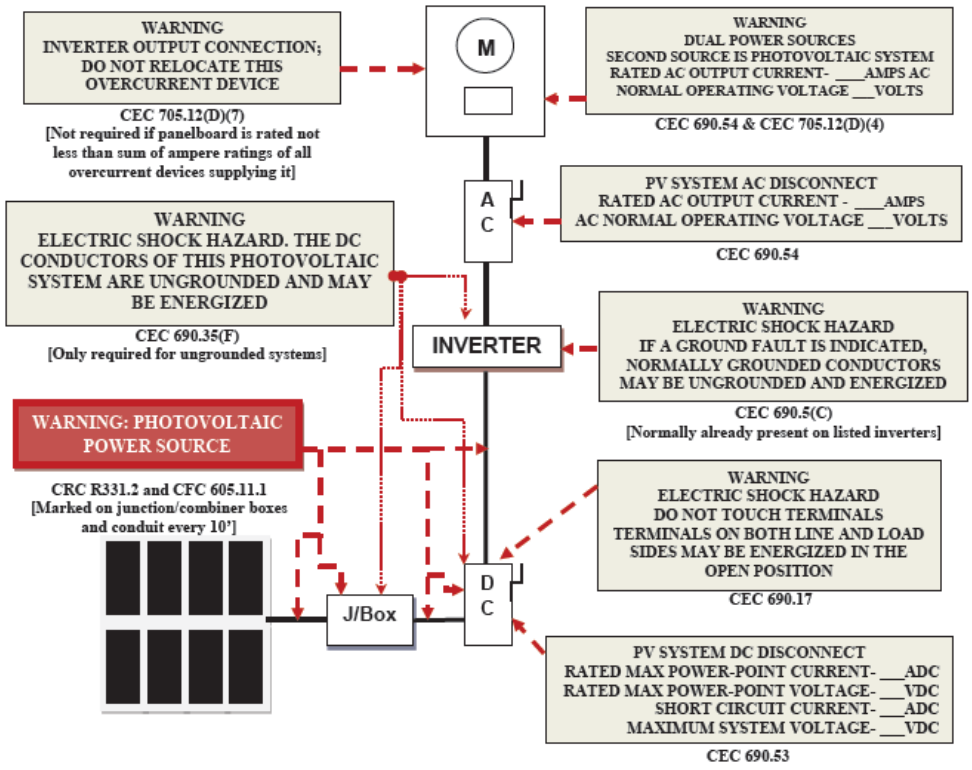


(Slide 47) d. Labels or Marking (*From California Solar Permitting Guidebook*)

Solar PV Standard Plan — Simplified
Central/String Inverter Systems for One- and Two-Family Dwellings

Markings

CEC Articles 690 and 705 and CRC Section R331 require the following labels or markings be installed at these components of the photovoltaic system:



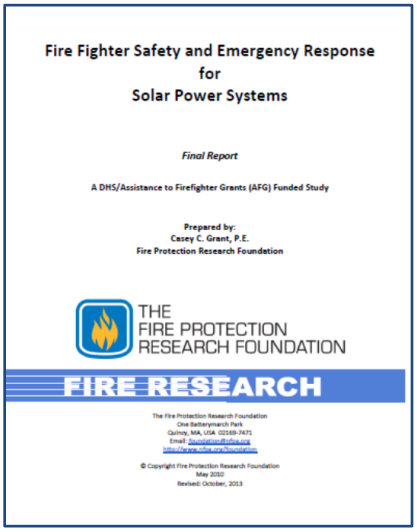
Code Abbreviations:
California Electrical Code (CEC)
California Residential Code (CRC)
California Fire Code (CFC)

Informational note: ANSI Z535.4 provides guidelines for the design of safety signs and labels for application to products. 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.

CEC 705.12 requires a permanent plaque or directory denoting all electric power sources on or in the premises.

(Slide 48 - 52) Photos and information via: Fire Fighter Safety and Emergency Response for Solar Power Systems *Final Report* - A DHS/Assistance to Firefighter Grants (AFG) Funded Study Prepared by: Casey C. Grant, P.E. Fire Protection Research Foundation. See:

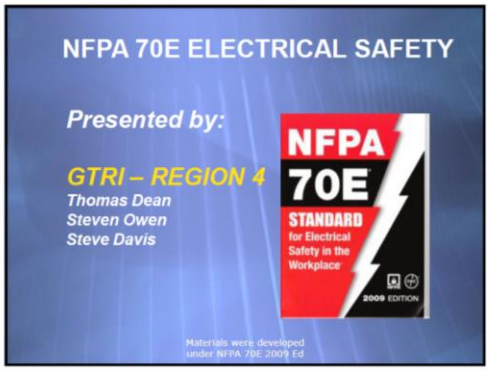
http://www.nfpa.org/research/fire-protection-research-foundation/projects-reports-and-proceedings/for-emergency-responders/fireground-operations/fire-fighter-safety-and-response-for-solar-power-systems



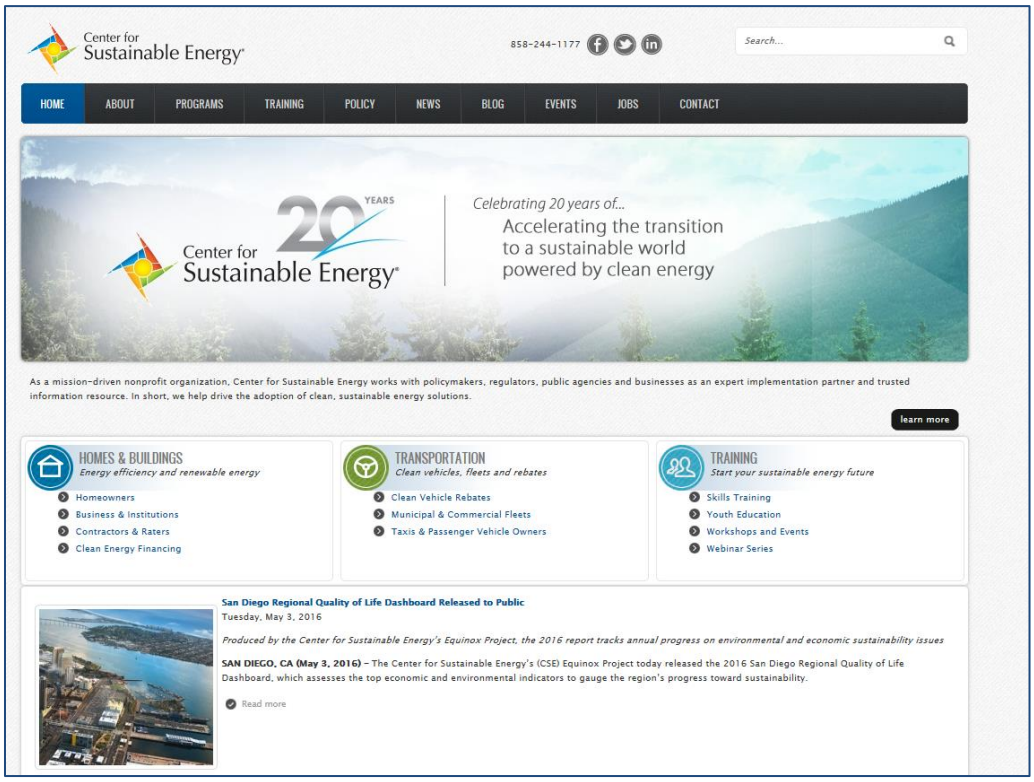
(Slide 53) Photo: Gatis Sluka – Cartoon About Electricity Posted On-Line January 30, 2014

(Slide 54-56) Photo credits and information courtesy Georgia Tech Research Institute via Grant SH-1942-09-06-f13 from OSHA, USDOL. For a detailed PowerPoint, see:

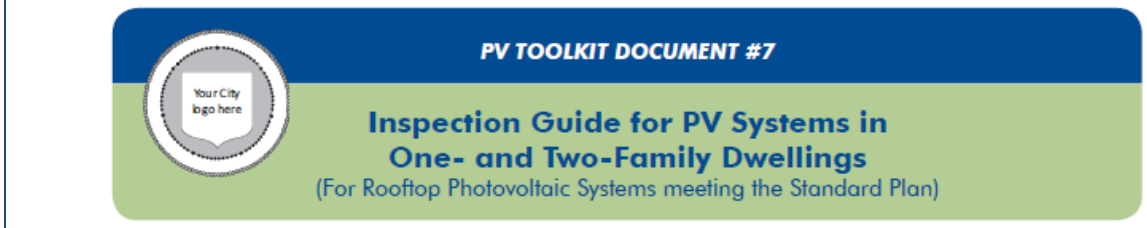
http://www.oshainfo.gatech.edu/nfpa/NFPA70E-1.pdf



(Slide 71) - https://energycenter.org/



(Slide 87) California Solar Permitting Guidebook Tool Kit 7



This document has two sections. Neither section is all-inclusive as this document is simply a tool to aid the inspection process.

SECTION 1 – Field Inspection Guide: The purpose of this section is to give the field inspector a single-page reminder of the most important items in a field inspection.

SECTION 2- Comprehensive Reference: This reference details items that may be relevant in the field inspection of rooftop PV systems that comply with the comprehensive or simplified versions of the "Solar PV Standard Plan." Not all items outlined in this section are relevant to each PV system. This inspection reference details most of the issues that relate to the PV system during the inspection process.

All California Electrical Code (CEC), California Residential Code (CRC), California Building Code (CBC) and California Fire Code (CFC) references are to the 2013 versions unless otherwise noted.

(Slide 87) California Solar Permitting Guidebook Tool Kit 7 "19 Point Checklist"

SECTION 1: Field Inspection Guide for Rooftop Photovoltaic (PV) Systems Standard Plan

Make sure all PV system AC/DC disconnects and circuit breakers are in the open position and verify the following.

1. All work done in a neat and workmanlike manner (CEC 110.12).
2. PV module model number, quantity and location according to the approved plan.
3. Array mounting system and structural connections according to the approved plan.
4. Roof penetrations flashed/sealed according to the approved plan.
5. Array exposed conductors are properly secured, supported and routed to prevent physical damage.
6. Conduit installation according to CRC R331.3 and CEC 690.4(F).
7. Firefighter access according to approved plan.
8. Roof-mounted PV systems have the required fire classification (CBC 1505.9 or CRC R902.4).
9. Grounding/bonding of rack and modules according to the manufacturer's installation instructions that are approved and listed.
10. Equipment installed, listed and labeled according to the approved plan (e.g., PV modules, DC/DC converters, combiners, inverters, disconnects, load centers and electrical service equipment).
11. For grid-connected systems, inverter is marked "utility interactive."
12. For ungrounded inverters, installation complies with CEC 690.35 requirements.
13. Conductors, cables and conduit types, sizes and markings according to the approved plan.
14. Overcurrent devices are the type and size according to the approved plan.
15. Disconnects according to the approved plan and properly located as required by the CEC.
16. Inverter output circuit breaker is located at opposite end of bus from utility supply at load center and/or service panelboard (not required if the sum of the inverter and utility supply circuit breakers is less than or equal to the panelboard bus rating).
17. PV system markings, labels and signs according to the approved plan.
18. Connection of the PV system to the grounding electrode system according to the approved plan.
19. Access and working space for operation and maintenance of PV equipment such as inverters, disconnecting means and panelboards (not required for PV modules) (CEC 110.26).

(Slide 87) California Solar Permitting Guidebook Tool Kit 7 Section 2

SECTION 2: Comprehensive Inspection Reference

GENERAL

1. Module manufacturer, make, model and number of modules match the approved plans. (CBC 107.4)
2. DC PV modules are listed to UL 1703. Ac modules are listed to UL 1703 and UL 1741. (CEC 110.3, 690.4 & CBC 1509.7.4 & CRC R908.1.5)
3. Modules are attached to the mounting structure according to the manufacturer's instructions and the approved plans. (CEC 110.3[B], CBC 107.4 & CRC R908.1.4)
4. Roof penetrations/attachments are properly flashed. (CBC Chapter 15 & 2012 CRC Chapter 9)
5. Rooftop systems are designed in accordance with the CBC. (CBC 1509.7 & CRC R908.1)
6. Roof access points, paths and clearances need to comply with the CFC. (CFC 605.11.3.1 - 605.11.3.3.3, CRC R331.4.1 through R331.4.2.4)
7. PV installation shall comply with requirements of the standard plan.
8. PV system operating at 80 volts or greater shall be protected by a listed DC arc fault protection. (CEC 690.11)
9. All work done in a neat and workmanlike manner. (CEC 110.12)

ELECTRICAL REQUIREMENTS

PV Array Configuration

10. DC modules are properly marked and labeled. (CEC 110.3, 690.4[D] & 690.51)
11. AC modules are properly marked and labeled. (CEC 110.3, 690.4[D] & 690.52)
12. PV modules are in good condition (i.e., no broken glass or cells, no discoloration, frames not damaged, etc.). (CEC 110.12[B])
13. Residential one- and two-family dwelling limited to maximum PV system voltage of 600 volts. (CEC 690.7)

Bonding and grounding

14. A complete grounding electrode system is installed. (CEC 690.47[A] & [B])
15. Modules are bonded and grounded in accordance with the manufacturer's installation instructions, that are listed and approved, using the supplied hardware or listed equipment specified in the instructions and identified for the environment. (CEC 690.43 & 110.3[B])
16. Racking systems are bonded and grounded in accordance with the manufacturer's installation instructions, that are listed and approved, using the supplied hardware or listed equipment specified in the instructions and identified for the environment. (CEC 690.43 & 110.3[B])
17. Properly sized equipment grounding conductor is routed with the circuit conductors. (CEC 690.45, 250.134[B] & 300.3[B])
18. AC and DC grounding electrode conductors are properly connected as required by code. Separate electrodes, if used, are bonded together. (CEC 690.47, 250.50 & 250.58)

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19. Bonding fittings are used on concentric/eccentric knockouts with metal conduits for circuits over 250 volts. (CEC 250.97) (see also exceptions 1 through 4)

20. Bonding fittings are used for ferrous metal conduits enclosing grounding electrode conductors. (CEC 250.64[E])

PV Source/output Circuit Conductor Management

21. Cables are secured by staples, cable ties, straps, hangers or similar fittings at intervals that do not exceed 4.5 feet. (CEC 334.30 & 338.12[A][3])

22. Cables are secured within 12 inches of each box, cabinet, conduit body or other termination. (CEC 334.30 & 338.12[A][3])

23. Cable closely follows the surface of the building finish or of the running boards. (CEC 690.4[F] & CFC 605.11.2 & CRC R331.3) NOTE: see Section 12 below for additional requirements on routing of conductors for fire fighter safety concerns.

24. Exposed single conductors, where subject to physical damage, are protected. (CEC 230.50[B] & 300.5[D])

25. Exposed single conductors used for ungrounded systems are listed and identified as "PV wire." (CEC 690.35[D][3]) For other conductor requirements for ungrounded systems, see CEC 690.35(D).

Conductors

26. Exposed single conductor wiring is a 90° C, wet rated and sunlight resistant type USE-2 or approved/listed PV wire. (CEC 690.31[B] & 110.2) If the wiring is in a conduit, it is 90° C, wet rated type RHW-2, THWN-2, or XHHW-2. (CEC 310.15)

27. Conductor insulation is rated at 90° C to allow for operation at 70° C+ near modules. (CEC 310.15)

28. Grounded conductor is identified white or gray. (CEC 200.6)

29. Open conductors are supported, secured and protected. (CEC 338.12[A][3] & 334.30)

30. Conductors are not in contact with the roof surface. (CEC 334.30)

31. DC conductors inside a building are in a metal raceway or MC metal-clad cable that complies with 250.118(10), or metal enclosures. (CEC 690.31[E])

32. DC wiring methods shall not be installed within 25 cm (10") of the roof decking or sheathing except where directly below the roof surface covered by the PV modules and associated equipment. (CEC 690.31[E][1])

33. If more than one nominal voltage system conductor is installed in the raceway, permanent identification and labeling is required. (CEC 200.6[D] & 210.5[C])

34. For underground conductor installations, the burial depth is appropriate and warning tape is in place. (CEC 300.5[D][3] & Table 300.5)

35. Aluminum is not placed in direct contact with concrete. (CEC 250.120[B] & 110.11)

36. PV circuit and premises wiring is separated. (CEC 690.4[B])

37. PV system conductors shall be grouped and identified. (CEC 690.4[B])

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Overcurrent Protection

38. Overcurrent protection devices (OCPD) in the DC circuits are listed for DC operation. (CEC 110.3[A], [B] & 690.9[D])
39. Overcurrent protection devices shall be provided per the approved plans. (CEC 690.9[A])
40. Combiner box is listed to UL 1741.
41. PV output OCPD is located at the opposite end of the bus from the feeder connection, unless otherwise approved. (CEC 705.12[D][7])

Electrical Connections

42. Crimp terminals are listed and installed using a listed tool specified for use in crimping those specific crimps. (CEC 110.3[B] & 110.14)
43. Pressure terminals are listed for the environment and tightened to manufacturer recommended torque specifications. (CEC 110.11, 110.3[B] & 110.14)
44. Connectors are listed for the voltage of the system and have appropriate temperature and ampere ratings. (CEC 110.3[B] & 110.14)
45. Twist-on wire connectors are listed for the environment (i.e., wet, damp, direct burial, etc.) and installed per manufacturer's instructions. (CEC 110.11, 110.3[B], 110.14 & 300.5[B])
46. Power distribution blocks are listed. (CEC 690.4 & 2011 NEC 314.28[E])
47. Terminals containing more than one conductor are listed for multiple conductors. (CEC 110.14[A] & 110.3[B])
48. Connectors and terminals used other than class B and C stranded conductors (fine stranded conductors) are listed and identified for use with specific conductor class or classes.. (CEC 110.14[A] & 110.3[B])
49. Connectors that are readily accessible and operating at over 30 volts require a tool for opening. (CEC 690.33[C])
50. All connectors are fully engages, tight and secure. (CEC 110.3[B] & 110.12)
51. Wiring and connections of inverters, PV source circuits, etc., and all interconnections are performed by qualified personnel. (CEC 690.4[E])

Disconnects

52. Disconnects used in DC circuits are listed for DC operation and located as allowed by the AHJ. (CEC 110.3)
53. Disconnects are installed for all current carrying conductors of the PV source. (CEC 690.13 - 690.14 & 690.35)
54. Disconnects are installed for the PV equipment. NOTE: For inverters and other equipment that are energized from more than one source, the disconnecting means must be grouped and identified per AHJ's requirements. (CEC 690.15)
55. Disconnects and overcurrent protection are installed for all ungrounded conductors in ungrounded PV power systems. (CEC 240.15 & 690.35)
56. Where connectors are used as disconnecting means, they shall be used in accordance with CEC 690.33.E (CEC 690.33.E & 690.17)

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Inverters

57. Inverters are listed to UL 1741. (CEC 690.4[D]) NOTE: grid-tied system inverters need to be identified for use in interactive power systems.

58. Point of connection is at a dedicated breaker or disconnect. (CEC 705.12[D][1])

59. Where a back-fed breaker is used as a utility interconnection means, the breaker is not marked "line and load." (CEC 110.3[B], 705.12[D][5])

60. Listed AC and DC disconnects and overcurrent protection are grouped and identified. (CEC 690.15)

61. No multiwire branch circuits are installed where single 120-volt inverters are connected to 120/240-volt load centers. (CEC 690.10[C])

62. The barrier is reinstalled between the AC, DC wiring and communication wires. (CEC 110.3[B] & 110.27)

Signs and Labels

63. All interior and exterior DC conduit, enclosures, raceways, cable assemblies, junction boxes, combiner boxes and disconnects are marked. (CFC 605.11.1, CEC 690.31[E][3], CEC 690.31[E][4], 690.17 & 690.53 & CRC R331.2)

64. The markings on the conduits, raceways and cable assemblies are every 10 feet, within one foot of all turns or bends and within one foot above and below all penetrations of roof/ceiling assemblies, walls and barriers. (CFC 605.11.1.4, CRC R331.2.4, CEC 690.31[E][3] & CEC 690.31[E][4])

65. Marking is placed adjacent to the main service disconnect in a location clearly visible from where the disconnect is operated. (CFC 605.11.1.3 & CRC R331.2.3)

66. The markings say "WARNING: PHOTOVOLTAIC POWER SOURCE" and have 3/8-inch (9.5 mm) minimum-sized white letters on a red background. The signs are made of reflective weather resistant material. (CFC 605.11.1.1, 605.11.1.2 & CRC R331.2.1 - R331.2.2 & CEC 690.31[E])[3] & 690.31[E][4])

67. Where PV circuits are embedded in built-up, laminate or membrane roofing materials in roof areas not covered by PV modules and associated equipment, the location of circuits shall be clearly marked. (CEC 690.4[F])

68. Required labels shall be permanent and suitable for the environment. The following labels are required as applicable.

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Table 1. Signage Requirements for PV systems		
Code Section	Location of Label	Text
CEC 690.5(C)	Utility-interactive inverter & battery enclosure	WARNING: ELECTRIC SHOCK HAZARD IF A GROUND FAULT IS INDICATED, NORMALLY GROUNDED CONDUCTORS MAY BE UNGROUNDED AND ENERGIZED
CEC 690.35(F)	All enclosures with ungrounded circuits or devices which are energized and may be exposed during service	WARNING: ELECTRIC SHOCK HAZARD. THE DC CONDUCTORS OF THIS PHOTOVOLTAIC SYSTEM ARE UNGROUNDED AND MAY BE ENERGIZED.
CEC 690.14(C)(1)	On the main service when DC wiring is run through the building and the DC disconnect is located other than at the main service	DC DISCONNECT IS LOCATED....
CEC 690.14(C)(2)	On the AC and DC disconnects	PHOTOVOLTAIC SYSTEM DISCONNECT
CEC 690.53	On the DC disconnects	OPERATING CURRENT _____ OPERATING VOLTAGE _____ MAXIMUM SYSTEM VOLTAGE ___ SHORT CIRCUIT CURRENT _____
CEC 690.54	At interactive points of interconnection, usually the main service	RATED AC OUTPUT CURRENT _____ AMPS NORMAL OPERATING AC VOLTAGE _____ VOLTS
CEC 690.56(B)/ 690.14(D)(4), 705.10 2011 CEC 690.4(H)	At the electrical service and at the PV inverter if not at the same location	A directory providing the location of the service disconnecting means and the photovoltaic system disconnecting means
CEC 690.17	On the DC disconnect and on any equipment that stays energized in the off position from the PV supply	WARNING! ELECTRIC SHOCK HAZARD. DO NOT TOUCH TERMINALS. TERMINALS ON BOTH THE LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION.
CEC 705.12 (D)(7)	Inverter output OCPD	WARNING: INVERTER OUTPUT CONNECTION DO NOT RELOCATE THIS OVERCURRENT DEVICE.
CFC 605.11.1.4, CEC 690.31(E)(3), 690.31(E)(4), CRC R331.2.4	On conduit, raceways and enclosures, mark every 10 feet, at turns, above/ below penetrations	WARNING: PHOTOVOLTAIC POWER SOURCE. *Note: This label shall have a red background with white lettering*

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FIRE SAFETY REQUIREMENTS

1. Rooftop-mounted PV panels and modules have the proper fire classification rating. (CBC 1509.7.2 & CRC R908.1.2)
2. Conduit, wiring systems and raceways for photovoltaic circuits are located as close as possible to the ridge, hip or valley and from the hip or valley as directly as possible to an outside wall to reduce trip hazards and maximize ventilation opportunities. (CFC 605.11.2 & CRC R331.3)
3. Conduit runs between sub arrays and to DC combiner boxes are installed in a manner that minimizes total amount of conduit on the roof by taking the shortest path from the array to the DC combiner box. (CFC 605.11.2 & CRC R331.3)
4. DC Combiner Boxes are located so that conduit runs are minimized in the pathways between arrays. (CFC 605.11.2 & CRC 331.3)
5. DC wiring in enclosed spaces in buildings is installed in metallic conduit or raceways. Conduit runs along the bottom of load bearing members. (CFC 605.11.2 & CEC 690.4[F] & CRC R331.3)
6. All roofs have an access point that does not place ground ladders over openings such as windows or doors, are located at strong points of building construction, and in locations where the access point does not conflict with overhead obstructions such as tree limbs, wires or signs. (CFC 605.11.3.1 & CRC R331.3)
7. Roofs with slopes greater than 2:12 have solar panel layouts with access pathways that comply with approved roof plan that meet the following criteria: (some exceptions apply, see diagrams in the California Solar Permitting Guidebook)
   A. Hip Roofs: Panels/modules are located so that there is a 3-foot wide clear access pathway from the eave to the ridge on each roof slope where panels/modules are located. (CFC 605.11.3.2.1 & CRC R331.4.2.1)
   B. Hips and Valleys: If panels/modules are placed on both sides of a hip or valley they are located no closer than 18 inches to a hip or valley. If the panels are located on only one side of a hip or valley that is of equal length, then the panels can be placed directly adjacent to the hip or valley. (CFC 605.11.3.2.3 & CRC R 331.4.2.3)
   C. Single Ridges: Panels/modules are located so that there are two 3-foot wide access pathways from the eave to the ridge on each roof slope where there are panels/modules installed. (CFC 605.11.3.2.2 & CRC R331.4.2.2)
   D. Ridges: Panels/modules are located no higher than 3 feet from the top of the ridge in order to allow for fire department smoke ventilation operations. (CFC605.11.3.2.4 & CRC R331.4.2.4)
   E. Access pathways are located at a structurally sound location capable of supporting the load of fire fighters accessing the roof. (CFC 605.11.3.2.1 & CRC R331.4.2.1)

STRUCTURAL AND OTHER CODE REQUIREMENTS

List the structural requirements by the Authority Having Jurisdiction.