QUALIFICATIONS PACK - OCCUPATIONAL STANDARDS FOR GREEN JOBS

Contents

What are Occupational Standards (OS)?

- OS describe what individuals need to do, know and understand in order to carry out a particular job role or function
- OS are performance standards that individuals must achieve when carrying out functions in the workplace, together with specifications of the underpinning knowledge and understanding

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Introduction

Qualifications Pack- Solar PV Installer (Suryamitra)

SECTOR: GREEN JOBS

SUB-SECTOR: Renewable Energy

OCCUPATION: Installation, Operation and Maintenance

REFERENCE ID: SGJ/Q0101

ALIGNED TO: NCO-2004/ NIL

Solar PV Installer is specialized for mechanical, civil and electrical installations of Solar Photovoltaic Systems as well as maintaining them properly and has the communication & soft skills.

Brief Job Description: Solar PV Installer checks, adapts, implements, configures, installs, inspects, tests, and commissions different components of photovoltaic systems, that meet the performance and reliability needs of customers by incorporating quality craftsmanship and complying with all applicable codes, standards, and safety requirements.

Personal Attributes: This job requires the individual to concentrate on the job at hand and complete it without any accidents so diligence and hardworking are desired attributes for individuals performing this role. He must also demonstrate strong work ethics, an ability to communicate courteously with co-workers, and must be good with following instructions of the supervisor.

Job Details

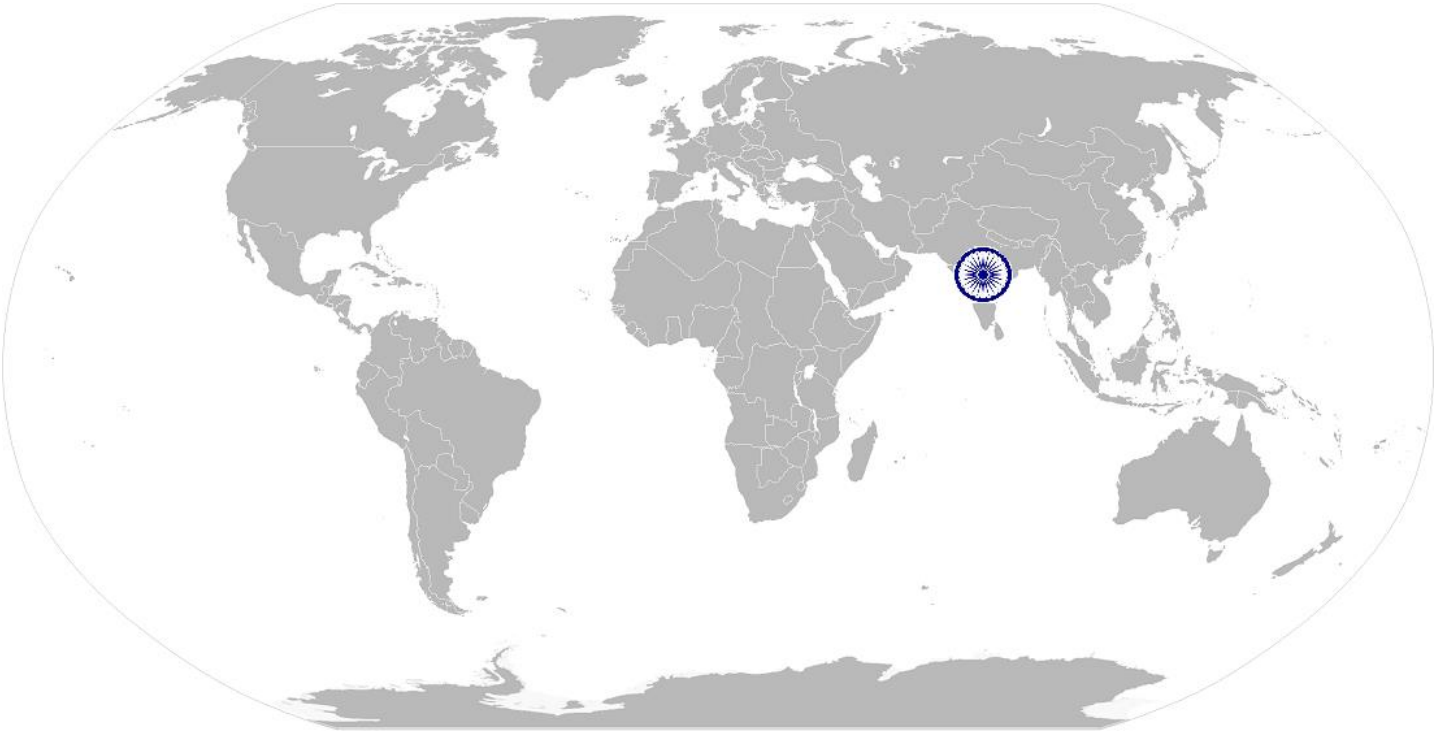
Qualifications Pack Code	**SGJ/Q0101**		
Job Role	**Solar PV Installer** **This job role is applicable in both national and international scenarios**		
Credits(NSQF)	**TBD**	**Version number**	**1.0**
Sector	**Green Jobs**	**Drafted on**	**01/10/2015**
Sub-sector	**Renewable Energy**	**Last reviewed on**	**20/11/2015**
Occupation	**Solar PV Installer**	**Next review date**	**01/10/2018**
NSQC Clearance on	**N.A**		

Job Role	**SOLAR PV INSTALLER**
Role Description	Solar PV Installer is specialized for mechanical, civil and electrical installations of Solar Power Plants as well as maintaining them properly and has the communication & soft skills.
NSQF level	4
Minimum Educational Qualifications	10th pass + ITI / Diploma (Electrical, Electronics, Civil, Mechanical, Fitter, Instrumentation, Welder)
Maximum Educational Qualifications	Not Applicable.
Training (Suggested but not mandatory)	N/A
Minimum Job Entry Age	18 years.
Experience	Not Required.
Applicable National Occupational Standards (NOS)	**Compulsory:** SGJ/N0101: Site Survey for installation of Solar PV System ELE/N5903: Assess the customer's Solar PV requirement SGJ/N0102: Procure Solar PV system components SGJ/N0103: Install Civil and Mechanical parts of Solar PV System SGJ/N0104: Install Electrical components of Solar PV System SGJ/N0105: Test and Commission Solar PV System ELE/N6001: Maintain Solar Photovoltaic System SGJ/N0106: Maintain Personal Health & Safety at project site SGJ/N0107: Customer orientation for Solar PV System **Optional:** Not Applicable.
Performance Criteria	As described in the relevant OS units.

Definitions

Keywords/Terms	Description
Sector	Sector is a conglomeration of different business operations having similar businesses and interests. It may also be defined as a distinct subset of the economy whose components share similar characteristics and interests.
Sub-sector	Sub-sector is derived from a further breakdown based on the characteristics and interests of its components.
Occupation	Occupation is a set of job roles, which perform similar/related set of functions in an industry.
Function	Function is an activity necessary for achieving the key purpose of the sector, occupation or area of work, which can be carried out by a person or a group of persons. Functions are identified through functional analysis and form the basis of OS.
Job Role	Job role defines a unique set of functions that together form a unique employment opportunity in an organization
OS	OS specify the standards of performance an individual must achieve when carrying out a function in the workplace, together with the Knowledge and understanding they need to meet that standard consistently. Occupational Standards are applicable both in the Indian and global contexts.
Performance Criteria	Performance Criteria are statements that together specify the standard of performance required when carrying out a task.
NOS	NOS are Occupational Standards which apply uniquely in the Indian context.
Qualifications Pack Code	Qualifications Pack Code is a unique reference code that identifies a qualifications pack
Qualifications Pack	Qualifications Pack comprises the set of OS, together with the educational, training and other criteria required to perform a job role. A Qualifications Pack is assigned a unique qualification pack code.
Unit Code	Unit Code is a unique identifier for an Occupational Standard, which is denoted by an 'N'.
Unit Title	Unit Title gives a clear overall statement about what the incumbent should be able to do.
Description	Description gives a short summary of the unit content. This would be helpful to anyone searching on a database to verify that this is the appropriate OS they are looking for.
Knowledge and Understanding	Knowledge and Understanding are statements which together specify the technical, generic, professional and organizational specific knowledge that an individual needs in order to conform to the required standard.
Organizational Context	Organizational Context includes the way the organization is structured And how it operates, including the extent of operative knowledge managers have of their relevant areas of responsibility.
Technical Knowledge	Technical Knowledge is the specific knowledge needed to accomplish specific designated responsibilities.
Core Skills or Generic Skills	Core Skills or Generic Skills are a group of skills that are key to learning and working in today's world. These skills are typically needed in any work environment. In the context of the OS, these include communication related skills that are applicable to most job roles.

National Occupational Standard



Overview

This unit is about doing survey for installation of Solar PV system and its Plant Components.

SGJ/ N 0101 **Site Survey for Installation of Solar PV System**

National Occupational Standard

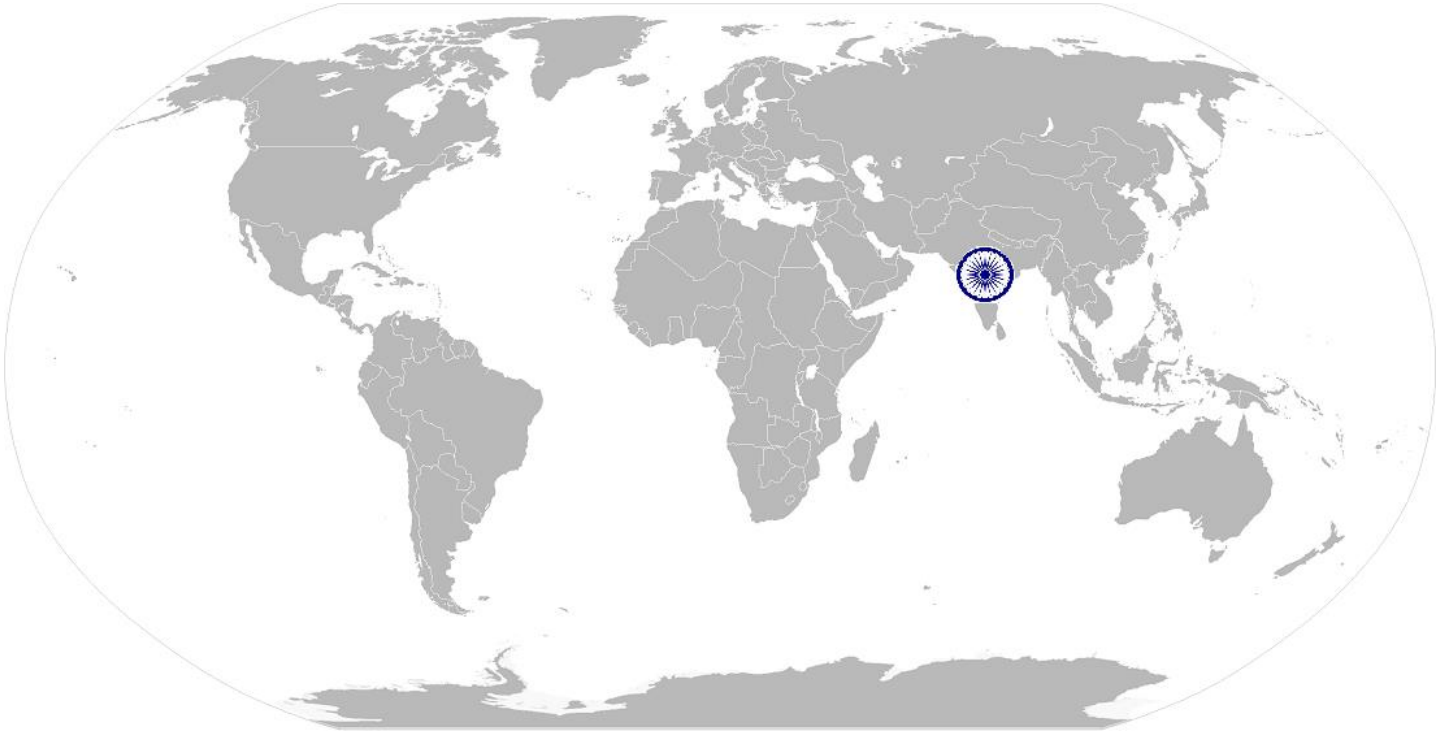
Unit Code	**SGJ / N0101**
Unit Title (Task)	**Site Survey for Installation of Solar PV System**
Description	This unit is about Solar Photovoltaic Technology and Plant Components.
Scope	This unit/task covers the following: • Assess the site condition • Identify load to be connected to Solar PV System
Performance Criteria(PC) w.r.t. the Scope	
Element	**Performance Criteria**
Assess the site conditions	To be competent, the user/ individual must be able to: PC1. Understand the location of installations and optimize the route plan PC2. Assess the site level pre-requisites for solar panel installation PC3. Check for any shading obstacles PC4. Decide on the type of mounting to be constructed PC5. Inform the customer for any civil construction to be undertaken for installing the panels PC6. Prepare a site map of the location where installation has to be carried out
Identify load to be connected to Solar PV System	PC7. Assess the load to be run on Solar Power Plant PC8. Prepare a load profile PC9. Document the site survey variables and complete the checklist/site survey form
Knowledge and Understanding (K)	
A. Organizational Context (Knowledge of the company /organization and its processes)	The user/individual on the job needs to know and understand: KA1. Company's Installation Policy. KA2. Company's Customer Support Policy. KA3. Company's documentation policy. KA4. Document information using appropriate corporate forms. KA5. Obtain authorization from specified field safety officer and supervisor. KA6. Company's reporting structure. KA7. Organization culture. KA8. Company's different department and concerned authority.
B. Technical Knowledge	The individual on the job needs to know and understand the following aspects: KB1. Definition of the terms: energy and power, cell, module, string, array, mono-crystalline, poly-crystalline, amorphous silicon. KB2. Basic concepts of Trigonometry and coordinate geometry KB3. Units and symbols for irradiation and irradiance. KB4. Effect on array output of current and voltage based on series / parallel connections of modules, tilt angle, orientation and shading. KB5. Perform simple calculations to derive the power and energy received from solar radiation in a given area.
	KB7. Efficiency, cost and typical specifications, functioning and operating principle of different types of Solar Photovoltaic Plants, commercially available PV modules, inverters, charge controllers, battery, mounting structures, cables, junction boxes and other components. KB8. Mechanical and electrical features necessary for the long life of the PV Power Plant under a wide range of operating conditions.

SGJ/ N 0101 Site Survey for Installation of Solar PV System

Skills	
A. Core Skills / Generic Skills	**Writing Skills**
	The user/ individual on the job needs to know and understand how to: SA1. Fill up documentation applicable to one's role.
	Reading Skills
	The user/individual on the job needs to know and understand how to: SA2. Read vernacular/English language. SA3. Read and understand manuals, health and safety instructions, memos, other company documents. SA4. Ability to read from different sources- books, screens in machines and signage. SA5. Understand the various colour codes, as per standard electrical, mechanical and civil nomenclature.
	Oral Communication (Listening and Speaking skills)
	The user/individual on the job needs to know and understand how to: SA6. Express statements or information clearly so that others can hear and understand. SA7. Participate in and understand the main points of simple discussions. SA8. Respond appropriately to any queries. SA9. Communicate with supervisor.
B. Professional Skills	**Decision Making**
	The user/individual on the job needs to know and understand how to: SB1. Follow organization rule-based decision making process. SB2. Take decision with systematic course of action and/or response.
	Plan and Organize
	The user/individual on the job needs to know and understand how to : SB3. Planning and organization of work to meet deadlines. SB4. Work constructively and collaboratively with others.
	Customer Centricity
	The user/individual on the job needs to know and understand how to: SB5. Follow code of conduct. SB6. Manage relationships with customers with intent on satisfying its requirements for service delivery.
	Problem Solving
	The user/individual on the job needs to know and understand how to: SB7. Recognize problems and search for solutions. SB8. Choose best methods to complete assigned tasks. SB9. Approach relevant authority when required.
	Analytical Thinking
	The user/individual on the job needs to know and understand how to: SB10. Apply domain knowledge, observations and data to select course of action to perform tasks related to Solar Photovoltaic Systems.
	Critical Thinking
	The user/individual on the job needs to know and understand how to: SB11. Critically evaluate information obtained from customers, supervisor and co-workers to perform day to day activities. SB12. Ask questions for better understanding.

NOS Version Control

NOS Code	SGJ/N0101		
Credits (NSQF)	TBD	Version number	1.0
Industry Sector	Green Jobs	Drafted on	26/06/2015
Industry Sub-sector	Renewable Energy	Last reviewed on	20/11/2015
Occupation	Site Survey	Next review date	01/10/2018



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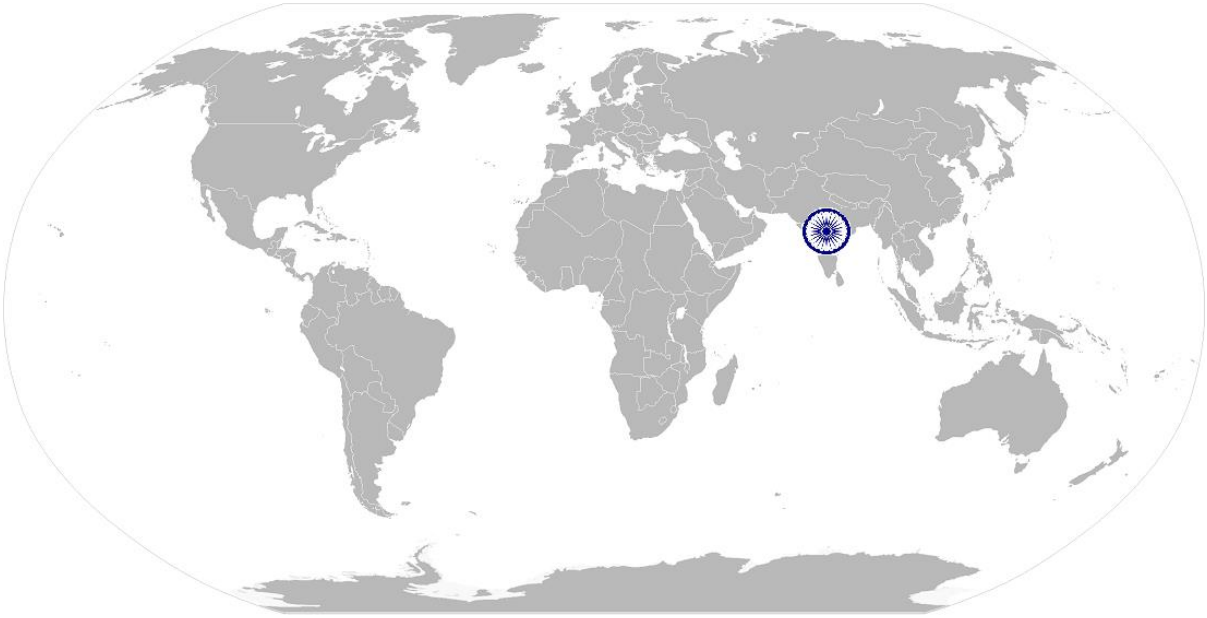
National Occupational Standard



Overview

This OS unit is about understanding the customer's requirement on solar photovoltaic system and suggesting suitable solution. This also includes understanding about components of solar power system and their functions.

ELE/N5903 Assess customer's PV system requirement

National Occupational Standard

Unit Code	ELE/N5903
Unit Title (Task)	**Assess the customer's PV system requirement**
Description	This OS unit is about understanding the customer's requirement for solar PV system and suggesting suitable solution
Scope	This unit/ task covers the following: • Understand the work requirement • Engage with customers to understand their requirement • Visit and evaluate the site for installation • Assess the photovoltaic system required • Assess the cost of system installation • Ensure quality, standards and regulatory requirement are adhered

Performance Criteria(PC) w.r.t. the Scope

Element	Performance Criteria
Understanding the work requirement	To be competent, the user/ individual must be able to: PC1. understand the work requirement and areas of operation PC2. interact with the superior for specific instructions PC3. plan the day's activities based PC4. coordinate with stores and sales team
Engaging with customers	To be competent, the user/ individual must be able to: PC5. coordinate with marketing executive to understand about the customer details and their expectations at a broad level PC6. visit the customer and understand their requirement PC7. ask both open ended and close end questions to customers to clearly understand their power requirement PC8. assess the area of installation, power output expectation, budget during discussion with customer PC9. understand any specific requirement of customers on choice of modules / inverters, place of mounting
Evaluation of installation site	To be competent, the user/ individual must be able to: PC10. assess the location and its potential for solar power system, e.g., location with less clouds, number of days with sunlight PC11. analyse the layout of the area and check space for installation PC12. understand the type of installation i.e., roof mounting or in plain and its requirements PC13. analyse the civil structure of building and its strength for roof top mounting PC14. evaluate the place of solar module mounting and ensure it is free of shade from trees or from existing or potential taller buildings
Assessing the PV system	To be competent, the user/ individual must be able to: PC15. analyse the photovoltaic system requirement of the customer PC16. decide whether the power system will be connected to transmission grid PC17. analyse for producing alternate current or direct current and match customer requirement PC18. decide on battery backup for equipment as per customer expectation PC19. understand the functions and controls of different components of solar PV system such as modules, inverter, grounding equipment, meters, disconnect PC20. ensure the equipment and system specification matches the customer expectation

ELE/N5903 **Assess customer's PV system requirement**

Assessing the cost of installation	To be competent, the user/ individual must be able to: PC21. prepare a costing sheet for installation based on the customer feedback on system requirement PC22. understand from customer for any budget constraints PC23. suggest for any alternatives and changes in design to suit customer's budget PC24. make understand the customer about market price of components of different models of power system PC25. prepare a cost benefit analysis and inform customers on savings while installing solar power system PC26. compare cost with other types of power generation and inform the benefits
Meeting quality and regulatory standards	To be competent, the user/ individual must be able to: PC27. suggest for procurement of quality and best products available in the market PC28. evaluate the safety concerns for installation and address them PC29. arrange trained and qualified technicians for installation PC30. ensure the system and structure meets the local government and regulatory requirement
Knowledge and Understanding (K)	
A. Organizational Context (Knowledge of the company / organization and its processes)	The individual on the job needs to understand: KA1. company's policies on: incentives, personnel management KA2. company's code of conduct KA3. importance of individual's role in the work flow KA4. organisation culture KA5. company's reporting structure KA6. company's documentation policy KA7. company's different department and concerned authority KA8. company's installation policy KA9. company's customer support policy
B. Technical Knowledge	The individual on the job needs to know and understand: KB1. basics on solar energy system and power generation KB2. solar photovoltaic system and its components KB3. Models, specifications, purpose, functionalities, cost details of PV system components such as modules, inverter, etc. KB4. power generation process of solar PV system KB5. usage and handling procedure of solar panels KB6. energy storage, control and conversion KB7. electrical system and functioning KB8. mechanical equipment and its functioning KB9. maintenance procedure of equipment KB10. regulatory aspects relating to solar PV system KB11. site surveying methods and evaluation parameters KB12. tools involved in installation of system KB13. prepare costing and cost benefit analysis for project KB14. project budgeting KB15. tools and equipment to be used in handling specific equipments KB16. quality and process standards KB17. occupational health and safety standards and waste management procedures KB18. importance of wearing protective clothing and other safety gear while carrying out installation activities KB19. precautions to be taken while handling different electrical and mechanical products

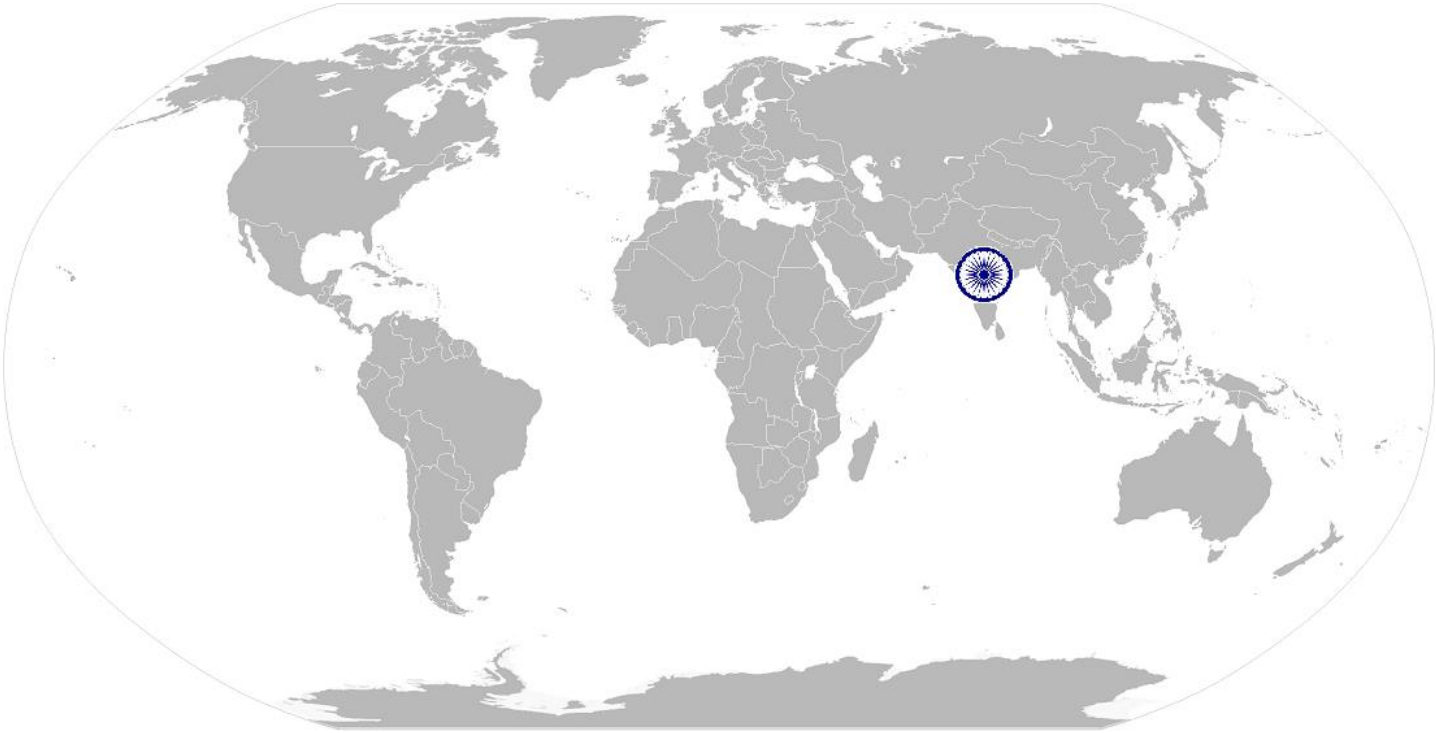
ELE/N5903 **Assess customer's PV system requirement**

Skills (S)	
A. Core Skills/ Generic Skills	**Reading and writing skills**
	The individual on the job needs to know and understand: SA1. How to read product and equipment manuals, installation manuals, etc. SA2. How to read warnings, instructions and other text material on product labels, components etc. SA3. how to fill in job completion form after installation activities have been completed
B. Professional Skills	**Using tools and machines**
	The individual on the job needs to know and understand: SB1. purpose and specification of tools used in maintenance activity SB2. How to operate/use different tools such as screw driver, inspection fixtures, wire cutter, pliers, tester, spanner etc. SB3. how to handle tools and equipment and maintain them in a good condition
	Interpersonal skills
	The individual on the job needs to know and understand: SB4. how to interact with supervisor to understand the daily production target SB5. how to interact with co-workers in order to coordinate work processes

NOS Version Control

NOS Code	ELE/N5903		
Credits(NVEQF/NVQF/NSQF) [*OPTIONAL*]	TBD	Version number	1.0
Industry	Electronics	Drafted on	24/02/14
Industry Sub-sector	Solar Electronics	Last reviewed on	24/03/14
		Next review date	31/03/16

National Occupational Standard



Overview

This unit is about procurement and receiving of solar power plant components on site.

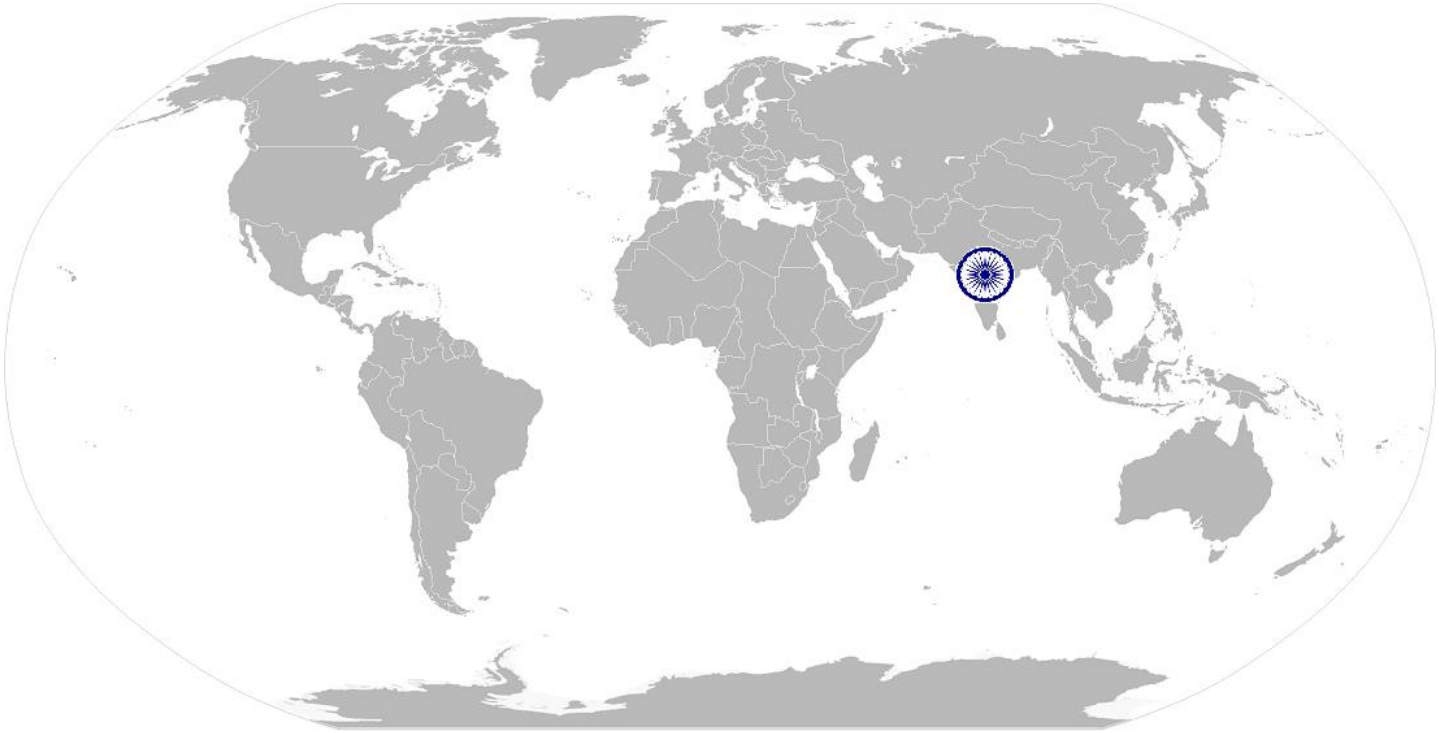
SGJ/ N 0102 **Procure Solar PV system components**

National Occupational Standard

Unit Code	**SGJ / N0102**
Unit Title (Task)	**Procure Solar PV system components**
Description	This unit is about confirming and adapting system design.
Scope	This unit/task covers the following: • Prepare Bill of Material. • Procure the components • Verify the components On-site
Performance Criteria(PC) w.r.t. the Scope	
Element	**Performance Criteria**
Prepare Bill of Material	PC1. Prepare Bill of materials from Single Line Diagram, civil/mechanical drawings and electrical drawings
Procure the components	PC2. Approach stores of the company or the market to place the requirement for components as per BOM PC3. Ensure that the quantity of modules / panels, inverter and batteries match the voltage requirement of the system PC4. Identify and list variation in equipment specifications, if any. PC5. Document variation and submit to design team (if required) and obtain approval or revised drawings PC6. Arrange for tools and consumables required for mounting the solar panels PC7. List the statutory and other requirements to dispatch the equipment at site PC8. Ensure that only company recommended quality materials are used unless specified by customer PC9. Ensure that all materials are QC passed PC10. Complete all documentation w.r.t. Procurement
Verify the Components On-site	PC11. Plan and receive the equipments at site. PC12. Ensure that all the components are handled and stored properly as per standard operating procedures PC13. Check materials received as per final BOM and ensure that the correct material for the job arrives on site and is damage free PC14. Report and document the status of material received at site and take appropriate action for replacements, if any.
Knowledge and Understanding (K)	
A. Organizational Context (Knowledge of the company /organization and its processes)	The user/individual on the job needs to know and understand: KA1. Company's Installation Policy. KA2. Company's Customer Support Policy. KA3. Company's documentation policy. KA4. Document information using appropriate corporate forms. KA5. Obtain authorization from specified field safety officer and supervisor. KA6. Company's reporting structure. KA7. Organization culture. KA8. Company's different department and concerned authority.
B. Technical Knowledge	The individual on the job needs to know and understand the following aspects: KB1. Definition of the terms: energy and power, cell, module, string, array, mono-crystalline, poly-crystalline, amorphous silicon. KB2. Units and symbols for irradiation and irradiance.

B. Technical Knowledge	KB3. Effect on array output of current and voltage based on series / parallel connections of modules, tilt angle, orientation and shading. KB4. Perform simple calculations to derive the power and energy received from solar radiation in a given area. KB5. Efficiency, cost and typical specifications functioning and operating principle of different types of commercially available Photovoltaic modules, inverters, charge controllers, battery, mounting structures, cables, junction boxes and other components. KB6. Mechanical and electrical features necessary for the long life of the PV system under a wide range of operating conditions. KB7. DO's and Don'ts of material handling and storage. KB8. Determining whether any shading will occur and estimate its effect on the system. KB9. Determining the cabling route and estimate the length of cable required. KB10. Determining where the array junction box (if required) and inverter will be located.
Skill	
A. Core Skills/ Generic Skills	**Writing Skills**
	The user/ individual on the job needs to know and understand how to: SA1. Fill up documentation applicable to one's role.
	Reading Skills
	The user/individual on the job needs to know and understand how to: SA2. Read English and/or vernacular language. SA3. Read and understand manuals, health and safety instructions, memos, other company documents. SA4. Ability to read from different sources- books screens in machines and signage. SA5. Understand the various color codes, as per standard electrical, mechanical and civil nomenclature.
	Oral Communication (Listening and Speaking skills)
	The user/individual on the job needs to know and understand how to: SA6. Express statements or information clearly so that others can hear and understand. SA7. Participate in and understand the main points of simple discussions. SA8. Respond appropriately to any queries. SA9. Communicate with supervisor.
B. Professional Skills	**Decision Making**
	The user/individual on the job needs to know and understand how to: SB1. Follow organization rule-based decision making process. SB2. Take decision with systematic course of actions and/or response.
	Plan and Organize
	The user/individual on the job needs to know and understand how to : SB3. Planning and organization of work to meet deadlines. SB4. Work constructively and collaboratively with others.
	Customer Centricity
	The user/individual on the job needs to know and understand how to: SB5. Follow code of conduct. SB6. Manage relationships with customers with intent on satisfying its requirements for service delivery.

	Problem Solving
	The user/individual on the job needs to know and understand how to: SB7. Recognize problems and search for solutions. SB8. Choose best methods to complete assigned tasks.
	Analytical Thinking
	The user/individual on the job needs to know and understand how to: SB10. Apply domain knowledge, observations and data to select course of action to perform tasks related to Solar Photovoltaic Systems.
	Critical Thinking
	The user/individual on the job needs to know and understand how to: SB11. Critically evaluate information obtained from customers, supervisor and co-workers to perform day to day activities. SB12. Ask questions for better understanding.



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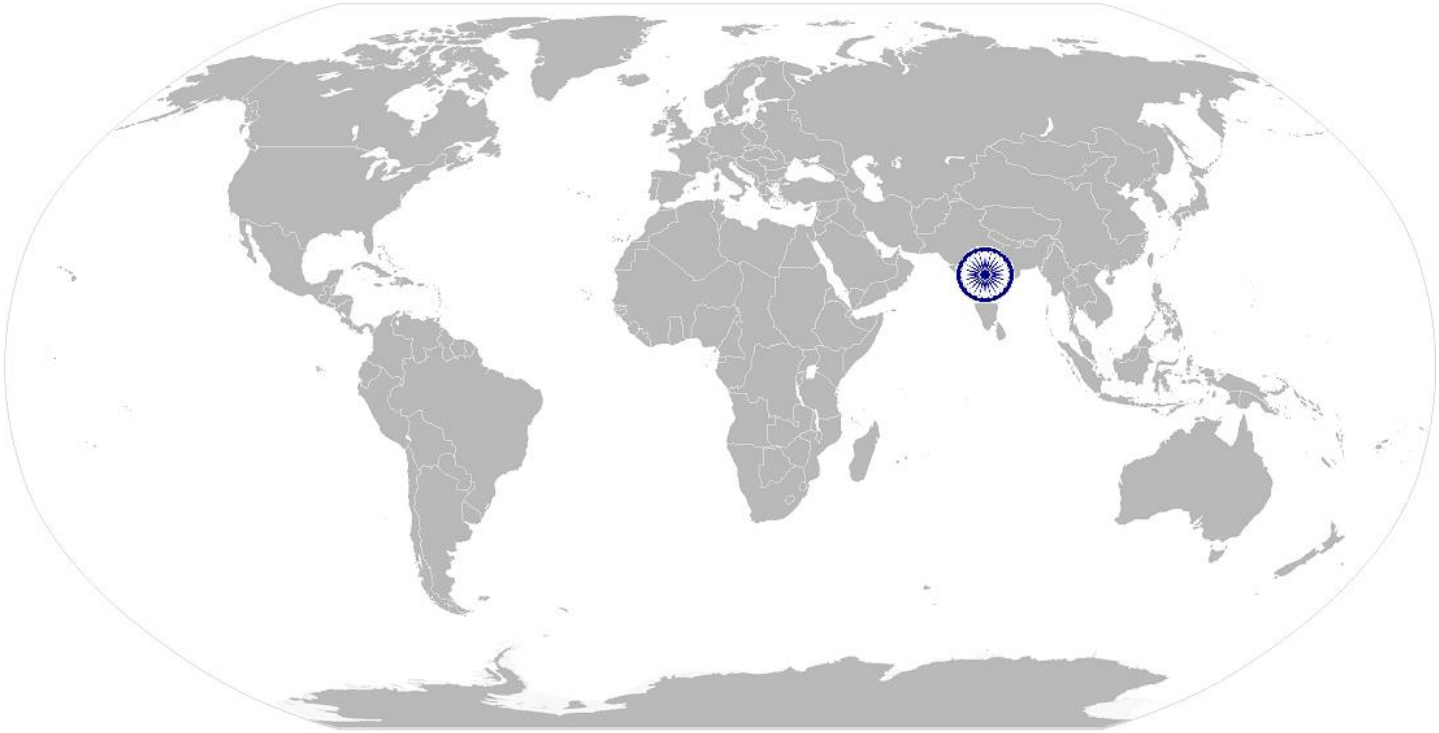
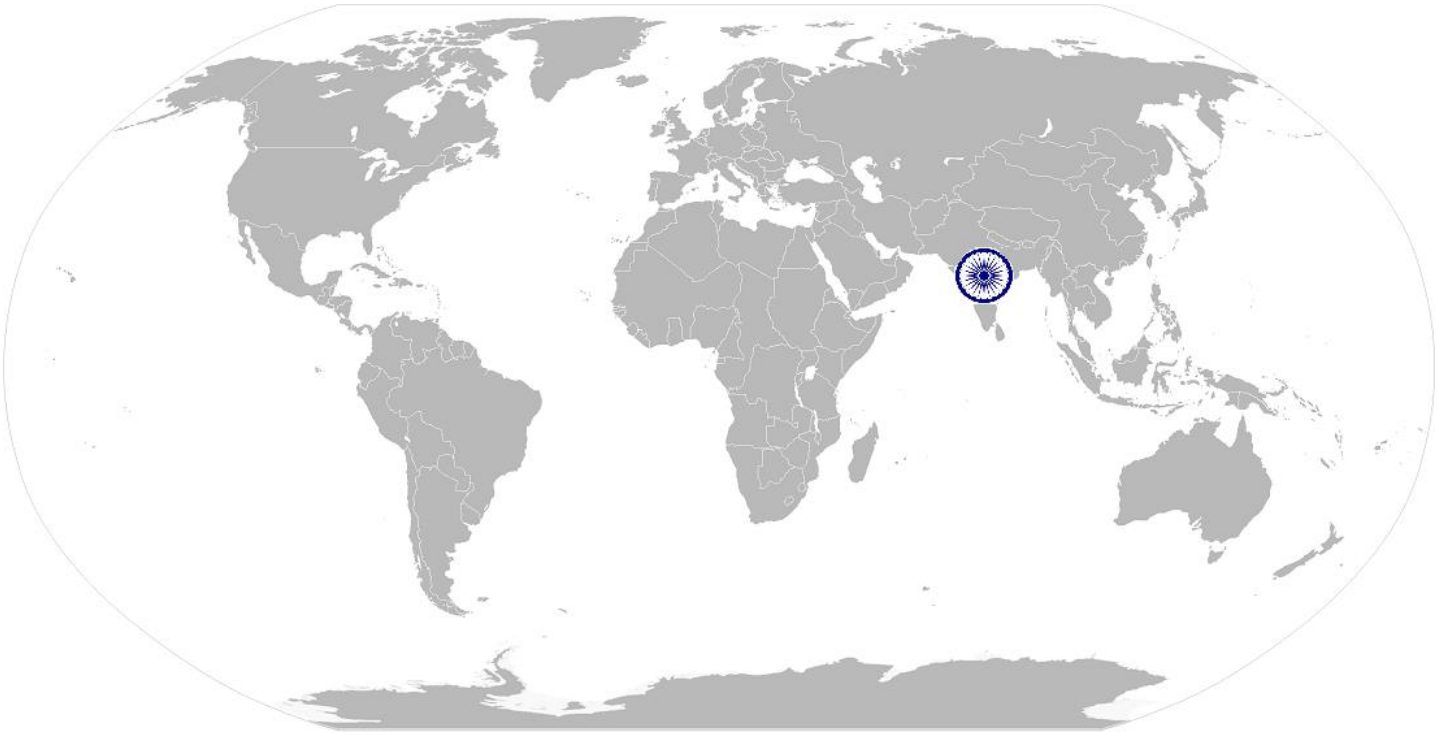
NOS Version Control

NOS Code	SGJ/N0102		
Credits (NSQF)	TBD	Version number	1.0
Industry Sector	Green Jobs	Drafted on	26/06/2015
Industry Sub-sector	Renewable Energy	Last reviewed on	21/10/2015
Occupation	Procurement	Next review date	01/10/2018



National Occupational Standard



Overview

This unit is about installation of civil and mechanical components of Solar Photovoltaic Power Plant

SGJ/ N 0103 **Install Civil & Mechanical parts of Solar PV System**

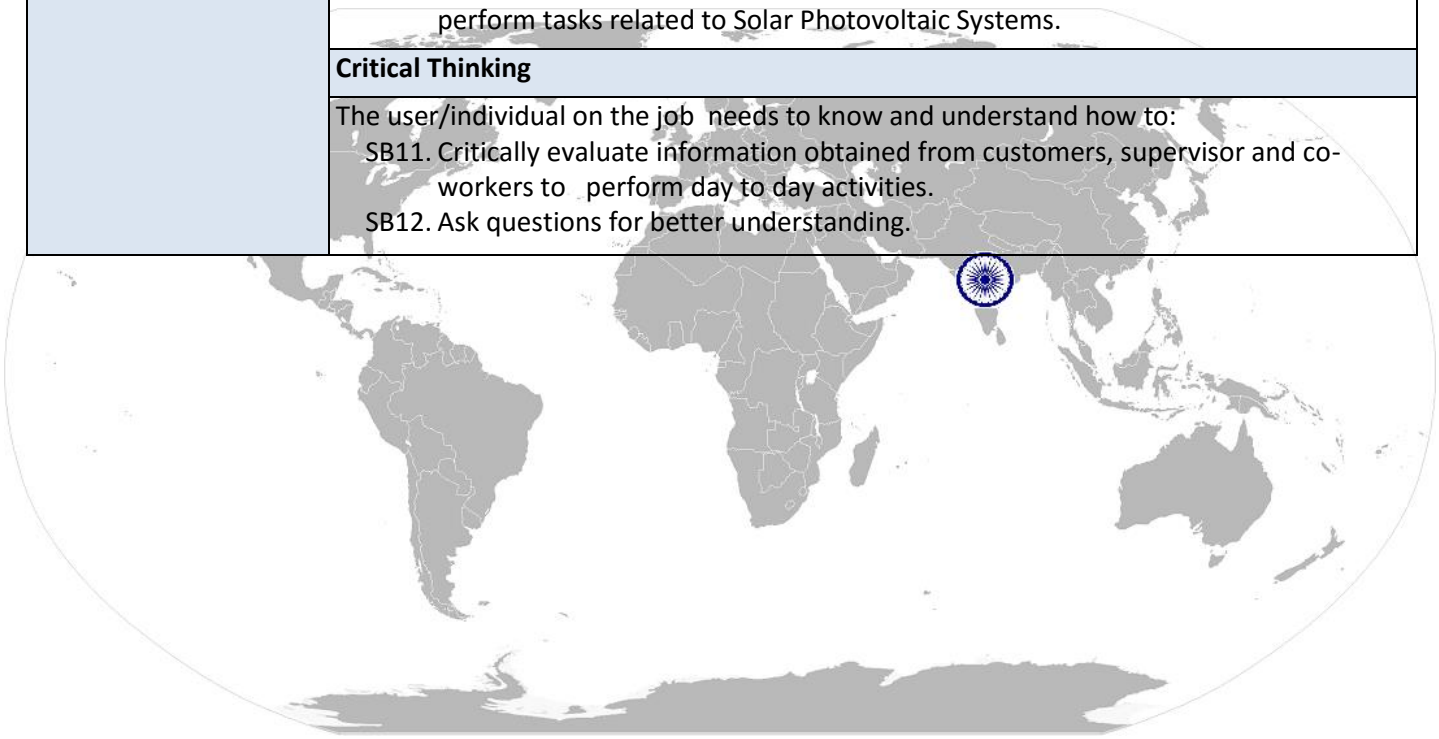
National Occupational Standard

Unit Code	**SGJ / N0103**
Unit Title (Task)	**Install Civil and Mechanical parts of Solar PV system**
Description	This unit is about installation of civil and mechanical components of the Solar Photovoltaic systems (for rooftop installations).
Scope	This OS unit/task covers the following: • Get Equipment Foundation constructed • Install Mounting System • Install Photovoltaic modules. • Install Battery Bank Stand and Inverter Stand.
Performance Criteria(PC) w.r.t. the Scope	
Element	**Performance Criteria**
Get Equipment Foundation constructed	To be competent ,the user/individual on the job must be able to: PC1. Identify type of footing required PC2. Locate structural footings PC3. Arrange for tools and consumables required for civil/mechanical installation PC4. Get the concrete forms constructed to design specifications PC5. Install mounting posts, roof attachments and anchors
Install Mounting System	PC6. Locate structural roof members and install structural attachments PC7. Install module support/racking frame PC8. Plumb and Level array structure PC9. Install supplementary structural supports PC10. Apply corrosion protection to cut surfaces PC11. Apply Weatherproofing to avoid any seepage and penetrations PC12. Install tracking system
Install Photovoltaic modules	PC13. Unpack PV modules PC14. Inspect module for physical damage PC15. Test PV modules' electrical output PC16. Install the modules as per layout diagrams PC17. Secure module wiring PC18. Fasten modules to structure PC19. Torque module fasteners
Install Battery Bank Stand and Inverter Stand	PC20. Install battery bank stand and battery spill containment as per drawings / manuals PC21. Install inverter stand as per drawings / manuals
Knowledge and Understanding (K)	
A. Organizational Context (Knowledge of the company/ organization and its processes)	The user/individual on the job needs to know and understand: KA1. Government/Corporate policies and guidelines on: workplace safety, identification and mitigation of safety hazards, work procedures and guidelines for working at height. KA2. Document information using appropriate corporate forms. KA3. Obtain authorization from specified field safety officer and supervisor. KA4. Legislative, organization, site requirements and procedures. KA5. The environmental requirements. KA6. Work in varying weather conditions. KA7. Complete knowhow on manufacturer's warranty policy.

SGJ/ N 0103 **Install Civil & Mechanical parts of Solar PV System**

A. Technical Knowledge	The user/individual on the job needs to know and understand: KB1. Knowhow of Tools & Tackles required for installation KB2. Effect on array output of current and voltage based on series / parallel connections of modules, tilt angle, orientation and shading KB3. Efficiency, cost, typical specifications, functioning and operating principle of different types of commercially available PV modules, inverters, charge controllers, battery, cables, junction boxes and other electrical components. KB4. Mechanical and electrical features necessary for the long life of the PV system under a wide range of operating conditions. KB5. Determine the type of mounting structure required depending upon the type of roof. KB6. Determine the type of footings and fixtures required depending upon the type of roof. KB7. Determining whether any shading will occur and estimate its effect on the system. KB8. Determining the cabling route and estimate the length of cable required. KB9. Determining where the array junction box (if required) and inverter will be located KB10. DO's and Don'ts of material handling and storage. KB11. Installation work on a PV power system in accordance with relevant standards and regulations KB12. Occupational health and safety (OHS) standards and associated risks when working on that particular site.
Skills	
A. Core Skills/ Generic Skills	**Writing Skills**
	The user/ individual on the job needs to know and understand how to: SA1. Fill up documentation applicable to one's role.
	Reading Skills
	The user/individual on the job needs to know and understand how to: SA2. Read English and/or vernacular language. SA3. Read and understand manuals, health and safety instructions, memos, other company documents. SA4. Ability to read from different sources- books screens in machines and signage. SA5. Understand the various color codes, as per standard electrical, mechanical and civil nomenclature.
	Oral Communication (Listening and Speaking skills)
	The user/individual on the job needs to know and understand how to: SA6. Express statements or information clearly so that others can hear and understand. SA7. Participate in and understand the main points of simple discussions. SA8. Respond appropriately to any queries. SA9. Communicate with supervisor
B. Professional Skills	**Decision Making**
	The user/individual on the job needs to know and understand how to: SB1. Follow organization rule-based decision making process. SB2. Take decision with systematic course of actions and/or response.
	Plan and Organize
	The user/individual on the job needs to know and understand how to : SB3. Planning and organization of work to meet deadlines. SB4. Work constructively and collaboratively with others.

	Customer Centricity
	The user/individual on the job needs to know and understand how to: SB5. Follow code of conduct. SB6. Manage relationships with customers with intent on satisfying its requirements for service delivery.
	Problem Solving
	The user/individual on the job needs to know and understand how to: SB7. Recognize problems and search for solutions. SB8. Choose best methods to complete assigned tasks. SB9. Approach relevant authority when required.
	Analytical Thinking
	The user/individual on the job needs to know and understand how to: SB10. Apply domain knowledge, observations and data to select course of action to perform tasks related to Solar Photovoltaic Systems.
	Critical Thinking
	The user/individual on the job needs to know and understand how to: SB11. Critically evaluate information obtained from customers, supervisor and co-workers to perform day to day activities. SB12. Ask questions for better understanding.



NOS Version Control

NOS Code	SGJ/N0103		
Credits (NSQF)	TBD	Version number	1.0
Industry Sector	Green Jobs	Drafted on	26/06/2015
Industry Sub-sector	Renewable Energy	Last reviewed on	21/10/2015
Occupation	Civil/Mechanical Installation	Next review date	01/10/2018

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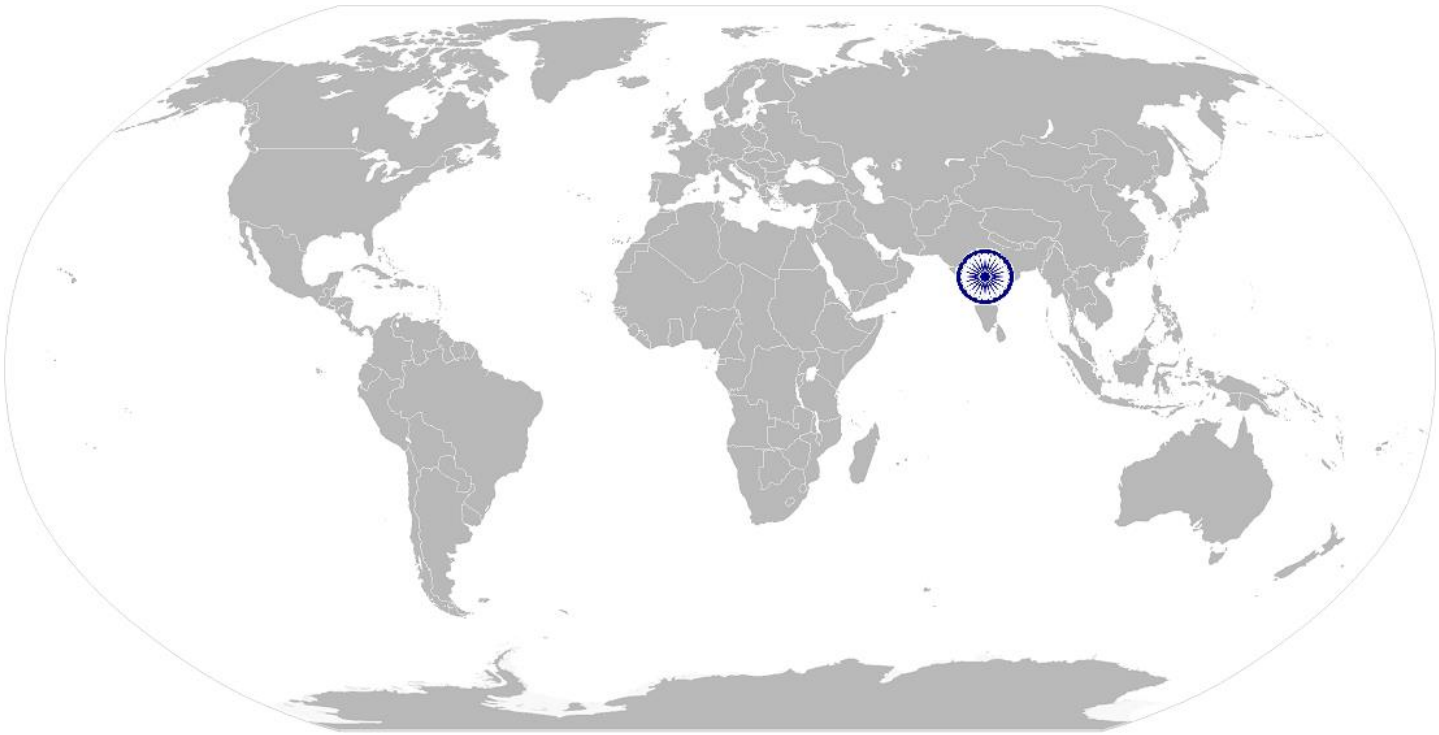


Overview

This unit is about installation of electrical components of Solar Photovoltaic Power Plant

SGJ/ N 0104 **Install electrical components of Solar PV system**

National Occupational Standard

Unit Code	**SGJ / N0104**
Unit Title (Task)	**Install electrical components of Solar PV system**
Description	This unit is about installation of electrical components of the Photovoltaic system.
Scope	This OS unit/task covers the following: • Prepare for Solar Installation. • Install Electrical Components. • Install Conduits and cables. • Get the Grounding Systems installed • Install Battery bank (as required)
Performance Criteria(PC) w.r.t. the Scope	
Element	**Performance Criteria**
Prepare for Solar Installation	To be competent ,the user/individual on the job must be able to: PC1. Implement the site safety plan and Maintain clear work area. PC2. Clarify the maximum working voltage PC3. Select required Personal Protective Equipment (PPE) PC4. Measure current and voltage on equipment before proceeding with work PC5. Inspect and demonstrate the use of electrical installation toolkit PC6. Inspect and maintain safety equipment PC7. Inspect and maintain testing equipment PC8. Demonstrate situational awareness
Install Electrical Components	PC9. Select the location of DC combiner box PC10. Install DC combiner box along with disconnect protections PC11. Install DC energy meters PC12. Confirm battery bank location and Install batteries. PC13. Prepare battery terminals and Install battery interconnection cables. PC14. Terminate fine stranded cables. PC15. Test final assembled battery polarity and voltage. PC16. Install charge controller (if required) PC17. Install inverter PC18. Install utility required disconnects PC19. Install AC combiner box PC20. Connect the solar system to the Distribution box or Transformer. PC21. Proper labeling of the components
Install Conduits and Cables	PC22. Prepare conduit and cable routing plan PC23. Select the correct cable type, color, and gauge. PC24. Support and secure conduit. PC25. Install the cables for modules, inverter and other components PC26. Terminate cables. PC27. Check cables for continuity PC28. Proper labeling of conduits and cables
Get the Grounding Systems installed	PC29. Locate underground hazards, if any PC30. Determine grounding conductor size. PC31. Get the grounding system installed for modules/mounting system and inverters PC32. Get the Bonding done for all electrical equipment's and apply anti – oxidant material

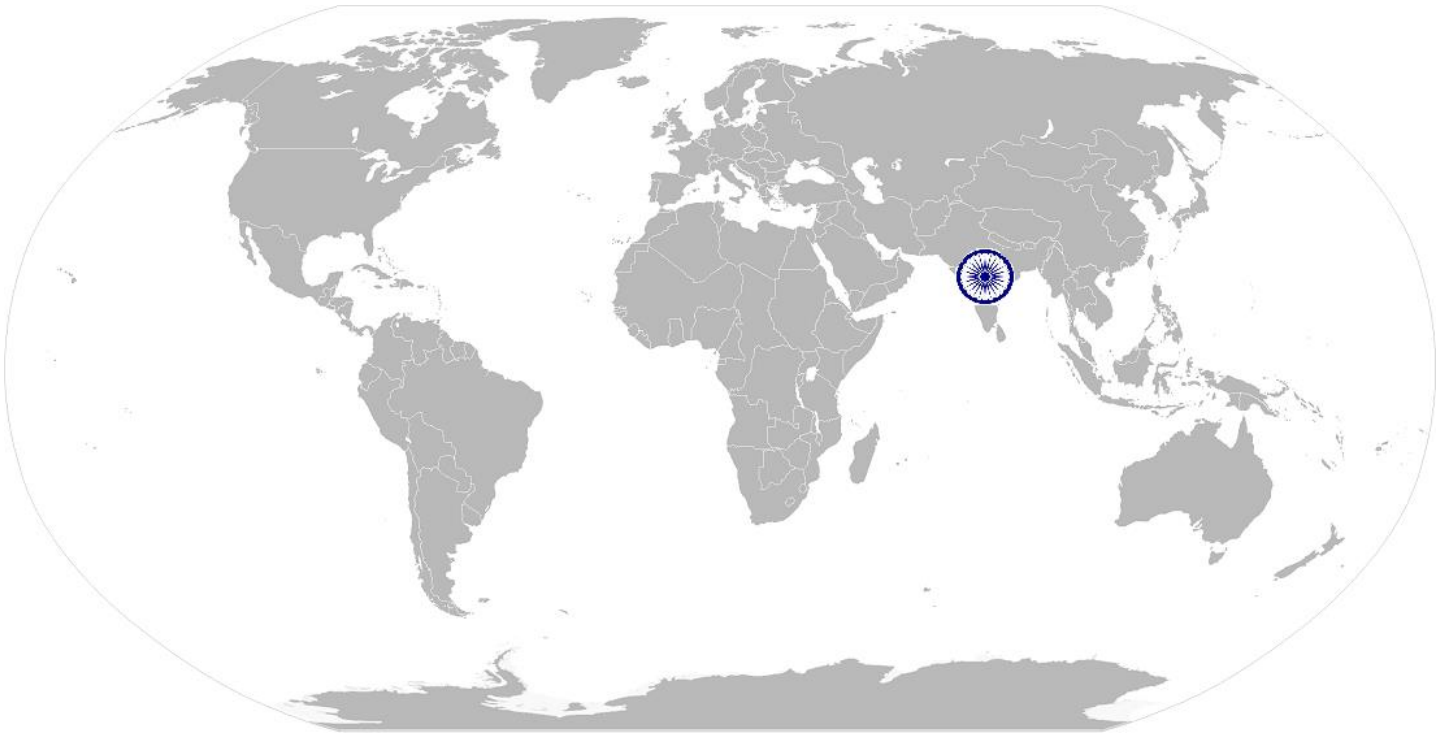
Install Battery Bank (as required)	PC33. Confirm and install battery bank enclosure/racks. PC34. Install battery spill containment (if required). PC35. Install batteries and Prepare battery terminals (e.g., clean). PC36. Install battery interconnection cables and apply anti-oxidant material PC37. Terminate fine stranded cables.
Knowledge and Understanding (K)	
A. Organizational Context (Knowledge of the company / organization and its processes)	The user/individual on the job needs to know and understand: KA1. Government/Corporate policies and guidelines on: workplace safety, identification and mitigation of safety hazards, work procedures and guidelines for working at height. KA2. Document information using appropriate corporate forms. KA3. Obtain authorization from specified field safety officer and supervisor. KA4. Legislative, organization, site requirements and procedures. KA5. Diagnostic/fault finding techniques. KA6. The environmental requirements. KA7. Work in varying weather conditions. KA8. Isolation procedures.
B. Technical Knowledge	The user/individual on the job needs to know and understand how to: KB1. Knowhow of Tools & Tackles required for installation. KB2. Effect on array output of current and voltage based on series / parallel connections of modules, tilt angle, orientation and shading. KB3. Efficiency, cost, typical specifications, functioning and operating principle of different types of commercially available PV modules, inverters, charge controllers, battery, cables, junction boxes and other electrical components. KB4. Mechanical and electrical features necessary for the long life of the PV system under a wide range of operating conditions. KB5. DO's and Don'ts of material handling and storage. KB6. Determining whether any shading will occur and estimate its effect on the system. KB7. Determining the cabling route and estimate the length of cable required. KB8. Determining where the array junction box (if required) and inverter will be located. KB9. Measuring solar irradiance with a pyranometer. KB10. Determining, using field measurements and a sun path diagram, the times and dates when a PV array will be shaded by obstacles at a particular site. KB11. Observe how current and voltage of a module varies w.r.t load. KB12. Effect of blocking and bypass diodes. KB13. Basic functioning and Operation of different types of inverters and other electrical components. KB14. Do's and don'ts of DC wiring and installation of other electrical components. KB15. Connection of the Solar Power Plant to the distribution box/ LT Panel and switchover along with precautions based on different types of plants KB16. Installation work on a Solar power system in accordance with relevant stan and regulations KB17. Occupational health and safety (OHS) standards and associated risks when working on that particular site.

SGJ/ N 0104 **Install electrical components of Solar PV system**

Skills	
A. Core Skills/ Generic Skills	**Writing Skills**
	The user/ individual on the job needs to know and understand how to: SA1. Fill up documentation applicable to one's role.
	Reading Skills
	The user/individual on the job needs to know and understand how to: SA2. Read English and/or vernacular language. SA3. Read and understand manuals, health and safety instructions, memos, other company documents. SA4. Ability to read from different sources- books screens in machines and signage. SA5. Understand the various color codes, as per standard electrical, mechanical
	Oral Communication (Listening and Speaking skills)
	The user/individual on the job needs to know and understand how to: SA6. Express statements or information clearly so that others can hear and understand. SA7. Participate in and understand the main points of simple discussions. SA8. Respond appropriately to any queries. SA9. Communicate with supervisor.
B. Professional Skills	**Decision Making**
	The user/individual on the job needs to know and understand how to: SB1. Follow organization rule-based decision making process. SB2. Take decision with systematic course of actions and/or response.
	Plan and Organize
	The user/individual on the job needs to know and understand how to : SB3. Planning and organization of work to meet deadlines. SB4. Work constructively and collaboratively with others.
	Customer Centricity
	The user/individual on the job needs to know and understand how to: SB5. Follow code of conduct. SB6. Manage relationships with customers with intent on satisfying its requirements for service delivery.
	Problem Solving
	The user/individual on the job needs to know and understand how to: SB7. Recognize problems and search for solutions. SB8. Choose best methods to complete assigned tasks. SB9. Approach relevant authority when required.
	Analytical Thinking
	The user/individual on the job needs to know and understand how to: SB10. Apply domain knowledge, observations and data to select course of action to perform tasks related to Solar Photovoltaic Systems.
	Critical Thinking
	The user/individual on the job needs to know and understand how to: SB11. Critically evaluate information obtained from customers, supervisor and co-workers to perform day to day activities. SB12. Ask questions for better understanding.

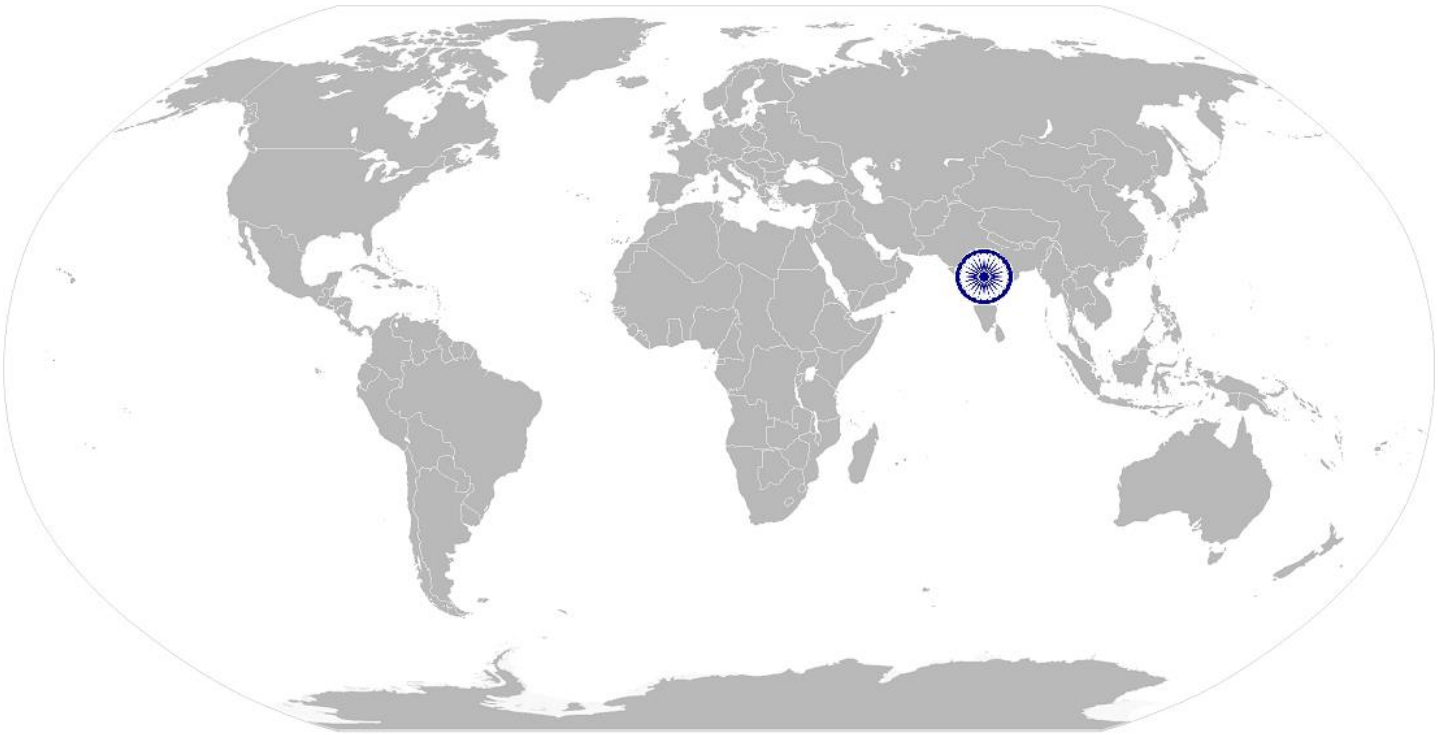
NOS Version Control

NOS Code	SGJ/N0104		
Credits (NSQF)	TBD	Version number	1.0
Industry Sector	Green Jobs	Drafted on	26/06/2015
Industry Sub-sector	Renewable Energy	Last reviewed on	21/10/2015
Occupation	Electrical Installation	Next review date	01/10/2018



Back to NOS List:

National Occupational Standard



Overview

This unit is about Testing and Commissioning of Solar PV System.

SGJ/ N 0105 **Test and Commission Solar PV System**

National Occupational Standard

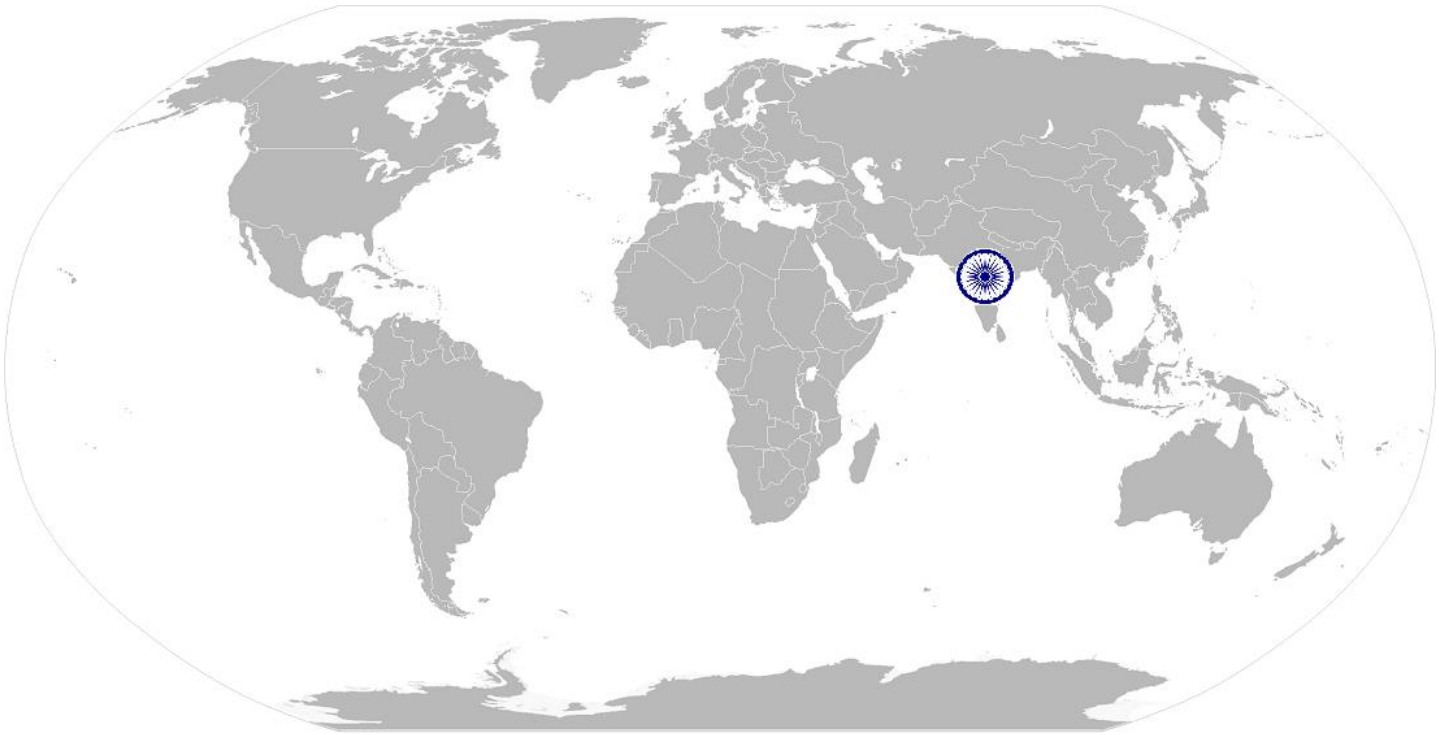
Unit Code	**SGJ / N0105**
Unit Title (Task)	**Test and Commission Solar PV System**
Description	This unit is about Testing, and Commissioning of electrical components of Photovoltaic System.
Scope	This OS unit/task covers the following: • Test the System. • Commission the System.
Performance Criteria (PC) w.r.t. the Scope	
Element	**Performance Criteria**
Test the System	To be competent, the user/ individual must be able to: PC1. Perform visual inspection. PC2. Inspect mechanical, civil and electrical installation components. PC3. Verify system grounding and measure insulation resistance PC4. Check continuity of the system and Verify polarity. PC5. Measure DC voltages and currents for each string and array for proper operation of the system PC6. Verify inverter operation including anti-islanding performance and measure AC system values. PC7. Verify calibration of Data Acquisition System. PC8. Verify workmanship and demonstrate proficiency in using tools PC9. Preparation of the Inspection report and take appropriate action
Commission the System	PC10. Verify labeling of solar PV system. PC11. Initiate startup procedures as per manufacturer instructions and record energy meter reading at startup PC12. Measure and record voltage of energy storage system PC13. Record and repair any anomalous conditions. PC14. Document design changes, if any
Knowledge and Understanding (K)	
A. Organizational Context (Knowledge of the company / Organization and Its processes)	The user/individual on the job needs to know and understand: KA1. Government/Corporate policies and guidelines on: workplace safety, identification and mitigation of safety hazards, work procedures and guidelines for working at height. KA2. Document information using appropriate corporate forms. KA3. Obtain authorization from specified field safety officer and supervisor. KA4. Legislative, organization, site requirements and procedures. KA5. Diagnostic/fault finding techniques. KA6. The environmental requirements.

SGJ/ N 0105	Test and Commission Solar PV System
B. Technical Knowledge	The user/individual on the job needs to know and understand: KB1. Definition of the terms: energy and power, cell, module, string, array, mono-crystalline, poly-crystalline, amorphous silicon KB2. Units and symbols for irradiation and irradiance KB3. Know-how of Tools & Tackles required for inspection and commissioning of the plant KB4. Effect on array output of current and voltage based on series / parallel connections of modules, tilt angle, orientation and shading KB5. Perform simple calculations to derive the power and energy received from solar radiation in a given area KB6. Efficiency, cost, typical specifications, functioning and operating principle of different types of commercially available PV modules, inverters, charge controllers, battery, cables, junction boxes and other electrical components. KB7. Mechanical and electrical features necessary for the long life of the PV system under a wide range of operating conditions KB8. Determine the type of mounting structure required depending on the type of roof KB9. Determine the type of footing and fixtures required depending on the type of roof KB10. DO's and Don'ts of material handling and storage KB11. Determining whether any shading will occur and estimate its effect on the system. KB12. Determining the cabling route and estimate the length of cable required. KB13. Determining where the array junction box (if required) and inverter will be located. KB14. Measuring solar irradiance with a pyranometer. KB15. Determining, using field measurements and sun path diagram, the times and dates when a PV array will be shaded by obstacles KB16. Observe how current and voltage of a module varies w.r.t load KB17. Effect of blocking and bypass diodes KB18. Basic functioning and Operation of different types of inverters and other electrical components KB19. Do's and don'ts of DC wiring and installation of other electrical components KB20. Connection of the Solar Power Plant to the distribution box/ LT Panel and switchover along with precautions based on different types of plants KB21. Installation work on a PV power system in accordance with relevant standards and regulations KB22. Testing and commissioning activities and its interpretation - visual inspection, continuity of wiring, Earthing, polarity check, insulation and voltage drop KB23. Measurement of losses in a PV system at different points and interpretation of the results KB24. Typical faults, their causes and resolution for all system components KB25. Occupational health and safety (OHS) standards and associated risks when working on that particular site.
Skills	
A. Core Skills/ Generic Skills	**Writing Skills**
	The user/ individual on the job needs to know and understand how to: SA1. Fill up documentation applicable to one's role.

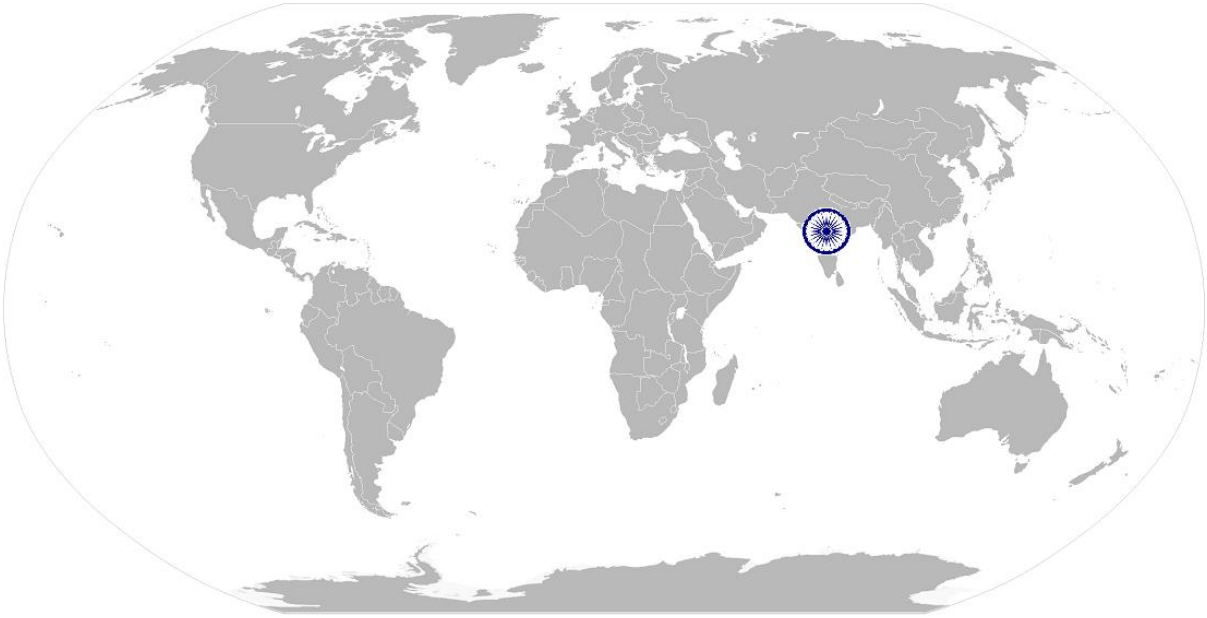
	Reading Skills
	The user/individual on the job needs to know and understand how to: SA2. Read English and/or vernacular language. SA3. Read and understand manuals, health and safety instructions, memos, other company documents. SA4. Ability to read from different sources- books screens in machines and signage. SA5. Understand the various color codes, as per standard electrical,
	Oral Communication (Listening and Speaking skills)
	The user/individual on the job needs to know and understand how to: SA6. Express statements or information clearly so that others can hear and understand. SA7. Participate in and understand the main points of simple discussions. SA8. Respond appropriately to any queries.
B. Professional Skills	**Decision Making**
	The user/individual on the job needs to know and understand how to: SB1. Follow organization rule-based decision making process. SB2. Take decision with systematic course of actions and/or response.
	Plan and Organize
	The user/individual on the job needs to know and understand how to : SB3. Planning and organization of work to meet deadlines. SB4. Work constructively and collaboratively with others.
	Customer Centricity
	The user/individual on the job needs to know and understand how to: SB5. Follow code of conduct. SB6. Manage relationships with customers with intent on satisfying its requirements for service delivery.
	Problem Solving
	The user/individual on the job needs to know and understand how to: SB7. Recognize problems and search for solutions. SB8. Choose best methods to complete assigned tasks. SB9. Approach relevant authority when required.
	Analytical Thinking
	The user/individual on the job needs to know and understand how to: SB10. Apply domain knowledge, observations and data to select course of action to perform tasks related to Solar Photovoltaic Systems.
	Critical Thinking
	The user/individual on the job needs to know and understand how to: SB11. Critically evaluate information obtained from customers, supervisor and co-workers to perform day to day activities. SB12. Ask questions for better understanding.

NOS Version Control

NOS Code	SGJ/N0105		
Credits (NSQF)	TBD	Version number	1.0
Industry Sector	Green Jobs	Drafted on	26/06/2015
Industry Sub-sector	Solar Photovoltaic	Last reviewed on	21/10/2015
Occupation	Testing & Commissioning	Next review date	01/10/2018



National Occupational Standard



Overview

This OS unit is about maintenance of solar photovoltaic system for effective functioning to achieve the specified energy output. It also includes fault assessment.

National Occupational Standard

ELE/N6001 **Maintain solar photovoltaic system**

Unit Code	**ELE/N6001**
Unit Title (Task)	**Perform solar photovoltaic system maintenance**
Description	This OS unit is about maintenance of solar photovoltaic system for effective functioning to achieve the specified energy output. It also includes trouble shooting the system.
Scope	This unit/ task covers the following: • Clean the solar panels periodically • Inspect the system periodically • Troubleshoot to identify faults in the system • Report and document completion of work • Follow quality and safety procedures

Performance Criteria(PC) w.r.t. the Scope	
Element	**Performance Criteria**
Cleaning the solar panels periodically	To be competent, the user/ individual must be able to: PC1. understand the importance of cleaning the solar panel as dirt in panel could affect power generation PC2. clean solar panels from dust, bird droppings, pollen, leaves, branches, snow PC3. use water to clean the accumulated dust in the panel PC4. wipe hard stains by wiping with sponge / cotton PC5. undertake cleaning activity during when the sunlight is low (early morning or after sunset) to avoid interruption in power generation PC6. use cleaning agents such as detergents to clean the stains / dust in the aluminium framing PC7. Clean without damaging the module by stepping on it, dropping objects, etc. PC8. clean modules periodically as per specification and document the date of cleaning
Inspecting the system periodically	To be competent, the user/ individual must be able to: PC9. regularly inspect the solar panel system, understand the check points and check for effective functioning PC10. ensure that modules are clean and power output is not affected PC11. ensure that modules are free of any tree shading, construction or other disruption from receiving sunlight PC12. check all cables for loose connections and any mechanical damage PC13. check the output voltage of the system and compare with the expected output voltage generation PC14. check for any damage for the system by external elements PC15. ensure that electrical connections are as per specifications PC16. check for the conditions of mounting and its stability to hold solar panels
Troubleshooting to identify faults	To be competent, the user/ individual must be able to: PC17. Identify the faults in the system when there is an interruption in power generation PC18. perform regular checks like looking for dust, shade, etc., which might interrupt power output PC19. check current output for each string and identify the string which gives an low / undesired power output PC20. identify the faulty module in the string by shading the modules and checking the output using ammeter reading PC21. perform sequentially the standard troubleshooting activity to identify faults when there is power supply interruption in the grid PC22. check for working conditions of fuses and circuit breakers

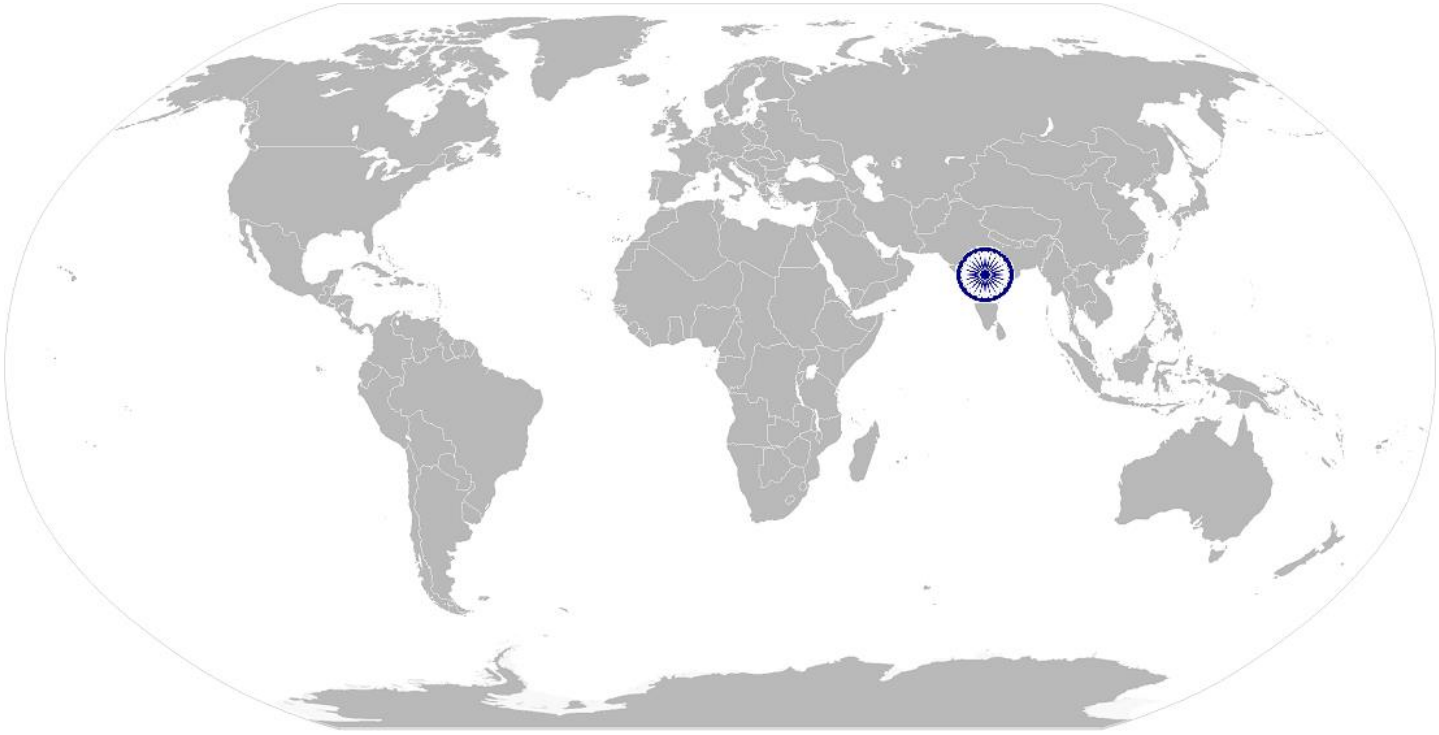
	PC23. check the service panel connections PC24. check the cables and ensure that there is no damage PC25. check the wire connection to inverter and identify for any damage in wire connection PC26. inform the inverter service technician if there is a circuit board level fault for further repair PC27. escalate the issue to superiors if faults cannot be identified
Completing the work	To be competent, the user/ individual must be able to: PC28. clean the work area after completing the maintenance activity PC29. remove all the tools, consumables used from the installation area PC30. fill in the job completion form and get the signature of the customer PC31. inform customers about maintenance of solar panels PC32. follow company standards in documentation of maintenance activities performed
Following quality and safety procedures	To be competent, the user/ individual must be able to: PC33. remove any metals or jewellery to avoid possibility of current shock during maintenance activity PC34. wear gloves while cleaning aluminium frame with sharp edges to avoid any accidents PC35. ensure no material damage occurs during maintenance activity PC36. take adequate precautionary measures while handling electrical system PC37. keep work area clean and organised PC38. adhere to relevant health and safety standards PC39. dispose off any waste materials in accordance with safe working practices and procedures
Knowledge and Understanding (K)	
B. Organizational Context (Knowledge of the company / organization and its processes)	The individual on the job needs to understand: KA1. company's policies on: incentives, personnel management KA2. company's code of conduct KA3. importance of individual's role in the work flow KA4. organisation culture KA5. company's reporting structure KA6. company's documentation policy KA7. company's different department and concerned authority KA8. company's installation policy KA9. company's customer support policy
B. Technical Knowledge	The individual on the job needs to know and understand: KB1. basics on solar energy system and power generation KB2. volts, amps and watts KB3. usage and handling procedure of solar panels KB4. energy storage, control and conversion KB5. basic electrical system and functioning KB6. mechanical equipment and its functioning KB7. maintenance procedure of equipment KB8. cleaning procedures and consumables used KB9. voltage requirement of various equipment KB10. specifications of a grid connection KB11. solar energy system components such as panels, batteries, charge controllers, inverters KB12. tools involved in maintenance and troubleshooting the system KB13. correct tools and equipment to be used in handling specific components KB14. basics in electrical and circuit KB15. quality and process standards

ELE/N6001 **Maintain solar photovoltaic system**

	KB16. relevant occupational health and safety standards and waste management procedures KB17. importance of wearing protective clothing and other safety gear while carrying out installation activities KB18. precautions to be taken while handling different electrical and mechanical products
Skills (S)	
C. Core Skills/ Generic Skills	**Reading and writing skills**
	The individual on the job needs to know and understand: SA1. How to read product and equipment manuals, system maintenance manuals etc. SA2. How to be able to read warnings, instructions and other text material on product labels, components etc. SA3. How to be able to fill in job completion form after installation activity is completed
D. Professional Skills	**Using tools and machines**
	The individual on the job needs to know and understand: SB1. How to operate/use screw driver, inspection fixtures, wire cutter, pliers, tester, spanner, etc. SB2. How to use tools for panel mounting
	Interpersonal skills
	The individual on the job needs to know and understand: SB3. how to interact with co-workers in order to coordinate work processes SB4. how to interact with supervisor to understand the daily target
	Reflective thinking
	The user/individual on the job needs to know and understand how: SB5. to improve work processes SB6. to reduce repetition of errors
	Decision making
	The individual on the job needs to know and understand: SB7. how to report potential areas of disruptions to work process SB8. when to report to supervisor and when to deal with a colleague depending on the type of concern

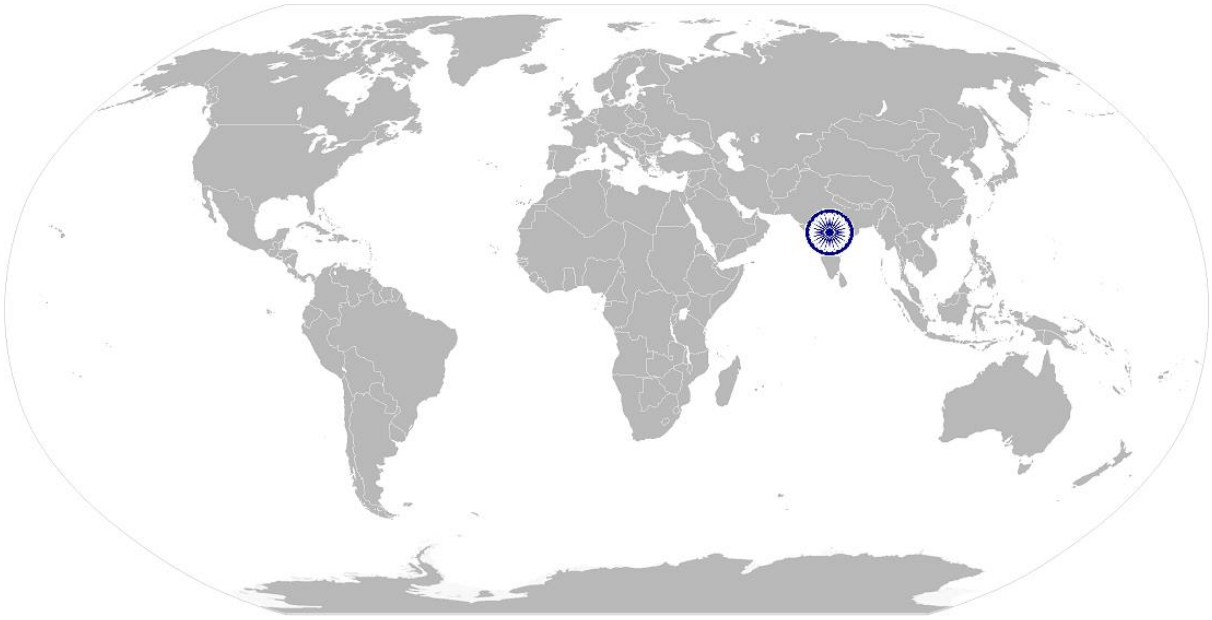
NOS Version Control

NOS Code	ELE/N6001		
Credits(NVEQF/NVQF/NSQF) [*OPTIONAL*]	TBD	Version number	1.0
Industry	Electronics	Drafted on	11/03/14
Industry Sub-sector	Solar Electronics	Last reviewed on	24/03/15
		Next review date	31/03/16



SGJ/ Q 0106 **Maintain Personal Health & Safety at project site**

National Occupational Standard



Overview

This unit is about maintaining Personal Health & Safety at project site.

SGJ/ Q 0106 **Maintain Personal Health & Safety at project site**

National Occupational Standard

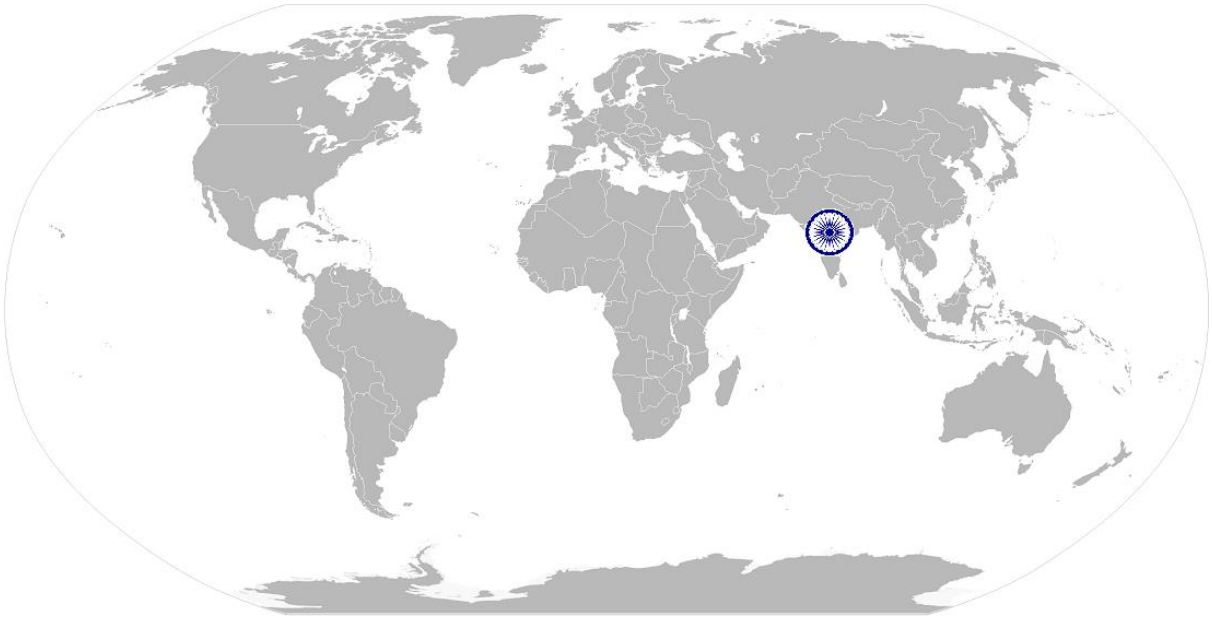
Unit Code	SGJ / N0106
Unit Title (Task)	**Maintain Personal Health & Safety at project site**
Description	This unit is about maintaining Work Safety for Solar Photovoltaic Power Plants.
Scope	This unit/task covers the following: • Establish and follow safe work procedure • Use and maintain personal protective equipment. • Identify and mitigate safety hazards. • Demonstrate safe and proper use of required tools and equipment. • Identify work safety procedures and instructions for working at height.
Performance Criteria (PC) w.r.t. the Scope	
Element	**Performance Criteria**
Establish and Follow safe work procedure	To be competent, the user/individual on the job must be able to: PC1. Identify corporate policies required for workplace safety. PC2. Identify requirements for safe work area and create a safe work environment. PC3. Identify contact person when workplace safety policies are violated. PC4. Provide information about incident/violation. PC5. Identify the location of First Aid materials and administer first aid
Use and maintain personal protective equipment	PC6. Identify the personal protection equipment required for specific locations on-site PC7. Identify expiry dates and wear & tear issues of specified equipment. PC8. Demonstrate safe and accepted practices for personal protection.
Identify and mitigate safety hazards	PC9. Identify environmental hazards associated with photovoltaic installations. PC10. Identify electrical hazards. PC11. Identify personal safety hazards or work site hazards and Mitigate hazards.
Demonstrate safe and proper use of required tools and equipment	PC12. Select tools, equipment and testing devices needed to carry out the work. PC13. Demonstrate safe and proper use of required tools and equipment.
Identify work safety procedures and instructions for working at height.	PC14. Check access from ground to work area to ensure it is safe and in accordance with requirements. PC15. Reassess risk control measures, as required, in accordance with changed work practices and/or site conditions and undertake alterations. PC16. Inspect/install fall protection and perimeter protection equipment ensuring adequacy for work and conformance to regulatory requirements. PC17. Identify approved methods of moving tools and equipment to work area and minimize potential hazards associated with tools at heights PC18. Select and install appropriate signs and barricades PC19. Place tools and materials to eliminate or minimize the risk of items being knocked down. PC20. Dismantle safety Power Plant in accordance with sequence and remove from worksite to clear work area.

SGJ/ Q 0106 **Maintain Personal Health & Safety at project site**

Knowledge and Understanding (K)	
A. Organizational Context (Knowledge of the company / organization and its processes)	The user/individual on the job needs to know and understand: KA1. Company's Installation Policy. KA2. Company's work safety policy KA3. Company's Customer Support Policy. KA4. Company's documentation policy. KA5. Obtain authorization from specified field safety officer and supervisor. KA6. Company's reporting structure and Organization culture. KA7. Company's different department and concerned authority.
B. Technical Knowledge	The individual on the job needs to know and understand the following aspects: KB1. The individual on the job needs to know and understand: KB2. Relevant Personal protective equipment's required for installation KB3. Relevant standards and regulations for installation of Solar Photovoltaic Power Plant in India KB4. Occupational health and safety (OHS) standards for installation of Solar Photovoltaic Power Plant KB5. Risk identification and mitigation procedure for safe installation of Solar Photovoltaic Power Plant KB6. Knowhow of tools & tackles required to carry out the work.
Skills	
A. Core Skills/ Generic Skills	**Writing Skills**
	The user/ individual on the job needs to know and understand how to: SA1. Fill up documentation applicable to one's role.
	Reading Skills
	The user/individual on the job needs to know and understand how to: SA2. Read English and/or vernacular language. SA3. Read and understand manuals, health and safety instructions, memos, other company documents. SA4. Ability to read from different sources- books screens in machines and signage. SA5. Understand the various color codes, as per standard electrical, mechanical
	Oral Communication (Listening and Speaking skills)
	The user/individual on the job needs to know and understand how to: SA6. Express statements or information clearly so that others can hear and understand. SA7. Participate in and understand the main points of simple discussions. SA8. Respond appropriately to any queries. SA9. Communicate with supervisor.
B. Professional Skills	**Decision Making**
	The user/individual on the job needs to know and understand how to: SB1. Follow organization rule-based decision making process. SB2. Take decision with systematic course of actions and/or response.
	Plan and Organize
	The user/individual on the job needs to know and understand how to : SB3. Planning and organization of work to meet deadlines. SB4. Work constructively and collaboratively with others.
	Customer Centricity
	The user/individual on the job needs to know and understand how to: SB5. Follow code of conduct. SB6. Manage relationships with customers with intent on satisfying its requirements for service delivery.

SGJ/ Q 0106 **Maintain Personal Health & Safety at project site**

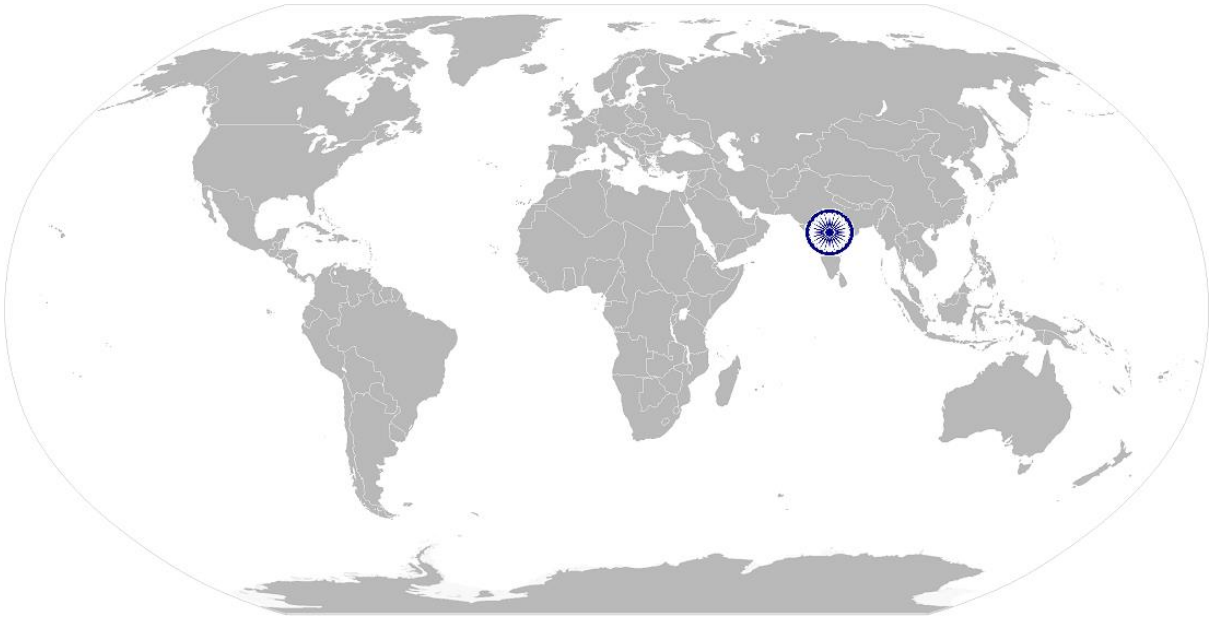
	Problem Solving
	The user/individual on the job needs to know and understand how to: SB7. Recognize problems and search for solutions. SB8. Choose best methods to complete assigned tasks. SB9. Approach relevant authority when required.
	Analytical Thinking
	The user/individual on the job needs to know and understand how to: SB10. Apply domain knowledge, observations and data to select course of action to perform tasks related to Solar Photovoltaic Systems.
	Critical Thinking
	The user/individual on the job needs to know and understand how to: SB11. Critically evaluate information obtained from customers, supervisor and co-workers to perform day to day activities. SB12. Ask questions for better understanding.



SGJ/ Q 0106 **Maintain Personal Health & Safety at project site**

NOS Version Control

NOS Code	SGJ/N0106		
Credits (NSQF)	TBD	Version number	1.0
Industry Sector	Green Jobs	Drafted on	26/06/2015
Industry Sub-sector	Renewable Energy	Last reviewed on	21/10/2015
Occupation	Health & Safety	Next review date	01/10/2018



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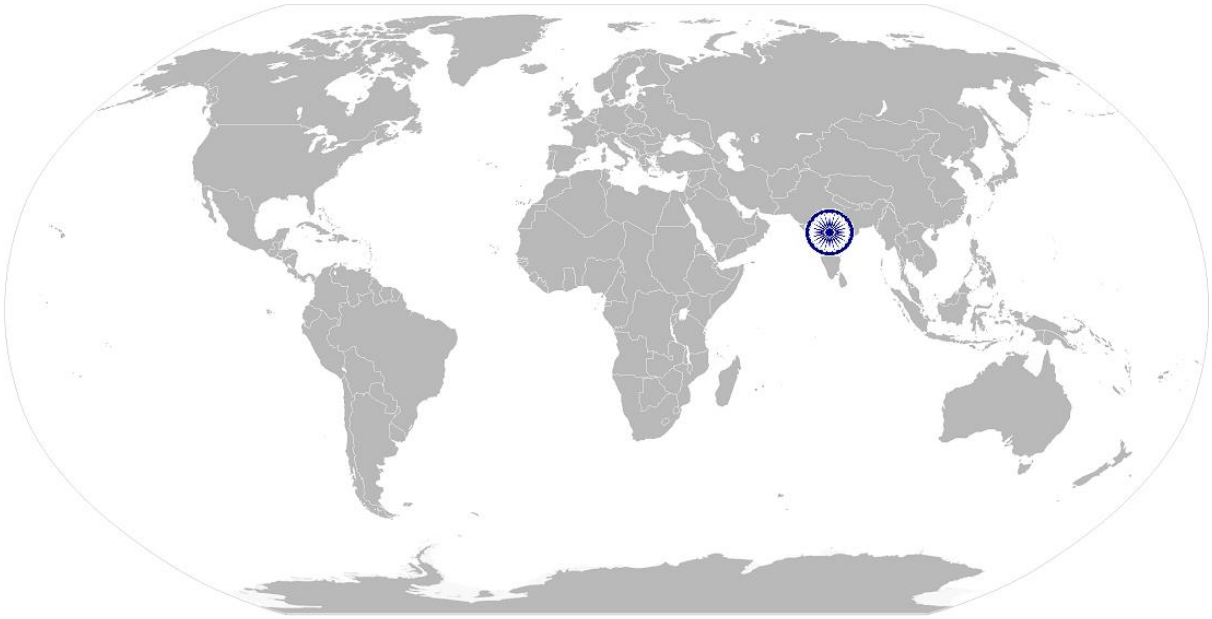
National Occupational Standard



Overview

This unit is about orientation of customer towards Solar PV System and handling over the completion documents.

SGJ/ Q 0107 **Customer Orientation for Solar PV System**

National Occupational Standard

Unit Code	**SGJ / N0107**
Unit Title (Task)	**Customer Orientation for Solar PV System**
Description	This unit is about orientation of customer towards Solar PV System and handling over the completion documents.
Scope	This unit/task covers the following: • Handover System Completion Documentation. • Demonstrate Working Procedure of Solar PV system.
Performance Criteria(PC) w.r.t. the Scope	
Element	**Performance Criteria**
Handover System Completion Documentation	PC1. Record component serial numbers and file data sheet and complete equipment warranty registration. PC2. Record and document inspection & commissioning certificates/forms. PC3. Deliver as-built documents along with project photographs and Permits. PC4. Deliver O&M documentation and customer operation manual.
Demonstrate Working Procedure of Solar PV System	PC5. Demonstrate Start-up and shutdown procedures. PC6. Demonstrate Safety procedures to the customer. PC7. Demonstrate maintenance procedures and provide basic training to maintain the system PC8. Demonstrate normal operation procedure of Solar PV system.
Knowledge and Understanding (K)	
A. Organizational Context (Knowledge of the company /organization and its processes)	The user/individual on the job needs to know and understand: KA1. The Keywords and its definitions used in industry KA2. Complete Technical and Commercial Knowledge of the product KA3. Document Information using appropriate corporate forms. KA4. Diagnostic/fault finding techniques. KA5. Environment requirements.
B. Technical Knowledge	The individual on the job needs to know and understand the following aspects: KB1. Definition of the Jargons/terminologies used by the industry. KB2. Units and symbols for irradiation and irradiance KB3. Effect on array output of current and voltage based on series / parallel connections of modules, tilt angle, orientation and shading. KB4. Efficiency, Cost, Typical Specification, functioning and operating principle of complete solar PV system including solar PV modules, inverters, charge controllers, battery cables, junction Boxes and other electrical components. KB5. Occupation health and safety procedures (OHS) standards and associated risk when working on the particular site.
Skills	
A. Core Skills/ Generic Skills	**Writing Skills**
	The user/ individual on the job needs to know and understand how to: SA1. Fill up documentation applicable to one's role.
	Reading Skills

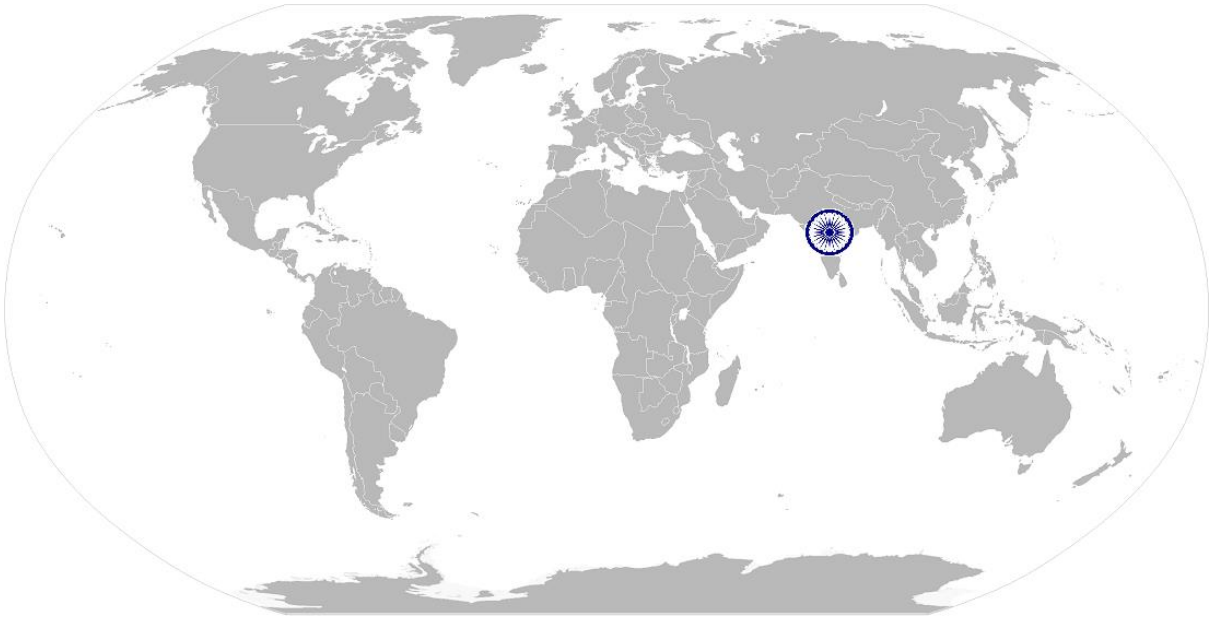
SGJ/ Q 0107 **Customer Orientation for Solar PV System**

	The user/individual on the job needs to know and understand how to: SA2. Read English and/or vernacular language. SA3. Read and understand manuals, health and safety instructions, memos, other company documents. SA4. Ability to read from different sources- books screens in machines and signage. SA5. Understand the various color codes, as per standard electrical, mechanical
	Oral Communication (Listening and Speaking skills)
	The user/individual on the job needs to know and understand how to: SA6. Express statements or information clearly so that others can hear and understand. SA7. Participate in and understand the main points of simple discussions. SA8. Respond appropriately to any queries.
B. Professional Skills	**Decision Making**
	The user/individual on the job needs to know and understand how to: SB1. Follow organization rule-based decision making process. SB2. Take decision with systematic course of actions and/or response.
	Plan and Organize
	The user/individual on the job needs to know and understand how to : SB3. Planning and organization of work to meet deadlines. SB4. Work constructively and collaboratively with others.
	Customer Centricity
	The user/individual on the job needs to know and understand how to: SB5. Follow code of conduct. SB6. Manage relationships with customers with intent on satisfying its requirements for service delivery.
	Problem Solving
	The user/individual on the job needs to know and understand how to: SB7. Recognize problems and search for solutions. SB8. Choose best methods to complete assigned tasks. SB9. Approach relevant authority when required.
	Analytical Thinking
	The user/individual on the job needs to know and understand how to: SB10. Apply domain knowledge, observations and data to select course of action to perform tasks related to Solar Photovoltaic Systems.
	Critical Thinking
	The user/individual on the job needs to know and understand how to: SB11. Critically evaluate information obtained from customers, supervisor and co-workers to perform day to day activities. SB12. Ask questions for better understanding.

SGJ/ Q 0107 **Customer Orientation for Solar PV System**

NOS Version Control

NOS Code	SGJ/N0109		
Credits (NSQF)	TBD	Version number	1.0
Industry Sector	Green Jobs	Drafted on	26/06/2015
Industry Sub-sector	Renewable Energy	Last reviewed on	20/11/2015
Occupation	Installation, Operation and Maintenance	Next review date	01/10/2018



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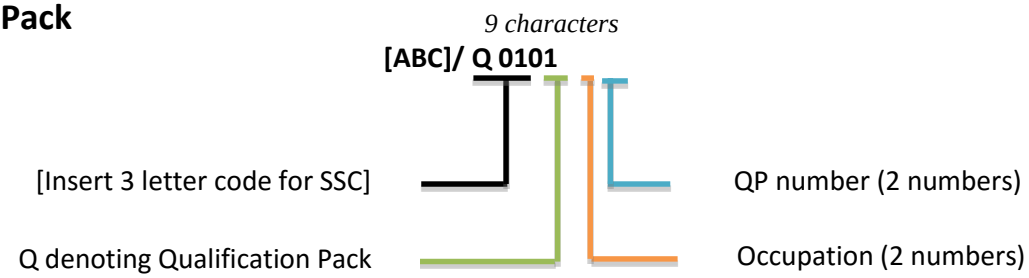
Annexure

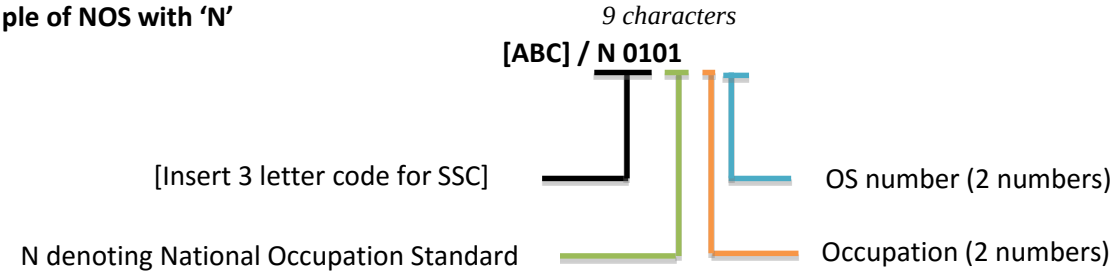
Nomenclature for QP and NOS

Qualifications Pack



Occupational Standard

An example of NOS with 'N'



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The following acronyms/codes have been used in the nomenclature above:

Sub-sector	Range of Occupation numbers
Solar Photovoltaic	01-05
Solar Thermal	06-10
Wind	11-15
Hydro	16-20
Biomass	21-25
Geothermal	26-30
All Renewables (Cross-cutting/ Enabling Activities)	31-35
Alternative Fuel Transportation	36-40
Bio-fuels and Farming	40-45
Environmental Compliance and Sustainability Planning	46-50
Green Buildings	51-55
Energy Efficiency	56-60
Waste Management	61-65
Water and Wastewater Management	66-70
Co-generation	71-75
Other Green Jobs	76-99

Sequence	Description	Example
Three letters	Industry name	SGJ
Slash	/	/
Next letter	Whether **Q**P or **N**OS	N
Next two numbers	Occupation code	01
Next two numbers	OS number	01

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CRITERIA FOR ASSESSMENT OF TRAINEES

Job Role Solar PV Installer

Qualification Pack SGJ/Q0101

Sector Skill Council Green Jobs

Guidelines for Assessment

1. Criteria for assessment for each Qualification Pack will be created by the Sector Skill Council. Each Performance Criteria (PC) will be assigned marks proportional to its importance in NOS. SSC will also lay down proportion of marks for Theory and Skills Practical for each PC
2. The assessment for the theory part will be based on knowledge bank of questions created by the SSC
3. Individual assessment agencies will create unique question papers for theory part for each candidate at each examination/training center (as per assessment criteria below)
4. Individual assessment agencies will create unique evaluations for skill practical for every student at each examination/training center based on this criteria
5. To pass the Qualification Pack, every trainee should score a minimum of 70% in every NOS
6. In case of successfully passing only certain number of NOS's, the trainee is eligible to take subsequent assessment on the balance NOS's to pass the Qualification Pack

		Marks Allocation			
NOS	**Performance Criteria**	Total Mark	Out Of	Theory	Skills Practical
SGJ/N0101 Site Survey for Installation of Solar PV System	PC1. Understand the location of Installation and optimize the route plan.	**30**	4	1	3
	PC2. Asses the site level pre-requisites for solar panel installation		3	2	1
	PC3. Check for any shading obstacles.		2	1	1
	PC4. Decide the type of mounting to be constructed.		2	2	
	PC5. Inform the customer for any civil construction to be undertaken for installing the panels		2	1	1
	PC6. Prepare a site map of the location where installation has to be carried out.		5	2	3
	PC7. Assess the load to be run on Solar Power Plant		5	2	3
	PC8. Prepare a load profile		3	3	
	PC9. Document the site survey variables and complete the checklist/site survey form		4	2	2
		TOTAL	30	16	14
ELE/N5903: Assess the customer's PV system requirement	PC1. understand the work requirement and areas of operation	**100**	2	1	1
	PC2. interact with the superior for specific instructions		2	1	1
	PC3. plan the day's activities based		2	1	1
	PC4. coordinate with stores and sales team		2	1	1
	PC5. coordinate with marketing executive to understand about the customer details and their expectations at a broad level		3	1	2
	PC6. visit the customer and understand their requirement		3	1	2

	PC7. ask both open ended and close end questions to customers to clearly understand their power requirement		3	1	2
	PC8. assess the area of installation, power output expectation, budget during discussion with customer		3	1	2
	PC9. understand any specific requirement of customers on choice of modules / inverters, place of mounting		3	1	2
	PC10. assess the location and its potential for solar power system, e.g., location with less clouds, number of days with sunlight		4	1	3
	PC11. analyze the layout of the area and check space for installation		4	1	3
	PC12. understand the type of installation i.e., roof mounting or in plain and its requirements		4	2	2
	PC13. analyze the civil structure of building and its strength for roof top mounting		4	2	2
	PC14. evaluate the place of solar module mounting and ensure it is free of shade from trees or from existing or potential taller buildings		4	2	2
	PC15. analyze the photovoltaic system requirement of the customer		4	2	2
	PC16. decide whether the power system will be connected to transmission grid		4	2	2
	PC17. analyze for producing alternate current or direct current and match customer requirement		4	2	2
	PC18. decide on battery backup for equipment as per customer expectation		4	2	2
	PC19. understand the functions and controls of different components of solar PV system such as modules, inverter, grounding equipment, meters, disconnect		4	2	2
	PC20. ensure the equipment and system specification matches the customer expectation		4	2	2
	PC21. prepare a costing sheet for installation based on the customer feedback on system requirement		3	1	2
	PC22. understand from customer for any budget constraints		3	1	2
	PC23. suggest for any alternatives and changes in design to suit customer's budget		3	1	2
	PC24. make understand the customer about market price of components of different models of power system		3	1	2
	PC25. prepare a cost benefit analysis and inform customers on savings while installing solar power system		3	1	2
	PC26. compare cost with other types of power generation and inform the benefits		3	1	2
	PC27. suggest for procurement of quality and best products available in the market		3	1	2
	PC28. evaluate the safety concerns for installation and address them		3	1	2
	PC29. arrange trained and qualified technicians for installation		3	1	2
	PC30. ensure the system and structure meets the local government and regulatory requirement		3	1	2
			3	1	2
		TOTAL	100	40	60

SGJ/N0102 Procure Solar PV system components	PC1. Prepare Bill of materials from Single Line Diagram, civil/mechanical drawings and electrical drawings	50	10	5	5
	PC2. Approach stores of the company or the market to place the requirement for components as per BOM		2	1	1
	PC3. Ensure that the quantity of modules / panels, inverter and batteries match the voltage requirement of the system		4	2	2
	PC4. Identify and list variation in equipment specifications, if any.		2	1	1
	PC5. Document variation and submit to design team (if required) and obtain approval or revised drawings		1	1	
	PC6. Arrange for tools and consumables required for mounting the solar panels		6	2	4
	PC7. List the statutory and other requirements to dispatch the equipment at site		3	2	1
	PC8. Ensure that all materials are QC passed		8	4	4
	PC9. Complete all documentation w.r.t. Procurement		4	2	2
	PC10. Plan and receive the equipment at site.		2	1	1
	PC11.Ensure that all the components are handled and stored properly as per standard operating procedures		2	1	1
	PC12. Check materials received as per final BOM and ensure that the correct material for the job arrives on site and is damage free		4	2	2
	PC14. Report and document the status of material received at site and take appropriate action for replacements, if any.		2	1	1
		TOTAL	50	25	25
SGJ/N0103 Install Civil and Mechanical parts of Solar PV Power Plant	PC1. Identify type of footing required	60	3	2	1
	PC2. Locate structural footings		1	1	
	PC3. Arrange for tools and consumables required for civil/mechanical installation		4	2	2
	PC4. Get the concrete forms constructed to design specifications		4	1	3
	PC5. Install mounting posts, roof attachments and anchors		1	1	
	PC6. Locate structural roof members and install structural attachments		1	1	
	PC7. Install module support/racking frame		4	1	3
	PC8. Plumb and Level array structure		2	1	1
	PC9. Install supplementary structural supports		2	1	1
	PC10. Apply corrosion protection to cut surfaces		2	1	1
	PC11. Apply Weatherproofing to avoid any seepage and penetrations		2	1	1
	PC12. Install tracking Power Plant		4	2	2
	PC13. Unpack photovoltaic modules		2	1	1
	PC14. Inspect module for physical damage		2	1	1
	PC15. Test photovoltaic modules' electrical output		2	1	1

	PC16. Install the modules as per layout diagrams		7	2	5
	PC17. Secure module wiring		4	1	3
	PC18. Fasten modules to structure		2	1	1
	PC19. Torque module fasteners		2	1	1
	PC20. Install battery bank stand and battery spill containment as per drawings / manuals		6	2	4
	PC21. Install inverter stand as per drawings / manuals		3	1	2
		TOTAL	60	26	34
SGJ/N0104 Install Electrical Components of Solar PV System	PC1. Implement the site safety plan and Maintain clear work area.	**90**	2	1	1
	PC2. Clarify the maximum working voltage		1	1	
	PC3. Select required Personal Protective Equipment (PPE)		2	1	1
	PC4. Measure current and voltage on equipment before proceeding with work		2	1	1
	PC5. Inspect and demonstrate the use of electrical installation toolkit		4	1	3
	PC6.Demonstrate situational awareness		3	1	2
	PC7.Select the location of DC combiner box		2	1	1
	PC8. Install DC combiner box along with disconnect protections		4	1	3
	PC9. Install DC energy meters		2	1	1
	PC10. Confirm battery bank location and Install batteries.		2	1	1
	PC11. Prepare battery terminals and Install battery interconnection cables.		2	1	1
	PC12. Terminate fine stranded cables.		2	1	1
	PC13. Test final assembled battery polarity and voltage.		2	1	1
	PC14. Install charge controller (if required)		2	1	1
	PC15. Install inverter		4	1	3
	PC16. Install utility required disconnects		3	1	2
	PC17. Install AC combiner box		2	1	1
	PC18. Connect the solar Power Plant to the Distribution box or Transformer.		4	1	3
	PC19. Proper labeling of the components		2	1	1
	PC20. Prepare conduit and cable routing plan		4	2	2
	PC21. Select the correct cable type, color, and gauge.		4	2	2
	PC22. Ensure that the conduits are properly supported and secured		2	1	1
	PC23. Install the cables for modules, inverter and other components		4	1	3
	PC24. Terminate cables.		3	1	2
	PC25. Check cables for continuity		2	1	1
	PC26. Proper labeling of conduits and cables		2	1	1
	PC27. Locate underground hazards, if any		2	1	1
	PC28. Get the grounding Power Plant installed for modules/mounting Power Plant and inverters		4	2	2
	PC29. Get the Bonding done for all electrical equipment and apply anti – oxidant material		4	2	2
	PC30. Confirm and install battery bank enclosure/racks.		4	2	2

	PC31. Install battery spill containment (if required).		2	1	1
	PC32. Install batteries and Prepare battery terminals (e.g., clean).		4	2	2
	PC33. Install battery interconnection cables and apply anti-oxidant material		2	1	1
		TOTAL	90	39	51
SGJ/N0105 Test and Commission Solar PV system.	PC1. Perform visual inspection.		4	2	2
	PC2. Inspect mechanical civil and electrical installation components.		4	2	2
	PC3. Verify Power Plant grounding and measure insulation resistance		4	1	3
	PC4. Check continuity of the Power Plant and Verify polarity.		4	2	2
	PC5. Measure DC voltages and currents for each string and array for proper operation of the system		4	2	2
	PC6. Verify inverter operation including anti-islanding performance and measure AC system values.		6	3	3
	PC7. Verify calibration of Data Acquisition System.	**50**	1	1	
	PC8. Verify workmanship and demonstrate proficiency in using tools		6	2	4
	PC9. Preparation of the Inspection report and take appropriate action		3	2	1
	PC10. Verify labeling of Solar PV system.		2	1	1
	PC11. Initiate startup procedures as per manufacturer instructions and record energy meter reading at startup		6	3	3
	PC12. Measure and record voltage of energy storage system		2	1	1
	PC13. Record and repair any anomalous conditions.		2	1	1
	PC14. Document design changes, if any		2	1	1
		TOTAL	50	24	26
ELE/N6001 Maintain solar photovoltaic system	PC1. Understand the importance of cleaning the solar panel as dirt in panel could affect power generation		3	2	1
	PC2. Clean solar panels from dust, bird droppings, pollen, leaves, branches, snow		3	1	2
	PC3. Use water to clean the accumulated dust in the panel		3	1	2
	PC4. Wipe hard stains by wiping with sponge / cotton		3	1	2
	PC5. Undertake cleaning activity during when the sunlight is low (early morning or after sunset) to avoid interruption in power generation	**100**	3	1	2
	PC6. Use cleaning agents such as detergents to clean the stains / dust in the aluminum framing		3	1	2
	PC7. Clean without damaging the module by stepping on it, dropping objects, etc.		3	1	2
	PC8. Clean modules periodically as per specification\n and document the date of cleaning		3	1	2

	PC9. Regularly inspect the solar panel system, understand the check points and check for effective functioning		3	1	2
	PC10. Ensure that modules are clean and power output is not affected		3	1	2
	PC11. Ensure that modules are free of any tree shading, construction or other disruption from receiving sunlight		3	1	2
	PC12. Check all cables for loose connections and any mechanical damage		3	1	2
	PC13. Check the output voltage of the system and compare with the expected output voltage generation		3	1	2
	PC14. Check for any damage for the system by external elements		3	1	2
	PC15. Ensure that electrical connections are as per specifications		3	1	2
	PC16. Check for the conditions of mounting and its stability to hold solar panels		3	1	2
	PC17. Identify the faults in the system when there is an interruption in power generation		3	1	2
	PC18. Perform regular checks like looking for dust, shade, etc., which might interrupt power output		3	1	2
	PC19. Check current output for each string and identify the string which gives an low / undesired power output		3	1	2
	PC20. Identify the faulty module in the string by shading the modules and checking the output using ammeter reading		3	1	2
	PC21. Perform sequentially the standard troubleshooting activity to identify faults when there is power supply interruption in the grid		3	1	2
	PC22. Check for working conditions of fuses and circuit breakers		3	1	2
	PC23. Check the service panel connections		2	1	1
	PC24. Check the cables and ensure that there is no damage		2	1	1
	PC25. Check the wire connection to inverter and identify for any damage in wire connection		2	1	1
	PC26. Inform the inverter service technician if there is a circuit board level fault for further repair		2	1	1
	PC27. Escalate the issue to superiors if faults cannot be identified		2	1	1
	PC28. Clean the work area after completing the maintenance activity		2	1	1
	PC29. Remove all the tools, consumables used from the installation area		2	1	1
	PC30. Fill in the job completion form and get the signature of the customer		2	1	1
	PC31. Inform customers about maintenance of solar panels		2	1	1

	PC32. Follow company standards in documentation of maintenance activities performed		2	1	1
	PC33. Remove any metals or jeweler to avoid possibility of current shock during maintenance activity		2	1	1
	PC34. Wear gloves while cleaning aluminum frame with sharp edges to avoid any accidents		2	1	1
	PC35. Ensure no material damage occurs during maintenance activity		2	1	1
	PC36. Take adequate precautionary measures while handling electrical system		2	1	1
	PC37. Keep work area clean and organized		2	1	1
	PC38. Adhere to relevant health and safety standards		2	1	1
	PC39. Dispose off any waste materials in accordance with safe working practices and procedures		2	1	1
		TOTAL	100	40	60
SGJ/N0106 Maintain Personal Health & Safety at project site	PC1. Identify corporate policies required for workplace safety.	**50**	2	1	1
	PC2. Identify requirements for safe work area and create a safe work environment.		3	2	1
	PC3. Identify contact person when workplace safety policies are violated.		1	1	0
	PC4. Provide information about incident/violation.		1	1	
	PC5. Identify the location of First Aid materials and administer first aid		2	1	1
	PC6. Identify the personal protection equipment required for specific locations on-site		3	2	1
	PC7. Identify expiry dates and wear & tear issues of specified equipment.		2	1	1
	PC8. Demonstrate safe and accepted practices for personal protection.		3	2	1
	PC9. Identify environmental hazards associated with the project site.		2	1	1
	PC10. Identify electrical hazards.		4	2	2
	PC11. Identify personal safety hazards or work site hazards and Mitigate hazards.		4	2	2
	PC12. Select tools, equipment and testing devices needed to carry out the work.		4	2	2
	PC13. Demonstrate safe and proper use of required tools and equipment.		4	2	2
	PC14. Check access from ground to work area to ensure it is safe and in accordance with requirements.		2	1	1
	PC15. Reassess risk control measures, as required, in accordance with changed work practices and/or site conditions and undertake alterations.		2	2	0
	PC16. Inspect/install fall protection and perimeter protection equipment ensuring adequacy for work and conformance to regulatory requirements.		4	2	2

	PC17. Identify approved methods of moving tools and equipment to work area and minimize potential hazards associated with tools at heights		2	1	1
	PC18. Select and install appropriate signs and barricades		2	1	1
	PC19. Place tools and materials to eliminate or minimize the risk of items being knocked down.		1	1	
	PC20. Dismantle Plant safely in accordance with sequence and remove from worksite to clear work area.		2	1	1
		TOTAL	50	29	21
SGJ/N0107 Customer Orientation for Solar PV System	PC1. Record Component serial numbers and file data sheet and complete equipment warranty registration.	**20**	2	1	1
	PC2. Record and document inspection & commissioning certificates/forms.		2	1	1
	PC3. Deliver as-built documents along with project photographs and permits.		1	1	
	PC4. Deliver O&M documentation and customer operation manual.		3	2	1
	PC5. Demonstrate Start-up and shutdown procedures		4	1	3
	PC6. Demonstrate maintenance procedures to the customers.		2	1	1
	PC7. Demonstrate maintenance procedures and provide basic training to maintain the system.		4	1	3
	PC8. Demonstrate normal operation procedure of solar PV system.		2	1	1
		TOTAL	20	9	11

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