

# NABCEP<sup>®</sup>

## Energy Storage Installation Professional Certification (ESIP)<sup>™</sup> Job Task Analysis



# ESIP™ JTA Guide

This document presents a comprehensive Job Task Analysis (JTA) for a range of energy storage professionals who work with electrochemical storage and/or UL 9540 ESS. NABCEP's Energy Storage Installation Professional Certification (ESIP) assesses the knowledge and skills necessary to competently perform tasks relating to battery energy storage systems (BESS).

The Exam was formulated by Subject Matter Experts working with a psychometrician to formulate a classification system used to evaluate the individual's proficiency in the domain areas described in this document.

## Content Domains and Examination Specifications

Tasks associated with carrying out the installation of energy storage systems fall under 5 main domain areas:

1. Development	15%
2. Design	25%
3. Installation	30%
4. Commissioning	17%
5. Operations, Maintenance, and Decommissioning	13%

The NABCEP ESIP Exams are designed to narrow the scope of duties while elevating the competency of the specified technology.

## Scope of the JTAs

NABCEP Certified Energy Storage Professionals work in a variety of responsible roles on PV installation jobs. Varying sizes and complexities of installations calls for a wide range of duties required of any Energy Storage Installation Professional.

## Task Steps & Knowledge

Individuals who achieve a NABCEP ESIP Certification will be familiar with and capable of executing all the tasks listed in the specific examination content outline below. These tasks may not be performed on every project but they are an important part of a body of knowledge.



# Domain 1: Development

## Task 1: Understand the Technologies and Applications

### Knowledge of:

- a. Power generation sources (e.g., photovoltaic [PV], engine generator, utility, wind)
- b. Battery chemistries
- c. Battery characteristics (e.g., weight, mounting configuration)
- d. Typical battery energy storage system (BESS) electrical specifications (e.g., voltage, capacity)
- e. Battery performance
- f. Power, energy, and C-rate
- g. Power electronics performance
- h. Effects of temperature on battery energy storage system (BESS)
- i. Battery energy storage system (BESS) interconnection
- j. Backup power
- k. Demand charge reduction
- l. Energy peak arbitrage for time of use (TOU)
- m. Off-grid power (i.e., stand-alone)
- n. Frequency regulation
- o. Black start
- p. Environmental impact

## Task 2: Identify and Manage Customer Expectations

### Knowledge of:

- a. Customer's power and energy requirements
- b. Desired and achievable performance (i.e., value engineering)
- c. Project budget
- d. Project schedule lead times (e.g., permitting, equipment)
- e. Battery performance degradation and capacity maintenance
- f. Warranties
- g. Location of equipment
- h. Aesthetics
- i. Customer's operation and maintenance expertise and capability
- j. Site hazards
- k. Energy efficiency opportunities
- l. Electric vehicle integration
- m. Environmental impact

### Skills in:

- Analyzing customer power demand and energy consumption
- Conducting energy audits (e.g., lighting audit, appliances, heating, ventilation, and air conditioning [HVAC])
- Matching battery performance with customer needs
- Identifying financing options

## DOMAIN 1: DEVELOPMENT

### Task 3: Quantify Financial and Energy Performance

#### Knowledge of:

- Software analysis
- Utility rates (e.g., energy, power, fixed versus variable fees, net metering)
- Off-grid energy costs (e.g., fuel, fuel transportation, maintenance)
- Available and applicable financing options
- Rebates and financial incentives
- Levelized cost of energy (LCOE)
- Financial criteria (e.g., straight-line payback, internal rate of return [IRR], net present value [NPV])

#### Skills in:

- Using energy modeling software (e.g., HOMER, Energy Toolbase)
- Understanding utility tariffs
- Interpreting customer utility bills
- Calculating financial performance criteria

### Task 4: ASSESS THE PROJECT SITE

#### Knowledge of:

- Imagery databases (e.g., Helioscope, Google Earth)
- Locations for system components (e.g., battery plant, photovoltaic [PV], electrical distribution, point of common coupling [POCC])
- Drilling and trenching equipment capabilities
- Types of interconnections
- Characteristics of appropriate staging/lifting/access locations
- Effects of environmental conditions (e.g., wind exposure)
- Building electrical distribution systems

#### Skills in:

- Using aerial imagery databases (e.g., Helioscope, Google Earth)
- Assessing existing building electrical distribution systems



# Domain 2: Design

## Task 1: Review Project Criteria

### Knowledge of:

- Applicable engineering support resources (e.g., structural, geotechnical, civil, fire protection, electrical)
- Applicable codes and standards
- Required safety measures

### Skills in:

- Creating preliminary estimate

## Task 2: Configure Electrical Design

### Knowledge of:

- Energy storage system sizing and performance calculations
- System architecture
- Power electronics selection criteria (e.g., charge controller, inverter, rectifier)
- Direct current (DC) circuit sizing
- Alternating current (AC) circuit sizing
- Voltage drop calculations
- Methods of interconnection
- Conductor properties and types
- Wiring methods and selection criteria, calculations, and installation
- Overcurrent protection selection criteria
- Power-limiting functions of equipment (e.g., power control systems, Zero-Export)
- Electrical enclosure selection criteria
- Panelboard selection criteria
- Disconnect selection criteria
- Grounding system criteria and components

### Skills in:

- Selecting and sizing appropriate battery energy storage system (BESS) components
- Applying codes and standards
- Performing appropriate calculations



## DOMAIN 2: DESIGN

### Task 3: Configure Mechanical Design

#### Knowledge of:

- a. Physical characteristics of battery energy storage system (BESS) components
- b. Physical characteristics of battery energy storage system (BESS) equipment installation
- c. Enclosure characteristics and ratings
- d. Applicable environmental conditions (e.g., wind, snow, seismic, temperature)
- e. Criteria for sizing and siting of battery energy storage system (BESS)
- f. Equipment clearances (e.g., ventilation, maintenance, fire separation, repairs)
- g. Codes and standards and safe work practices
- h. Ventilation requirements
- i. Physical impact protection (e.g., vehicle impact)
- j. Electrolyte spill containment systems
- k. Requirements for first aid and emergency response equipment

#### Skills in:

- Applying manufacturer's operation and installation requirements into the design documents

### TASK 4: Develop the Fire Prevention, Detection, and Suppression Strategy

#### Knowledge of:

- a. Fire prevention and prevention systems
- b. Fire detection and detection systems
- c. Fire suppression and suppression systems
- d. Codes and standards and safe work practices
- e. Manufacturer's equipment handling requirements
- f. Manufacturer's installation instructions
- g. Evacuation requirements
- h. Equipment clearances (e.g., ventilation, maintenance, fire separation, repairs)

#### Skills in:

- Identifying and mitigating fire hazards
- Selecting and locating fire suppression equipment (e.g., fire extinguisher, sprinkler)



## DOMAIN 2: DESIGN

### TASK 5: Configure System Monitoring, Control, and Communications

#### Knowledge of:

- Monitoring criteria and control systems
- Communications methods and protocols
- Codes and standards
- Shutdown methods
- Low-voltage wiring methods
- Characteristics of building automation systems

### TASK 6: Specify the Decommissioning and Disposal Plan

#### Knowledge of:

- Expected equipment lifecycle
- Existing recycling and disposal options
- Manufacturer's decommissioning requirements
- Codes and standards and safe work practices

### TASK 7: Prepare Project Documentation

#### Knowledge of:

- Requirements of the Authority Having Jurisdiction (AHJ)
- Codes and standards
- Documents required for a complete project plan set
- Characteristics of electrical diagrams and schematics (e.g., one-line, three-line)
- Use and meaning of electrical symbols and terms
- Engineering requirements (e.g., fire protection, structural, electrical, civil, geotechnical, environmental)
- Architectural plan requirements (e.g., site plan, elevations, street-view renderings)
- Permit application package requirements (e.g., manufacturer specification sheets, certification documents)
- Labeling requirements
- Operational safety

#### Skills in:

- Drafting documents
- Generating operating documents (e.g., standard operating procedures, sequence of operations)



# Domain 3: Installation

## TASK 1: Develop a Safety Plan

### Knowledge of:

- a. Occupational Safety and Health Administration (OSHA) requirements (e.g., fall protection, competent/qualified person, reporting of incidents, confined space)
- b. National Fire Protection Association (NFPA) 70E (Standard for Electrical Safety in the Workplace)
- c. Personal protective equipment (PPE) (e.g., specific equipment required for project, maintenance of PPE)
- d. Job hazard analysis (JHA)
- e. Safety data sheet (SDS)
- f. Emergency response resources and protocols
- g. Specific equipment required for site
- h. Elements of an effective safety meeting
- i. Proper care and use of equipment (e.g., safety equipment, test equipment, power tools)
- j. Safe work practices
- k. Training requirements (e.g., education materials, security clearances, certifications, manufacturer recommendations)

### Skills in:

- Implementing the site-specific safety plan

## TASK 2: Handling and Staging Material

### Knowledge of:

- a. Occupational Safety and Health Administration (OSHA) requirements (e.g., hand signals, ergonomics, caught between, struck by)
- b. Hydraulic or motorized material handling equipment (e.g., lulls, skid steers, table lifts)
- c. Chemical hazards and spills
- d. Hazardous material storage (e.g., ventilation, vehicle impact protection)

### Skills in:

- Operating motorized equipment
- Understanding hand signals
- Implementing the safety plan
- Selecting and using personal protective equipment (PPE)

## TASK 3: Prepare Equipment Locations

### Knowledge of:

- a. Applicable building, fire, and electrical codes
- b. Multi-trade coordination
- c. Manufacturer's specification for supporting equipment
- d. Ventilation methods and requirements

### Skills in:

- Interpreting construction plans



## DOMAIN 3: INSTALLATION

### TASK 4: Install Wire Methods and Supports

#### Knowledge of:

- a. National Fire Protection Association (NFPA) 70 (National Electrical Code [NEC]) articles for use, installation, and construction specifications for wiring methods, supports, and associated fittings
- b. Proper wiring methods selection and sizing
- c. Conditions of use
- d. Proper installation and labeling of wiring methods per National Fire Protection Association (NFPA) 70/ Authority Having Jurisdiction (AHJ) requirements (e.g., expansion joints, physical protection)
- e. Neat and workmanlike manner of installation of wiring methods

#### Skills in:

- Confirming wiring methods routing per plans and client input
- Installing raceways/cable tray per National Electrical Code (NEC)

### TASK 5: Install Electrical Equipment

#### Knowledge of:

- a. National Fire Protection Association (NFPA) 70 (National Electrical Code [NEC]) articles for use, installation, and construction specifications for equipment and associated fittings
- b. Neat and workmanlike manner of installation of electrical equipment
- c. Proper installation and labeling of equipment per applicable codes and standards
- d. Plan sets and schematics

#### Skills in:

- Confirming equipment suitability and placement per plans and client input
- Providing and maintaining access and working space around all electrical equipment
- Interpreting construction plans (e.g., electrical plans, schematics, line diagrams)



## DOMAIN 3: INSTALLATION

### TASK 6: Install Battery Energy Storage System (BESS)

#### Knowledge of:

- a. Applicable codes and standards (e.g., National Fire Protection Association (NFPA) 70, NFPA 70E, NFPA 855)
- b. Occupational Safety and Health Administration (OSHA) safety standards
- c. Proper installation of batteries and battery equipment (e.g., labeling, spill kits, enclosure, ventilation)
- d. Neat and workmanlike manner of installation of battery equipment
- e. Proper conductor installation, routing, identification, size, color, type, and rating
- f. Proper battery handling, storage, future maintenance, and installation techniques

#### Skills in:

- Implementing the site-specific safety plan
- Confirming battery equipment placement per plans and client input
- Installing batteries and battery-related equipment per applicable codes and standards
- Conducting field verification of proper conductor identification, size, color, type, and rating

### TASK 7: Install Battery Energy Storage System (BESS) Wiring and/or Busing

#### Knowledge of:

- a. National Fire Protection Association (NFPA) 70 (National Electrical Code [NEC]) articles for use, installation, and construction specifications for direct current (DC) conductors
- b. National Fire Protection Association (NFPA) 70E (Standard for Electrical Safety in the Workplace)
- c. Proper conductor installation and pulling practices
- d. Wire management in a neat and workmanlike manner
- e. Terminations and connections per National Fire Protection Association (NFPA) 70

#### Skills in:

- Conducting field verification of proper conductor labeling, size, color, type, polarity, and rating
- Identifying and labeling direct current (DC) conductors per plan set and applicable codes and standards

### TASK 8: Install Grounding and Bonding Systems

#### Knowledge of:

- a. Applicable codes and standards (e.g., National Fire Protection Association [NFPA] 70 (National Electrical Code [NEC]) for use in installation and construction specifications for grounding and bonding
- b. Proper installation of grounding and bonding components

#### Skills in:

- Conducting field verification of existing grounding electrode systems
- Installing grounding electrode per applicable codes and standards (e.g., National Fire Protection Association [NFPA] 70)
- Installing equipment grounding conductor per applicable codes and standards (e.g., National Fire Protection Association [NFPA] 70)



## DOMAIN 3: INSTALLATION

### TASK 9: Install System Interconnection

#### Knowledge of:

- a. Applicable codes and standards (e.g., National Fire Protection Association (NFPA) 70, NFPA 70E, NFPA 855)
- b. Occupational Safety and Health Administration (OSHA) safety standards
- c. Verification of overcurrent protection device (OCPD) and disconnecting means
- d. Shutdown and inspection processes
- e. Termination of conductors per applicable codes and standards (e.g., National Fire Protection Association [NFPA] 70)
- f. Local electric service provider requirements for interconnection
- g. Methods of interconnection

#### Skills in:

- Implementing the site-specific safety plan
- Interpreting design and construction documents

### TASK 10: Install System Monitoring, Control, and Communication Hardware

#### Knowledge of:

- a. National Fire Protection Association (NFPA) 70 (National Electrical Code [NEC]) articles for use, installation, and construction specifications
- b. Neat and workmanlike installation of monitoring equipment
- c. Types and methods of data communication hardware
- d. Termination and connection per National Fire Protection Association (NFPA) 70

#### Skills in:

- Confirming monitoring equipment placement per plans and with client
- Performing field verification of final system configuration
- Performing field verification of proper cable labeling, size, type, and rating
- Installing equipment per National Fire Protection Association (NFPA) 70 and approved plan sets
- Preparing monitoring system for commissioning

### TASK 11: Connect to Fire Prevention, Detection, and Suppression Systems

#### Knowledge of:

- a. Authority Having Jurisdiction (AHJ) requirements for licensing, permitting, and inspections
- b. Fire prevention, detection, and suppression systems
- c. Manufacturer's requirements

#### Skills in:

- Understanding and implementing construction drawings

### TASK 12: Create As-Built Drawings

#### Knowledge of:

- a. Construction drawings
- b. Field installation

#### Skills in:

- Verifying field installation
- Drafting documents

# Domain 4: Commissioning

## TASK 1: Develop and Review Commissioning Protocol

### Knowledge of:

- a. Manufacturer commissioning requirements
- b. Applicable codes and standards (e.g., National Fire Protection Association [NFPA] 855, International Residential Code [IRC], International Fire Code [IFC], NFPA 1)
- c. Project-specific requirements
- d. Test equipment

### Skills in:

- Creating project documentation

## TASK 2: Complete Visual Inspection

### Knowledge of:

- a. Project design
- b. Manufacturer's requirements
- c. National Electrical Code (NEC) and local Authority Having Jurisdiction (AHJ) requirements
- d. Utility provider requirements (e.g., disconnecting means, interconnection method, labeling requirements)

### Skills in:

- Verifying installation per project design and requirements
- Verifying installation per environmental conditions

## TASK 3: Conduct Mechanical Tests

### Knowledge of:

- a. Installation per torque specifications, fastener anchoring, seismic ratings, structural loading

### Skills in:

- Verifying manufacturer fixed-in-place requirements

## TASK 4: Conduct Electrical Tests

### Knowledge of:

- a. Insulation resistance testing
- b. Polarity testing
- c. Direct current (DC) voltage testing (e.g., string, unit, cell)
- d. Alternating current (AC) voltage testing
- e. Current transformers (CT) orientation
- f. Continuity testing
- g. Electrical theory (e.g., Ohm's law)
- h. Grounding and bonding requirements
- i. Energy storage system (ESS) safety features and functionality
- j. Short circuit current interrupt ratings

### Skills in:

- Operating diagnostic electrical tools (e.g., multimeter)

## DOMAIN 4: COMMISSIONING

### TASK 5: Conduct Communication System Tests

**Knowledge of:**

- a. Communication cable testing methods (e.g., RJ45/CAT6 cable tester, shielded cables)
- b. Communication methods and protocols (e.g., wireless, cellular)
- c. Manufacturer firmware and communication equipment

**Skills in:**

- Performing communication tests as per manufacturer's specifications

### TASK 6: Verify System Operation

**Knowledge of:**

- a. Equipment startup procedures
- b. Charging battery modules to acceptable voltage/state-of-charge tolerance
- c. Charging battery bank to acceptable state-of-charge for operational testing
- d. Use and calibration requirements of charging equipment
- e. Performance verification testing
- f. Acceptance testing (e.g., remote shutdown)
- g. Impact of site conditions on testing

**Skills in:**

- Interpreting the battery energy storage system (BESS) data interface
- Confirming system operations
- Verifying microgrid interconnection device (MID) function for islanding systems
- Verifying correct operation of power-limiting devices and functions (e.g., power control systems, Zero-Export)

### TASK 7: Confirm Project Completion

**Knowledge of:**

- a. Finalized documentation (e.g., commission report, testing results, signed permits, permission to operate, as built)
- b. Visual documentation (e.g., photograph)
- c. Close-out procedures (e.g., punch lists, contract reconciliation, demobilization)
- d. Owner sign-off requirements (e.g., appropriate site condition, customer satisfaction)
- e. Warranty and owner's documents (e.g., manuals, specifications sheets)
- f. Equipment identification requirements (e.g., labeling, tags signage)
- g. Operation instructions and/or training for owner
- h. System design, operation, and performance metrics (e.g., performance ratio)

### TASK 8: Provide End User Training

**Knowledge of:**

- a. Applicable codes and standards (e.g., National Fire Protection Association [NFPA] 70B, NFPA 70E)
- b. Safety data sheets
- c. Manufacturer's installation and operations instructions (e.g., startup, operation, and shutdown procedures)
- d. Emergency procedures (e.g., spill containment)
- e. Location of components
- f. Monitoring access

**Skills in:**

- Training system operation and limitations (e.g., operational indicators)
- Reviewing system and project documentation with end user

# Domain 5: Operations, Maintenance, and Decommissioning

## TASK 1: Verify System Operation and Performance

### Knowledge of:

- a. Equipment startup procedures
- b. Charging battery modules to acceptable voltage/state-of-charge tolerance
- c. Charging battery bank to acceptable state-of-charge for operational testing
- d. Use and calibration requirements of charging equipment
- e. Performance verification testing
- f. Acceptance testing (e.g., remote shutdown)
- g. Impact of site conditions on testing
- h. Access to system monitoring, control, and communication platforms
- i. Platform settings and alert mechanisms
- j. Indicators of failure, underperformance, or false alarms
- k. Interpretation of performance data
- l. Seasonal impacts on system performance

### Skills in:

- Identifying remote diagnostic solutions
- Interpreting the battery energy storage system (BESS) data interface
- Confirming system operations

## TASK 2: Perform and Log Preventative Maintenance

### Knowledge of:

- a. Electrical equipment manufacturer's maintenance requirements
- b. Occupational Safety and Health Administration (OSHA) safety regulations
- c. Maintenance practices and causes of failure
- d. Battery energy storage system (BESS) safety
- e. Maintenance schedule criteria
- f. National Fire Protection Association (NFPA) 70E (e.g., lock out/tag out [LOTO])
- g. Site specific safety requirements
- h. Site specific maintenance procedure
- i. Appropriate testing, equipment, and documentation required
- j. Startup/shutdown procedures
- k. Inspection schedule
- l. Instrumentation calibration
- m. Mounting system degradation, failure points, and causes (e.g., loose connections, corrosion, displacement)
- n. Electrical equipment failure points and causes (e.g., vermin, debris, ventilation, water intrusion)
- o. Wiring degradation, failure points, and causes (e.g., unsupported conductors, connector failure, loose terminations, physical damage to raceway)
- p. Battery degradation, failure points, and causes (e.g., cable terminations, corrosion, capacity testing, deformation of battery)
- q. Site factors affecting performance (e.g., operating temperature, ventilation, drainage)
- r. Comparison of system performance to predicted values

### Skills in:

- Executing maintenance plan
- Maintaining and preserving maintenance log

## DOMAIN 5: OPERATIONS, MAINTENANCE, AND DECOMMISSIONING

### TASK 3: Perform and Log Corrective Maintenance

#### Knowledge of:

- a. Occupational Safety and Health Administration (OSHA) regulations
- b. Troubleshooting procedures
- c. National Fire Protection Association (NFPA) 70E (e.g., lock out/tag out [LOTO], personal protective equipment [PPE])
- d. Site-specific safety requirements
- e. Methods for diagnosing failure or low performance
- f. Startup/shutdown procedures
- g. Repair or replacement procedures

#### Skills in:

- Executing the repair
- Maintaining and preserving maintenance log
- Using personal protective equipment (PPE)
- Using testing equipment (e.g., multi-meter)

### TASK 4: Develop, Review, and Execute Decommissioning Protocol

#### Knowledge of:

- a. Manufacturers decommissioning requirements
- b. Applicable codes and standards (e.g., National Fire Protection Association [NFPA] 1, International Fire Code [IFC], International Residential Code [IRC], NFPA 855)
- c. Discharge battery to safe state of charge
- d. Department of Transportation hazardous material shipping and handling requirements
- e. Local recycling requirements

#### Skills in:

- Creating project documentation
- Handling material (e.g., heavy lifting, securing for transport)
- Handling hazardous material
- Using personal protective equipment (PPE)
- Performing lock out/tag out (LOTO)





NABCEP's mission is to establish and operate high-quality credentialing programs for renewable energy professionals. NABCEP credentials promote worker safety, provide value to practitioners and consumers, and set the standard for measurable cognitive skill levels.



Since 2007, NABCEP's PV Installation Professional (PVIP) Certification has met the vigorous standards for accreditation under the ISO/IEC 17024:2012 Certification of Persons. The ANAB/ANSI symbol signals to employers and the public that the PVIP Certified Professional has undergone a valid, fair and reliable assessment to verify their skills and competencies to practice.

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