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NABCEP PV System Inspector Job Task Analysis

NREL PV Reliability Workshop /
IECRE PV System Certification Workshop
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Golden, CO

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This presentation contains no confidential information

History

- The North American Board of Certified Energy Practitioners (NABCEP) was founded in 2002 as a non-profit 501 (c)(6) corporation with a mission “to support, and work with, the renewable energy and energy efficiency industries, professionals, and stakeholders to develop and implement quality credentialing and certification programs for practitioners.”
- NABCEP’s voluntary credentials are the most widel recognized and respected in the US solar industry.
- The NABCEP PV Installation Professional ™ and NABCEP Solar Heating Installer ™ certification programs are accredited to ISO/IEC 17024 by ANSI.

NABCEP's Current Schemes

- PV Installation Professional Certification
- PV Technical Sales Professional Certification
- Solar Heating Installer Certification
- PV Entry Level Exam
- Solar Heating Entry Level Exam

- PV Installation Company Accreditation

Job Task Analysis Development Process Overview

Role Delineation Study

Draft Job Task Analysis (JTA) created by Committee of SMEs during 2-day meeting

Industry Validation Study

Broad stakeholder input sought via online survey to refine and validate Draft JTA

Final Job Task Analysis Published

NABCEP Board of Directors approves final version of JTA developed by the Committee

PV System Inspector (PVSI) Target Audience

- Primary Audience
  - Individuals performing inspections of PV systems for an Authority Having Jurisdiction (AHJ), I.E. Town Electrical Inspector, to ensure code compliance
- Secondary Audience
  - Individuals performing inspection services for utilities to ensure compliance with interconnection requirements
  - Individuals performing inspection services for incentive programs, I.E. State or utility rebate programs, to ensure quality workmanship and performance
  - Individuals performing inspections of systems installed through a finance mechanism (loan, lease, PPA, utility program, ..)
  - **Individuals inspecting systems to the IECRE standard?**

PVSI Program Objectives

- Increase the quality of PV System Inspections to improve the reliability of PV Systems, protect the reputation of the PV Industry, and ensure safe operations
- Facilitate training of PV System Inspectors by providing an industry validated Job Task Analysis upon which curriculum can be based
- Provide employers and customers of PV System Inspectors with a tool to evaluate their competence at performing the job

PVSI Timeline

Q3 14	• Technical Committee Formed
Q4 14	• Role Delineation Study Performed • Draft Job Task Analysis Developed
Q1 15	• Industry Validation Study Conducted
Q2 15	• Final JTA Approved and Published • Examination Committee Formed
Q3 15	• Examination Questions Developed • Examination Form(s) Created and Passing Score Study Completed
Q4 15	• Credential Scheme finalized • First Exams Administered

Domain I: Inspecting Electrical Components and Systems

Domain I: Inspecting Electrical Components and Systems	
Task 1: Visually verify system labeling meets applicable codes to ensure safety.	
Subtask 1.1: Confirm AC interconnection point is properly labeled.	**Critical**
Subtask 1.2: Confirm labels are of sufficient durability to withstand the environment involved.	**Critical**
Subtask 1.3: Confirm DC raceways are properly labeled.	**Important**
Subtask 1.4: Confirm DC disconnects are properly labeled.	**Important**
Subtask 1.5: Confirm AC disconnects are properly labeled.	**Important**
Subtask 1.6: Confirm the main service panel is properly labeled.	**Important**
Subtask 1.7: Confirm the inverter or other power conditioning units are properly labeled.	**Important**
Subtask 1.8: Confirm labels pertaining to the ungrounded system are in place (if applicable).	**Important**
Subtask 1.9: Confirm the rapid shutdown system is properly labeled (if applicable).	**Important**
Subtask 1.10: Confirm labels are the proper color and in legible print (not handwritten).	**Useful**

Domain I: Inspecting Electrical Components and Systems Cont.

Domain I: Inspecting Electrical Components and Systems	
Task 2: Visually and physically verify installed components match those on the approved plans and adhere to applicable codes and standards.	
Subtask 2.1 Verify working clearances on components.	**Critical**
Subtask 2.2 Ensure all components are listed, labeled, and identified for use.	**Critical**
Subtask 2.3 Verify model numbers of components.	**Important**
Subtask 2.4 Confirm the number of PV modules.	**Important**
Subtask 2.5 Verify the National Electrical Manufacturer's Association (NEMA) rating (indoor/outdoor/hazardous environment).	**Important**
Subtask 2.6 Confirm the location of components matches the plans.	**Important**
Task 3: Visually and physically inspect conductors and raceways to ensure safety and compliance to applicable codes.	
Subtask 3.1 Verify conductor ampacity is appropriate for circuit current.	**Critical**
Subtask 3.2 Verify the conductor type is suitable for the location and environment.	**Critical**
Subtask 3.3 Verify the conductor voltage rating for the circuit.	**Critical**
Subtask 3.4 Verify installation of conduit expansion joints based on length.	**Critical**
Subtask 3.5 Ensure raceway connections are suitable for the location and environment.	**Critical**
Subtask 3.6 Verify conductor color is correct.	**Important**
Subtask 3.7 Verify conduit size is suitable based on conduit fill.	**Important**
Subtask 3.8 Verify raceway type is suitable for the location and environment.	**Important**
Subtask 3.9 Ensure raceways are secured and supported properly.	**Important**

Domain I: Inspecting Electrical Components and Systems Cont.

Domain I: Inspecting Electrical Components and Systems	
Task 4: Assess conductor terminations for integrity and compatibility of components to ensure safety.	
Subtask 4.1 Verify conductor size and type are appropriate for the terminal.	**Critical**
Subtask 4.2 Verify the conductor and terminal materials are compatible.	**Critical**
Subtask 4.3 Verify the connection is secure.	**Critical**
Subtask 4.4 Verify the termination device is rated for the voltage and current of the circuit.	**Critical**
Task 5: Ensure the integrity of the grounding system by visually and physically verifying continuity to ensure safety and compliance with applicable codes.	
Subtask 5.1 Ensure all non-current carrying metallic components are grounded.	**Critical**
Subtask 5.2 Ensure the grounding electrode is properly installed.	**Critical**
Subtask 5.3 Check the inverter or power conditioning unit for ground fault error when in operation.	**Critical**
Subtask 5.4 Ensure the equipment grounding conductor (EGC) is appropriately sized.	**Important**
Subtask 5.5 Ensure the grounding electrode conductor (GEC) is continuous and appropriately sized.	**Important**

Domain I: Inspecting Electrical Components and Systems Cont.

Domain I: Inspecting Electrical Components and Systems	
Task 6: Visually and physically inspect the point of PV system interconnection with the utility grid for compliance with applicable codes, following standard electrical safety practices.	
Subtask 6.1: Verify the interconnection devices are appropriate for use.	**Critical**
Subtask 6.2: Verify the maximum current fed to the busbar does not exceed code limitations.	**Critical**
Subtask 6.3: Verify the proper installation of the overcurrent protection device for the supply-side interconnection.	**Critical**
Subtask 6.4: Confirm the location of interconnection devices.	**Important**
Task 7: Verify proper sizing and ratings of overcurrent protection devices per applicable codes and standards to ensure safety.	
Subtask 7.1: Confirm voltage limitations of the overcurrent protection devices.	**Critical**
Subtask 7.2: Confirm circuit current calculations.	**Critical**
Subtask 7.3: Confirm characteristics of existing electrical distribution system.	**Critical**
Subtask 7.4: Confirm the allowable interrupting current ratings of overcurrent protection devices.	**Critical**
Subtask 7.5: Confirm the selection of overcurrent protection enclosures.	**Important**
Subtask 7.6: Confirm current limits of overcurrent protection devices.	**Important**

Domain II: Inspecting Energy Storage Components and Systems

Domain II: Inspecting Energy Storage Components and Systems	
Task 1: Verify PV array design and control per applicable codes and standards to ensure safety.	
Subtask 1.1: Verify conductor sizing is appropriate for array and charge controller ampacity.	**Critical**
Subtask 1.2: Verify the size and rating of overcurrent protection devices (OCPD) for array and charge controller conductors.	**Critical**
Subtask 1.3: Confirm the charge controller is suitable for the type of storage used.	**Important**
Task 2: Verify the energy storage system design and installation adheres to applicable codes and standards to ensure safety.	
Subtask 2.1: Verify the mechanical enclosure is sufficient to support the weight of the battery bank.	**Critical**
Subtask 2.2: Verify the grounding of any metal structures.	**Critical**
Subtask 2.3: Verify proper working clearance around batteries.	**Critical**
Subtask 2.4: Verify the battery enclosure has appropriate ventilation when required.	**Critical**
Subtask 2.5: Confirm the battery conductors and terminals are compliant and conductor insulation is appropriate.	**Critical**
Subtask 2.6: Verify seismic structural requirements meet applicable codes and standards.	**Important**
Subtask 2.7: Ensure the provision for the containment of battery acid if appropriate.	**Important**
Subtask 2.8: Verify the battery disconnect location.	**Important**
Subtask 2.9: Verify the battery overcurrent protection device(s) (OCPD) are appropriate for inverter output.	**Important**
Subtask 2.10: Verify code-compliant labeling.	**Important**

Domain II: Inspecting Energy Storage Components and Systems Cont.

Domain II: Inspecting Energy Storage Components and Systems	
Task 3: Verify the operation of the multi-mode inverter complies with applicable codes and standards to ensure safety.	
Subtask 3.1: Verify the proper installation and usage of the multimode inverter.	**Important**
Subtask 3.2: Verify the proper interconnection of system components.	**Important**
Task 4: Verify the inverter AC connections comply with applicable codes and standards to ensure safety.	
Subtask 4.1: Verify the proper AC overcurrent protection devices (OCPD) and conductors.	**Critical**
Subtask 4.2: Verify the overcurrent protection device is sized properly for bidirectional current flow at grid connection.	**Critical**
Subtask 4.3: Verify the installation and rating of the critical load panel.	**Critical**
Subtask 4.4: Verify proper generator sizing and interconnection as required.	**Important**

Domain III Inspecting Mechanical / Structural Components

Domain III: Inspecting Mechanical/Structural Components	
Task 1: Inspect roof-mounted components and systems to verify integrity and compliance with applicable codes to ensure longevity and safety.	
Subtask 1.1: Verify quantity and type of attachment points for racking.	**Critical**
Subtask 1.2: Verify the integrity of structural members.	**Critical**
Subtask 1.3: Verify the proper use of any dissimilar metals to avoid corrosion and deterioration.	**Critical**
Subtask 1.4: Verify ballast weights and placement.	**Critical**
Subtask 1.5: Inspect flashing and weather sealing.	**Critical**
Subtask 1.6: Verify module attachments meet listing requirements.	**Critical**
Subtask 1.7: Verify equipment is installed securely and meets listing requirements.	**Critical**
Subtask 1.8: Verify junction boxes and disconnects are mounted securely and meet listing requirements.	**Critical**
Subtask 1.9: Verify the racking system is properly mounted and meets listing requirements.	**Critical**
Subtask 1.10: Inspect modules for physical damage.	**Critical**
Subtask 1.11: Verify the rooftop array configuration meets setback requirements as defined by applicable codes and standards.	**Critical**
Subtask 1.12: Verify the location of attachment points.	**Important**
Subtask 1.13: Verify the integrity of attachment points into/on the structure.	**Important**
Subtask 1.14: Verify the array structure is level and plumb.	**Useful**

Domain III Inspecting Mechanical / Structural Components Cont.

Domain III: Inspecting Mechanical/Structural Components and Systems	
Task 2: Inspect ground-mounted components and systems to verify integrity and compliance with applicable codes to ensure longevity and safety.	
Subtask 2.1: Verify the proper use of any dissimilar metals to avoid corrosion and deterioration.	**Critical**
Subtask 2.2: Verify module attachments meet listing requirements.	**Critical**
Subtask 2.3: Verify equipment is installed securely and meets listing requirements.	**Critical**
Subtask 2.4: Verify DC conductors are not readily accessible.	**Critical**
Subtask 2.5: Confirm foundation inspection documentation if applicable.	**Important**
Subtask 2.6: Verify the ground-mounted array location meets setback requirements as defined by local jurisdictional requirements.	**Useful**

Domain IV: Documentation for the System Inspection

Domain IV: Documentation for the System Inspection	
Task 1: Review permit package for accuracy, completeness, and compliance with applicable codes to ensure a safe and functioning system design.	
Subtask 1.1: Verify a site diagram includes the location of major components.	**Important**
Subtask 1.2: Verify the electrical diagram includes information on electrical components, wiring methods, and electrical connection to the utility service.	**Important**
Subtask 1.3: Verify string sizing for compatibility with the inverter or other power conditioning unit.	**Important**
Subtask 1.4: Ensure the permit package includes the specification sheets for major components.	**Useful**
Subtask 1.5: Verify the permit plans identify an array that is mounted on a code-compliant and permitted structure.	**Useful**
Subtask 1.6: Verify the permit plans identify a mounting system.	**Useful**
Task 2: Quantify and report deviations of the installed system from design documentation and applicable codes and standards for various stakeholders.	
Subtask 2.1: Report any deviation from the manufacturer's specifications.	**Critical**
Subtask 2.2: Report any code violations.	**Critical**
Subtask 2.3: Report any deviation from submitted design documentation.	**Important**
Subtask 2.4: Present supporting documentation (e.g., photographs, measurements, technical documents, code reference).	**Important**

PVSI Validation Study

- NABCEP will be conducting an Industry Validation Study of the Draft PV System Inspector Job Task Analysis in March/April 2015.
- To access the survey during this time and provide feedback on the DRAFT PV System Inspector JTA please visit www.nabcep.org or e-mail info@nabcep.org to request an invitation.