Solar Operations and Maintenance Training

Curriculum Development Support from Wisconsin Distributed Resources Collaborative

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1/19/18
Solar Operations and Maintenance (O&M) Training

Project Goals:
Develop and deliver advanced Solar Operations and Maintenance (O&M) training to municipalities, facility owners and solar contractors in Wisconsin with the objective of ensuring that new and existing PV systems in Wisconsin are properly maintained throughout their expected lifetimes of 25 or more years.
Cari Helberg is the Asset Manager for Ecos Energy, based in Minneapolis, MN. She is responsible for the operation of more than 30 MW of utility-scale solar plants throughout the US. She is a licensed master electrician and IAEI certified electrical inspector. When not in the field, she teaches classes in code calculations, code updates and Article 690 (solar PV).
PV Operations and Maintenance
Course Development

Establish Learning Objectives:

1. Recognize hazards related to working with PV systems
2. Describe steps necessary for performing visual PV inspection
3. Identify and remove obstructions to the solar window
4. Identify improperly installed PV components
5. Calculate expected PV system energy output
6. Compare expected PV system output with system monitoring data
7. Identify equipment required for taking safe field measurements
8. Measure system output (voltage, current, power and energy)
9. Verify and interpret field measurements
10. Recognize common PV system malfunctions
11. Follow logical troubleshooting procedures
12. Identify proper protocols in re-commissioning PV system
1) Recognize Safety Hazards Related to Working with PV systems
2) Describe Steps Necessary for Performing Visual PV Inspection
3) Identify and Remove Obstructions to the Solar Window

Number of Participants

1 = Confident ... 5 = Unsure
4) Identify Improperly Installed PV Components

Number of Participants

1 = Confident ... 5 = Unsure

1 2 3 4 5

Pre-Course
Post-Course
5) Calculate Expected PV System Energy Output

Number of Participants

1 = Confident ... 5 = Unsure

Pre-Course
Post-Course
6) Compare expected PV system output with system monitoring data.

[Graph showing number of participants with confidence levels ranging from 1 to 5, with blue line labeled Pre-Course and orange line labeled Post-Course.]
7) Identify equipment required for taking safe field measurements
8) Measure System Output (Voltage, Current, Power and Energy)
9) Verify and Interpret Field Measurements

![Graph showing the number of participants before and after a course, with ratings from 1 (confident) to 5 (unsure). The graph compares Pre-Course and Post-Course levels.]

- Number of Participants
- 1 = Confident ..., 5 = Unsure
10) Recognize Common PV System Malfunctions
11) Follow Logical Troubleshooting Procedures
12) Identify proper protocols in re-commissioning PV system

![Graph showing the number of participants' confidence levels before and after a course.](image-url)
Measuring Training Success
Pre Training Assessment

Number of Participants
1 = Very Confident ... 5 = Unsure

- Recognize safety hazards related to working with PV systems
- Describe steps necessary for performing visual PV inspection
- Identify and remove obstructions to the solar window
- Identify improperly installed PV components
- Calculate expected PV system energy output
- Compare expected PV system output with system monitoring data
- Identify equipment required for taking safe field measurements
- Measure system output (voltage, current, power and energy)
- Verify and interpret field measurements
- Recognize common PV system malfunctions
- Follow logical troubleshooting procedures
- Identify proper protocols in recommissioning PV system
Measuring Training Success
Post Training Assessment

Number of Participants

1 = Very Confident ... 5 = Unsure

- Recognize safety hazards related to working with PV systems
- Describe steps necessary for performing visual PV inspection
- Identify and remove obstructions to the solar window
- Identify improperly installed PV components
- Calculate expected PV system energy output
- Compare expected PV system output with system monitoring data
- Identify equipment required for taking safe field measurements
- Measure system output (voltage, current, power and energy)
- Verify and interpret field measurements
- Recognize common PV system malfunctions
- Follow logical troubleshooting procedures
- Identify proper protocols in re-commissioning PV system
Pre-Course vs. Post-Course Assessment

Pre-Course Assessment

Post-Course Assessment
Oneida System Renovation
November 2017
1) Recognize Safety Hazards Related to Working with PV systems
2) Describe Steps Necessary for Performing Visual PV Inspection
3) Identify and Remove Obstructions to the Solar Window
4) Identify Improperly Installed PV components
5) Calculate Expected PV System Energy Output
6) Compare Expected PV System Output with System Monitoring Data
7) Identify Equipment Required for Taking Safe Field Measurements
8) Measure System Output (Voltage, Current, Power and Energy)
9) Verify and Interpret Field Measurements

Verify and interpret field measurements

Series 1
Series 2
10) Recognize Common PV System Malfunctions
11) Follow Logical Troubleshooting Procedures
12) Identify Proper Protocols in Re-commissioning PV System
Recognize safety hazards related to working with PV systems
Describe steps necessary for performing visual PV inspection
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PV O&M Training

What’s next?

• Offer the class online
• Offer the class at 2018 Energy Fair
• Submitted for Solar Power International 2018 in September
• Other regional Conferences

Thank you for making this training possible!