



FROM YOUR PARTNER IN ENERGY EDUCATION

BEST GLOBAL PRACTICES

8th Solar PV Installation Boot Camp



EXPERT TRAINER
DR. SEAN WHITE

October 23 to 27, 2017 | The Lighthouse, Lopez Building
Meralco Compound, Ortigas Center, Brgy. Ugong, Pasig City, Philippines

8th Solar PV Installation Boot Camp

COURSE OBJECTIVES

This 5 day comprehensive training workshop will teach participants how solar photovoltaic (PV) systems work, how they are designed, how to predict its output, and how its components are installed. The program will cover the fundamentals of PV, such as how voltage, current, power and energy interrelate (which is very different from the conventional electric systems) and including the economics and expected payback period. Participants will determine how to calculate for variables, such as roof slope, weather patterns, shading, tilt angles, and temperature effects on voltage and equipment variables.

Those who complete this course will earn credit units and be eligible to take the USA/Canada NABCEP (North American Board of Certified Energy Practitioners) Entry Level PV Examination.

Moreover, upon completion of this course, the participants should be able to demonstrate understanding of the basic concepts, principles and applications on the following areas required by NABCEP:

- PV Markets and Applications
- Safety Basics
- Electricity Basics
- Solar Energy Fundamentals
- PV Module Fundamentals
- System Components
- PV System Sizing Principles
- PV System Electrical Design
- PV System Mechanical Design
- Performance Analysis,
- Maintenance and Troubleshooting

WHO SHOULD ATTEND

This program is designed for those who intend to pursue a professional career in Solar PV design and installation such as solar installers, contractors, project managers, engineers, electricians, quality inspectors, technical support crew and customer service professionals in the solar energy industry.



EXPERT COURSE TRAINER DR. SEAN WHITE

Sean White is an Interstate Renewable Energy Council (IREC) certified Master Trainer, industry consultant and an internationally recognized expert on solar energy. He is the author of well-known instructional and technical books:

- Solar Photovoltaic Basics
- Solar PV Engineering and Installation
- PV Technical Sales
- Photovoltaic Systems and the 2017 National Electric Code (to be released soon).

Sean has delivered personal classroom and hands-on training to thousands of solar energy professionals throughout the world. He also developed curricula for technical learning institutes (Kaplan and others) and a popular series of interactive online training courses (Heatspring). His courses provide beginner and advanced-level PV professionals with several levels of industry-specific training and certifications, including PV Basics, NABCEP Examination Prerequisites, NABCEP Associate Level examinations, NABCEP Continuing Education credits and a specialized advanced package for commercial installers.

Sean was recognized as the IREC Clean Energy Trainer of the Year 2014-2015 and served on the NABCEP PV Installation Professional Technical Committee in 2010 and 2011. He has participated as a chairperson and presenter in industry workshops and seminars throughout the world and has received numerous awards and industry recognition for his continued dedication to PV education, operation and promotion.



Meralco Power Academy (MPA) is a premier training and energy education provider that leverages on MERALCO's 114 years of industry experience, expertise and network. Its array of technical programs lend industry practitioners a competitive edge through top of the line learning solutions which are delivered in a variety of methods. MPA provides the learning platforms and coalitions for leaders, decision makers, managers and advocates by facilitating technical exchanges on global innovations and technologies on power and energy.



COURSE OUTLINE | 8th Solar PV Installation Boot Camp

DAY 1 | INTRODUCTION AND COURSE OVERVIEW

1 - PV Markets and Applications

- History of PV
- Off-Grid and Grid-Tied PV with and without batteries
- Residential, commercial, BIPV, concentrating, and utility-scale PV
- PV systems vs. other RE systems
- Off-Grid (Utility-Interactive) PV
- Grid-Tied (Stand-Alone) PV
- Segments of the PV industry, licensing, credentialing & certification
- Market value of PV on & off the grid
- Energy efficiency & PV
- Local and global trends
- PV adoption
- Incentives, net-metering, FITs, Tenders, Self-consumption
- Price trends
- Market leaders
- Regulatory trends

2 - PV Safety 101

- PV Specific Safety Hazards
- PV PPE (Personal Protective Equipment)
- OSHA
- Electrical safety
- Material safety
- PV electrical shock, electrocution and arc flash
- Ladder Safety Angles
- Philippine Electric Code vs. the National Electric Code and the IEC
- Choosing high quality listed inverters and equipment
- Personnel certifications
- Contractor licensing
- Permitting, planning, relevant codes and standards
- Team composition
- Work best practices

3 - Electrical Basics

- Current, voltage, power and resistance, and hydraulic analogies
- Power v Energy
- Electrical circuit components
- Electrical test equipment
- Ohm's Law, current, voltage, power & resistance relationships
- Utility systems, generation, transmission, distribution & electrical service
- Philippine Distribution Code (Energy Regulatory Commission)
- Using a digital multimeter to test voltage, current and resistance
- Measuring Voc, Isc and voltage and current under a load
- Using a power meter to make an IV curve
- Relevant and applicable rules and standards
- PEC, NEC, UL, IEC, CE, inverter grid standards

4 - Solar Energy Fundamentals

- Solar terminology
- Making a sun path diagram

- Reading sun path diagrams
- Irradiance v. irradiation
- The solar resource (locational irradiance)
- Factors that increase/decrease energy collected at the PV
- Magnetic v. true azimuth
- POA (Plane Of Array) tilt/azimuth energy estimations and optimal positioning
- PV shading principles
- Shade analysis tools (Solmetric, Pathfinder, CAD & common sense)
- Modeling software and profiling
- Shading ratios, 9am-3pm solar window & inter-row calculations
- Global, direct, diffuse and albedo solar radiation, flat-plate v. concentrating
- Irradiance & irradiation measuring devices

5 - PV Module Fundamentals

- Photovoltaic effect
- PV cells, modules, panels and arrays
- Voc, Isc, Vmp, Imp and Pmp on the I-V curve
- Irradiance and temperature & the IV curve
- Load on I-V curve without MPPT
- PV & battery charging shown on I-V curve
- Module mismatch v. matching modules in series & parallel on I-V curves
- STC, NOCT, PVUSA, CEC and PTC
- Testing current, voltage, power and energy
- PV manufacturing processes
- Crystalline and thin film PV module construction
- Touching 99.99% pure silicon
- Calculating PV efficiency
- PV as a limited current & power source
- Bypass diodes
- PV standards & UL 1703
- Examining crystalline and thin film module production
- Testing PV efficiency and commissioning modules
- PV as a limited power and current source
- Testing bypass diodes
- Understanding and documenting labeling PV standards, CE, IEC and UL 1703
- PV fire class rating system

DAY 2

6 - System Components

- PV, inverters, chargers, storage & sources
- Cables, overcurrent protection, wiring systems, conduit
- PV power conditioning
- Maximum power point tracking MPPT and MPPs
- PV system components for different PV system types
- Turning on inverters, chargers, storage and sources
- Disconnecting means and isolating devices
- Testing anti-islanding
- Programming power conditioning
- Installing different system components for different system types

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- String inverters vs. central inverters for utility scale projects
- Microinverters, power optimizers and residential string inverters
- Cheap inverters vs. quality inverters
- Quality verification
- Choosing appropriate equipment for vis-à-vis local conditions
- Choosing equipment that complies with utility standards
- Choosing equipment that complies with the Philippine Distribution Code
- Ac and dc microgrids
- Small and large stand-alone systems
- PV diesel hybrid island systems
- Micro PV projects, phone charging and lights for underdeveloped rural communities

7 - PV System Sizing and Design

- Grid-Tied v. Off-Grid system sizing
- Load calculations, peak power & demand
- PV derating from solar energy to DC to AC by hand and PVWATTS
- Utility-interactive String Sizing
- Stand-alone system sizing

Lab: Shading Analysis with Solmetric SunEye Irradiance Meter & IV Curve Trace

8 - PV System Electrical Design & Installation

- Applying the Philippine Electric Code and the National Electric Code to Electrical Design
- SLDs for complete On & Off-Grid PV systems
- Line drawing exercises
- PV series & parallel connections for different applications
- Conductors, conductor sizing & OCPD requirements
- PV & BOS parameters
- Charging batteries with correct current, voltage & rates
- Labeling, plaques and directories
- Grounding
- Voltage drop & voltage rise
- Permitting, AHJ, Interconnection Agreement & Construction Job Management
- NEC
- Rapid shutdown requirements in the 2017 and 2014 NEC
- Impact on local grid stability
- Utility requirements

DAY 3

9 - System Mechanical Design & Installation

- Roof, Ground, Pole, Trackers, BIPV
- Compare different types of PV integration
- Installing for PV temperature and wind variables
- Building-integrated PV (BIPV) applications
- Materials for a harsh outdoor environment
- Roofing & PV
- Mechanical loads
- Mech. design/components
- Mechanical design features for thermal, orientation & electrical performance
- Manufacturers' instructions & Philippine Electric Code 110.1.3 (b)
- Using a civil engineer to make sure roof or structure can support solar system

10 - Performance Analysis, Maintenance & Troubleshooting

- Performance problems
- Performance monitoring & parameters
- Performance assessment
- Expected v. actual performance
- Maintenance
- Operation & Management (O&M) safety
- Most common system failures
- Troubleshooting
- Maintenance planning to manufacturers' instructions
- Diagnosis & treatment of unhealthy PV systems
- Warranties and guarantees
- Insurance

PV opportunities in new markets around the world

- Rapid Shutdown Requirements of PV Systems on Buildings
- 2014 NEC Rapid Shutdown Requirements
- 2017 NEC Rapid Shutdown Requirements
- Module level and array level shutdown
- DC arc-fault protection

Inverter capabilities

- Reactive power
- Low and high voltage ride through
- Non-exporting systems (self-consumption)
- AC coupling

Interconnections (grid connection)

- Supply side connection
- Load side connections
- Philippine Distribution Code
- Anti-islanding
- Examples of PV systems positively and negatively affecting grid quality

DAY 4

Hands-on Day with supplier exhibits

- Fastening PV to roofing systems

Wiring at panelboard of inverter connection

- 120% Rule
- Supply Side Connection
- Breaker sizing
- DC conductor sizing
- Grounding

DAY 5

- NABCEP Associate Exam review
- PV system design exercises
- Transformerless v. Transformer Based Inverters
- Differences in Fuse Requirements
- Differences in DC Disconnect Requirements
- Grounded Conductor Requirements

ADVANCED TOPICS

NABCEP Practice Exams

Mapping your future. Further study, licensing & certifications
White House Solar Certification Exam & Award Presentation

SEMINAR RATES

Includes course manual, lunch, snacks and program certificate.

REGULAR RATE
PhP39,200 net
Per Participant
VAT inclusive

GROUP RATE
for 3 or more delegates
PhP35,000 net
Per Participant
VAT inclusive

YES! I am interested in attending Meralco Power Academy's 8TH SOLAR PV INSTALLATION BOOT CAMP Course!

I am sorry but I won't be able to attend. You may send me materials on your upcoming events.

PAYMENT METHODS AND TERMS

1. Payments may be deposited to:

Account Name: Meralco Power Foundation Inc.

BDO Savings Account No 4630-2297-12 (Meralco Branch)

Please email a copy of your deposit slip to astibayan@meralco.com.ph or power.academy@meralco.com.ph

2. We shall send you a confirmation of your enrollment upon receipt of the accomplished registration form.

3. Cancellations made 7 days before the program shall be non-refundable.

4. For any concerns, please contact Angie Tibayan at 1622-6758, mobile: 0999-881-3762, email: astibayan@meralco.com.ph

REGISTRATION FORM

COMPANY DETAILS

Company Name	<input type="text"/>
Company's TIN Number	<input type="text"/>
Office Address (Billing Address)	<input type="text"/>
Contact Person	<input type="text"/>
Email Address	<input type="text"/>
Contact Number	<input type="text"/>

PARTICIPANT'S DETAILS

Name	<input type="text"/>
Nickname (for the name tag)	<input type="text"/>
Designation	<input type="text"/>
Email Address	<input type="text"/>
Contact Number	<input type="text"/>
Dietary Restrictions	<input type="text"/>