Streamlining the Solar Permitting Process

Jeff Spies: President - Planet Plan Sets





Instructor Bio

Jeff Spies - Planet Plan Sets

- Planet Plan Sets: President
 - Permitting plan sets for residential solar
- NABCEP: Secretary
 - Executive Board Member, Conference Education Chair
- CALSSA (aka CALSEIA): Board Member
 - Chair of Codes/Standards Committee
- UL 2703 Standard Technical Panel Member
 - 6 years as Bonding/Grounding Task Group Leader
- "Solar Roots the Pioneers of PV" Executive Producer
 - The TRUE story of the birth of an industry. Hear from the industry pioneers who brought PV down from
 - space into homes around the world.













Codes and Standards

Solar codes and standards are complicated by the need for multiple trades and skillsets

- Electrical
- Roofing
- Plumbing
- Carpentry
- IT





Growing Complexity in Codes & Standards

- Alphabet soup of codes, standards, and industry best practices
- Codes and standards growing more complex
- Confusion is the new solar standard





Permitting and Inspection

- Federal government grants states the rights to administer safety codes
- State governments empower jurisdictions to interpret building, electrical, fire, and plumbing code
- AHJ allowed to impose more restrictive requirements than code requires if it can be justified on unique site conditions
 - must be done through ordinance





AHJ's make the rules

AHJ's interpret codes based upon state law and state building code requirements with some possible amendments





BUILDING DEPARTMENT



AHJ's can establish more stringent requirements

AHJ's legally empowered to amend building, electrical, fire codes based on unique conditions

- Climatic
- Geological
- Seismological
- Topographical





California Solar Permitting Guidebook

- PV Toolkit for Local Governments ..
 - Submittal Requirements
 - Eligibility Checklist for Expedited Permitting
 - Solar PV Standard Plan
 - String Inverter Systems
 - Microinverter Systems
 - Structural Criteria
 - MOU Regarding Solar Photovoltaic Plan Review and Inspection Services
 - Inspection Guide for PV Systems





AHJ - Authority Having Jurisdiction

- Important AHJ Officials
 - Permit techs
 - Inspectors
 - Combination Inspectors
 - Electrical Inspectors
 - CBO: Chief Building Officials
- Most are conscientious and competent professionals
 - However, many lack sufficient education in PV codes/standards
- Review AHJ websites for city/ county ordinances and permitting requirements





What's the best way to make friends with AHJs?





A good plan set!

- Elements of a quality plan set
 - Site plan
 - Layout
 - Structural details
 - Electrical diagrams
 - Warning Labels/Placards
 - Spec sheets
 - Certification Docs



Clear consistent plan sets are key to efficient permitting



Who Uses a PV Plan Set?

- Building department Permit Tech
 - Simple easy to read plans help
- Inspector
 - Clear wire diagrams and layout facilitates efficient inspection
- Installers
 - Plans serve as blueprint for system construction
- Homeowners
 - Needed for future service if installing contractor no longer available





Plan Set Generation

Knowledge and Experience Required

Codes and Standards

- PV String, Wire, and Conduit Sizing: NEC
- Fire Setbacks and Pathways: IFC, IRC, & IBC
- Rapid Shutdown: NEC 690.12, UL 1741
- System Grounding and Bonding, NEC and UL 2703
- Fire Classification: UL 2703/1703
- Structural Requirements: IBC, IRC, ASCE 7

CAD Drafting

- AHJ Permitting Practices
 - Streamlined permitting standard plans





Codes and Standards

- Most PV systems were not permitted and inspected until the 2000's
- PV permitting now represents over half of permits issued by many building departments
- Codes & standards getting more complex
 - Building officials struggling to keep up





Nationally Recognized Test Labs

Five OSHA Nationally Recognized Test Labs (NRTL's) test and list solar products to key UL standards

- UL 1703 modules
- -UL 2703 racking
- UL 1741 inverters
- UL 9540 energy storage
- UL 508 for array level RSD controls







Product Certification

- Intended to help AHJ's evaluate equipment not specifically addressed by code language
- Two labs certify products to the "intent of the code"
 - ICC-ES (Evaluation Services Lab) certifies products to standards called "Acceptance Criteria"
 - IAPMO-EGS certifies products to standards they call "Evaluation Criteria"







Installation Guidelines



NRCA Roofing Manuals

- Membrane roofs
- Steep Slope Roofs
- Metal panel & Foam roofs
- Re-roofing, Flashing, & Condensation

Tile Roofing Institute Install Manual

- 90% of tile roof
 - manufacturers mandate flashing guidelines found on page MC-07





AHJ Website Building Permit Requirements

- Chandler Arizona Building
 Department Website
 - <u>https://www.chandleraz.gov/government/</u> <u>departments/development-services/building-</u> <u>safety-plan-review-permits-and-inspections</u>

Electronic Plan Review

The City now offers electronic plan review for all projects. Please click on the links below for instructions on electronic submittals.

- Quick Tips for Electronic Submittal
- Registering for Citizen Access
- Full Electronic Submittal Instructions
- Pay Permit Fees: Citizen Access Portal
- Online Permitting & Inspection Scheduling
- Building Inspections Zone Map



Home | Business | Permits & Plan Reviews

Building Safety: Plan Review, Permits and Inspections

Building Safety reviews plans, issues permits, and conducts building inspections for development projects.

Electronic Plan Review

The City now offers electronic plan review for all projects. Please click on the links below for instructions on electronic submittals.

- Quick Tips for Electronic Submittal
- Registering for Citizen Access
- Full Electronic Submittal Instructions
- Pay Permit Fees: Citizen Access Portal

Building Inspections

Walk-In Plan Review

A "walk-in" plan review service is offered Monday Friday from 8 - 10 a.m. for residential and small commercial projects. Most residential additions and renovations may be reviewed using this service along with a limited number of minor scale commercial projects. Whether any particula project may be reviewed using our walk-in service will be determined by the plan reviewer on duty.

Building Safety staff inspects new development and redevelopment projects constructed in the City fc conformance to the approved building plans. To schedule inspections through our automated system please call 480-782-3100. For General Building Inspection questions, please contact the Chief Buildin Inspector at 480-782-3104.

Online Permitting & Inspection Scheduling
Building Inspections Zone Map



AHJ Website Code Requirements

- Chandler Arizona Building
 Department Website
 - <u>https://www.chandleraz.gov/government/</u> <u>departments/development-services/building-</u> <u>safety-plan-review-permits-and-inspections</u>

Building Construction Codes

The City of Chandler currently operates under the 2015 editions of International Codes with the 2014 edition of the National Electrical Code. The City has adopted the 2018 editions of the International Codes and the 2017 edition of the National Electrical Code with an effective date of July 1, 2019. All plans submitted for review on or after July 1 must be designed to comply with the new code editions. Plans submitted prior to July 1 may be designed under the 2015 or 2018 editions. For General Building de questions, please contact the Plan Reviewer of the day at 480-782-3078.

Building Construction Codes

The City of Chandler currently operates under the 2015 editions of Internatio edition of the National Electrical Code. The City has adopted the 2018 editions o and the 2017 edition of the National Electrical Code with an effective date or submitted for review on or after July 1 must be designed to comply with the r submitted prior to July 1 may be designed under the 2015 or 2018 edition Code questions, please contact the Plan Reviewer of the day at 480-782-3078.

- Chandler Amendments to the 2015 International Construction Codes
- Chandler Amendments to the 2018 International Construction Codes
- View International Construction Codes
- Homeowner's Building Permit Manual
 - Pool Fencing Requirements
- Development Fee Schedule
 - Building Permit Fees

Chandler Amendments to the 2015 International Construction Codes Chandler Amendments to the 2018 International Construction Codes View International Construction Codes Homeowner's Building Permit Manual Pool Fencing Requirements Development Fee Schedule Building Permit Fees

elf Certification of Building Plans

gistered design professionals can now self-certify that a project complies with all applicable laws and des.

Self Certification of Building Plans Policy

equest for Public Records

request a copy of a Permit, Certificate of Occupancy, Building Plans or other information, a Request r Public Records form must be submitted. Requests can be submitted in person, by fax or via email at **cords.requestinfo@chandleraz.gov**.

Request for Public Records



California Codes and Ordinances View for free at CBSC website

- California Building **Standards Commission** website
 - https://www.dgs.ca.gov/ -**BSC/Codes**
- View codes for free
- View AHJ ordinances





View (D) Standards for Free!

- Sign up for free account at <u>https://www.shopulstandards.com/</u>
- Important PV standards
 - UL 1741 Inverters
 - UL 1703 Modules
 - UL 2703 Racking and Grounding
 - UL 467 old grounding standard
 - UL 9540 Energy Storage
 - UL 508 Industrial Controls (RSD)



ભ

UL Standard

Since 1901, UL has been creating Standards for product safety. With over 1,000 Standards available for delivery in hardcopy, PDF, or electronic HTML formats, if you're looking for a UL Standard you've come to the right place.

Browse Standards Now

ULC

Standar



AHJ and Utility Requirements

- Equipment Locations
 - Easily accessible
 - Behind a fence or locked gate?
- Disconnecting means
 - External lockable AC disconnect vs backfed breaker?
- Rapid shutdown initiation device location
- Energy storage location
 - Definition of Habitable Space
 - UL 9540 or UL 1973 compliant?
- Inverters
 - Rule 21 compliant?
 - IEEE 1547 advanced inverter functions







Plan Set Generation In-House or Outsourced?

In-House Designer

- Benefits
 - In house oversight and control
 - Rapid response (in some cases)
- Challenges
 - Variable work load keeping drafter/designer busy
 - Employee turnover hiring/training designers

Outsourced Plan Drafting

- Benefits
 - Best option for small contractors
 - Unburden yourself from administrative tasks
 - Relief valve for overflow work
- Challenges
 - Prices (\$75 to \$600) and quality vary widely
 - Inexpensive plan drafting: quality and communication challenges

Do you prepare your own taxes?



Should you draft your own plans?



Or should you focus on installation?





Key Elements of a Plan Set

- 1) Cover Page
- 2) Site Plan
- 3) Layout
- 4) Structural Details
- 5) Electric Wire Diagram
- 6) Labels and Placards
- 7) Spec Sheets and Certification Documents
- 8) OPTIONAL Structural or Electrical PE Stamps



Cover Page

Scope of Work

- Wind Exposure and Speeds
- Ground Snow Load
- Code Versions
 - ► NEC, IBC, IRC, IFC, etc..
- Location on Map
- General Notes
 - Standards compliance
 - 1741, 1703, 2703, 508
 - AHJ ordinance compliance
- Table of Contents
- Contact information
 - Contractor, System Owner, Installation Address, Drafter





Site Plan

- Property Lines
- Driveway and Street
- Gates and Fences
- Pools and Septic Fields
- Major Equipment Locations
 - Meters: Utility and Production
 - MSP, Subpanels
 - Disconnects, Combiners
 - Inverters and Other Controls
 - Rapid Shut Down Initiation Device
 - Energy Storage Systems
 - Generators, Transfer Switch





String Configuration





Array Layout

- Module location
- Roof Attachments
- Fire setbacks
 - Ridges, Hips, Valleys
- Access pathways
 - One Path or Two?
- Rooftop Combiners
- Junction Boxes
- Conduit runs
- Roof Conduit Penetrations





Structural Details





Attachment Details

- Roof attachment
- Rafter size, spacing
- Fastener detail
 - embedment specs



PV MODULE -



American Wood Council's National Design Specification

Code Requirements for Centering Roof Fasteners



2018









Centering lag screw



American Wood Council's National Design Specification requires minimum edge distance of 1.5 x screw diameter

- 5/16" lag screw = 0.31" diameter
- 0.31" x 1.5 = 0.47"
- 1.50" 0.47" 0.47 = 0.56"

Table 11.5.1CEdge DistanceRequirements1,2

Direction of Loading	Minimum Edge Distance
Parallel to Grain:	
where $\ell/D \le 6$	1.5D
where $\ell/D > 6$	1.5D or $\frac{1}{2}$ the spacing between
	rows, whichever is greater





Centering Fasteners

- Missing rafter increases leak potential
- Wood knots increase blowouts
 - Always drill pilot hole
- Inspect for rafter blowouts
 - Repair before commissioning
- Code mandates centered fasteners









ALWAYS DRILL PILOT HOLES !!!





Finding Rafters

- Locate rafters at eaves
- Attic rafter mapping
- Roof dance
- Hammer tapping
- Exploratory Drilling
- Stud finders
- Thermal imaging camera
- NEW chiptoolz Rafter Finder!



Quick Mount PV rafter finding video tutorial



chiptoolz Rafter Finder





chiptoolz - Rafter Finder

Finds the center every time!

- Drill finder hole near rafter (up to 3" away)
- 2. Insert wire into hole
- 3. Rotate tool to locate center of rafter
- 4. Mark the center of rafter and drill hole
- 5. Seal finder hole
- 6. Use proper flashing





Electrical Plans

- Single Line Wire Diagram vs 3-Line Wire Diagram
- Service Panel Information
 - End Fed vs Center Fed
 - Bus bar rating 20% rule
 - Main breaker size
- Additional Backfeed Options
 - Derate Main Breaker (easiest cheapest option)
 - Line side connection
 - Service panel upgrade
 - Solar ready service panel best
 - Meter socket Adapter
 - B3 bypass main breaker





Rapid Shutdown

- 2017 NEC 690.12 requires array voltage inside array boundaries 80V or less after RSD initiated
 - Requires use of MLPE
 - Micro-inverters, Optimizers/Maximizers
 - Shutdown switch options
 - ► Tigo, Maxim, TI, ??
- NOTE: Solar Shingles have no "Inside the array" limit, but must reduce voltage to 30 volts or less in 30 seconds within 12" of array boundary or in attic within 36" of wire passthrough. Controls available from some inverter mfg'rs and 3rd party companies.









Line Side Connectors

- Possible when meter and main are connected with accessible conductor cables
- Many AHJs do not allow line side connection
- Meter Mains may not work with line side connection
- Utilities often make line side connection administratively difficult

Milbank Connector

llsco

KUP-L-TAP

Polaris

Connector









Energy Storage Systems

- Gateway/Transfer switches
- Warning labels and wiring diagrams vary based on unique system configurations
- Additional panels may be needed
 - generation panel
 - critical load panel (backed up loads)
- Communication wiring
 - CT's
 - Data cable connections?
- Gas/diesel/propane generator?









Safety Labels and Placard

ANSI standard colors matter

INSTALL ON THE UTILITY METER	INSTALL ON THE AC DISCONNECT	INSTALL ON THE INVERTER #	#1 & #2 (OUTBACK RADIAN)	INSTALL ON THE INVERTER	R #3 (SMA INVERTER)
AWARNING	PHOTOVOLTAIC AC DISCONNECT	PHOTOVOLT	AIC SYSTEM	PHOTOVOLTA	
	MAXIMUM AC OPERATING CURRENT: 50 A	DC DISC	ONNECT	DC DISCO	NNECT
THIS SERVICE METER	NOMINAL AC OPERATING VOLTAGE: 240 V	OPERATING VOLTAGE	162.50 VDC	OPERATING VOLTAGE	325.00 VDC
IS ALSO SERVED BY A		OPERATING CURRENT	36.96 AMPS	OPERATING CURRENT	9.24 AMPS
PHOTOVOLTAIC SYSTEM	PV SYSTEM DISCONNECT FOR	MAX SYSTEM VOLTAGE	300 VDC	MAX SYSTEM VOLTAGE	600 VDC
	UTILITY OPERATION	SHORT CIRCUIT CURRE	ENT 39.32 AMPS	SHORT CIRCUIT CURRE	NT 9.83 AMPS
INSTALL ON THE MAIN BREAKER PANEL		CHARGE CONTROLLER	MAX 100 AMPS	CHARGE CONTROLLER	MAX N/A AMPS
PHOTOVOLTAIC CIRCUIT				INSTALL ON THE INVERTER	#4 (SMA INVERTER #2)
EQUIPPED WITH RAPID	WARNING: PHOTOVOLTAIC			PHOTOVOLTA	IC SYSTEM
SHUTDOWN	POWER SOURCE				NNECT
		ELECTRICAL SI	HOCK HAZARD		
TO BE INSTALLED IN ACCORDANCE	[Only use when applicable for PV load center]	DO NOT TOUC	H TERMINALS	OPERATING CURRENT	9 24 AMPS
WITH SECTION 690.56(C):		TERMINALS ON	BOTH LINE AND	MAX SYSTEM VOLTAGE	600 VDC
CAUTION: SOLAR ELECTRIC		LOAD SIDES MAY	BE ENERGIZED	SHORT CIRCUIT CURRE	NT 9.83 AMPS
SYSTEM CONNECTED		IN THE OPEI	N POSITION	CHARGE CONTROLLER	MAX N/A AMPS
PHOTOVOLTAIC AC DISCONNECT	PHOTOVOLTAIC SYSTEM				
MAXIMUM AC OPERATING CURRENT: 50 A	COMBINER PANEL		INSTALL ON INV	VERTERS #3 & #4	
NOMINAL AC OPERATING VOLTAGE: 240 V	DO NOT ADD LOADS	1			
				RNING	
INSTALL INSIDE THE MAIN BREAKER PANEL, NEXT TO THE SOLAR BREAKER					DRAFTER NAME:- PLANETPLANSETS
	CAUTION.		ELECTRICAL S	HOCK HAZARD	PHONE NO. (866) 898-6886
		IED	IF A GROUND FA	ULT IS INDICATED	
	DISCONNECTS LOCATED AS SHOWN:	' 	NORMALLY GROU	NDED CONDUCTORS	CONTRACTOR INSTALLED
TURN OFF PHOTOVOLTAIC			MAY BE UNGROUN	DED AND ENERGIZED	KIENAN MAXFIELD
AC DISCONNECT PRIOR TO					CONTRACTOR AND A CONTRACTOR
WORKING INSIDE PANEL					and a state of the second s
					Contraction of the country care
INSTALL INSIDE THE MAIN BREAKER PANEL,					The second second second
NEXT TO THE SOLAR BREAKER					100-1000-000-00
PV SOLAR BREAKER					GM2086-101180800
DO NOT RELOCATE THIS					COLO-COMPLICATION
OVERCURRENT DEVICE					
PHOTOVOLTAIC CIRCUIT	TRANSER SWITCHES LO,	AD CENTER			
EQUIPPED WITH RAPID					
SHUTDOWN	690 HIGH RIDGE DR, ALPINE, UT 84004				



Product Spec Sheets





Certification Docs

- Modules: UL 1703
 - Fire classification "Type"
- Racking: UL 2703
 - bonding/grounding
 - mechanical loading
 - fire classification
- Inverter: UL 1741
 - NEW!: California requires all inverters certified for reactive power priority for Volt-Var
- Energy Storage: UL 9540
 - Battery cells listed to UL 1973

			And the second second
Ce	rtificat	te	TÜV Rheinlan
Certificate no.	US 8216001	5 01	
Lkense Hølder: Unirac Inc. 1411 Broadway B Albuguerque NM USA	6E 87102	Massificturing Plant: Unirac Inc. 1411 Broadway NE Albuquerque NM 87102 USA	
Test report no.: USA- 3 Tested to: UL	2703-2015	Client Reference: Ton. Young	
Certified Product: No	dule Rack Mount]	ing System	License Fee - Units
Certified Product: No Nodel Designati Max System Vol Max Size of Po	dule Rack Mount ion: SolarMount Ltage of PV Modul 2 Module: 20.8 sc	Ing System (SM) le: 1000 VDC I.f. surface area	License Fre - Units 7
Cartified Product: No Nodel Designati Max System Vol Max Size of Po Max Overcurret 30 A when us 20 A when us	dule Rack Mount ion: SolarMount ltage of PV Modul Module: 20.8 so it Protection Ra sing the qualific ing the Enphase	Ing System (SM) le: 1000 VDC q.ft. surface area ting of FV Module: ad grounding lugs; micro inverter EGC.	Liconse Fre - Units 7
Cartified Product: Not Nodel Designati Max System Vol Max Size of PX Max Overcurrer 30 A when us 20 A when us Fire Rating: 0 Type 1, Type	dule Rack Mount ion: SolarMount ltage of PV Modul Module: 20.8 so it Protection Ra sing the gualific ing the Enphase class A when inst 2, Type3, or Ty	Ing System (SM) le: 1000 VDC q.ft. surface area ting of FV Module: ad grounding lugs; micro inverter RGC. talled with ype 10 fire rated modules.	License Fre-Units 7
Certified Product: No Nodel Designati Max System Vol Max Size of PV Max Overcurrer 30 A when us 20 A when us Fire Rating: O Type 1, Type	dule Rack Mount ion: SolarMount bage of PV Modul Module: 20.8 so it Protection Rat ing the qualifie ing the Enphase class A when inst 2, Type3, or Ty	Ing System (SM) le: 1000 VDC q.ft. surface area ting of FV Nodule: ad grounding lugs: micro inverter EGC. talled with ype 10 fire rated modules. (continued	License Fee - Units 7
Certified Product: No Model Designati Max System Vol Max Size of PV Max Overcurrer 30 A when us 20 A when us Fire Rating: O Type 1, Type Appendix: 1,1-5	dule Rack Mount] ion: SolarMount tage of PV Modul 7 Module: 20.8 so bing the qualifie ing the Enphase class A when inst 2, Type3, or Ty	Ing System (SM) le: 1000 VDC q.ft. surface area ting of FV Module: ed grounding lugs; micro inverter EGC. talled with ype 10 fire rated modules. (continued	License Fee - Units 7
Certified Product: No Nodel Designati Max System Vol Max Size of PA Max Overcurrer 30 A when us 20 A when us Pire Rating: O Type 1, Type Appendix: 1,1-5 Licensed Test mark:	dule Rack Mount ion: SolarMount tage of PV Modul Module: 20.8 so it Protection Rai ring the gualific ing the Enphase class A when inst 2, Type3, or Ty	Ing System (SM) le: 1000 VDC q.ft. surface area ting of FV Module: ad grounding lugs; micro inverter EGC. talled with ype 10 fire rated modules. (continued	License Fee - Units 7 7 Date of Issue (day/me/yr) 27/07/2016



Important Structural Information





Important Structural Information





Corrections and Revisions

Corrections: from AHJ

- Corrections for mistakes or local code requirements
- AHJ's can impose more stringent requirements than NEC, IBC, IRC, IFC, or other applicable codes require

Revisions: from contractor or system owner

- Occur due to site survey errors, product availability, and system owner aesthetic issues
- Good photos, recorded specs, and accurate measurements matter
- Update plan set with "As Built" revisions
 - For benefit of contractor, AHJ, and owner
 - Avoid unneeded truck roles to diagnose system configuration







Inspections

- Have plans in hand ready for review
- Have code books available to address complicated questions
- Be prepared to:
 - Get on roof
 - Remove PV modules to verify listing
 - Inspect weatherproofing
 - Perform attic inspections
 - Inspect for smoke/CO detectors
 - Inspect DC/AC wiring, inverter, disconnects, j-boxes
 - Array grounding
 - Perform service panel inspection
- Be respectful





Working with AHJ's

- State Solar Trade Orgs
 - CALSSA codes/standards committee works for member companies to appeal codes & standards interpretations using top subject matter experts
- Solar Industry Building Official Org
 - SEAC Sustainable Energy Action Committee
- Code Official Organizations
 - ICC Chapter Meetings
 - IAEI Section Meetings
 - State Building Official Training
 - ► CALBO
 - ► NEBOAC









Streamlining the Solar Permitting Process

Jeff Spies: President - Planet Plan Sets

