THE NATIONAL COUNCIL FOR TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING OF TANZANIA

OCCUPATIONAL STANDARDS

OCCUPATION: RENEWABLE ENERGY ENGINEERING TECHNICIAN (SOLAR)

LEVEL: NTA LEVEL 5

FEBRUARY 2024

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ABBREVIATIONS

6S	Standardized Management Mode for the Production Operation Site: Security, Seiketsu, Seiri, Seiso, Seiton and Shitsuke
AC	Alternating Current
APP	Application Program
BMS	Battery Management System
CAD	Computer Aided Design
CBET	Competency Based Education and Training
DC	Direct Current
MC4	Multi-Contact-4mm Photovoltaic Pin Connector
MPPT	Maximum Power Point Tracking
NACTVET	NATIONAL COUNCIL FOR TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING OF TANZANIA
NOS	National Occupational Standards
OS	Occupational Standards
PF	Power Factor
PLC	Programmable Logic Controller
PV	Photovoltaic Power Generation
SVG	Static Var Generator
TET	Technical Education and Training
TVET	Technical and Vocational Education and Training

GLOSSARY OF TERMS

Circumstantial knowledge:	Detailed knowledge, which allows the decision-making in regard to different circumstances and cross-cutting issues.
Competence:	The ability to use knowledge, understanding, practical and thinking skills to perform effectively to the workplace standards required in employment.
Competency:	A description of the ability one possesses when able to perform a given occupational task effectively and efficiently.
Competency-based education:	An instructional programme that derives its content from validated tasks and bases assessment on the learner's performance.
Curriculum:	A description or composite of statements about "what is to be learned" by the trainee/student in a particular instructional programme; a product that states the "intended learning outcomes".
Educational/training programme:	The complete curriculum and instruction (what and how) that is designed to prepare a person for employment in a job or other particular performance situation.
Occupation:	A specific position requiring the performance of specific tasks - essentially the same tasks are performed by all employees having the same title.
Occupational area:	This is a broad grouping of related jobs. (Example: catering service)
Occupational standards:	Specific requirements of competences people are expected to demonstrate in a particular occupational area, including knowledge and relevant attitudes. They also act as performance tools of assessment of the prescribed outcomes.
Performance criteria:	Indicate the expected end results or outcome in form of evaluative statements.
Skills:	The ability to perform occupational tasks with a high degree of proficiency within a given occupation. Skills are conceived of as a composite of three completely interdependent components: cognitive, affective, and psychomotor activities.
Standards:	A set of statements, which, if proved true under working conditions, means that an individual is meeting an expected level and type of performance.
Task analysis:	The process of analyzing each task to determine the steps, circumstantial knowledge, attitudes, performance criteria, tools and materials needed, and safety concerns required of employees performing it.

Task:	A work activity that has a definite beginning and ending, is observable or measurable, consists of two or more definite steps, and leads to a product, service, or decision.
UNDERPINNING KNOWLEDGE	The crucial knowledge that an individual must acquire in order to perform a given task.
Verification process:	The process of experts reviewing and confirming the statements of tasks (competency) through occupational analysis. Other questions such as the degree of task learning difficulty are also frequently asked. This process is sometimes referred to as validation.
Occupational competence:	The application of knowledge and skills to perform consistently to the standards required in the working context.

1.0. INTRODUCTION

Technical Education and Training (TET) is one of the most important education sub-sectors in Tanzania, responsible for developing a skilled workforce to support the country's industrialization economic agenda. Tanzania's *Development Vision 2025* intends to raise the country's economy to a middle-income status, with a high level of human development. This requires a skilled workforce that is aligned with the needs of the public and private sectors of the economy. The National Council for Technical and Vocational Education and Training (NACTVET) has begun the job of drafting Occupational Standards (OS) that will eventually be adopted as National Occupational Standards (NOS) for use in the delivery of TET that meets the needs of the labour market and the country's economic agenda.

Occupational Standards (OS) are performance criteria that are matched with labour market demands. Each of them describes the functions, performance standards, and understanding or knowledge underpinning a given occupation. They combine skills, knowledge, and attitudes to describe best practice. They are useful tools for establishing job roles, personnel recruitment, supervision, and appraisal, as well as TET Standards. They are also helpful for benchmarking and harmonizing job qualifications on a national and international level. Standards, in general, provide a solid framework for high-quality TET that is labour market-relevant, current, and consistent in application across all public and private institutions.

However, it must be noted that Occupational Standards are different from Training /Education Standards. Occupational standards are defined in terms of activities performed by a person in a selected occupation (e.g., an electrical engineer designs electrical circuits, performs troubleshooting in electrical circuits, etc.), and are usually defined by Employers following procedures as agreed upon by all the stakeholders. On the other hand, Training and Education Standards are developed from the activities defined in the occupational standards, and they specify learning objectives to ensure that the necessary skills and knowledge are developed by a person to enable him/her to function at an agreed level in an occupation. Training and Education Standards are used to define curricula in training institutions. It is critical, however, to establish a direct link between the occupational standards and the training standards for both of them to respond collaboratively to the demands of the labour market.

For the purpose of TET delivery, Tanzania has adopted the Competence Based Education and Training (CBET) approach. The CBET approach focuses on providing learners with the skills and knowledge required to meet the occupational standards. Occupational standards are thus the starting point for developing competency-based training (CBET) programmes. Therefore, it is quite pertinent

for TET institutions to use the relevant occupational standards as a benchmark for formulating their curricula.

Occupational Standards are developed based on a given occupation's current and future demands. As a result, they serve as a means of bridging the gap between the worlds of employment and technical education and training.

The document explains how the occupational standards were developed, as well as the scope, the occupational profile in the form of DACUM charts, and the Occupational Standards.

2.0. OCCUPATIONAL STANDARDS DEVELOPMENT PROCESS

The process of developing these Occupational Standards involved both local and international expertise. The process began with an examination of major documents that guide Tanzanian skills development including the *10-year National Skills Development Strategy (2016-2026).* NACTVET labour market reports were also used in the literature review to determine the skills demand in the Tanzanian labour market as a whole.

After the literature review, a team of experts in consultation with practitioners developed draft occupational standards. The draft document was used to develop an occupational profile for each occupation (DACUM Chart), which is attached as an **Appendix** to every Occupational Standard.

The occupational standards were validated during the stakeholders' forum held on 22nd and 23rd February 2024 at Morogoro. The information from the stakeholders' forum provides insight from the workplaces, professional bodies, regulatory bodies and sector ministries regarding trends and changes in the profession, including how well graduates are prepared for working in the occupation.

3.0. THE SCOPE AND OVERVIEW OF THE OCCUPATIONAL STANDARDS FOR RENEWABLE ENERGY ENGINEERING TECHNICIANS (SOLAR)

These standards cover a broad range of duties and tasks that can be performed by a Renewable Energy Engineering Technician (Solar). However, the occupational standards are not meant to replace individual job descriptions, they are to be used for guidance in defining skill levels and knowledge for the technician in specific settings or positions. The Renewable Energy Engineering Technician (Solar) may perform tasks in a number of key areas of the occupational standards, but not necessarily in all areas. For example, in large operations, other individuals may be employed or designated to perform specific tasks.

Renewable Energy Engineering Technicians (Solar) refer to the personnel engaged in identification and review of the assembly drawings for the solar PV generation system and station power load and materials, installation and debugging of solar PV power station modules, monitoring devices and other related facilities and equipment, as well as inspection and maintenance of the operating status

of the solar PV power station during the construction of the solar solar PV power station, and the following are the main responsibilities of a Renewable Energy Engineering Technician (Solar):

Generally, a Renewable Energy Engineering Technician (Solar) performs the following duties:

a) Perform equipment selection, material accounting, installation, operation, maintenance and hand-over of equipment for the small solar PV system;

b) Perfom household solar PV construction scheme design, installation, inspection and maintenance;

c) Determine routine use and maintenance methods for various solar PV generation systems;

d) Analyze and determine the failure reasons of the solar PV generation system and dispose common failures according to various fault phenomena.

The Occupational Standards have been clustered into NTA qualification levels, i.e. NTA 4, 5 and 6.

4.0. VALIDITY PERIOD

The Occupational Standards will be valid for 3-5 years due to the fast-changing nature of technology. The review will proceed in the same manner as the previous one, with new occupational standards being developed based on current labour market information.

5.0. OCCUPATIONAL STANDARDS

5.1 OCCUPATIONAL STANDARDS FOR RENEWABLE ENERGY ENGINEERING TECHNICIAN (SOLAR) – NTA LEVEL 5

OCCUPATION	RENEWABLE ENERGY ENGINEERING TECHNICIAN (SOLAR)	**OCCUPATION CODE**	
DUTY TITLE	INTERPRET HOUSEHOLD SOLAR PV CONSTRUCTION DRAWINGS	**DUTY NO.**	501
TASK TITLE	INTERPRET CONSTRUCTION DRAWINGS OF PHOTOVOLTAIC POWER GENERATION SUBSYSTEM	**TASK NO.**	5011
PERFORMANCE CRITERIA	The person performing this task must be able to interpret construction drawings of photovoltaic power generation subsystem in accordance with the reading specifications and electrical graphic symbol standards.		
RANGE STATEMENT	The task may be executed on the installation site of solar PV generation systems under the supervision of a Renewable Energy Engineering Technician (Solar) Senior Technician. The tools and equipment to be used include: 1. Data such as principle drawings, wiring drawings and installation drawings of photovoltaic power generation subsystem; 2. Computers (to check electronic drawings); 3. Safety gear.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Check the catalog of drawings; 2. Read general instructions; 3. View the general construction plan; 4. Interpret installation construction drawings of household grid-connection solar PV generation system; 5. Interpret installation construction drawings of AC/DC hybrid off-grid solar PV generation system; 6. Interpret installation construction drawings of complementary solar PV street lights; 7. Observe health, occupational and environmental safety rules and regulations.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Interpret construction drawings of photovoltaic power generation subsystem. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Principles of household grid-connection solar PV generation system; 2.2 Principles of AC/DC hybrid off-grid solar PV generation system; 2.3 Principles of independent wind-solar street lights, complementary commercial power street lights and off-grid wind-solar power generation system; 2.4 Relevant standards of installation construction drawings. **3.0 Theories** The person performing this task must be able to explain:

	3.1 Components of household grid-connection solar PV generation system and functions of all parts; 3.2 Functions of components and parts of AC/DC hybrid off-grid solar PV generation system; 3.3 Functions of components and parts of independent wind-solar street lights, complementary commercial power street lights and off-grid wind-solar power generation system. **4.0 Essential skills** 4.1 Learning skills; 4.2 Communication skills; 4.3 Teamwork skills; 4.4 Writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The construction drawings of solar PV power generation subsystem are interpreted in accordance with the interpretation standards and specifications.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Reading standards and specifications of installation construction drawings of power generation system and power street lights; 2. Reading methods of installation construction drawings of power generation system and power street lights.

OCCUPATION	RENEWABLE ENERGY ENGINEERING TECHNICIAN (SOLAR)	**OCCUPATION CODE**	
DUTY TITLE	INTERPRET HOUSEHOLD SOLAR PV CONSTRUCTION DRAWINGS	**DUTY NO.**	501
TASK TITLE	INTERPRET CONSTRUCTION DRAWINGS OF ENERGY STORAGE SUBSYSTEM	**TASK NO.**	5012
PERFORMANCE CRITERIA	The person performing this task must be able tointerpret construction drawings of energy storage subsystem in accordance with the interpretation specifications and electrical graphic symbol standards.		
RANGE STATEMENT	The task may be executed on the installation site of solar PV generation systems under the supervision of a Renewable Energy Engineering Technician (Solar) Senior Technician. The tools and equipment to be used include: 1. Data such as principle drawings, wiring drawings and installation drawings of energy storage subsystem; 2. Computers (to check electronic drawings); 3. Safety gear.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Check the list of drawings; 2. Read general instructions; 3. View the general construction plan; 4. Interpret principle drawings of the household energy storage subsystem; 5. Interpret wiring drawings of the energy storage subsystem; 6. Interpret installation drawings of the energy storage subsystem; 7. Observe health, occupational and environmental safety rules and regulations.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Read construction drawings of the energy storage subsystem. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Installation and operation principles of the energy storage subsystem; 2.2 Construction principles of installing energy storage subsystem: A battery consistency management and traceability system must be established to monitor battery performance parameters in real-time, conduct regular maintenance and safety assessments, and prepare emergency plans in accordance with the full lifecycle concept. **3.0 Theories** The person performing this task must be able to explain: 3.1 Functions of energy storage subsystem; 3.2 Components of energy storage subsystem;

	3.3 Functions of parts of energy storage subsystem. **4.0 Essential skills** 4.1 Learning skills; 4.2 Communication skills; 4.3 Teamwork skills; 4.4 Writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The construction drawings of energy storage subsystem are interpreted in accordance with the interpretation specifications and electrical graphic symbol standards
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Construction reading knowledge; 2. Safety protection knowledge.

OCCUPATION	RENEWABLE ENERGY ENGINEERING TECHNICIAN (SOLAR)	**OCCUPATION CODE**	
DUTY TITLE	DESIGN OF THE SCHEME OF HOUSEHOLD SOLAR PV SYSTEMS	**DUTY NO.**	502
TASK TITLE	DESIGN THE HOUSEHOLD GRID-CONNECTION SOLAR PV GENERATION SYSTEM	**TASK NO.**	5021
PERFORMANCE CRITERIA	The person performing this task must be able to determine the installation location, design the support foundation method, the battery, inverter and controller and cable laying plan of household grid connection solar PV generation system in accordance with the installation location and technical requirements for solar PV system installation.		
RANGE STATEMENT	The task may be executed on the installation site of solar PV generation systems under the supervision of a Renewable Energy Engineering Technician (Solar) Senior Technician. The tools and equipment to be used include: 1. PV support; 2. PV module; 3. PV controller; 4. Inverter; 5. Battery; 6. Electric cabinet, electric meter, communication line, cable, etc. 7. Safety gear.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Determine the location for installation 2. Design the foundation construction of solar PV supports in accordance with the construction drawings; 3. Design the installation of of solar PV modules; 4. Design the installation of solar PV controllers, inverters and batteries; 5. Design the installation of the solar PV generation system distribution cabinet and other auxiliary facilities; 6. Observe health, occupational and environmental safety rules and regulations.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Desing the installation of solar PV supports made of galvanized steel, stainless steel, aluminum alloy and other materials on flat roof, terra-cotta tile roof, and color steel tile roof; 1.2 Design the installation of solar PV modules, controllers, inverters, batteries, distribution cabinets, communication and other equipment. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Principle of installation angle of solar PV supports; 2.2 Principle of controllers and inverters. **3.0 Theories** The person performing this task must be able to explain:

	3.1 Components of household grid-connection solar PV generation system and functions; 3.2 Functions and connection methods of solar PV modules; 3.3 Functions of solar PV controllers and inverters; 3.4 Functions of battery; 3.5 Functions of electric cabinets, electric meters and communication lines. **4.0 Essential skills** 4.1 Learning skills; 4.2 Communication skills; 4.3 Teamwork skills; 4.4 Writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The household solar PV generation system is designed in accordance with the installation location and technical requirements for solar PV system installation.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Underpinning knowledge of data; 2. Safe operation of equipment installation; 3. User Manual for relevant manufacturers.

OCCUPATION	RENEWABLE ENERGY ENGINEERING TECHNICIAN (SOLAR)	**OCCUPATION CODE**	
DUTY TITLE	INSTALLATION OF THE SCHEME OF HOUSEHOLD SOLAR PV SYSTEM	**DUTY NO.**	503
TASK TITLE	CONSTRUCT THE FOUNDATION OF SOLAR PV SUPPORTS IN ACCORDANCE WITH THE CONSTRUCTION DRAWINGS	**TASK NO.**	5031
PERFORMANCE CRITERIA	The person performing this task must be able to construct the foundation of solar PV supports in accordance with the construction requirements, construction schemes and standard solar PV installation technical requirements.		
RANGE STATEMENT	The task may be executed under the supervision of a Renewable Energy Engineering Technician (Solar) Senior Technician. The tools and equipment to be used include: 1. Electric welding machine; 2. Protractor; 3. Level ruler; 4. High pressure gloves; 5. Insulating shoes; 6. Safety helmet; 7. Crimpling plier; 8. Wire stripper; 9. Impact drill; 10. Multimeter; 11. Clamp ammeter; 12. Electrical insulation test meter; 13. Safety gear.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Interpret installation construction drawings of household grid-connection solar PV generation system; 2. Perform material accounting; 3. Conduct on-site investigation; 4. Use an impact drill to drill holes in the wall; 5. Use an electric drill to drill holes on the metal support.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Read installation construction drawings; 1.2 Perform material accounting; 1.3 Conduct on-site investigation; 1.4 Conduct solar PV support construction. **2.0 Principle** The person performing this task must be able to explain the following principles:

6. Use an angle grinder or a toothless saw to cut the metal support; 7. Perform rust removal of metal supports, painting, and installation of flat roof solar PV supports made of galvanized steel, stainless steel, aluminum alloy, and other materials. 8. Construct the foundation of solar PV support 9. Observe health, occupational and environmental safety rules and regulations.	2.1 Components of solar PV generation system; 2.2 Working principles of solar PV generation system. **3.0 Theories** The person performing this task must be able to explain: 3.1 Reading knowledge of installation construction drawings of power generation system; 3.2 Functions of each component and type selection knowledge. **4.0 Essential skills** 4.1 Learning skills; 4.2 Communication skills; 4.3 Teamwork skills; 4.4 Writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The foundations of solar PV Supports are constructed in accordance with the construction requirements, construction schemes and standard solar PV installation technical requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Underpinning knowledge of machinery; 2. Underpinning knowledge of construction; 3. Safety protection knowledge.

OCCUPATION	RENEWABLE ENERGY ENGINEERING TECHNICIAN (SOLAR)	**OCCUPATION CODE**	
DUTY TITLE	INSTALLATION OF THE SCHEME OF HOUSEHOLD SOLAR PV SYSTEM	**DUTY NO.**	503
TASK TITLE	INSTALL BATTERIES, ELECTRIC CABINETS AND ELECTRIC METERS	**TASK NO.**	5032
PERFORMANCE CRITERIA	The person performing this task must be able to install batteries, electrical cabinets and electric meters in accordance with theconstruction requirements, construction schemes and standard solar PV installation technical requirements		
RANGE STATEMENT	The task may be executed under the supervision of a Renewable Energy Engineering Technician (Solar) Senior Technician. The tools and equipment to be used include: 1. Electric welding machine; 2. Protractor; 3. Level ruler; 4. High pressure gloves; 5. Insulating shoes; 6. Safety helmet; 7. Crimpling plier; 8. Wire stripper; 9. Impact drill; 10. Multimeter; 11. Clamp ammeter; 12. Electrical insulation test meter; 13. Safety gear.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Interpret installation construction drawings of household grid-connection solar PV generation system; 2. Perform material accounting; 3. Conduct on-site investigation; 4. Install batteries, distribution cabinets, and grid-connection cabinets; 5. Install electric energy meters in accordance with the requirements of different grid-connection methods;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Install the battery of the off-grid solar PV generation system; 1.2 Install the solar PV generation system distribution cabinet; 1.3 Install the solar PV generation system grid-connection cabinet. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Components of solar PV generation system;

6. Observe health, occupational and environmental safety rules and regulations.	2.2 Working principles of solar PV generation system; 2.3 Wiring principles of batteries, cabinets, and electric meters. **3.0 Theories** The person performing this task must be able to explain: 3.1 Reading theory of installation construction drawings of power generation system. **4.0 Essential skills** 4.1 Learning skills; 4.2 Communication skills; 4.3 Teamwork skills; 4.4 Writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The batteries, electric cabinets, and electric meters are installed in accordance with the construction requirements, construction schemes and standard solar PV installation technical requirements
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Underpinning knowledge of machinery; 2. Underpinning knowledge of construction; 3. Safety protection knowledge.

OCCUPATION	RENEWABLE ENERGY ENGINEERING TECHNICIAN (SOLAR)	**OCCUPATION CODE**	
DUTY TITLE	INSTALLATION OF THE SCHEME OF HOUSEHOLD SOLAR PV SYSTEM	**DUTY NO.**	503
TASK TITLE	INSTALL THE SOLAR PV CONTROLLERS	**TASK NO.**	5033
PERFORMANCE CRITERIA	The person performing this task must be able to install solar PV contollers in accordance with theconstruction requirements, construction schemes and standard solar PV installation technical requirements		
RANGE STATEMENT	The task may be executed under the supervision of a Renewable Energy Engineering Technician (Solar) Senior Technician. The tools and equipment to be used include: 1. Electric welding machine; 2. Protractor; 3. Level ruler; 4. High pressure gloves; 5. Insulating shoes; 6. Safety helmet; 7. Crimpling plier; 8. Wire stripper; 9. Impact drill; 10. Multimeter; 11. Clamp ammeter; 12. Electrical insulation test meter; 13. Safety gear.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Interpret installation construction drawings of household grid-connection solar PV generation system; 2. Perform material accounting; 3. Conduct on-site investigation; 4. Prepare and select tools; 5. Use an impact drill to drill holes in the wall; 6. Use an electric drill to drill holes on the metal support; 7. Install the solar PV controller; 8. Install the wind-solar complementary controller;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Read installation construction drawings; 1.2 Perform material accounting; 1.3 Conduct on-site investigation; 1.4 Install the controller. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Components of solar PV generation system; 2.2 Working principles of solar PV controller.

9. Install the complementary commercial power street light controller; 10. Observe health, occupational and environmental safety rules and regulations.	**3.0 Theories** The person performing this task must be able to explain: 3.1 Reading theory of installation construction drawings of power generation system; 3.2 Application scope of installation tools. **4.0 Essential skills** 4.1 Learning skills; 4.2 Communication skills; 4.3 Teamwork skills; 4.4 Writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The solar PV controllers are installed in accordance with the construction requirements, construction schemes and standard solar PV installation technical requirements
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Underpinning knowledge of machinery; 2. Underpinning knowledge of construction; 3. Safety protection knowledge.

OCCUPATION	RENEWABLE ENERGY ENGINEERING TECHNICIAN (SOLAR)	**OCCUPATION CODE**	
DUTY TITLE	INSTALLATION OF THE SCHEME OF HOUSEHOLD SOLAR PV SYSTEM	**DUTY NO.**	503
TASK TITLE	COMPLETE THE INSTALLATION OF HOUSEHOLD SOLAR PV SYSTEM BY INSTALLING THE SOLAR PV INVERTERS AND DOING THE ELECTRICAL CONNECTIONS	**TASK NO.**	5034
PERFORMANCE CRITERIA	The person performing this task must be able to complete the installation of the household solar PV system by installing solar PV inverters and carrying out the electrical connections in accordance in accordance with theconstruction requirements, construction schemes and standard solar PV installation technical requirements.		
RANGE STATEMENT	The task may be executed under the supervision of a Renewable Energy Engineering Technician (Solar) Senior Technician. The tools and equipment to be used include: 1. Electric welding machine; 2. Protractor; 3. Level ruler; 4. High pressure gloves; 5. Insulating shoes; 6. Safety helmet; 7. Crimpling plier; 8. Wire stripper; 9. Impact drill; 10. Multimeter; 11. Clamp ammeter; 12. Electrical insulation test meter; 13. Safety gear.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Interpret installation construction drawings of household grid-connection solar PV generation system; 2. Interpret installation construction drawings of complementary solar PV street lights; 3. Perform material accounting; 4. Conduct on-site investigation; 5. Prepare and select tools;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Read installation construction drawings; 1.2 Perform material accounting; 1.3 Conduct on-site investigation; 1.4 Install solar PV inverters 1.5 Carry out the electrical connections. **2.0 Principle**

6. Use an impact drill to drill holes in the wall. 7. Use an electric drill to drill holes on the metal support; 8. Install solar PV inverters. 9. Complete the installation by carrying out the electrical connections; 10. Observe health, occupational and environmental safety rules and regulations.	The person performing this task must be able to explain the following principles: 2.1 Components of solar PV generation system; 2.2 Working principles of solar PV generation system. **3.0 Theories** The person performing this task must be able to explain: 3.1 Reading theory of installation construction drawings of power generation system; 3.2 Model and application scope of installation tools; 3.3 Functions and type selection knowledge of each solar PV inverter. **4.0 Essential skills** 4.1 Learning skills; 4.2 Communication skills; 4.3 Teamwork skills; 4.4 Writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The installation of household solar PV system is completed by installing the inverter in accordance with the construction requirements, construction schemes and standard solar PV installation technical requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Underpinning knowledge of machinery; 2. Underpinning knowledge of construction; 3. Safety protection knowledge.

OCCUPATION	RENEWABLE ENERGY ENGINEERING TECHNICIAN (SOLAR)	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT HOUSEHOLD INSPECTION AND HANDOVER OF SOLAR PV SYSTEM	**DUTY NO.**	504
TASK TITLE	CHECK THE STABILITY OF THE FOUNDATION AND SUPPORT OF THE SOLAR PV GENERATION SYSTEM	**TASK NO.**	5041
PERFORMANCE CRITERIA	The person performing this task must be able to check the stability of the foundation and support of the solar PV generation system in accordance with the construction requirements, construction schemes, standard solar PV installation technical requirements and test specifications.		
RANGE STATEMENT	The task may be executed on the household solar PV engineering site under the supervision of a Renewable Energy Engineering Technician (Solar) Senior Technician or a Renewable Energy Engineering Engineer (Solar). The tools and equipment to be used include: 1. Checklist information; 2. Wrench and other support installation tools; 3. Level ruler and plummet; 4. Tape; 5. Flashlight; 6. Personal protective equipment, such as safety helmet, insulating shoes, gloves.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Select the required tools and equipment such as wrenches, level rulers, plummets; 2. Check and determine whether the appearance of concrete foundations, supports, bolts, etc. is in order; 3. Check and determine whether the installation dimensions, levelness, verticality, etc. of the foundation and support comply with technical requirements; 4. Check and determine whether the bolts are tightened; 5. Check and determine whether the foundation and support are stable as a whole;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Prevent electric shock; 1.2 Check the tightness of bolts; 1.3 Judge the stability of the foundation and support. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Foundation of solar PV generation system; 2.2 Technical requirements for stability determination of supports. **3.0 Theories** The person performing this task must be able to explain:

6. Observe health, occupational and environmental safety rules and regulations.	3.1 Appearance inspection theory for concrete foundations, supports, bolts, etc.; 3.2 Theory for judging the tightening degree of bolts. **4.0 Essential skills** 4.1 Communication skills; 4.2 Checklist filling skills; 4.3 Teamwork skills. **5.0 Mathematical skills** 5.1 Calculation of size addition and subtraction; 5.2 Unit conversion of dimensions.
DESCRIPTION OF THE END PRODUCT / SERVICE	The stability of the foundation and support of the solar PV generation system are checked in accordance with the construction requirements, construction schemes, standard solar PV installation technical requirements and test specifications.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Underpinning knowledge of machinery; 2. Underpinning knowledge of construction; 3. Safety protection knowledge.

OCCUPATION	RENEWABLE ENERGY ENGINEERING TECHNICIAN (SOLAR)	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT HOUSEHOLD INSPECTION AND HANDOVER OF SOLAR PV SYSTEM	**DUTY NO.**	504
TASK TITLE	CHECK THE ACCURACY AND SAFETY OF THE ELECTRICAL CONNECTION OF SOLAR PV GENERATION SYSTEM	**TASK NO.**	5042
PERFORMANCE CRITERIA	The person performing this task must be able to check the accurancy and safety of electrical connections of the solar PV generation system in accordance with the construction requirements, construction schemes, standard solar PV installation technical requirements and test specifications.		
RANGE STATEMENT	The task may be executed on the household solar PV engineering site under the supervision of a Senior Technician or a Renewable Energy Engineering Engineer (Solar). The tools and equipment to be used include: 1. Handover list information; 2. Tools such as multimeter; 3. Flashlight; 4. Personal protective equipment, such as safety helmet, insulating shoes, gloves.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Correctly use a multimeter to detect voltage, current, circuit continuity, etc.; 2. Read electrical wiring diagrams; 3. Check and determine whether the electrical wiring is secure and safe; 4. Check and determine whether the electrical wiring is accurate and correct. 5. Check whether the electrical parameters are compying with the product specifications; 6. Observe health, occupational and environmental safety rules and regulations.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Prevent electric shock; 1.2 Use tools such as wrenches to determine whether the electrical wiring is secure and safe; 1.3 Use a multimeter to determine whether the electrical wiring is accurate and correct. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Electrical wiring principles solar PV generation system; 2.2 Electrical wiring specifications. **3.0 Theories** The person performing this task must be able to explain:

	3.1 Basic principles of electrician internal wire installation; 3.2 Criteria for determining the accuracy and safety of electrical connections of the solar PV generation system. **4.0 Essential skills** 4.1 Communication skills; 4.2 Checklist filling skills; 4.3 Teamwork skills. **5.0 Mathematical skills** 5.1 Unit conversion; 5.2 Rate multiplication.
DESCRIPTION OF THE END PRODUCT / SERVICE	The accuracy and safety of electrical connections of the solar PV generation system are checked in accordance with the construction requirements, construction schemes, standard solar PV installation technical requirements and test specifications.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Underpinning knowledge of machinery; 2. Underpinning knowledge of construction; 3. Safety protection knowledge.

OCCUPATION	RENEWABLE ENERGY ENGINEERING TECHNICIAN (SOLAR)	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT HOUSEHOLD INSPECTION AND HANDOVER OF SOLAR PV SYSTEM	**DUTY NO.**	504
TASK TITLE	COMPLETE THE TIME, COMMUNICATION AND SWITCH STATUS SETTINGS OF SOLAR PV GENERATION GRID-CONNECTION INVERTERS	**TASK NO.**	5043
PERFORMANCE CRITERIA	The person performing this task must be able to complete the time, communication and switch status settings of solar PV generation grid-connection inverters in accordance with the construction requirements, construction schemes, standard solar PV installation technical requirements and test specifications.		
RANGE STATEMENT	The task may be executed on the household solar PV engineering site under the supervision of a Senior Technician or a Renewable Energy Engineering Engineer (Solar). The tools and equipment to be used include: 1. Inverter manual data; 2. Personal protective equipment, such as safety helmet, insulating shoes, gloves.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Read the inverter manual; 2. Check the inverter parameters; 3. Set the inverter parameters; 4. Observe health, occupational and environmental safety rules and regulations.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Prevent electric shock; 1.2 Install and connect the inverter, check whether the circuit meets the requirements, whether the components are loose, whether the insulation is in good condition, and whether the input voltage is normal. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Technical requirements for setting time, communication and switch status of grid-connection inverters. **3.0 Theories** The person performing this task must be able to explain: 3.1 Key functions of grid-connection inverters;

	3.2 Technical standards for communication setting of grid-connection inverters. **4.0 Essential skills** 4.1 Communication skills; 4.2 Teamwork skills. **5.0 Mathematical skills** 5.1 Unit conversion.
DESCRIPTION OF THE END PRODUCT / SERVICE	The setting of time, communication and switch status of solar PV generation grid-connection inverters are completed in accordance with the construction requirements, construction schemes, standard solar PV installation technical requirements and test specifications.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safety measures to prevent electric shock; 2. Underpinning knowledge of electricians; 3. Manufacturer user manual.

OCCUPATION	RENEWABLE ENERGY ENGINEERING TECHNICIAN (SOLAR)	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT HOUSEHOLD INSPECTION AND HANDOVER OF SOLAR PV SYSTEM	**DUTY NO.**	504
TASK TITLE	SET THE CHARGING AND DISCHARGING PARAMETERS OF THE SOLAR PV GENERATION CONTROLLER	**TASK NO.**	5044
PERFORMANCE CRITERIA	The person performing this task must be able to set the charging and discharging parameters of the solar PV generation controller in accordance with the solar PV technical requirements and manufacturer specifications.		
RANGE STATEMENT	The task may be executed on the household solar PV engineering site under the supervision of a Senior Technician or a Renewable Energy Engineering Engineer (Solar). The tools and equipment to be used include: 1. Controller manual; 2. Personal protective equipment, such as safety helmet, insulating shoes, gloves.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Observe safety requirements during the setting process to avoid electric shock; 2. Read the controller manual; 3. Check the charging and discharging parameters of the controller; 4. Set the charging and discharging parameters of the controller; 5. Observe health, occupational and environmental safety rules and regulations.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Prevent electric shock; 1.2 Operate the controller, check whether the circuit meets the requirements, whether the components are loose, whether the insulation is in good condition. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Technical standards for setting charging and discharging parameters of solar PV power generation controllers. **3.0 Theories** The person performing this task must be able to explain: 3.1 Key functions of the controller; 3.2 Technical standards for setting charging and discharging parameters.

	4.0 Essential skills 4.1 Communication skills; 4.2 Teamwork skills. **5.0 Mathematical skills** 5.1 Unit conversion.
DESCRIPTION OF THE END PRODUCT / SERVICE	The charging and discharging parameters of the solar PV generation controller are set in accordance with the solar PV technical requirements and manufacturer specifications.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safety measures to prevent electric shock; 2. Underpinning knowledge of electricians; 3. Manufacturer user manual.

OCCUPATION	RENEWABLE ENERGY ENGINEERING TECHNICIAN (SOLAR)	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT HOUSEHOLD INSPECTION AND HANDOVER OF SOLAR PV SYSTEM	**DUTY NO.**	504
TASK TITLE	DEMONSTRATE TO USERS OPERATION AND MAINTENANCE PRACTICES OF HOUSEHOLD GRID-CONNECTION SOLAR PV GENERATION SYSTEMS	**TASK NO.**	5045
PERFORMANCE CRITERIA	The person performing this task must be able to demonstrate to users the operation and maintenance practices of household grid-connection solar PV generation systems in accordance with the construction requirements, construction schemes, standard solar PV installation technical requirements. and actual on-site engineering.		
RANGE STATEMENT	The tools and equipment to be used include: 1. Operation and Maintenance Instructions; 2. Safety gear.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Explain to users the daily use and maintenance methods of household grid-connection solar PV generation systems; 2. Explain to users the daily use and precautions of household grid-connection solar PV generation systems; 3. Observe health, occupational and environmental safety rules and regulations.	**Detailed knowledge about:** **2.0 Methods** The person performing this task must be able to explain how to: 2.1 Operate the grid-connection solar PV generation system; 2.2 Maintain the grid-connection solar PV generation system; 2.3 Explain to users the use and maintenance methods and precautions of solar PV generation systems. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Power generation and grid-connection principles of grid-connection solar PV generation systems. **3.0 Theories** The person performing this task must be able to explain: 3.1 Composition of grid-connection solar PV generation systems; 3.2 Operation of grid-connection solar PV generation systems;

	3.3 Common faults in grid-connection solar PV generation systems. **5.0. Essential skills** 6.1 Correct and fluent interpretation; 6.2 Patient and meticulous attitude; 6.3 Teamwork skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The operation and maintenance practices of household grid-connection solar PV generation systems are demonstrated to users in accordance with the construction requirements, construction schemes, standard solar PV installation technical requirements. and actual on-site engineering.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safety measures to prevent electric shock; 2. Underpinning knowledge of electricians; 3. Use and maintenance instructions for relevant manufacturers.

OCCUPATION	RENEWABLE ENERGY ENGINEERING TECHNICIAN (SOLAR)	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT HOUSEHOLD INSPECTION AND HANDOVER OF SOLAR PV SYSTEM	**DUTY NO.**	504
TASK TITLE	DEMONSTRATE TO USERS OPERATION AND MAINTENANCE PRACTICES OF HOUSEHOLD OFF-GRID SOLAR PV GENERATION OFF-SYSTEMS	**TASK NO.**	5046
PERFORMANCE CRITERIA	The person performing this task must be able to demonstrate to users the operation and maintenance practices of household off-grid solar PV generation systems in accordance with the construction requirements, construction schemes, standard solar PV installation technical requirements and actual on-site engineering.		
RANGE STATEMENT	The tools and equipment to be used include: 1. Operation and Maintenance Instructions; 2. Safety gear.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Clean the solar panel, test the photoelectric conversion efficiency and maintain it; 2. Maintain steel supports; 3. Maintain the solar inverter; 4. Check the equipment wiring and grounding; 5. Conduct solar panel cleaning and maintenance procedures; 6. Check the color of the solar cell of the solar PV panel, the connection of the circuit, template, molded glass, and frame looseness and damage, clean them regularly for half a month, and record the relevant information in the maintenance/repair log; 7. Clean the surface of the solar PV panel and increase the cleaning frequency appropriately based on the actual situation on site; 8. Observe health, occupational and environmental safety rules and regulations.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Operate the off-grid solar PV generation system; 1.2 Maintain the off-grid solar PV generation system. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Power generation and grid-connection principles of off-grid solar PV generation systems. **3.0 Theories** The person performing this task must be able to explain: 3.1. Composition of off-grid solar PV generation systems. 3.2. Operation of off-grid solar PV generation systems; 3.3. Faults of off-grid solar PV generation systems; 3.4. Maintenance technology for off-grid solar PV generation systems. **4.0 Essential skills** 5.1. Correct and fluent interpretation;

	5.2. Patient and meticulous attitude; 5.3. Teamwork skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The operation and maintenance practices of household off-grid solar PV generation systems are demonstrated to users in accordance with the construction requirements, construction schemes, standard solar PV installation technical requirements and actual on-site engineering..
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safety measures to prevent electric shock; 2. Underpinning knowledge of electricians; 3. Use and maintenance instructions for relevant manufacturers.

OCCUPATION	RENEWABLE ENERGY ENGINEERING TECHNICIAN (SOLAR)	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT OPERATION AND MAINTENANCE OF HOUSEHOLD SOLAR PV SYSTEMS	**DUTY NO.**	505
TASK TITLE	CONDUCT TROUBLESHOOTING AND MAINTENANCE OF SOLAR STREET LIGHTS	**TASK NO.**	5051
PERFORMANCE CRITERIA	The person performing this task must be able to conduct troubleshooting and maintencance on independent solar street lights in accordance with the standard solar troubleshooting guidelines.		
RANGE STATEMENT	The task may be executed on the household solar PV engineering site under the supervision of a Senior Technician or a Renewable Energy Engineering Engineer (Solar). The tools and equipment to be used include: 1. Equipment list; 2. Tools such as multimeter; 3. Flashlight; 4. Personal protective equipment, such as safety helmet, insulating shoes, gloves.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Select tools and equipment such as multimeter; 2. Check the appearance for damage; 3. Check if the battery has run out of charge; 4. Check whether the controller has broken wires or short circuits; 5. Check whether the inverter has a fault 6. Find the cause of the fault and repair it; 7. Clean the tools, equipment and workplace; 8. Store tools and equipment; 9. Observe health, occupational and environmental safety rules and regulations.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1. Check the battery; 1.2. Check the controller; 1.3. Find the cause of the fault and repair it. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Electrical schematic diagrams of solar street lights; 2.2 Protection design principles of the solar street light. **3.0 Theories** The person performing this task must be able to explain: 3.1 Common fault detection and diagnosis techniques for batteries and controllers. **4.0 Essential skills** 4.1 Communication skills; 4.2 Customer service skills;

	4.3 Teamwork skills; 4.4 Report writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The troubleshooting and maintenance of solar street lights are conducted in accordance with the standard solar PV fault detection, diagnosis, and repair.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safety measures to prevent electric shock; 2. Underpinning knowledge of electricians; 3. Use and maintenance instructions for relevant manufacturers.

OCCUPATION	RENEWABLE ENERGY ENGINEERING TECHNICIAN (SOLAR)	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT OPERATION AND MAINTENANCE OF HOUSEHOLD SOLAR PV SYSTEMS	**DUTY NO.**	505
TASK TITLE	CONDUCT TROUBLESHOOTING AND MAINTENANCE OF LOW-POWER SOLAR PV PUMP	**TASK NO.**	5052
PERFORMANCE CRITERIA	The person performing this task may be able to conduct troubleshooting and maintenance of low-power solar PV pumps in accordance with the standard solar troubleshooting guidelines.		
RANGE STATEMENT	The task may be executed on the household solar PV engineering site under the supervision of a Senior Technician or a Renewable Energy Engineering Engineer (Solar). The tools and equipment to be used include: 1. Equipment list; 2. Tools such as multimeter; 3. Flashlight; 4. Personal protective equipment, such as safety helmet, insulating shoes, gloves.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Choose suitable tools and equipment for the task; 2. Check the appearance for damage; 3. Check if the battery has run out of charge; 4. Check whether the controller has broken wires or short circuits; 5. Check whether the pump motor has broken wires or short circuited; 6. Find the cause of the fault and repair the appearance inspection; 7. Clean the tools, equipment and workplace; 8. Store tools and equipment; 9. Observe health, occupational and environmental safety rules and regulations.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Check the appearance; 1.2 Check the battery; 1.3 Check the controller; 1.4 Check the motor; 1.5 Find the cause of the fault and repair it. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Technical requirements for motor structure and wiring; 2.2 Technical requirements for batteries and controllers. **3.0 Theories** The person performing this task must be able to explain: 3.1 Working principle of motor;

	3.2 Common fault detection and diagnosis techniques for batteries and controllers. **4.0. Essential skills** 4.1 Communication skills; 4.2 Customer service skills; 4.3 Teamwork skills; 4.4 Report writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The troubleshooting and maintenance of low power solar PV pump are conducted in accordance with the standard solar troubleshooting specifications
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safety measures to prevent electric shock; 2. Underpinning knowledge of electricians; 3. Use and maintenance instructions for relevant manufacturers.

OCCUPATION	RENEWABLE ENERGY ENGINEERING TECHNICIAN (SOLAR)	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT OPERATION AND MAINTENANCE OF HOUSEHOLD SOLAR PV SYSTEMS	**DUTY NO.**	505
TASK TITLE	CONDUCT TROUBLESHOOTING AND MAINTENANCE OF SOLAR LIGHTING DEVICE	**TASK NO.**	5053
PERFORMANCE CRITERIA	The person performing this task may be able to conduct troubleshooting and maintenance of solar lighting devices in accordance with the standard solar troubleshooting guidelines.		
RANGE STATEMENT	The task may be executed on the household solar PV engineering site under the supervision of a Senior Technician or a Renewable Energy Engineering Engineer (Solar). The tools and equipment to be used include: 1. Equipment list; 2. Tools such as multimeter; 3. Flashlight; 4. Personal protective equipment, such as safety helmet, insulating shoes, gloves.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Select tools and equipment such as multimeter for the task; 2. Check the appearance of the solar panel for damage; 3. Check if the battery has run out of charge; 4. Check whether the controller has broken wires or short circuited; 5. Find the cause of the fault and repair solar lighting device; 6. Clean the tools, equipment and workplace; 7. Store tools and equipment; 8. Observe health, occupational and environmental safety rules and regulations.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Check the appearance of the battery panel; 1.2 Check the battery; 1.3 Check the controller; 1.4 Check the wiring of the lighting device; 1.5 Find the cause of the fault and repair it. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Solar power principle; 2.2 Technical requirements for batteries and controllers. **3.0 Theories** The person performing this task must be able to explain: 3.1 Structure and technical requirements of solar panels;

	3.2 Common fault detection and diagnosis techniques for batteries and controllers. **4.0 Essential skills** 4.1 Communication skills; 4.2 Customer service skills; 4.3 Teamwork skills; 4.4 Report writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The troubleshooting and maintenance of solar lighting devices are conducted according to the standard solar troubleshooting specifications .
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safety measures to prevent electric shock; 2. Underpinning knowledge of electricians; 3. Use and maintenance instructions for relevant manufacturers.

OCCUPATION	RENEWABLE ENERGY ENGINEERING TECHNICIAN (SOLAR)	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT OPERATION AND MAINTENANCE OF HOUSEHOLD SOLAR PV SYSTEMS	**DUTY NO.**	505
TASK TITLE	CONDUCT TROUBLESHOOTING AND MAINTENANCE OF THE DC SOLAR PV POWER SUPPLY BY A BATTERY	**TASK NO.**	5054
PERFORMANCE CRITERIA	The person performing this task must be able conduct troubleshooting and maintenance of DC solar PV power supply by a battery, in accordance with the standard solar troubleshooting guidelines		
RANGE STATEMENT	The task may be executed on the household solar PV engineering site under the supervision of a Senior Technician or a Renewable Energy Engineering Engineer (Solar). The tools and equipment to be used include: 1. Equipment list; 2. Tools such as multimeter; 3. Flashlight; 4. Personal protective equipment, such as safety helmet, insulating shoes, gloves.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Select tools and equipment such as multimeterfor the task; 2. Check the appearance of the battery; 3. Check the battery circuit; 4. Check the battery capacity; 5. Check whether there is a short circuit in the battery; 6. Find the cause of the fault and repair it; 7. Clean the tools, equipment and workplace; 8. Store tools and equipment; 9. Observe health, occupational and environmental safety rules and regulations.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Check whether the appearance of the battery is damaged; 1.2 Check whether the battery circuit is disconnected; 1.3 Check whether the battery capacity is insufficient; 1.4 Check whether there is a short circuit in the battery; 1.5 Find the cause of the fault and repair it. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Technical requirements for wiring of DC solar PV power supply. **3.0 Theories** The person performing this task must be able to explain: 3.1 Functions of batteries; 3.2 Common fault detection and diagnosis techniques for batteries.

	4.0 Essential skills 4.1 Communication skills; 4.2 Customer service skills; 4.3 Teamwork skills; 4.4 Report writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The troubleshooting and maintenance of DC power supply by a battery are conducted according to the standard solar troubleshooting specifications.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safety measures to prevent electric shock; 2. Underpinning knowledge of electricians; 3. Use and maintenance instructions for relevant manufacturers.

APPENDIX: DACUM CHARTS FOR RENEWABLE ENERGY ENGINEERING TECHNICIAN (SOLAR) - NTA LEVEL 5

DUTIES	TASKS	ENABLERS
1.0 Interpret household solar PV construction drawings	1.1 Interpret the construction drawings of the photovoltaic electronic system. 1.2 Interpret the construction drawings of the photovoltaic power generation subsystem.	**Generic skills and knowledge** · Principles of household grid-connection solar PV generation system · Principles of AC/DC hybrid off-grid solar PV generation system · Principles of independent wind-solar street lights, complementary commercial power street lights and off-grid wind-solar power generation system · Principles of energy storage subsystem · Construction methods for installing the energy storage subsystem **Tools and equipment** · Principle wiring drawings **Materials** · Drawings **Worker behaviors** · Teamwork, integrity, time management and commitment
2.0 Design the household solar PV construction scheme	2.1 Design the household solar PV construction scheme	**Generic skills and knowledge** · Principles of installation angle of solar PV supports · Principles of controllers and inverters **Tools and equipment** · PV support · PV module · PV controller · Inverter · Battery · Electric cabinet, electric meter, communication line, cable, etc. **Materials** · Wire and cable **Worker behaviors** · Teamwork, integrity, time management and commitment
3.0 Install the scheme of household solar PV system	3.1 Construct the foundation of solar PV supports in accordance with the	**Generic skills and knowledge** · Knowledge of reading of installation and construction drawings, system composition, working principles, functions and selection of various components of power generation systems

DUTIES	TASKS	ENABLERS
	construction drawings. 3.2 Install double-sided solar PV modules. 3.3 Install batteries, electric cabinets, electric meters, etc 3.4 Install solar PV controllers. 3.5 Complete the installation of household solar PV system by installing the Install solar PV inverters and doing the electrical connections.	· Knowledge of reading of installation and construction drawings, system composition, working principles, functions and selection of batteries, electrical cabinets and electric meters · Knowledge of reading of installation and construction drawings, system composition, working principles, functions and selection of solar PV controllers **Tools and equipment** · Electric welding machine · Protractor · Level ruler · High pressure gloves · Insulating shoes · Safety helmet · Crimpling plier · Wire stripper · Impact drill · Multimeter · Clamp ammeter · Electrical insulation test meter **Materials** · Construction materials and wires that comply with the requirements **Worker behaviors** · Teamwork, integrity, time management and commitment
4.0 Conduct household inspection and hand over household solar PV system	4.1 Check the stability of the foundation and support of the solar PV generation system. 4.2 Check the accuracy and safety of electrical connection of the solar PV generation system. 4.3 Complete the time, communicatio n and switch	**Generic skills and knowledge** · Criteria for determining the stability of the foundation and support of solar PV generation systems · Criteria for determining the accuracy and safety of electrical connections of the solar PV generation system · Criteria for setting time, communication and switch status of grid-connection inverters · Criteria for setting the charging and discharging parameters of solar PV generation controllers · Power generation and grid-connection principles of grid-connection solar PV generation systems **Tools and equipment** · Multimeter, safety helmet, insulating shoes, gloves, etc. **Materials**

DUTIES	TASKS	ENABLERS
	status settings of solar PV generation grid-connection inverters. 4.4 Set the charging and discharging parameters of the solar PV generation controller. 4.5 Demonstrate to users the operation and maintenance practices of household grid-connection solar PV generation systems. 4.6 Demonstrate to users the operation and maintenance practices of household of off-grid solar PV generation systems.	· Wire and cable **Worker behaviors** · Teamwork, integrity, time management and commitment
5.0 Conduct Operation and maintenance of household solar PV system	5.1 Conduct troubleshooting and maintenance of solar street lights. 5.2 Conduct troubleshooting and maintenance of solar street lights of the low-power solar PV pump.	**Generic skills and knowledge** · Power generation principles of solar street lights · Common faults of batteries and controllers · Working principles of motors **Tools and equipment** · Multimeter, safety helmet, insulating shoes, gloves, etc. **Materials** · Wire and cable **Worker behaviors** · Teamwork, integrity, time management and commitment

DUTIES	TASKS	ENABLERS
	5.3 Conduct troubleshooting and maintenance of solar street lights of the solar solar PV lighting device. 5.4 Conduct troubleshooting and maintenance of solar street lights of the DC solar PV power supply with a battery.	