



SCGJ | SKILL COUNCIL FOR
GREEN JOBS

Participant Handbook

Sector
Green Jobs

Sub-Sector
Renewable Energy

Occupation
Operation & Maintenance

Reference ID: **SGJ/Q0115, Version-1.0**
NSQF Level 4



**Solar PV Maintenance
Technician - Electrical
(Ground Mount)**



Certificate

COMPLIANCE TO QUALIFICATION PACK – NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

SKILL COUNCIL FOR GREEN JOBS

for

SKILLING CONTENT : PARTICIPANT HANDBOOK

Complying to National Occupational Standards of

Job Role/ Qualification Pack: '**Solar PV Maintenance Technician – Electrical (Ground Mount)**'
QP No. '**SGJ/Q 0115 NSQF Level 4**'

Date of issuance: 14/06/2017
Valid up to*: 01/12/2020

*Valid up to the next review date of the Qualification Pack or the
Valid up to date mentioned above (whichever is earlier)

Dr. Praveen Saxena
Authorised Signatory
(Skill Council for Green Jobs)

Acknowledgements

National Skill Development Corporation (NSDC) working with the object of developing unskilled and semi-skilled labour force into productive and skilled labour through Sector Skill Councils (SSCs) and Assessment agencies has entrusted the responsibility of developing participant handbooks with National Instructional Media Institute (NIMI).

NIMI, set up by the Government of India to develop instructional material for the overall improvement in the standard of training in ITIs and skill development programmes is happy to widen the scope of its outreach by developing content for NSDC.

NIMI sincerely acknowledges the co-operation rendered by the media developers and their sponsoring organisations to bring out the participant handbook under Green Jobs Sector for Qualification Pack for Solar PV Project Helper.

This book is the outcome of teamwork by Green Job Sector Skill Council and experts from the construction industry.

NIMI thanks the media development committee members, data entry operators, CAD personnel, reviewer, editors and all others for their dedicated and continued support.

About this book

Government of India cares more for the planet Earth and protects it from global warming through the exponential growth in Renewable energy capacity pushing coal to shade. Remarkably, since 2014 the electricity generated through renewable energy resources such as solar, wind, hydro and bio mass has been doubled from cumulative capacity of 35500 MW in 2013-14 to 70000 MW in 2017-18.

As on 2018 India stands in sixth place globally in solar electricity production. The installations unbelievably surpassed the target with current plants on going at 15000 MW and those tendered for 25000 MW are already on cards with a total estimate of 110000 MW against earlier expected 100000 MW by 2020. Hence the target is proudly revised by the Government of India to 175000 MW by 2022. This could be our cumulative renewable energy installation capacity in 2022.

If only solar energy is considered it has increased eight times since 2013-14. That is, in 2013-14 the solar energy installed capacity was 2630 MW and in 2017-18 the same is 22000 MW.

The benefits of these developments not only include reduction in energy cost, but also saving the planet against environment pollution, and also retaining the coal for some more years. It also gives way for huge manpower development in India. There are many needs for skilled Indian youths for installing, commissioning, operating and maintaining the solar photovoltaic electrical plants in all parts of the country. Every state has its own nodal agency to implement state’s solar policy at par with global counterparts. There exists a healthy competition among the states in promoting the projects supporting government of India’s plans to achieve the target in time.

The training for **Solar PV Maintenance Technician - Electrical (Ground Mount)** is naturally a great gift for the Indian youth who already have a basic technical qualification but faces difficulties in obtaining entry in the industry to start a beautiful carrier as one ever dreams. The job role of maintenance technician has evergreen scope of excellent opportunities in solar energy based electricity generation plants. Even if India fulfills the complete energy needs of installation there would be always a bright requirement for manpower in operating and maintenance of the installed plants. This study material is elaborately prepared to give total insight of all technical information for a maintenance technician electrical. Extensive allocating on field safety norms ensures the development of globally challenging manpower that refers this study material and obtain the training in the solar field. The aspiring Indian youths must utilize the efforts made in this book and upgrade oneself.

Jai hind.

NOS code	Major function/Task
1. SGJ/N0137:	Carryout Electrical Maintenance of the Ground Mount Solar PV Plant
2. SGJ/N0121:	Maintain Personal Health and Safety at Solar PV Power Plant
3. SGJ/N0120:	Work Effectively with others

.....

Symbols Used



Key Learning Outcomes



Steps



Unit Objectives



Notes



Tips



Exercise

Table of Contents

Sl. No.	Modules and Units	Page No.
1. Introduction		
	Unit 1.1 Introduction to the Training Programme	3
	Unit 1.2 An overview of the green Jobs sector	5
	Unit 1.3 Solar PV Maintenance technician-Electrical-Ground Mount: Job Role	10
2. Carry Out Electrical Maintenance of the Ground Mount Solar PV Power Plant		
	Unit 2.1 Maintenance and Troubleshooting of DC Connections Including Cables & Junction Boxes	15
	Unit 2.2 Maintenance and Troubleshooting of Earthing and Lightening Protection Systems	44
	Unit 2.3 Maintenance and Troubleshooting of Inverter and Monitoring System	48
	Unit 2.4 Completing the Work Monitoring System	57
3. Maintain Personal Health and Safety at Solar PV Power Plant		
	Unit 3.1 Establish and Follow Safe Work Procedure	61
	Unit 3.2 Use and Maintain Personal Protective Equipment	67
	Unit 3.3 Identify and Mitigate Safety Hazards	71
	Unit 3.4 Demonstrate Safe and Proper Use of Required Tools and Equipment	77
4. Work Effectively with others		
	Unit 4.1 Work Effectively with others	85





SCGJ SKILL COUNCIL FOR
GREEN JOBS

1. Introduction

Unit 1.1 Introduction to the Training Programme

Unit 1.2 An Overview of the Solar Green Jobs Sector

Unit 1.3 Solar PV Maintenance Technician - Electrical -
Ground Mount - Job Role



UNIT 1.1 Introduction to the Training Programme

Unit Objectives

At the end of this unit, you will be able to:

1. identify the purpose of training
2. state National Occupation Standards and Qualification Pack
3. explain the benefits of the training.

1.1.1 Green Job Sector

At the end of this topic, you will be able to:

1. get an idea about the Skill Council for Green Jobs.

Green Jobs sector demonstrates the use of renewable energy as a viable approach. It is a policy instrument for clean local development. It brings poverty reduction through the creation of direct green jobs. Indirectly it induces decent work opportunities in small enterprises all over the country providing growth potential to enter the global market through Make in India initiatives. Skill Council for Green Jobs covers the following Sectors:



Fig. 1.1.1 Green Job Sector

1.1.2 Purpose of Training

At the end of this topic, you will be able to:

1. understand the utility of this training.

This training brings an opportunity to the trainees to enter the world of trending Green technology as a maintenance technician - (Electrical) and practice necessary skills in the solar PV Ground mount electrical systems. In the process of job he/she can acquire enough national market ideas and grow as an independent maintenance contractor later on. The training includes a lot many practical exercises on Solar PV ground mount field rather than practicing in workshop. The training can extend from 6 to 8 weeks. Considerable assessment carried out on each trainee results in a qualified and certified, field ready maintenance technician for a solar PV Ground mount plant.

1.1.3 National Occupation Standards and Qualification Pack

At the end of this topic, you will be able to:

1. understand the meaning of SSC, QP, NOS etc
2. understand about the qualification package and NOS in which the trainee undergo training.

Sector Skill Council (SSC) comprises well defined broad collection of skill domains of similar characteristics. Under SSC, different sectors are identified with connected skills commonly required to do major activities in a set of organizations.

Each subsector has significant occupation standards (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.

QP comprises the set of OSs, together with the educational, training and other criteria required to perform a job role. A QP is assigned with a unique qualifications pack code. NOS are specific to Indian industries.

The Qualifications Pack (QP) Code relevant to the context is SGJ/Q0115. It has the following three Applicable National Occupational Standards (NOS) which are of compulsory nature for acquiring this QP.

They are

NOS code	Function /Task
1. SGJ/N0137:	Carry out electrical maintenance of the ground mount solar PV power plant
2. SGJ/N0121:	Maintain personal health & safety at solar PV power plant
3. SGJ/N0120:	Work effectively with others

Since this is a growing market with emerging technologies, this job role has more acceptances in the field.

The training enables the trainee to get awareness and practice to operate and maintain the solar PV ground mount plant.

After successful completion of the training and passing the assessment, the candidate will be issued a certificate. The certificate will help the candidate to get employment and earn better wages than an untrained person.

Exercise

I. Answer the following questions.

1. What does a QP consist of?

2. What does NOS specify?

II. State whether the following statements are True or False.

1. This certificate will help you to get a job and earn better wages in the Solar PV sector.

True False

2. The skill acquired along with the certificate will also help you to grow in your career.

True False

Notes

UNIT 1.2 An Overview of the Solar Green Jobs Sector

Unit Objectives

At the end of this unit, you will be able to:

1. identify different job roles under green jobs sector
2. appraise about the employment opportunities in Renewable energy industries
3. acquire knowledge of Solar electricity
4. know the Indian Government Solar energy policy and regional variation
5. consider the benefits of the solar power plants.

1.2.1 Renewable Energy Industries and Opportunities

At the end of this topic, you will be able to:

1. appreciate briefly about the Skill Council for Green Jobs.

The Sector Skill Council is “Skill Council for Green Jobs”. This includes around 18 subsectors under the major sectors such as Renewable Energy, Green Transportation, Green Construction, Waste Management, Water Management, Co- Generation and Other Green Jobs.

Solar Photovoltaic (PV) is one of subsector under Renewable Energy head. Actually five occupations are identified under the Solar PV subsector.



Fig. 1.2.1 Solar PV plant

Some of National Occupation Standards in Solar PV are

Sl. No.	Qualification Pack Title	QP Code	NSQF level
1	Solar PV Installer (Suryamitra)	SGJ/Q0101	4
2	Solar PV Installer - Electrical	SGJ/Q0102	4
3	Solar PV Installer - Civil	SGJ/Q0103	4
4	Rooftop Solar Photovoltaic Entrepreneur	SGJ/Q0104	6

5	Solar Proposal Evaluation Specialist	SGJ/Q0105	7
6	Rooftop Solar Grid Engineer	SGJ/Q0106	5
7	Solar PV Business Development Executive	SGJ/Q0107	5
8	Solar PV Site Surveyor	SGJ/Q0108	6
9	Solar PV Structural Design Engineer	SGJ/Q0109	5
10	Solar PV Designer	SGJ/Q0110	7
11	Solar PV Project Helper	SGJ/Q0111	2
12	Solar PV Engineer (Option: Water pumping system)	SGJ/Q0112	5
13	Solar Site In-charge	SGJ/Q0113	6
14	Solar PV Project Manager (E&C)	SGJ/Q0114	7
15	Solar PV Maintenance Technician - Electrical (Ground Mount)	SGJ/Q0115	4
16	Solar PV Maintenance Technician - Civil (Ground Mount)	SGJ/Q0116	4
17	Solar PV O&M Engineer	SGJ/Q0117	5
18	Solar Off Grid Entrepreneur	SGJ/Q0118	5
19	Solar Lighting Technician (Options: Home lighting system / Street lights)	SGJ/Q0201	4
20	Solar PV Manufacturing Technician	SGJ/Q0119	4

Some of National Occupation Standards in Solar PV are Solar PV installer, Solar PV Technician, Solar PV maintenance Mechanic etc. The job role of Solar PV maintenance technician-Electrical: Ground mount is to operate and maintain the solar PV plant for healthy functioning and obtain desired commercial results.

As per the skill gap report developed by Skill Council for Green Jobs, approximately 2.3 lakh Solar PV Project helpers will be required across the solar PV domain in India itself by 2025. It means there is a huge requirement of Solar PV Project helpers in EPC (Erection , Procurement and Commissioning), O&M, Manufacturing and off grid sectors. Solar PV helpers may be employed by the organizations conducting Site Survey, Site Preparation, Logistics of Solar PV Components, installations of Solar PV plants, Maintenance of solar PV plants. Helpers will assists their supervisors in Installation and Maintenance of on-grid as well as off-grid solar PV power plants, they will also carry out their work with all the required personal health and safety.

Different Types of Solar PV Systems:

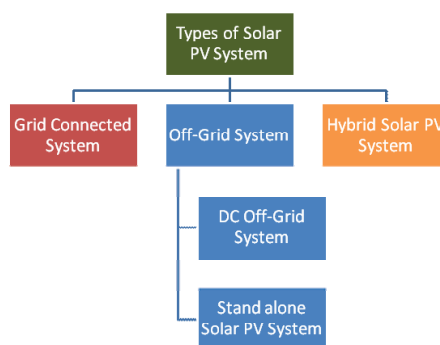


Fig. 1.2.2 Solar PV System

1.2.2 Solar Photovoltaic Power Plant

At the end of this topic, you will be able to:

1. get a broad idea on the categories of Solar energy based technologies
2. differentiate between thermal based and light based solar energy utilization techniques.

Solar technology broadly classified as Solar Thermal and Solar Photovoltaic applications. Solar Thermal is based on heat from sunlight and will use tube, Box or concentrator type collectors for trapping the energy. Its applications include cookers, water heaters and agricultural products most of which are not yet much popular. Solar Thermal electricity plants are more viable solution for our power needs.

On the other hand Solar Photovoltaic power plants use components like PV panel, Charge controller, inverter and battery to produce electricity. Most of the Solar PV integrator companies work in this area and promote Government policies. Hence more Solar PV Project Helpers are on demand. Installations of solar power PV plants require nearly 2.0 hectares (5 acres) land per MW capacity. Ideally 110 square feet or 10 square meter area is required for installing 1 kilowatt Solar PV power plant.

1.2.3 Government of India's Energy Policies

At the end of this topic, you will be able to:

1. understand Government of India energy policy
2. appraise the growth over recent years in solar energy utilities
3. get motivated to work in this sector.

India has set an ambitious target of reaching 175 GW of installed capacity from renewable energy sources by the year 2022, which includes 100 GW of solar and 60 GW of wind power capacity. Various policy initiatives have been taken to achieve this target. At the end of 2017-18 the total renewable power installed capacity in the country was almost 70 GW. The knowledge on our Government of policies will help us to understand the need of manpower in Solar PV plant installation, operation and maintenance.

As a Solar PV Project Helper, one can plan to gain enough experience in ongoing projects with a futuristic approach developing as an integrator. This would be possible by upgrading self through various training programs organized time and again. Updated details of Renewable energy generation, utilization and demand in different states of India will be available in MNRE website periodically. Cost of projects, cost of electricity etc also can be obtained similarly to have an effective plan.

Installed solar PV on 31 March 2018	
Year	Cumulative Capacity (in MW)
2010	161
2011	461
2012	1,205
2013	2,319
2014	2,632
2015	3,744
2016	6,763
2017	12,289
2018	21,651

UNIT 1.3 Solar PV maintenance Technician - Electrical - Ground Mount - Job Role

Unit Objectives

At the end of this topic, you will be able to:

1. understand the need of the Job role
2. know the activities of a solar PV maintenance technician-Electrical: Ground mount
3. appraise the activities in a solar plant.

1.3.1 Role of Solar PV Maintenance technician-Electrical : Ground Mount

At the end of this topic, you will be able to:

1. understand the importance of the job role.

Solar PV power plant projects are growing rapidly and future demand is likely to grow further. Solar PV maintenance technician-Electrical: Ground mount will attend to works related to operation and maintenance of Solar PV power plants, attending to the breakdowns and reported failures, predict failure chance and provide remedy immediately to avoid breakdown, documentation and record keeping, report making, identifying spare part requirement for store related to maintenance, procurement of spares, vendor development, material management etc.

The job role required is enormous, starting from rural and interior areas to urban, National and international places. Hence abundant scope of employment requirement, for maintenance technician-Electrical: Ground mount.

Since there are multiple skills such as selection and usage of tools, usage of testing tools, fault finding and troubleshooting, purchase, disposal of wastage etc therefore maintenance technician-Electrical: Ground mount will not develop monotony for him/herself. So a change of work on rotational basis is an added advantage within this short module of training.

1.3.2 Activities of Solar PV Maintenance Technician-Electrical: Ground Mount

At the end of this topic, you will be able to:

1. appraise the duties of the Solar PV maintenance technician-Electrical: Ground mount
2. prepare to learn the technical knowledge in Solar electricity
3. plan to obtain the necessary skills to deliver the duties in field.

The job of Solar PV maintenance technician-Electrical: Ground mount requires the individual to concentrate on the work at hand and complete it without any accidents. Awareness and adherence to safety protocols are critical attributes for individuals performing this role.

He/she must be good with following instructions provided in the manual. Solar PV maintenance technician-Electrical: Ground mount shall assist operation, troubleshooting and maintenance activities for solar PV power plants including off grid solar systems.



SCGJ
SKILL COUNCIL FOR
GREEN JOBS

2. Carry Out Electrical Maintenance of the Ground Mount Solar PV Power Plant

- Unit 2.1 Maintenance and Troubleshooting of DC Connections Including Cables & Junction Boxes
- Unit 2.2 Maintenance and Troubleshooting of Earthing and Lightning Protection Systems
- Unit 2.3 Maintenance and Troubleshooting of Inverter and Monitoring System
- Unit 2.4 Completing the Work Monitoring System



