NATIONAL SKILLS QUALIFICATIONS/NATIONAL OCCUPATIONAL STANDARDS

(NSQ)

FOR

SOLAR PHOTOVOLTAIC (PV) INSTALLATION AND MAINTENANCE

LEVEL 4

APRIL, 2025

OVERVIEW

This qualification is for those interested in developing a career in Solar Photovoltaic (PV) Installation and Maintenance for the award of National Skills Qualifications (NSQ). It is aimed at producing specialists and supervisors in Solar PV Installation and Maintenance at NSQ Level 4 with the competencies to professionally install, troubleshoot and maintain Solar system components while complying with relevant regulatory requirements, health and safety.

This qualification is subject to review as and when the need aris

NATIONAL SKILLS QUALIFICATION

NSQ LEVEL 4 – Solar PV Installation and Maintenance

GENERAL INFORMATION

QUALIFICATION PURPOSE

This qualification is designed for individuals who are interested in developing a career in the Solar PV Installation and Maintenance.

QUALIFICATION REQUIREMENTS

Candidates must:

a. Be at least 18 years of age
b. Be medically fit
c. Be mentally fit
d. Have achieved all the mandatory units in the qualification

Note:

This is a 46 credit unit qualification. To achieve this qualification; learners are required to achieve all credits units. Each Credit is equivalent to 10 Guided Learning Hours (GLH).

QUALIFICATION OBJECTIVE

At the end of the qualification, the Solar PV Installation and Maintenance supervisor should be able to:

a. Identify Electrical AC components

b. Carry out system Installation and Testing

c. Carryout Solar PV system Selection

d. Install Solar PV systems

e. Conduct Project Handover and Customer Support in Solar PV Installation

f. Maintain Solar PV Systems

g. Observe Health, Safety and The Environment

h. Demonstrate Communication and Interpersonal Skills

i. Demonstrate Team Work

j. Carry out Preparation for Solar PV work at the Site

Unit assessment requirements/evidence requirements:

Assessment must be carried out in real workplace environment in which learning and human development is carried out. Simulation is not allowed in this unit and level.

Assessment methods to be used include:

1. Direct Observation (DO)
2. Question and Answer (QA)
3. Witness Testimony (WT)
4. Personal statement (PS) or Reflective Practice (RP)
5. Recognition of Prior Learning (RPL)
6. Other methods (OM) as may be applicable

NATIONAL SKILLS QUALIFICATION (NSQ)/ NATIONAL OCCUPTIONAL STANDARDS TABLE

MANDATORY UNITS LEVEL 4

S/No /Unit No	Reference Number	NOS Title	Credit Value	Guided Learning Hours	Remark
1	PWR/SPV/001/L4	Occupational Health and Safety	3	30	Level 4
2	PWR/SPV/002/L4	Teamwork	3	30	Level 4
3	PWR/SPV/003/L4	Communication	3	30	Level 4
4	PWR/SPV/004/L4	Preparation for Solar PV work at the Site	8	80	Level 4
5	PWR/SPV/005/L4	Electrical AC components, system Installation and Testing	6	60	Level 4
6	PWR/SPV/006/L4	Solar PV system Selection	6	60	Level 4
7	PWR/SPV/007/L4	Installation of Solar PV systems	8	80	Level 4
8	PWR/SPV/008/L4	Project Handover and Customer Support in Solar PV Installation	4	40	Level 4
9	PWR/SPV/009/L4	Maintenance of Solar PV Systems	5	50	Level 4
	TOTAL		**46**	**460**	

UNIT 1: OCCUPATIONAL HEALTH AND SAFETY

Unit reference number: PWR/SPV/001/L4

NSQ level: 4

Credit value: 3

Guided learning hours: 30

Unit Purpose: This unit is designed to provide the trainee with the knowledge and skills needed to observe occupational health and safety in Solar PV installation and maintenance workplace

Unit Assessment Requirements/Evidence Requirements:

Assessment must be carried out in real workplace environment in which learning and human development is carried out. Simulation is not allowed in this unit and level.

Assessment methods to be used include:

1. Direct Observation (DO)
2. Question and Answer (QA)
3. Witness Testimony (WT)
4. Personal statement (PS) or Reflective Practice (RP)
5. Assignment (ASS)
6. Other methods as may be applicable

Unit 1: Occupational Health, Safety, and Environmental Compliance					
LO 1: Know the use of PPE	1.1	Ensure team members select the appropriate PPE for the work task in accordance with organisation safety instructions			
	1.2	Ensure consistent PPE for the work task in accordance with the organisation safety instructions.			
	1.3	Provide proper orientation oh health and safety before commencement of work on site			
LO 2: Know safety protocols for high-voltage solar PV systems	2.1	Identify hazards associated with high voltage PV installations and apply risk mitigation strategies.			
	2.2	Follow Lockout/Tagout (LOTO) and personal protective equipment (PPE) procedures.			
	2.3	Ensure compliance with safety best practices when working with live electrical components.			
LO 3: Understand fire risk management in Solar PV system	3.1	Identify fire hazards in solar farms, including arc faults and overheating risks.			
	3.2	Implement fire suppression systems and emergency response plans.			
	3.3	Ensure adherence to fire safety standards in system design and installation.			
LO 4: Comply with local (NERC, SON) and international (IEC, IEEE, OSHA) regulations.	4.1	Explain Nigerian Electricity Regulatory Commission (NERC) guidelines for grid-connected and off grid solar installations.			
	4.2	Ensure PV systems meet Standards Organization of Nigeria (SON) certifications			

		for electrical safety and equipment quality.			
	4.3	Comply with International Electrotechnical Commission (IEC) and Institute of Electrical and Electronics Engineers (IEEE) standards for system design, interconnection, and performance testing.			
	4.4	Implement Occupational Safety and Health Administration (OSHA) guidelines for workplace safety in solar installations.			
	4.5	Maintain regulatory documentation, including permits, inspection reports, and system certifications.			
LO 5: **Understand environmental and social impact assessments (ESIA) for solar PV installations**	5.1	Conduct site assessments to evaluate the environmental and social effects of solar PV installations.			
	5.2	Discuss mitigation strategies to address concerns such as land degradation, wildlife disruption, and displacement issues.			
	5.3	Engage with stakeholders, including local communities, environmental agencies, and policymakers, to ensure project sustainability.			
	5.4	Prepare Environmental and Social Impact Assessment (ESIA) reports following national and international guidelines.			
LO 6: **Understand sustainable end of-life disposal of solar panels, batteries**	6.1	Discuss the lifecycle impact of solar PV panels and batteries, including their environmental footprint.			

and how it affects the environment					
	6.2	Identify recycling and repurposing options for decommissioned panels, inverters, and energy storage systems safely			
	6.3	Follow hazardous waste management protocols for handling lithium-ion and lead-acid battery disposal.			
	6.4	Explain sustainable decommissioning strategies, including recycling in accordance to safety in the environment			
	6.5	Promote circular economy principles, encouraging manufacturers and installers to adopt eco-friendly materials and recycling initiatives.			

Learners Signature:	Date
Assessors Signature:	Date:
IQA Signature (if sampled)	Date:
EQA Signature (if sampled)	**Date:**

UNIT 2: TEAMWORK

Unit reference number: PWR/SPV/002/L4

NSQ level: 4

Credit value: 3

Guided learning hours: 30

Unit Purpose: This unit is designed to provide the trainee with the knowledge and skills needed to participate in teamwork in Solar PV installation and maintenance workplace

Unit Assessment Requirements/Evidence Requirements:

Assessment must be carried out in real workplace environment in which learning and human development is carried out. Simulation is not allowed in this unit and level.

Assessment methods to be used include:

1. Direct Observation (DO)
2. Question and Answer (QA)
3. Witness Testimony (WT)
4. Personal statement (PS) or Reflective Practice (RP)
5. Assignment (ASS)
6. Other methods as may be applicable

LEARNING OBJECTIVE (LO) The learner will:		PERFORMANCE CRITERIA The learner can:	Evidence Type		Evidence Ref Page No
LO 1: Understand fundamentals of team management	1.1	State principles of effective team management			
	1.2	Identify roles and responsibilities of a team leader			
	1.3	Discuss individual responsibility in a team			
	1.4	Discuss team dynamics and development stages (Tuckman's model)			
LO 2: Understand Communication and Collaboration in a team	2.1	Ensure effective communication within teams			
	2.2	Demonstrate active listening and feedback culture			
	2.3	Collaborate in a cross-functional and multicultural team setting			
	2.4	Explain remote team communication and tools			
	2.5	Describe ways to Conflict resolution and negotiation in teams			
LO 3: Understand team development and engagement	3.1	Discuss the strategies for building high-performing teams			
	3.2	Conduct team training and skill development			
	3.3	Ensure team engagement through moral-boosting strategies			

	3.4	Discuss diversity, equality, fairness and inclusion in team environments			
	3.5	Demonstrate awareness of issues relating to Wellness and burnout prevention in teams			

Learners Signature:	Date
Assessors Signature:	Date:
IQA Signature (if sampled)	Date:
EQA Signature (if sampled)	**Date:**

UNIT 3: COMMUNICATION SKILLS

Unit reference number: PWR/SPV/003/L4

NSQ level: 4

Credit value: 3

Guided learning hours: 30

Unit Purpose: This unit is designed to provide the trainee with the knowledge and skills needed to communicate in Solar PV installation and maintenance workplace

Unit Assessment Requirements/Evidence Requirements:

Assessment must be carried out in real workplace environment in which learning and human development is carried out. Simulation is not allowed in this unit and level.

Assessment methods to be used include:

1. Direct Observation (DO)
2. Question and Answer (QA)
3. Witness Testimony (WT)
4. Personal statement (PS) or Reflective Practice (RP)
5. Assignment (ASS)
6. Other methods as may be applicable

UNIT 3: COMMUNICATION SKILLS					
LEARNING OBJECTIVE (LO) The learner will:		PERFORMANCE CRITERIA The learner can:	Evidence Type		Evidence Ref Page No
LO 1: **Effective Interpersonal Communication**	1.1	Demonstrate active listening skills.			
	1.2	Engage in effective communication			
	1.3	Use appropriate verbal and non-verbal communication techniques.			
LO 2: **Presentation Skills**	2.1	Plan a simple presentation for a client/team			
	2.2	Make a presentation to a client/team			
	2.3	Communicate using visual aids and instructional materials			
	2.4	Resolve issues from feedback and questions			
LO3: Understand Written Communication	3.1	Draft a business correspondence			
	3.2	Follow grammatical and formatting standards in communicating with client/team			
	3.3	Adapt communication to target audience			
LO4: **Understand Negotiation Skills**	4.1	Explain negotiation skills			
	4.2	Demonstrate basic negotiation skills			
	4.3	use effective communication and persuasion techniques.			
	4.4	Demonstrate problem-solving skills			

LO5: Know Feedback Mechanisms	5.1	Explain types of feedback mechanisms			
	5.2	Use feedback for problem-solving.			
	5.3	Ensure open communication lines			
LO 6: **Understand cross-Cultural Communication**	6.1	Identify cultural differences in communication			
	6.2	Ensure communication approaches based on cultural context			
	6.3	Demonstrate politeness and courtesy during interactions			
LO 7: Understand Conflict management	7.1	Explain conflict management in communication			
	7.2	State types of conflict management			
	7.3	Use conflict management techniques to address disagreement.			
LO 8: Understand Customer relations	8.1	Address clients in a respectful manner			
	8.2	Explain technical process in simple terms.			
	8.3	Represent the company positively through professional behavior.			
	8.4	Identify social class in communicating with client			

Learners Signature:	Date
Assessors Signature:	Date:
IQA Signature (if sampled)	Date:
EQA Signature (if sampled)	**Date:**

UNIT 4: PREPARATION FOR SOLAR PV WORK AT THE SITE

Unit reference number: PWR/SPV/004/L4

NSQ level: 4

Credit value: 8

Guided learning hours: 80

Unit Purpose: This unit is designed to provide the trainee with the knowledge and skills needed to prepare Solar PV installation and maintenance work

Unit Assessment Requirements/Evidence Requirements:

Assessment must be carried out in real workplace environment in which learning and human development is carried out. Simulation is not allowed in this unit and level.

Assessment methods to be used include:

1. Direct Observation (DO)
2. Question and Answer (QA)
3. Witness Testimony (WT)
4. Personal statement (PS) or Reflective Practice (RP)
5. Assignment (ASS)
6. Other methods as may be applicable

Unit 04: **PREPARATION FOR SOLAR PV WORK AT THE SITE**

LO (Learning outcome)		Criteria:-	Evidence Type					Evidence Ref Page number			
LO 1: **Prepare for work using appropriate PPE**	1.1	Select the appropriate PPE for the work task in accordance with organisation safety instructions									
	1.2	Ensure appropriate PPE for work site operations									
	1.3	Ensure consistent PPE for the work task in accordance with the organisation safety instructions.									
	1.4	Supervise the arrangement of transporting materials and equipment to site									
LO 2: **Plan installation work using drawings, specifications, or instructions**											
	2.1	Interpret drawings and specifications to plan installation work activities									
	2.2	Drafts diagrams and schematics using symbols for common components to plan installation work activities									
	2.3	Plan installation works on given instructions									
LO 3: **Select appropriate tools and equipment for the work assignment.**	3.1	Use appropriate tools and equipment to complete the work task in accordance with the work specifications.									
	3.2	Test tools/equipment for functionality									
	3.3	Clean and prepare tools for storage									

LO 4: **Be able to identify appropriate location for placement of equipment, wires, orienting and mounting modules**	4.1	Supervise the identification of site to determine appropriate location for placement of system components									
	4.2	Approve the identified site for installation in accordance with the system specifications and the work site plans.									
	4.3	Determine the correct placement of ladders and scaffolding as detailed in the system specifications and worksite plans									
	4.4	Determine the correct sitting and spacing of the PV modules as detailed in the system specifications and work site plans.									
	4.5	Calculate the approximate dimensions required for suitable installation of the PV arrays in accordance with system specifications and procedures for evaluating site options/limitations.									
	4.6	identify the combination of site selection factors in accordance with the established design parameters for spacing and shadow or shading avoidance.									

LO 5: **Confirm appropriate cable sizes and ratings of protective devices**	5.1	Determine the required overcurrent protection devices (fuses, MCB etc.) based on the system specifications.								
	5.2	Determine the rating of each protective device required for the installation based on the system specifications								
	5.3	Determine grounding requirements and the necessary material based on the system specifications and existing building/grounds infrastructure.								
	5.4	Determine required DC and AC cables based on system inspection guidelines.								

	5.5	Ensure voltage protection in DC circuits is as detailed in the technical specification.									
	5.6	Check voltage protection requirements with the site supervisor.									

Learners Signature:	Date
Assessors Signature:	Date:
IQA Signature (if sampled)	Date:
EQA Signature (if sampled)	**Date:**

Unit 5: Electrical AC Components, System Installation and Testing

Unit reference number: PWR/SPV/005/L4

NSQ level: 4

Credit value: 6

Guided learning hours: 60

Unit Purpose: This unit is designed to provide the trainee with the knowledge and skills in Electrical AC Components, System Installation and Testing

Unit Assessment Requirements/Evidence Requirements:

Assessment must be carried out in real workplace environment in which learning and human development is carried out. Simulation is not allowed in this unit and level.

Assessment methods to be used include:

1. Direct Observation (DO)
2. Question and Answer (QA)
3. Witness Testimony (WT)
4. Personal statement (PS) or Reflective Practice (RP)
5. Assignment (ASS)
6. Work product (WP)
6. Other methods as may be applicable

LO (Learning outcome)		Criteria:-	Evidence Type					Evidence Ref Page number			
LO 1: Select and install electrical appliances, components	1.1	Select the appliances (knife switch, AC breaker, combiner box etc), components and accessories as described in the system drawings and specifications.									
	1.2	Install the required appliances (knife switch, AC breaker, combiner box etc), components and accessories in accordance with the manufacturer's specifications.									
	1.3	Mount each electrical appliance (knife switch, AC breaker, combiner box etc) in accordance with manufacturer's and technical specifications.									
	1.4	Ensure the mounted electrical appliance (knife switch, AC breaker, combiner box etc) are Secured in accordance with manufacturer's and technical specifications.									
LO 2: **Install ducting, trunking pipe and cabling systems on different surfaces.**											
	2.1	Select the required ducting, trunking pipe and cabling materials in accordance with the job specifications.									
	2.2	Plan the best routing to connect the ducting, trunking pipe and cabling system in accordance with the job specifications, existing infrastructure and site supervisor instructions.									
	2.3	Install the ducting, trunking pipe and cabling system in accordance with the job specifications, and site supervisor instructions.									
LO 3:	3.1	Plan the cable run, inside ducts, conduits and truncking pipe using appropriate cable sizes and observing the colour codes. in									

Select and install single and double insulated cables		accordance with the work specifications.									
	3.2	Select the appropriate cable(s) in each of the runs in accordance with the system specifications,									
	3.3	install cable(s) in each of the runs in accordance with the system specifications,									
	3.4	Secure, cover or protect cabling in accordance with the system design and job specifications.									
LO 4: Terminate cables, connect components and **Install distribution boards**	4.1	connect system cables, components and junction boxes in accordance with the manufacturers' instructions.									
	4.2	Select the required AC breakers in accordance with the system specifications.									
	4.3	Install electrical switchboards in accordance with the system specifications.									
	4.4	Carry out Wiring of the distribution board/switchboards and breakers in accordance with the system specifications.									
LO 5: Ground system components	5.1	Select the system components that require equipment grounding (earthing),									
	5.2	Ground component that requires earthing in accordance with the system design and technical specifications.									
	5.3	Check the effectiveness of grounding system									
	5.4	Determine the best placement of grounding rod(s) in accordance with the system specifications									

Learners Signature:	Date
Assessors Signature:	Date:
IQA Signature (if sampled)	Date:
EQA Signature (if sampled)	**Date:**

Unit 6: SOLAR PV SYSTEM SELECTION

Unit reference number: PWR/SPV/006/L4

NSQ level: 4

Credit value: 6

Guided learning hours: 60

Unit Purpose: This unit is designed to provide the trainee with the knowledge and skills in Selection of solar PV system

Unit Assessment Requirements/Evidence Requirements:

Assessment must be carried out in real workplace environment in which learning and human development is carried out. Simulation is not allowed in this unit and level.

Assessment methods to be used include:

1. Direct Observation (DO)
2. Question and Answer (QA)
3. Witness Testimony (WT)
4. Personal statement (PS) or Reflective Practice (RP)
5. Assignment (ASS)
6. Work product (WP)
6. Other methods as may be applicable

UNIT 6: SOLAR PV SYSTEM SELECTION

LO (Learning outcome)		Criteria:-	Evidence Type					Evidence Ref Page number			
LO 1: Understand solar PV system configurations	1.1	Confirm the client requirements for PV system									
	1.2	Determine the solar PV system configuration to meet expectations									
	1.3	Confirm the suitability of the system configuration with the customer									
	1.4	Check the system configuration with the site supervisor.									
	1.5	Plan the PV system configuration and confirm to the client's satisfaction.									
LO 2: **Select major PV system components and determine PV modules and materials**	2.1	Plan the PV system components in accordance with the system requirements.									
	2.2	Select the appropriate materials in accordance with the system requirements.									
	2.3	Select the PV modules in accordance with the system requirements									
	2.4	Select the types and sizes of wire needed to install the system in accordance with the system specifications									
LO 3 **Assemble solar modules, panels, or support structures**	3.1	Select the appropriate materials for the assembling of the solar PV modules, in accordance with the system design.									
	3.2	Identify tools and equipment for assembling solar PV modules									
	3.3	Assemble supporting structures for positioning in the location in accordance with the specific system design.									
	3.4	Assemble the solar PV modules on the supporting structure appropriately									

LO 4: Remedy site-specific safety hazards	4.1	Identify any worksite hazards for installation.									
	4.2	Mark the Identified hazard in accordance with safety guidelines on work site hazards.									
	4.3	Mitigate the marked hazard in accordance with safety guidelines on work site hazards									

Learners Signature:	Date
Assessors Signature:	Date:
IQA Signature (if sampled)	Date:
EQA Signature (if sampled)	**Date:**

Unit 7: **Installation of solar PV Systems**

Unit reference number: PWR/SPV/007/L4

NSQ level: 4

Credit value: 8

Guided learning hours: 80

Unit Purpose: This unit is designed to provide the trainee with the knowledge and skills in **Installation of solar PV Systems**

Unit Assessment Requirements/Evidence Requirements:

Assessment must be carried out in real workplace environment in which learning and human development is carried out. Simulation is not allowed in this unit and level.

Assessment methods to be used include:

1. Direct Observation (DO)
2. Question and Answer (QA)
3. Witness Testimony (WT)
4. Personal statement (PS) or Reflective Practice (RP)
5. Assignment (ASS)
6. Work product (WP)
6. Other methods as may be applicable

UNIT 7**: Installation of solar PV Systems**

LO (Learning outcome)		**Criteria:-**	Evidence Type					Evidence Ref Page number			
LO 1: Mounting PV modules securely	1.1	Plan the access for PV mounting area in preparation to PV module mounting.									
	1.2	Supervise mounting of the PV modules following the installation instructions.									
	1.3	Determine Solar constant, declination angle and sun to earth relationship									
	1.4	Determine the sun to earth angles using appropriate instruments									
LO 2: **Install PV balance of system (BOS) components**											
	2.1	Explain BOS components in commercial and industrial applications									
	2.2	Mount battery in a stable and protected structure in accordance with the system design									
	2.3	Install controller(s) in accordance with the technical specifications for fastening and heat dissipation.									
	2.4	Fix the system components in accordance with the manufacturer specifications and the system design									
	2.5	Test the system components in accordance with design specifications									
LO 3: **Perform wiring with required cable sizes and sheathing types.**	3.1	Select the wiring types and gauges for the installation as detailed in the system specification									
	3.2	Determine routing for each wire run in accordance with standards for surface and conduit wiring.									
	3.3	Measure each length of needed wire in accordance with the system design.									
	3.4	Place, pull and secure electrical wires in compliance with set									

		standards (SON, IEC, and IEEE) and aesthetics									
	3.5	Secure to provide strain relief or slack in accordance with standard wiring practices.									
LO 4 Connect cables to system components	4.1	Explain cable termination points									
	4.2	Prepare cable termination points									
	4.3	Connect the cables to system switches, breakers, etc, in accordance with the installation instructions									
	4.4	Insulate cable termination and connection points in accordance with system design and installation instructions.									
LO 5: Know system grounding components	5.1	Explain system grounding									
	5.2	Identify types of system grounding									
	5.3	Carryout system grounding accordance with design and manufacturer specifications.									
	5.4	Test system grounding using appropriate tools and equipment									
LO 6: Configure charge controllers and inverters for desired operating modes.	6.1	Explain configuration of charge controllers and inverters									
	6.2	Describe stages of configuration									
	6.3	Configure charge controller and inverter in accordance with the installation instructions									
LO 7: Connect batteries											
	7.1	Determine the required cross-section of cables and shortest routes for the battery bank, in accordance with the installation									

		instructions and manufacturers specification									
	7.2	Carryout termination of series and parallel battery in accordance with relevant electrical code and standard practice									
	7.3	Carryout termination of connection for the charge controllers and inverter in accordance with relevant electrical code and standard practice									
	7.4	Connect battery bank to the charge controller and inverter in accordance with relevant electrical standard operating procedures									
	7.5	Test run the connection in accordance with design specifications									

Learners Signature:	Date
Assessors Signature:	Date:
IQA Signature (if sampled)	Date:
EQA Signature (if sampled)	**Date:**

Unit 8: PROJECT HANDOVER AND CUSTOMER SUPPORT IN SOLAR PV INSTALLATION

Unit reference number: PWR/SPV/008/L4

NSQ level: 4

Credit value: 4

Guided learning hours: 40

Unit Purpose: This unit is designed to provide the trainee with the knowledge and skills in handing over of project and and customer support

Unit Assessment Requirements/Evidence Requirements:

Assessment must be carried out in real workplace environment in which learning and human development is carried out. Simulation is not allowed in this unit and level.

Assessment methods to be used include:

1. Direct Observation (DO)
2. Question and Answer (QA)
3. Witness Testimony (WT)
4. Personal statement (PS) or Reflective Practice (RP)
5. Assignment (ASS)
6. Work product (WP)
6. Other methods as may be applicable

UNIT 8: PROJECT HANDOVER AND CUSTOMER SUPPORT IN SOLAR PV INSTALLATION

LO (Learning outcome)		**Criteria:-**	Evidence Type					Evidence Ref Page number			
LO 1: Test completed installations	1.1	Identify stages to test installations before energizing to ensure personal and electrical safety									
	1.2	Confirm connections throughout the installation in accordance the testing instructions.									
	1.3	Test earth continuity in installation and correct polarity in accordance with manufacturers specification									
LO 2: **Test installations when energized (Operation Test)**											
	2.1	Test installations with client in attendance for some times when energized in accordance with instructions									
	2.2	Use an appropriate device to operate a system in accordance with manufacturer's instruction.									
	2.3	Inspect possible site for damage to buildings and facilities for evidence of damage in accordance with acceptance checklist.									
	2.4	Report any damage found to supervisor in accordance with acceptance checklist.									
	2.5	Set installations for full functionality and ensure customers can operate same									
LO 3: **Organize/prepare tools and leftover material for departure.**	3.1	Return all tools to their storage location in preparation for departure in accordance with worksite closeout checklist.									
	3.2	Dispose materials in accordance with worksite closeout checklist									
	3.3	Ensure clean-up in accordance with worksite closeout checklist.									
	3.4	Provide data of updated drawings and related documentation after finalized installation work.									

	3.5	Submit documentation to supervisor in accordance with worksite closeout checklist.									

Learners Signature:	Date
Assessors Signature:	Date:
IQA Signature (if sampled)	Date:
EQA Signature (if sampled)	**Date:**

Unit 9: **Maintenance of solar PV systems**

Unit reference number: PWR/SPV/009/L4

NSQ level: 4

Credit value: 5

Guided learning hours: 50

Unit Purpose: This unit is designed to provide the trainee with the knowledge and skills in Maintenance of solar PV systems

Unit Assessment Requirements/Evidence Requirements:

Assessment must be carried out in real workplace environment in which learning and human development is carried out. Simulation is not allowed in this unit and level.

Assessment methods to be used include:

1. Direct Observation (DO)
2. Question and Answer (QA)
3. Witness Testimony (WT)
4. Personal statement (PS) or Reflective Practice (RP)
5. Assignment (ASS)
6. Work product (WP)
6. Other methods as may be applicable

UNIT 9: **Maintenance of solar PV systems**

LO (Learning outcome)	**Criteria:-**		Evidence Type					Evidence Ref Page number			
LO 1: Test measuring equipment.	1.1	Test measuring equipment in accordance with manufacturers specifications									
	1.2	Take readings with appropriate testing devices in accordance with troubleshooting guidelines.									
	1.3	Record readings with appropriate testing devices in accordance with troubleshooting guidelines									
	1.4	Use a clamp meter to test for current and voltage accordingly in circuits									
LO 2: **Troubleshoot solar PV installations faults**											
	2.1	Diagnose solar PV installations faults									
	2.2	Identify faults in accordance with troubleshooting guidelines									
	2.3	Replace any defective components as necessary, in accordance with troubleshooting guidelines.									
	2.4	Report faults to the supervisor in accordance with troubleshooting guidelines									
LO 3: **Perform routine checks of solar PV system**	3.1	Conduct physical inspection of all system components and the structure in accordance with troubleshooting guidelines									
	3.2	Take readings of electrical parameters of solar PV system									
	3.3	Report readings to the site supervisor in accordance with the maintenance instructions.									

Learners Signature:	Date
Assessors Signature:	Date:
IQA Signature (if sampled)	Date:
EQA Signature (if sampled)	**Date:**

NATIONAL SKILLS QUALIFICATIONS/NATIONAL OCCUPATIONAL STANDARDS

(NSQ/NOS)

FOR

SOLAR PV INSTALLATION AND MAINTAINANCE

LEVEL 5

APRIL, 2025

OVERVIEW

This qualification is for those interested in developing a career in Solar Photovoltaic (PV) Installation and Maintenance for the award of National Skills Qualifications (NSQ). It is aimed at producing specialists and supervisors in Solar PV Installation and Maintenance at NSQ Levels 5 with the competencies to install, troubleshoot and maintain Solar system professionally while complying with relevant regulatory requirements, teamwork, health and safety.

This qualification is subject to review as and when the need arises.

NATIONAL SKILLS QUALIFICATION

NSQ LEVEL 5 – Solar PV Installation and Maintenance

GENERAL INFORMATION

QUALIFICATION PURPOSE

This qualification is designed for individuals who are interested to further develop career in Solar PV Installation and Maintenance.

QUALIFICATION REQUIREMENTS

Candidates must:

a. Be at least 18 years of age
b. Be medically fit
c. Be mentally fit
d. Have achieved all the mandatory units in the qualification

QUALIFICATION OBJECTIVE

At the end of the qualification, the Solar PV Installation and Maintenance supervisor should be able to:

1. Comply with Industrial Health, Safety, and Environmental regulations
2. Demonstrate Communication and interpersonal skills in Solar PV System Installation and Maintenance
3. Demonstrate Team Management
4. Carry out Solar PV System Optimization
5. Deploy Solar PV Mini-Grid and Hybrid System
6. Carry out Troubleshooting and Performance Diagnostics
7. Apply Solar PV Policy, Regulation, and Grid Codes
8. Carry out Solar PV Financial Analysis and Business Development
9. Use Energy Storage and Advanced Battery Technologies

Unit assessment requirements/evidence requirements:

Assessment must be carried out in real workplace environment in which learning and human development is carried out. Simulation is not allowed in this level.

Assessment methods to be used include:

7. Direct Observation (DO)
8. Question and Answer (QA)
9. Witness Testimony (WT)
10. Personal statement (PS) or Reflective Practice (RP)
11. Recognition of Prior Learning (RPL)
12. Other methods (OM) as may be applicable

SOLAR PHOTOVOLTAIC SYSTEM INSTALLATION AND MAINTENANCE

NATIONAL SKILLS QUALIFICATION (NSQ)/NATIONAL OCCUPATIONAL STANDARDS TABLE

MANDATORY UNITS LEVEL 5

S/No /Unit No	Reference Number	NOS Title	Credit Value	Guided Learning Hours	Remark
1	PWR/SPV/001/L5	Industrial Health, Safety, and Environmental Compliance	4	40	Level 5
2	PWR/SPV/002/L5	Communication and interpersonal skills in Solar PV System Installation and Maintenance	4	40	Level 5
3	PWR/SPV/003/L5	Team Management	4	40	Level 5
4	PWR/SPV/004/L5	Solar PV System Optimization	10	100	Level 5
5	PWR/SPV/005/L5	Solar PV Mini-Grid and Hybrid System Deployment	10	100	Level 5
6	PWR/SPV/006/L5	Troubleshooting and Performance Diagnostics	10	100	Level 5
7	PWR/SPV/007/L5	Solar PV Policy, Regulation, and Grid Codes	7	70	Level 5
	Optional Units				
8	PWR/SPV/008/L5	Solar PV Financial Analysis and Business Development	7	70	Level 5
9	PWR/SPV/009/L5	Energy Storage and Advanced Battery Technologies	7	70	Level 5
	TOTAL		**56**	**560**	

NOTE: This is a 56 credit qualification. To achieve this qualification. Each Credit is equivalent to approx 10 Guided Learning Hours (GLH). The Total Learning Hours will therefore consist of the GLH *plus* the independent learning hours of the candidate, which is generally 50% – 150% of the GLH. ***The actual Total Learning Hours for each Credit will then be a minimum of 15 hours***.

Qualification Purpose:

Unit title	Provides a clear explanation of the content of the unit.
Unit number	The unique number assigned to the unit
Unit reference	The unique reference number given to each unit at qualification approval by NBTE
Unit level	Denotes the level of the unit within the National skills Qualification framework NSQF.
Unit credit value	The value that has been given to the unit based on the expected learning time for an average learner. 1 credit = 10 learning hours
Unit aim	Provides a brief outline of the unit content.
Learning outcome	A statement of what a learner will know, understand or be able to do, as a result of a process of learning.
Assessment criteria	A description of the requirements a learner must achieve to demonstrate that a learning outcome has been met.
Unit assessment guidance	Any additional guidance provided to support the assessment of the unit.
Unit guided learning hours	The average number of hours of supervised or directed study time or assessment required to achieve a qualification or unit of a qualification.

Unit 1: INDUSTRIAL HEALTH, SAFETY AND ENVIRONMENTAL COMPLIANCE

Unit Reference Number: PWR/SPV/001/L5
NSQ Level: 5
Credit Value: 4
Guided Learning Hours: 40

Unit Purpose: This unit is designed to provide the trainee with the knowledge and skills needed to adhere to industrial health, safety and the environmental compliance in Solar PV installation and maintenance workplace

Unit assessment requirements/evidence requirements:
Assessment must be carried out in real workplace environment. in which learning and human development is carried out. ***Simulation is not allowed*** (where/when necessary) in this unit and level.

Assessment methods to be used include:

1. Direct Observation (DO)
2. Question and Answer (QA)
3. Witness Testimony (WT)
4. Personal statement (PS) or Reflective Practice (RP)
5. Recognition of Prior Learning (RPL)
6. Other methods (OM) as may be applicable

Unit 1: Industrial Health, Safety, and Environmental Compliance					
LEARNING OBJECTIVE (LO) The learner will:		PERFORMANCE CRITERIA The learner can:	Evidence Type		Evidence Ref Page No
LO 1: **Understand risks management in high-voltage PV installations**.	1.1	Identify potential failure points. e.g insulation breakdown, arc faults, and overvoltage conditions			
	1.2	Evaluate site-specific risks such as weather conditions, terrain, and proximity to other infrastructure.			
	1.3	Follow relevant industry regulations, codes of practice, and safety standards			
	1.4	Explain risk management			
	1.5	Provide clear signage and labelling of high-voltage areas and equipment			
LO 2: Understand advanced electrical safety protocols	2.1	Identify electrical safety protocols in solar PV installation and maintenance			
	2.2	List standard operational procedures in solar PV installation and maintenance			
	2.3	Follow safe work procedures, including lockout/tagout (LOTO) protocols			
	2.4	Document incidents as per safety protocols in appropriate template			
LO 3: Know the local and international safety Standards (SON, IEC, IEEE, NERC, OSHA)	3.1	Identify relevant safety regulations (SON, IEC, IEEE, NERC, OSHA).			
	3.2	Use best practices for electrical safety, system design, and maintenance			

	3.3	Carryout regular audits to verify adherence to safety codes.			
	3.4	Maintain proper documentation for inspections, incidents, and corrective actions.			
	3.5	Describe procedures for reporting and addressing non-compliance issues.			
	3.6	Describe proper grounding, insulation, and overcurrent protection in line with IEC and IEEE standards.			
	3.7	Perform hazard identification and risk control per NERC reliability standards.			
	3.8	Describe emergency preparedness and response plans align with regulatory guidelines.			
	3.9	Sensitize on legal and technical safety requirements.			
	3.10	Enforce use of Personal Protective Equipment (PPE) as per OSHA and IEC guidelines.			
	3.11	Promote a culture of safety through regular training and updates on regulatory changes.			
LO 4: Understand emergency response planning for solar PV projects	4.1	Create site-specific emergency response procedures for fire, electrical hazards, and extreme weather events.			
	4.2	Define clear emergency reporting and escalation procedures.			
	4.3	Maintain accessible and up to date emergency contact information			

	4.4	Conduct regular safety drills, including fire evacuation and electrical hazard response.			
	4.5	Maintain fire-fighting equipment, first aid kits, and emergency shutdown tools on-site.			
	4.6	Label emergency exits, shutoff points, and hazard zones			
	4.7	Interpret emergency exits, shutoff points, and hazard zones			
	4.8	Explain importance of collaboration with local fire departments and medical responders.			
	4.9	Provide site access details and emergency response guidelines to external responders			
LO 5: Understand component/material handling and transportation	5.1	Identify sensitive components that require careful handling in solar PV system			
	5.2	Describe packaging of items in 5.1 above for transportation			
	5.3	Describe processes of loading and offloading of items in 5.1			
LO 6: Decommission and disposal of component and materials	6.1	Identify materials/component due for decommissioning and disposal			
	6.2	Explain disposal methods of materials/components			
	6.3	State the advantages of disposal of materials/component in terms of: • Economic • Environmental			

		• Social • Technical			

Learners Signature:	Date
Assessors Signature:	Date:
IQA Signature (if sampled)	Date:
EQA Signature (if sampled)	**Date:**

UNIT 2: COMMUNICATION AND INTERPERSONAL SKILL IN SOLAR PV INSTALLATION AND MAINTENANCE

Unit reference number: PWR/SPV/002/L5

NSQ level: 5

Credit value: 4

Guided learning hours: 40

Unit Purpose: This unit is designed to provide the trainee with the advanced knowledge and skills needed to communicate effectively in solar PV installation and maintenance.

Unit Assessment Requirements/Evidence Requirements:

Assessment must be carried out in real workplace environment in which learning and human development is carried out. Simulation is not allowed in this unit and level.

Assessment methods to be used include:

1. Direct Observation (DO)
2. Question and Answer (QA)
3. Witness Testimony (WT)
4. Personal statement (PS) or Reflective Practice (RP)
5. Assignment (ASS)
6. Other methods as may be applicable

UNIT 2: Communication and interpersonal skills in Solar PV System Installation and Maintenance

LEARNING OBJECTIVE (LO) The learner will:		PERFORMANCE CRITERIA The learner can:	Evidence Type		Evidence Ref Page No
LO 1: Understand Effective Interpersonal Communication	1.1	Demonstrate active listening skills.			
	1.2	Engage in empathetic communication			
	1.3	Use appropriate verbal and non-verbal communication techniques.			
LO 2: Understand Presentation Skills	2.1	Carry out a presentation effectively			
	2.2	Use visual aids and technology to enhance communication			
	2.3	Discuss audience engagement, feedback, and questions.			
LO3: Understand Written Communication	3.1	Prepare clear and concise business correspondence			
	3.2	Adhere to grammatical and formatting standards			
	3.3	Tailor communication to the target audience			
LO4: Understand Negotiation Skills	4.1	Prepare for negotiations by obtaining relevant information			
	4.2	Utilize effective communication and persuasion techniques.			
	4.3	Demonstrate win-win outcomes through collaborative problem-solving			

LO5: Know Feedback Mechanisms	5.1	Explain constructive feedback that is actionable and specific			
	5.2	Use feedback actively and implement necessary changes.			
	5.3	Foster a culture of open communication within teams			
LO 6: know **Cross-Cultural Communication**	6.1	Identify cultural differences in communication			
	6.2	Adapt communication approaches based on cultural context			
	6.3	Demonstrate respect and inclusivity in diverse interactions			
LO 7: Understand Conflict management	7.1	Identify types of conflict in communication			
	7.2	Identify causes of conflict in communication			
	7.3	Use negotiation and mediation techniques to resolve conflicts.			
	7.4	Develop strategies to prevent recurring conflicts			
LO 8: Understand Customer relations	8.1	Communicate with clients respectfully & clearly			
	8.2	Explain technical process in simple terms.			
	8.3	Represent the company positively through professional behavior.			

Learners Signature:	Date
Assessors Signature:	Date:
IQA Signature (if sampled)	Date:
EQA Signature (if sampled)	**Date:**

UNIT 3: TEAM MANAGEMENT

Unit reference number: PWR/SPV/003/L5

NSQ level: 5

Credit value: 4

Guided learning hours: 40

Unit Purpose: This unit is designed to provide the trainee with the advanced knowledge and skills needed for team management in solar PV installation and maintenance.

Unit Assessment Requirements/Evidence Requirements:

Assessment must be carried out in real workplace environment in which learning and human development is carried out. Simulation is not allowed in this unit and level.

Assessment methods to be used include:

1. Direct Observation (DO)
2. Question and Answer (QA)
3. Witness Testimony (WT)
4. Personal statement (PS) or Reflective Practice (RP)
5. Assignment (ASS)
6. Other methods as may be applicable

LEARNING OBJECTIVE (LO) The learner will:		PERFORMANCE CRITERIA The learner can:	Evidence Type		Evidence Ref Page No
LO 1: Understanding Team Dynamics	1.1	Describe the key elements that define a successful team.			
	1.2	Analyze the differences between formal and informal teams			
	1.3	List the roles and responsibilities of team members in various team structures			
	1.4	Discuss the stages of team development (forming, storming, norming, performing, adjourning).			
LO 2: Understand Leadership in Teams	2.1	Describe different leadership styles (e.g., transformational, transactional, servant leadership) and their suitability in various contexts			
	2.2	Demonstrate skills in conflict resolution and negotiation within a team.			
	2.3	Develop a motivational plan that aligns the team's goals with individual strengths			
	2.4	Assess personal leadership style and adapt it to situational needs.			
LO 3: Understand building Trust	3.1	Discuss the role of trust in team collaboration and performance			
	3.2	Implement strategies to enhance team cohesion and minimize conflicts			
	3.3	Conduct team-building activities that foster			

		relationships and collaboration			
	3.4	Evaluate the effectiveness of trust-building techniques utilized in the team			

Learners Signature:	Date
Assessors Signature:	Date:
IQA Signature (if sampled)	Date:
EQA Signature (if sampled)	**Date:**

UNIT 4: SOLAR PV SYSTEM OPTIMIZATION

Unit reference number: PWR/SPV/004/L5

NSQ level: 5

Credit value: 10

Guided learning hours: 100

Unit Purpose: This unit is designed to provide the trainee with the advanced knowledge and skills of Solar PV system optimization

Unit Assessment Requirements/Evidence Requirements:

Assessment must be carried out in real workplace environment in which learning and human development is carried out. Simulation is not allowed in this unit and level.

Assessment methods to be used include:

1. Direct Observation (DO)
2. Question and Answer (QA)
3. Witness Testimony (WT)
4. Personal statement (PS) or Reflective Practice (RP)
5. Assignment (ASS)
6. Other methods as may be applicable

Unit 4: Solar PV System Optimization					
LEARNING OBJECTIVE (LO) The learner will:		PERFORMANCE CRITERIA The learner can:	Evidence Type		Evidence Ref Page No
LO 1: ***Understand Power electronics in solar PV systems***	1.1	Carryout audit of a given premises for solar system installation			
	1.2	Determine inverters, charge controllers, and other power conversion components for a particular load			
	1.3	Implement synchronization techniques for seamless PV system connection to the grid.			
	1.4	Optimize voltage, frequency, and reactive power control			
	1.5	Apply anti-islanding protection and fault detection measures.			
	1.6	Ensure compliance with grounding, surge protection, and insulation standards.			
	1.7	Follow interconnection guidelines and approval processes with grid operators.			
	1.8	Maintain documentation for compliance with regulatory and safety standards			
LO 2: Understand electrical load calculations and power factor correction	2.1	Analyze real, reactive, and apparent power requirements for a given electrical systems.			
	2.2	Describe demand factor, diversity factor, and load factor in system design.			
	2.3	Ensure compliance with industry standards for power quality and efficiency (IEEE 1459, IEC 61000).			

	2.4	Troubleshoot power distribution to prevent overloading and inefficiencies.			
	2.5	Use power analyzers and monitoring tools to track electrical loads and power factor trends.			
	2.6	Explain utility guidelines and regulatory standards for power factor correction and load balancing			
LO 3: Understand PV efficiency under variable environmental conditions	3.1	Recognize shading obstacles and inclination angles in Solar Pv Installation			
	3.2	Interpret meteorological data to predict performance fluctuations.			
	3.3	Develop appropriate cleaning and maintenance schedules to reduce performance losses.			
	3.4	Measure PV system performance to identify faults.			
	3.5	Optimize wiring, inverter settings, and cooling mechanisms to minimize losses.			
	3.6	Identify anti-reflective coatings and advanced module technologies for higher yield.			
	3.7	Follow guidelines of SON, IEC, IEEE, for PV system performance and efficiency.			
LO 4: Understand smart grid technologies and their application in solar PV systems	4.1	Explain smart grid technology			
	4.2	Identify component of smart grid technology			

	4.3	List smart grid technologies installation procedures			
	4.4	Use appropriate tools and equipment to install smart grid technology components			
	4.5	Operate smart grid technologies in accordance to specification			
	4.6	Test smart grid technologies equipment in accordance with manufacturers specification			
	4.7	Troubleshoot smart grid technologies in accordance to specification			
	4.8	Discuss bi-directional power flow for distributed energy resource (DER) integration.			
	4.9	Develop strategies for seamless integration of EV charging and smart appliances (L5)			

Learners Signature:	Date
Assessors Signature:	Date:
IQA Signature (if sampled)	Date:
EQA Signature (if sampled)	**Date:**

UNIT 5: Solar PV Mini-Grid and Hybrid System Deployment

Unit reference number: PWR/SPV/005/L5

NSQ level: 5

Credit value: 10

Guided learning hours: 100

Unit Purpose: This unit is designed to provide the trainee with the advanced knowledge and skills in Solar PV Mini-Grid and Hybrid System Deployment

Unit Assessment Requirements/Evidence Requirements:

Assessment must be carried out in real workplace environment in which learning and human development is carried out. Simulation is not allowed in this unit and level.

Assessment methods to be used include:

1. Direct Observation (DO)
2. Question and Answer (QA)
3. Witness Testimony (WT)
4. Personal statement (PS) or Reflective Practice (RP)
5. Assignment (ASS)
6. Other methods as may be applicable

Unit 5: Solar PV Mini-Grid and Hybrid System Deployment					
LO 1: Understand mini-grids for rural and off-grid applications	1.1	Explain Mini-grids			
	1.2	Assess Energy Needs and Site Conditions			
	1.3	Install an Efficient Mini-Grid System			
	1.4	Integrate Smart Energy Management			
	1.5	Supervise mounting of PV modules securely on racks or rails while observing required orientation and angle			
	1.6	Supervise Installation of PV balance of system (BOS) components, including charge controller, battery, inverter, load controller, and electrical protection devices in accordance with codes and standards using drawings, schematics, and instructions			
	1.7	Check wiring with required cable sizes. Place, pull and secure electrical wires in compliance with set standards (e.g., IEC, NERC) and aesthetics			
	1.8	Check appropriate connection of individual circuits, distribution, combiner, junction, breaker boxes and DC appliances			
	1.9	Install appropriate system grounding components (bare cabling, grounding rod, bonding connectors, lightning arrestors, surge protectors).			
	1.10	Configure charge controllers and inverters for desired operating modes			

	1.11	Supervise connection of multi-battery systems in series, parallel, or combined series/parallel			
	1.12	Supervise the connection and assembling of battery banks to charge controller(s) and/or inverter.			
LO 2: Know Interconnection of solar PV with diesel generators and micro-grid systems.	2.1	Explain hybridisation (2 or more sources of power supply that can be integrated with solar power)			
	2.2	Select the back up power capacity to ensure continuity of electric power supply			
	2.3	Perform the integration of mini solar PV and generators			
	2.4	Configure hybrid inverters and controllers for seamless power management.			
	2.5	Integrate Smart Control and Monitoring devices			
	2.6	Train local operators on system management, troubleshooting, and best practices.			
	2.7	Supervise group projects to design and present mini-grid solutions.			
LO 3: Understand types of mini-grid development in Nigeria	3.1	State types of Mini-grid			
	3.2	Identify key factors contributing to the success or failure of mini-grid deployments in Nigeria			
	3.3	State applicable Policy and Regulatory Frameworks of mini-grid in Nigeria			

Learners Signature:	Date
Assessors Signature:	Date:
IQA Signature (if sampled)	Date:
EQA Signature (if sampled)	**Date:**

UNIT 6: TROUBLE SHOOTING AND PERFORMANCE DIAGNOSTICS

Unit reference number: PWR/SPV/006/L5

NSQ level: 5

Credit value: 10

Guided learning hours: 100

Unit Purpose: This unit is designed to provide the trainee with the knowledge and skills of trouble shooting and performance diagnostics

Unit Assessment Requirements/Evidence Requirements:

Assessment must be carried out in real workplace environment in which learning and human development is carried out. Simulation is not allowed in this unit and level.

Assessment methods to be used include:

1. Direct Observation (DO)
2. Question and Answer (QA)
3. Witness Testimony (WT)
4. Personal statement (PS) or Reflective Practice (RP)
5. Assignment (ASS)
6. Other methods as may be applicable

Unit 6: Trouble Shooting and Performance Diagnostics					
LO 1: Maintain using AI and big data analytics	1.1	Explain AI and Big Data in Solar PV Maintenance			
	1.2	Analyze historical performance data to anticipate system issues			
	1.3	Design proactive maintenance plans to reduce downtime and costs			
	1.4	Discuss detection and alert systems for rapid response			
LO 2: Understand common fault in solar PV system failures and degradation analysis	2.1	Identify issues in solar panels			
	2.2	Identify issues in inverters.			
	2.3	Identify issues in batteries.			
	2.4	Identify issues in charge controllers			
	2.5	Detect electrical faults, wiring issues and connection failures.			
	2.6	Monitor performance for early detection			
	2.7	Discuss the impact of weather, aging, and environmental conditions on system components.			
	2.8	Use electrical testing tools for system health diagnosis.			
	2.9	Develop maintenance schedules to minimize wear and prevent failures.			
	2.10	Implement best practices for cleaning, cooling, and protective measures.			
LO 3: Log data, system audits and performance reports	3.1	Configure data loggers to track solar PV performance metrics			

	3.2	Record key parameters such as energy output, battery status and inverter efficiency			
	3.3	Perform regular inspection to identify inefficiencies, faults, or degradation			
	3.4	Compare actual performance data with expected benchmarks for optimization			
	3.5	Compile audit findings into structured reports for stakeholders and decision makers.			
	3.6	Provide actionable recommendations for improving system efficiency and reliability.			
	3.7	Identify patterns in energy production, consumption, and system losses			
	3.8	Carry out troubleshooting in solar PV in collaboration with colleagues			

Learners Signature:	Date
Assessors Signature:	Date:
IQA Signature (if sampled)	Date:
EQA Signature (if sampled)	**Date:**

UNIT 7: Solar PV Policy, Regulation, and Grid Codes

Unit reference number: PWR/SPV/007/L5

NSQ level: 5

Credit value: 7

Guided learning hours: 70

Unit Purpose: This unit is designed to provide the trainee with the knowledge and skills of Solar PV Policy, Regulation, and Grid Codes**.**

Unit Assessment Requirements/Evidence Requirements:

Assessment must be carried out in real workplace environment in which learning and human development is carried out. Simulation is not allowed in this unit and level.

Assessment methods to be used include:

1. Direct Observation (DO)
2. Question and Answer (QA)
3. Witness Testimony (WT)
4. Personal statement (PS) or Reflective Practice (RP)
5. Assignment (ASS)
6. Other methods as may be applicable

Unit 7: Solar PV Policy, Regulation, and Grid Codes

LEARNING OBJECTIVE (LO) The learner will:		PERFORMANCE CRITERIA The learner can:	Evidence Type		Evidence Ref Page No
LO 1: Understand Nigerian Renewable Energy Policy and NERC regulations	1.1	Explain Nigeria's renewable energy goals and their impact on the solar industry.			
	1.2	Identify key NERC (Nigerian Electricity Regulatory Commission) regulations for solar PV deployment.			
	1.3	Ensure compliance with licensing, grid interconnection, and safety requirements.			
LO 2: Know International solar PV standards and certifications.	2.1	Discuss global solar PV standards, including IEC, IEEE, and UL certifications.			
	2.2	State the importance of certification for PV modules, inverters, and energy storage systems.			
	2.3	Apply best practices to ensure system quality, reliability, and safety.			
	2.4	Follow utility guidelines and regulatory standard for power factor correction and load balancing			
LO 3: Understand Net metering and Feed-in-Tariff (FiT) policies	3.1	Explain the concept of net metering and how it allows energy export to the grid.			
	3.2	Discuss Feed-in-Tariff (FiT) policies and how they impact solar investment.			
	3.3	Calculate potential revenue and savings from solar PV systems.			

Learners Signature:	Date
Assessors Signature:	Date:
IQA Signature (if sampled)	Date:
EQA Signature (if sampled)	**Date:**

UNIT 8: SOLAR PV FINANCIAL ANALYSIS AND BUSINESS DEVELOPMENT

Unit reference number: PWR/SPV/008/L5

NSQ level: 5

Credit value: 7

Guided learning hours: 70

Unit Purpose: This unit is designed to provide the trainee with the knowledge and skills in Solar PV financial analysis and business development.

Unit Assessment Requirements/Evidence Requirements:

Assessment must be carried out in real workplace environment in which learning and human development is carried out. Simulation is not allowed in this unit and level.

Assessment methods to be used include:

1. Direct Observation (DO)
2. Question and Answer (QA)
3. Witness Testimony (WT)
4. Personal statement (PS) or Reflective Practice (RP)
5. Assignment (ASS)
6. Work Product (WP)
6. Other methods as may be applicable

Unit 8: Solar PV Financial Analysis and Business Development					
LO 1: Understand feasibility studies and investment planning for solar PV projects	1.1	Carry out Site Assessment on: ➢ solar potential ➢ land availability ➢ environmental factors. ➢ historical weather data for accurate projections.			
	1.2	Carry out Resource Assessments			
	1.3	Perform Technical Feasibility Analysis			
	1.4	Perform Financial Feasibility Analysis			
	1.5	Develop a Business Model.			
	1.6	Develop Investment Strategies			
	1.7	Discuss financing options, including loans, grants, and power purchase agreements (PPAs).			
	1.8	Identify key stakeholders and potential investors for project funding.			
	1.9	Explain government policies, incentives, and tariff structures.			

	2.1	Discuss how to market solar products			
	2.2	Close a deal after marketing a solar PV product			
LO2: Understand solar business	2.3	Discuss merits and demerits of solar business			
LO3 understand Customer relations and management	3.1	State the importance of user feedback			
	3.2	Ensure compliance with industry standards and grid integration requirements			
	3.3	Present findings, risk assessments, and investment recommendations.			
	3.4	Provide decision-makers with clear insights on project viability and sustainability.			
LO 4: Learn Cost-benefit analysis, Levelized Cost of Energy (LCOE) calculations	4.1	Discuss Financial Metrics in Solar PV Projects ➢ capital, ➢ operational ➢ maintenance expenses			
	4.2	Identify key cost factors in Cost-benefit analysis, -			
	4.3	Learn the principles of cost-benefit analysis for evaluating solar investments			

	4.4	Calculate Levelized Cost of Energy (LCOE)			
	4.5	Compute return on Investment (ROI) and Payback Period			
	4.6	Determine the break-even point and long-term profitability of the investment.			
	4.7	Estimate revenue generation from solar PV projects based on energy tariffs and incentives			
	4.8	Carry out System Design for Cost Efficiency			
	4.9	Prepare Financial Reports for Decision Making			
LO 5: Understand Solar Power Purchase Agreements (PPAs) and financing models.	5.1	Discuss Power Purchase Agreements (PPAs)			
	5.2	Explain financial implications of each model on project costs and returns.			
	5.3	Identify key risks in PPAs, including pricing structures, contract duration, and termination clauses.			
	5.4	Ensure compliance with regulatory and legal requirements for solar energy agreements.			

	5.5	Calculate expected revenue based on energy tariffs and incentive programs.			
	5.6	Draft clear and structured proposals for investors, utilities, and customers.			
	5.7	Present financial and operational benefits to stakeholders for informed decision-making.			
LO 6: Understand entrepreneurship in solar PV and scaling solar businesses.	6.1	Explain the Solar PV Business Landscape			
	6.2	Identify market opportunities and challenges in the solar industry. -			
	6.3	Analyze trends in solar adoption, government policies, and consumer demand			
	6.4	Define a clear value proposition and target customer segments.			
	6.5	Choose the right business structure and revenue streams for profitability.			
	6.6	Explore Financing and Investment Strategies			
	6.7	Implement Effective Marketing and Sales Strategies			
	6.8	Scale and Sustain Business Growth			

Learners Signature:	Date
Assessors Signature:	Date:
IQA Signature (if sampled)	Date:
EQA Signature (if sampled)	**Date:**

UNIT 9: Energy Storage Systems and Battery Management

Unit reference number: PWR/SPV/009/L5

NSQ level: 5

Credit value: 7

Guided learning hours: 70

Unit Purpose: This unit is designed to provide the trainee with the knowledge and skills in Energy Storage Systems and Battery Management.

Unit Assessment Requirements/Evidence Requirements:

Assessment must be carried out in real workplace environment in which learning and human development is carried out. Simulation is not allowed in this unit and level.

Assessment methods to be used include:

1. Direct Observation (DO)
2. Question and Answer (QA)
3. Witness Testimony (WT)
4. Personal statement (PS) or Reflective Practice (RP)
5. Assignment (ASS)
6. Other methods as may be applicable

Unit 9: Energy Storage Systems and Battery Management					
LO 1: Understand battery chemistry, including Li-ion and Flooded Batteries.	1.1	State key characteristics of Li-ion, flooded batteries, lead-acid, and other energy storage technologies.			
	1.2	Analyze differences in energy density, cycle life, efficiency, and cost of batteries			
	1.3	Select appropriate battery types based on application, load profile, and storage requirements.			
	1.4	Check charge/discharge efficiency, degradation rates, and temperature sensitivity of batteries			
	1.5	Follow safety protocols for battery installation and maintenance			
	1.6	Implement temperature management and protective measures to prevent overheating and failures in batteries			
	1.7	Install battery storage solutions for off-grid and hybrid solar applications.			
LO 2: Understand energy storage systems for solar PV applications.	2.1	Choose appropriate battery technology (Li-ion, flooded and dry lead-acid) based on load requirements and application.			
	2.2	Calculate storage capacity, depth of discharge (DoD), and cycle life for optimal performance.			
	2.3	Minimize energy losses through proper cables, proper inverter and charge controller selection			
	2.4	Follow safety protocols for installation, maintenance, and emergency response.			

	2.5	Carryout maintenance strategies to enhance longevity and reduce operational costs			
LO 3: Understand battery Management Systems (BMS) and temperature management.	3.1	Discuss BMS in solar PV systems			
	3.2	Discuss temperature management of battery system in solar PV system			
	3.3	Monitor voltage, current, temperature, and state of charge (SoC).			
	3.4	Describe tools/equipment for fault diagnosis.			
	3.5	Implement maintenance schedule to reduce downtime and maximize energy storage reliability.			
	3.6	Confirm seamless communication between BMS, inverters, and charge controllers			

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Assessors Signature:	Date:
IQA Signature (if sampled)	Date:
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