Electricity and Circuits Learning Outcome and Objectives NABCEP Review

# Domain I: Application

Task 2: Identify key features and benefits of specific types of PV Systems

* Energy security

Task 4: Understand the safety concerns associated with the different types of PV Systems

* DC hazards (e.g. electrical arcing, fire)
* AC hazards (e.g., arc flash)
* Shock hazards

Task 5: List the advantages and disadvantages of PV systems compared to other electricity generation sources

* Efficiency
* Distributed generation

# Domain II: Sales and Economics

Task 3: Estimate system size to meet the customer’s financial objective

* Utility rate structure
* General system sizing (e.g., calculations)

Task 4: Identify information from a client customer utility bill relevant to grid-interactive solar

* Existing rate schedule and options
* Customer usage profile (e.g., daily patterns, seasonal patterns)
* Demand charges (e.g., peak loads)

Task 5: Identify information from the client on electricity usage relevant to stand-alone solar

* Power and energy requirements (e.g., critical load)
* Customer usage profile (e.g., daily patterns, seasonal patterns)
* Days of autonomy

Task 6: List key factors that impact the economics of solar

* Cost of electricity from utility
* Energy storage

Task 8: Identify financial risks associated with PV systems

* System performance

# Domain III: Design

Task 1: Ensure equipment is appropriate for intended use

* Electrical hazards

Task 2: Identify relevant codes and requirements that impact PV design and installation

* Electrical codes

Task 3: Recognize electrical concepts and terminology

* Ohm’s law
* Power and energy
* Electrical measurements (e.g., voltage, current, impedance, resistance)
* Alternating current (AC) and direct current (DC)
* Single-phase, split-phase, and three-phase circuits
* Series and parallel circuits
* Properties of common conductors (e.g., insulation types [PV wire, USE-2, THWN-2], sizes and ampacities, voltage ratings, color)
* Types of common multi-conductor cables (e.g., Romex, MC, TC)
* Grounding and bonding terminology (e.g., equipment grounding conductor, grounding electrode conductor, grounding electrode, bonding jumper)

Task 5: Identify equipment specification data

* Voltage and current ratings
* Battery (e.g., capacity, max current)

Task 6: Describe the function of typical components in PV systems

* Overcurrent protection devices
* Batteries
* Grounding and bonding terminology (e.g., equipment grounding conductor, grounding electrode conductor, grounding electrode, bonding jumper)

Task 7: Explain PV system sizing considerations

* Derating factors
* System losses
* Power rating
* Energy production
* Energy efficiency
* Electric service infrastructure
* Electrical codes
* Load analysis
* String configuration
* Inverter ratings

Task 8: Read an electrical diagram of a PV system

* Electrical symbols
* PV circuit terminology
* String configuration
* Equipment nameplate ratings
* Conductor properties (e.g., temperature ratings ampacity ratings, UV resistance, moisture rating)

# Domain IV: Installation

Task 1: Identify the elements of a complete site-specific safety plan

* Electrical hazards and control methods (e.g., electrical shock, arc flash, de-energization plan, lockout/tagout, energized electrical work permit)
* Use of multimeter
* Battery safety (e.g., insulated tools, face guards, chemical goggles, eye wash, gloves, aprons)

Task 2: Identify the elements of the plan set

* Electrical diagrams (e.g., one-line or three-line diagrams, wiring or string diagrams
* Equipment data sheets and installation instructions

Task 4: Identify the elements of electrical components installation

* Types of electrical components (e.g., inverters, hybrid inverters, microinverters, optimizers, charge controllers, disconnects, switchgear)
* Manufacturer manuals and specifications (e.g., termination torque specifications, NEMA ratings sunlight exposure, application of antioxidants)
* Common electrical fittings (e.g., connectors)

Task 5: Identify the elements of energy storage component installation

* Types of batteries (e.g., flooded lead acid, sealed lead acid, lithium)
* Battery bank location and protection (e.g., venting, insulation)

Task 6: Identify the elements of the system commissioning procedure

* Relevant electrical measurements (e.g., string voltage, polarity)
* Proper operation of all electrical equipment

# Domain V: Maintenance and Operation

Task 1: Identify commonly used electrical test equipment and its purpose

* Multimeter (e.g., current, voltage, resistance, continuity)
* Insulation testing devices (e.g., megohmmeter)
* IV curve tracer
* Battery capacity testing device (e.g., load tester)
* Hydrometer

Task 2: Demonstrate the ability to analyze simple electrical circuits

* Ohm’s law
* Power formula (e.g., Watt’s law)

Task 3: Describe the effects of performance parameters that are commonly monitored for PV systems

* IV curve characteristics (e.g., short circuit, open circuit)
* Inverter AC and DC voltage
* Utility voltage and frequency
* Battery voltage

Task 4: Describe different types and elements of system performance monitoring equipment

* Current transformer
* Voltage sense

Task 7: Identify the safety requirements for operating and maintaining different types of PV systems

* Electrical hazards and control methods (e.g., electrical shock, arc flash, de-energization plan, lockout/tagout, ground fault)
* Use of multimeter
* Battery safety (e.g., insulated tools, face guards, chemical goggles, eye wash, gloves, aprons)
* Risk in working with energized and/or faulty equipment