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Intro to PV Systems: 5-Day NABCEP Cert of Knowledge Preparation

1. Markets and Applications for Photovoltaic Systems (PV)
2. PV Safety
3. Basics of Electricity
4. Fundamentals of Solar Energy
5. Module Fundamentals of Photovoltaic Systems
6. System Components
7. Sizing
8. Electrical Design
9. Mechanical Design
10. Performance Analysis and Troubleshooting

Detailed Outline

1. Markets and Applications for Photovoltaic Systems (PV)
    a. History
    b. Technology
    c. Markets
    d. Applications
    e. Types
    f. Features
    g. Benefits

2. PV Safety
    a. Operational and non-operational PV systems safety hazards
    b. Safety during installation and maintenance
        i. Identification of hazards
        ii. Practices
        iii. Protective equipment

3. Basics of Electricity
    a. Contrast of energy and power
    b. Basic electrical terms
    c. Digital multi-meter uses
    d. Calculation of simple circuit values

4. Fundamentals of Solar Energy
    a. Basic Solar terminology
    b. Determination of true (solar) south from magnetic (compass) south with a declination map
    c. Earth tilt effect on basic solar movement
    d. Use of solar path diagrams on solar positioning
    e. Angular effects on the irradiance of array
    f. Identification of factors reducing/enhancing solar irradiation
    g. Determination of average solar irradiation on various surfaces
    h. Conversion of solar irradiation into a variety of units
    i. Effect of horizon on solar (shading)
    j. Use of Solar Pathfinder or sun charts

5. Module Fundamentals of Photovoltaic Systems
    a. Use of a solar cell in the conversion of sunlight into electric power
    b. Identification of key points on a typical IV curve
    c. Identification of key output values of solar modules using manufacturer literature
    d. Illustration of effects of environmental conditions on IV curve
    e. Illustration of effects of series/parallel connections on IV curve
    f. Measurement conditions for solar cells and modules (SCT, NOCT, PTC)
    g. Computation of expected output values of solar module under a variety of environmental conditions
    h. Construction of solar cells by various manufacturing technologies
    i. Performance and characteristics of various cell technologies
    j. Flat plate solar module components and construction
    k. Efficiency of solar module calculation
    l. Purpose and operation of bypass diode
    m. Typical deterioration/failure modes of solar modules
    n. Qualification tests and standards for solar modules

6. System Components
    a. Common solar module mounting techniques
        i. Ground
        ii. Roof
        iii. Pole
    b. Features and benefits of different solar mounting techniques
    c. Relationship between solar module cell temperature and environmental conditions based on mounting method
    d. Purpose and operation of main electrical BOS components
        i. Inverter
        ii. Charge controller
        iii. Combiner
        iv. Ground fault protection
        v. Battery
        vi. Generator
    e. Specifications of main electrical BOS components
        i. Inverter
        ii. Charge controller
        iii. Combiner

iv. Battery
v. Generator

7. Sizing
    a. Typical loads interaction with IV curve
    b. Load demand for stand-alone and grid interactive service
    c. Identification of electrical output derating factors
    d. Peak power output (dc and ac) calculation
    e. Array and inverter size for grid-connected systems
    f. Estimating monthly and annual energy output of grid-connected systems
    g. Differences between array and battery size for stand-alone systems
    h. Calculation o f array, battery, and inverter size for stand-alone systems

8. Electrical Design
    a. Determination of series/parallel PV array arrangement
        i. Module specifications
        ii. Inverter specifications
    b. Appropriate BOS components for specific system requirements
    c. Voltage drop between major components

9. Mechanical Design
    a. Relationship between row spacing of tilted modules and sun angle
    b. Mechanical loads on PV array (wind, snow, seismic)

10. Performance Analysis and Troubleshooting
    a. Typical system design errors
    b. Typical system performance problems
    c. Typical causes of performance problems
    d. System performance analysis equipment
    e. Actual system power output compared to expected output
    f. Typical locations for electrical/mechanical failure
11. Hands-on Lab with a real, working system.

Course description is approximate. Exact material is not guaranteed and is flexible to the participants at the discretion of the instructor.