

## SOLAR PHOTOVOLTAIC QUALITY ASSURANCE SUMMARY REPORT

Report prepared for MassCEC Solar Loan Program

Contractor Information	
ID Number	All Period Installers
Contractor	All Period Installers
Status	All Period Installers

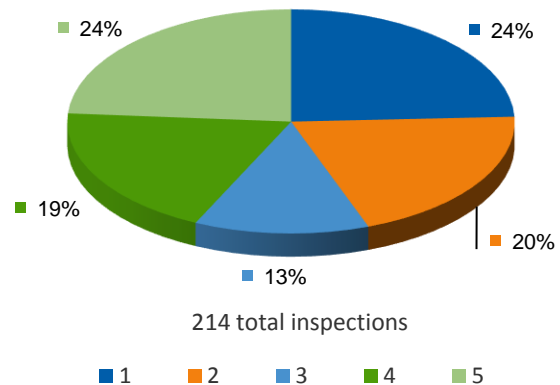
Summary Inspections Results For	
Start Date	1/1/2018
End Date	12/31/2018
Inspections	214

This report summarizes the results of solar quality assurance (QA) inspections completed for the time period and installer(s) noted above. These results were collected and analyzed in the PV Quality Evaluation and Scoring Tool (PVQUEST) and are presented here to provide important guidance on common installation issues in an effort to support installer training and improve the quality of solar PV installations.

Using PVQUEST, Cadmus rates each project on a 1-5 scale, with a higher score corresponding to fewer installation issues found. These scores, and our findings for this group of installations, are shown below.

Solar QA Score Summary		
Score	Description	Count
1	System has critical and/or multiple major deficiencies	52
2	System has at least one major deficiency	43
3	System has multiple minor deficiencies	27
4	System has minor and/or incidental deficiencies	41
5	System has no, or only incidental, deficiencies	51

### Summary of Solar QA Results



Inspection Year	Total Inspections	Count by QA Score					Average Score
		1	2	3	4	5	
2018	214	52	43	27	41	51	2.98

We have summarized these inspection results using a variety of key metrics, as shown below. These metrics include QA scoring statistics, an indication of the most common portion of the system found with installation deficiencies, and the most common deficiency found in each defect category (Incidental, Minor, Major, or Critical).

### Key Metrics and Recommendations

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Average QA Score for Period	2.98 out of 5
Most Frequent Deficiency Type	Labeling (23% of Issues Identified)
Inspection Element with Highest Percentage of Deficiencies	Array (42% of Issues Identified)
*Most Common Critical Deficiency	(42 out of 307) Array conductors found disconnected or improperly connected, which may be causing portions of the array to be inoperable and/or pose a shock hazard.
*Most Common Major Deficiency	(61 out of 307) Module is not properly secured to the racking system, per manufacturer instructions and NEC Article 110.3(B).
*Most Common Minor Deficiency	(62 out of 307) Circuit conductors are sagging and in contact with the roof and/or not supported and secured at least every 4.5' and within 12" of every outlet box, junction box, cabinet, or fitting, in violation of NEC Articles 338.10(B)(4) and 334.30.
*Most Common Non-Labeling Incidental Deficiency	(50 out of 313) DC conduit was not labeled "WARNING: PHOTOVOLTAIC POWER SOURCE" every 10', or was not reflective or colored in violation of NEC Article 690.31(G)(3) and (4).
*Most Common Incidental Deficiency	(81 out of 165) Permanent plaque or directory denoting location of all power sources and location of disconnects on premise at each service equipment location is missing, incomplete, or unsuitable for the environment, in violation of NEC Articles 705.10, 690.56 and/or 110.21.

\* Frequency is defined as the number of issues found out of the number of inspection elements of that type observed. For example, "10 out of 30" means that, of all the inspections analyzed, we found an issue 10 times on a total of 30 times we saw that inspection element.

Cadmus rates each deficiency with a defect category, which reflects the severity of the issue and how likely it is to create a hazard to personnel or property. These defect categories are explained, below.

Defect Category	Definition	Examples
Critical	Imminent hazard or system not operating	Modules on roof loose, busbars overloaded, Missing/inadequate OCPD
Major	Very likely to create a hazard or cause system to fail	Water collecting in enclosures, EGC/GEC undersized, breakers undersized, component not grounded
Minor	May cause a hazard/failure over time or under special circumstances	AC disconnect wired backwards, conductors touching roof surface, missing expansion joint, GEC not continuous
Incidental	Unlikely to cause a hazard/failure but not code compliant	Missing/incomplete labels, missing conduit indoor/outdoor air sealing, improper wire coloring

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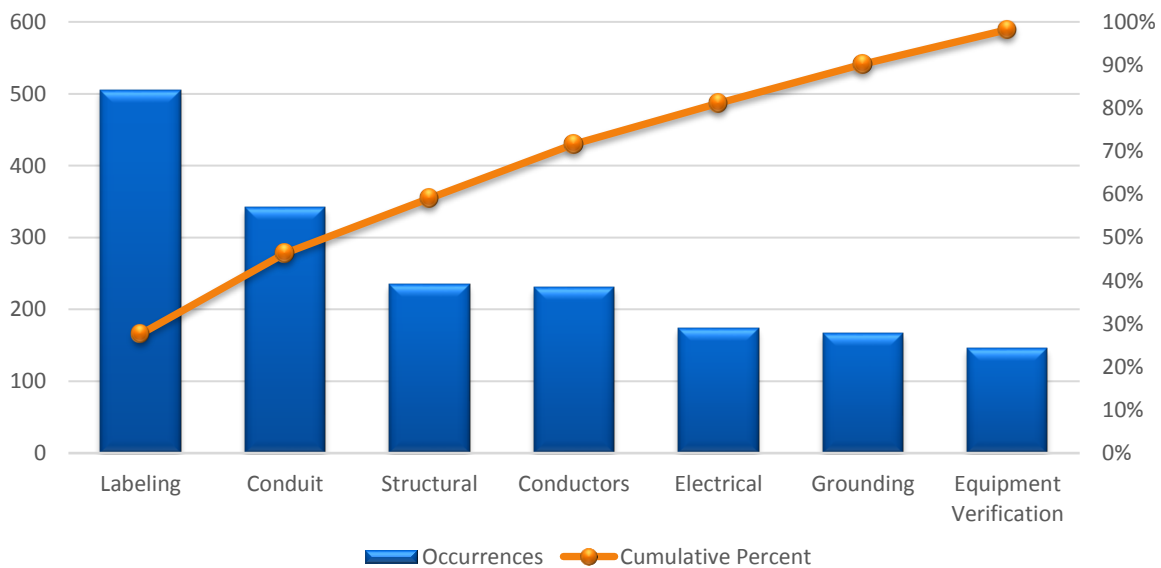
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Program Info		Inspections Completed	
Program:	N/A	Start Date:	1/1/2018
Report Date:	3/4/2019	End Date:	12/31/2018

### Inspection Issues Found by Inspection Element

During inspections, Cadmus inspects each major system component (known as an "Inspection Element") such as the array, disconnects, interconnection point, or inverter. We summarize our findings for each element in order to help target improvements in installation practices.

Inspection Element	Recommendation	Incidental	Minor	Major	Critical	Total
AC Combiner	0	95	49	11	1	156
AC Disconnect	1	75	46	2	1	125
Array	3	217	367	167	8	762
DC Combiner	0	20	4	0	0	24
DC Disconnect	0	8	1	1	1	11
Feeder Tap Connection	1	15	18	4	6	44
Inverter	1	215	263	13	0	492
Junction Box	0	37	57	5	1	100
Load Side Connection	0	71	17	7	5	100
Optimizer	0	0	4	2	0	6
Overall Observations	5	9	0	17	0	31
Production Meter	1	4	17	1	0	23
Subpanel	0	3	1	0	0	4
Supply Side Connection	1	181	127	31	1	341



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*Top Deficiencies*

Frequency*	Inspection Element	Deficiency Type / Defect Category	Deficiency Description
81 out of 165	Supply Side Connection	Labeling	Permanent plaque or directory denoting location of all power sources and location of disconnects on premise at each service equipment location is missing, incomplete, or unsuitable for the environment, in violation of NEC Articles 705.10, 690.56 and/or 110.21.
62 out of 307	Array	Conductors	Circuit conductors are sagging and in contact with the roof and/or not supported and secured at least every 4.5' and within 12" of every outlet box, junction box, cabinet, or fitting, in violation of NEC Articles 338.10(B)(4) and 334.30.
61 out of 307	Array	Structural	Module is not properly secured to the racking system, per manufacturer instructions and NEC Article 110.3(B).
61 out of 231	Inverter	Labeling	Inverter information label is missing, incomplete, or unsuitable for the environment, in violation of NEC Article 690.53. Label: Rated maximum power-point current (Imp): ____ADC Rated maximum power-point voltage (Vmp): ____VDC Maximum system voltage (Voc): ____VDC Short-circuit current (Isc): ____ADC Maximum rated output current of charge controller (if installed): ____ADC
58 out of 307	Array	Structural	Racking system mechanical connections not made correctly and/or racking not installed per manufacturer instructions, in violation of NEC Article 110.3(B).
50 out of 313	Array	Conduit	DC conduit was not labeled "WARNING: PHOTOVOLTAIC POWER SOURCE" every 10', or was not reflective or colored in violation of NEC Article 690.31(G)(3) and (4).
47 out of 165	Supply Side Connection	Labeling	Service Disconnect label with AC output information is missing, incomplete, or not suitable for the environment, in violation of NEC Article 690.54 and/or 110.21. Label: Rated AC output current: ____AAC Nominal operating AC voltage: ____VAC
44 out of 308	Array	Electrical	The array contained components that were not listed for an outdoor environment, in violation of NEC Articles 300.6 and 110.3(B). See inspector comments/photos for further details.
42 out of 307	Array	Conductors	Array conductors found disconnected or improperly connected, which may be causing portions of the array to be inoperable and/or pose a shock hazard.