Course: **Certificate in Commercial Photovoltaics Systems Design and Installation: PV Installer Level 2**

Guided Learning Hours: **60**

Pre-Requisite: **ETA PV Installer Level 1 / Nabcep Pv Associate or Equivalent Training**

Abstract

This course is a comprehensive training program for PV Installers and persons engaged in the design of large commercial scale systems as well involved in industrial applications. Persons who already have residential systems training or entry level in PV systems designs, and or working experience in the field with residential will find this course very useful. The course contents cover relevant areas of knowledge that is required for the ETA PV Installer level 2 certification and is also required for advanced training listed by NABCEP Board Certifications. The program will include the use and practices of design using current industry standards modelling and simulation software PV Watts, PV Syst, and Helioscope

Target Audience

- Electrical PV Technicians
- PV System Designers
- Renewable Energy Integrators

Learning Outcomes

On completion of this course, learners will be able to:

1) Intro to Photovoltaics
2) How the Electric Grid Works
3) Determine Customer Needs
4) Site Survey
5) Components Selection
6) Arrays Sizing & System Wiring
7) Energy Storage Systems
8) Managing the Project Safety
10 Testing and Troubleshooting
11 Commission and Maintenance

Course Content

1. Intro to Photovoltaics

PV Module price, connecting to the Grid, Issues Connecting to the Grid, Economic Concern of Utilities, Technical Concern of Utilities, Future Trends. National Electric Code (NEC)

2. How the Electric Grid Works

What is the Grid, Single Phase Power, Three Phase Power, Regional Regulations, Energy Provider vs Utility, Managing Demand, Understanding Power, Real Power, Apparent Power, Reactive Power, Power Factor, Maintaining Power Quality, Energy Storage on The Grid,

3. Determine Customer Needs

Load Assessment, Determine System Load, Load Analysis Spreadsheet, Maximum Power Draw vs Daily Load, , Calculating Load Factor, Electric Vehicles, Determining the System Configuration, Grid Tie Systems,

4 Site Survey

Mounting Options, Rafter Design, Setbacks, Loading Issues, Wind /Snow/Seismic Load Calculations, Roof Coverings, Flat roof systems, inter row shading, Ground Mounts, Foundation Types, Drilled and ground, Pole Mount, Building Integrated Photovoltaics (BIPV), Shading Issues, Total Solar Resource Factor (TSRF), BOS Location, Battery Bank Storage, Evaluating Existing Electrical Equipment, Load side connection, Supply Side Connection. Generators, Conduit pathways, Site Hazard Assessment.

5 Components Selection

Rapid Shutdown Requirement, Impact of Inverter types on combiner box selection, AC Combiner box Inverter Voltage and Current Rating, Listings, Lighting and Surge Protection, DC and AC Disconnects, Selecting Grid Tie Commercial Inverters, Multiple String Inverters, Microinverters and Optimizers, 3 Phase Energy Production Meters, Use of CT and meter as Grid Tie Limiters (GTL) PV wire /Conductors, Conduit and Trucking, cable trays, DC and AC OCP Breakers and Fuses), SPDs, Transformers, Monitoring Hardware and software for System Performance. Commercial ESS Systems

6 Arrays Sizing & System Wiring

Sizing Grid Tie and Stand Alone PV Array, , String Calculations, Derate Factor of components, Space Requirements, Conductors Ampacity Ratings, Temperature Ratings, Overcurrent Protection, Back Fed and Ground Fault Breakers, Terminating MC4 connectors, Conduits, AC and DC Combiners Box. PV Source and Output Circuits. Inverter Input Circuit, , Inverter Output Circuits, Multiple Inverter Systems, Utility Connections. Software use in Design: PV Watts. PV Syst, Helioscope

7 Energy Storage Systems (ESS)

Battery types, Factors affecting Battery performance, AC Coupled and High Voltage Battery Systems, Battery Bank Sizing, Installing and Testing, Wiring, Power Outage and Load Shifting, Rapid Shutdown, Electric Vehicle Charging Stations

8 Managing the Project

Preparing Bid Packages, Project Design, Procure Materials, Equipment and Service, Project Budget, Project Team, Permits and Contracts, The Utility, The Application Package, Project Documentation, Operation and Maintenance Documentation, Customer Orientation Meeting, Project Safety. (CASE STUDY)

9 Testing and Troubleshooting

Safety, Inspection, Checking Mechanical & Electrical Connections, Continuity Test, Polarity Test, Voltage and Current Test, Insulation Test, Inverter Start Up Sequence, System Function Test, Verify Energy Production, Testing the Grounding System, Soil Type, Ground Resistance Testing, Leakage Current, Arc Faults

10 Commissioning and Maintaining the System

Final Installation Checklist, Verification of Code Compliance, NEC, International Code Council ICC, UL, IEC, System Documentation, Labelling, Inspection, Monitoring Performance, System Maintenance, Warranties

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Assessment Criteria

In order to achieve Learning Outcome…	The Learner must…
1. Intro to Photovoltaics	State issue with grid utility interconnections.
2 Electric Grid Review	Describe Single Phase and Three Phase Power, Sate the difference between Apparent, Active and Reactive power. Transmission and Distribution, Utility Voltages and frequency
3 Determine Customer Needs	Conduct a load assessment in commercial buildings. Determine maximum power draw. Energy Consumption Requirements, Determine Electric Vehicle ESS requirements from RE. Budget
4 Site Survey	Evaluate site for PV System Installation. Conduct a shading analysis, Determine space requirements for large commercial PV arrays. Evaluate existing electrical systems for interconnections., PV Syst. Helioscope for site analysis and design Ground Mount Racking Requirements
5 Components Selection	Determine ESS types and requirements for commercial scale PV Systems. Determine Inverters requirements for Grid interconnected systems standards. Transformer Selection, LV Switchgear, IEC, UlL1741-SA. IEEE 1547.Determine Line Side /Supply side requirements.
6 Arrays Sizing & System Wiring	Determine PV Array size . Use PV Watts and PV Syst /Helioscope to determine Energy Output of PV systems. Select Grid Inverters for commercial scale systems. Understand Grid Inverters Utility interconnection requirements. Design Large scale ESS for commercial systems, DC AND AC Coupled systems. Calculate wiring size and design . Use CAD to draw three line and SLD PV systems.
7 Managing the Project	Understand Bid and Tender documentations requirements. Provide solutions to Tender or

	project system technical specifications. Acquire licenses and permits from AHJ. Utility PPA and Interconnections requirements. Provide a maintenance scheduled
8 Testing, Troubleshooting and .Commission	Conduct Functional Testing of System components. Perform Electrical test on PV System an identify issues. Perform start-up and shut-down operation sequence of PV Systems. Carry out Commission procedures of commercial PV systems.