

# Solar Systems Advanced Certification - Photovoltaic

4 Days, 2.8 CEUs

Photovoltaic (PV) systems are electrical systems that utilize the energy from photons within sunlight to produce electrical current and power anything from a single-family home to industrial-sized buildings. These systems are installed and maintained according to familiar electrical standards such as the National Electrical Code (NEC) and the National Fire Protection Association (NFPA). These Code bodies also defined specific practices and procedures to keep electrical workers safe in both energized and deenergized conditions. This course is designed to discuss PV principles, outline standards, and deliver the safest practices for all work involving PV systems.

## Lab and Classroom Attire

AVO is committed to the personal safety of each participant and requires safety glasses, long pants, and ANSI rated "safety-toe" work shoes for lab activities. Lecture courses may involve a tour of a work or shop area and for this reason open-toe shoes and shorts are not considered appropriate attire for the classroom.

## Learning Objectives

To receive 2.8 CEUs, participants must attend 4 days of class (28 contact hours) and attain a minimum average grade of 80% on the final exam. Upon completion of this course the participants will demonstrate that they are able to:

- Evaluate the principles of photovoltaic cells and their interaction with sunlight to create usable electrical energy.
- Interpret the articles of the National Electrical Code (NEC) and other standards to evaluate how photovoltaic systems must be utilized in accordance with all regulatory bodies.
- Employ the necessary safety practices and procedures to establish an electrically safe working condition for any photovoltaic system.

## SCOPE

### Day 1\* (7 contact hours)

- I. Introduction - Outline
- II. Fundamentals of PV Technology
  - A. Sunlight
  - B. PV Cell
  - C. Silicon Semiconductor Layer
  - D. PV Cell Implementation
- III. PV System Components and Applications
  - A. PV System Characteristics
  - B. Array Locations
  - C. Definitions
  - D. Typical Components and Accessories
  - E. Typical Applications
- IV. NEC Article 690 Parts I, II, and III
  - A. National Electrical Code (NEC)
  - B. General Definitions and Markings
  - C. Article 690 Part I - General
  - D. Article 690 Part II - Circuit Requirements
  - E. Article 690 Part III - Disconnecting Means

### Day 2 (7 contact hours)

- V. NEC Article 690 Parts IV, V, VI, VII, and VIII
  - A. Article 690 Part IV - Wiring Methods and Materials
  - B. Article 690 Part V - Grounding and Bonding
  - C. Article 690 Part VI - Marking
  - D. Article 690 Part VII - Connection to Other Sources
  - E. Article 690 Part VIII - Energy Storage Systems
- VI. NEC Articles 691 and 705
  - A. Article 691- Large-Scale Photovoltaic (PV) Electrical Supply Stations
  - B. Article 705 - Interconnected Electric Power Production Sources

### Day 3 (7 contact hours)

- VII. Hazards, Tools, and Safe Performance
  - A. Identify the Hazards
  - B. Tools
  - C. Safely Performing Work
  - D. Additional Resources
- VIII. NFPA 70E Article 110 - General Requirements for Electrical Safety-Related Work Practices
  - A. 110.1 - Priority
  - B. 110.2 - General
  - C. 110.3 - Electrically Safe Work Condition
  - D. 110.4 - Energized Work
  - E. 110.5 - Electrical Safety Program
  - F. 110.6 - Training Requirements
  - G. 110.8 - Test Instruments and Equipment
  - H. 110.11 - Overcurrent Protection Modification
  - I. 110.12 - Equipment Use

\*Class scheduling times may vary based on discussions and size of class

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## SCOPE (cont'd)

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| <p>IX. NFPA 70E Article 120 - Establishing an Electrically Safe Work Condition</p> <ul style="list-style-type: none"><li>A. 120.1 - Lockout/Tagout Program</li><li>B. 120.2 - Lockout/Tagout Principles</li><li>C. 120.3 - Lockout/Tagout Equipment</li><li>D. 120.4 - Lockout/Tagout Procedures</li><li>E. 120.5 - Process for Establishing and Verifying an Electrically Safe Work Condition</li></ul> <p><b>Day 4 - (7 contact hours)</b></p> <p>X. NFPA 70E Article 130 - Work Involving Electrical Hazards</p> <ul style="list-style-type: none"><li>A. 130.1 - General</li><li>B. 130.2 - Energized Electrical Work Permit</li><li>C. 130.4 - Shock Risk Assessment</li><li>D. 130.5 - Arc Flash Risk Assessment</li><li>E. 130.7 - Personal and Other Protective Equipment</li><li>F. 130.8 - Other Precautions for Personnel Activities</li></ul> <p>XI. Components, Applications, and Concepts of Energy Storage Systems (ESS)</p> <ul style="list-style-type: none"><li>A. Understand ESS Components, Functions and System Configurations</li><li>B. Utility-Scale Energy Storage Systems Applications</li><li>C. Key Terms and Concepts</li></ul> | <p>XII. ESS Chemistries and Configurations of ESS</p> <ul style="list-style-type: none"><li>A. ESS Chemistries</li><li>B. Common ESS Configurations</li></ul> <p>XIII. NEC Articles, Code Requirements, Safety Hazards, and Maintenance of ESS</p> <ul style="list-style-type: none"><li>A. 2020 NEC Articles and Sections Applied to ESS</li><li>B. Key Fire Code Requirements and Equipment Listings for ESS</li><li>C. Safety Hazards by ESS Chemistry</li><li>D. Inspection, Maintenance, and Testing of ESS</li></ul> <p>XIV. Conclusion</p> <ul style="list-style-type: none"><li>A. Review</li><li>B. Exam</li></ul> |
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## STANDARD EQUIPMENT LIST

### Solar Systems Advanced Certification - Photovoltaic

REVISED: May 2023

BY: R. Stansbury

DAYS: 4 DAYS

NOTE: All items indicated with an asterisk (\*) must be supplied by the client on On-Site courses

<b>TEXT ( PER 1 STUDENT )</b>	
1	Solar Systems Advanced Certification - Photovoltaic Course 606, May 2023

<b>MATERIALS NEEDED (PER CLASSROOM)</b>	
*1	PROJECTOR OR TV WITH PROJECTION CAPABILITIES
*1	DRY ERASE BOARD WITH MARKERS AND ERASER
*10	STUDENT TABLES
*10	STUDENT CHAIRS

FOR VIRTUAL CLASSES:

CONTENT MATERIAL WILL BE PROVIDED IN DIGITAL FORMAT