



ESWATINI VOCATIONAL QUALIFICATIONS PACKAGE
FOR

SOLAR PV INSTALLATION AND MAINTENANCE

LEVEL 4



Prepared by the Directorate of Industrial and Vocational Training (DIVT)

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Registration documents can be downloaded at the link:

<https://www.divt.org.sz/qualifications>

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The following individuals together with their organizations are acknowledged for their special inputs

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Nathie	Tfwala	TRRC
Malangeni	Dlamini	Tambankulu Estate
Nikitha	Hlophe	ESWASWA
Edgar	Dlamini	REASWA
Nosipho	Simelane	EEC
Hlob'sile	Hlophe	EEC
Jabulani	Shongwe	Gwamile VOCTIM
Marius	Uys	Simply Swazi
Ncamiso	Nkambule	ESERA
Mazambane	Dlamini	Taiwan Technical Mission
Mandla	Vilakati	MNRE
Gcina	Singwane	DIVT
Lucky	Phakathi	DIVT

THE QUALIFICATION

**NATIONAL VOCATIONAL CERTIFICATE SOLAR PHOTO-VOLTAIC (PV)
INSTALLATION AND MAINTENANCE LEVEL 4**

Originator Qualification Developer	DIVT		
Qualification Type:	Certificate	Descriptor:	Solar Photovoltaic Installation and Maintenance
Specialisation (if relevant):			
Level:	4	Minimum Credits:	120
Actual Credits	126		
Sub-Framework (Sub- Sector)	TVET		
Field name	Engineering, Manufacturing and Construction	Field no:	07
Sub-field no:	Mechanics and metal trades	Sub-field no:	0715

Rationale

Describe the context of ETSDS The Technical and Vocational System in Eswatini lacks occupational standards and harmonised curricula for training which has the input for the industry players. There is general dissatisfaction with competences produced by the system in terms of relevance with the labour market. There is currently no correlation between the required industry skills and the qualification the system produces.
Describe how will the qualification impact positively within the sketched context: The qualification will provide the much-needed correlation between the required industry skills and the competences produced by the system. The qualification will also harmonise curricula for training with input of industry players.
Why do you need the qualification? This qualification will enhance the status and productivity of the learner as well as contribute to improved quality, production rate and growth within the engineering sector. The range of typical learners at this level could include individuals preparing to qualify as a Solar Photovoltaic

Installation and Maintenance technician. Qualifying learners will obtain a National Vocational Certificate in Solar Photovoltaic Installation and Maintenance which places the learner in a position to investigate requirements for advancement to qualified artisan status or progress to a National Certificate or Diploma at NQF Level 5.

Purpose

The purpose of the qualification is to develop learners who have the competencies required for performing Solar Photovoltaic Installation and Maintenance tasks. It is awarded to people who have demonstrated the skills and knowledge to design a three-phase photovoltaic power system, troubleshoot and repair PV systems, commission a PV system, integrate standby generator and/ or PV generator in a grid-tied system and select a back-up generator for a stand-alone renewable energy system.

Learners attracted to this qualification include those who are training in institutions to be Solar Photovoltaic Installation and Maintenance technician at an Artisan level 4, learners who are in the apprenticeship training system and those who are in the non-formal sector who will acquire through trade testing.

Graduates will be able to ...

The qualification is developed to produce a Solar Photovoltaic Installation and Maintenance technician who can design a three-phase photovoltaic power system, troubleshoot and repair PV systems, commission a PV system, integrate standby generator and/ or PV generator in a grid-tied system and select a back-up generator for a stand-alone renewable energy system. They will also be able to maintain and support the various policies and procedures related to the safety, health, environment and quality systems that govern their workplace.

Entry Requirements

Minimum requirements for entry:

Solar Photovoltaic Installation and Maintenance Level 3 and/ or RPL

Associated Level Descriptors

Knowledge	• To demonstrate advanced knowledge in specialized and emerging situations to make informed judgments. • To understand key concepts, terms, rules and established principles and theories in one or more fields or disciplines.
Skills	• To apply strategic approaches to tasks that arise in work and using expert sources of information. • To use technology to solve existing and emerging situations.
Personal Attributes	• To demonstrate accountability and responsibility in work/ learning situations.

- To show proactivity and reliability in performance of tasks.

Learning Outcomes Statements and Associated Assessment Criteria

This qualification will enable the learner to find employment as a skilled worker to perform Artisan duties in Solar Photovoltaic Installation and Maintenance field.

The learner after when competent should be able to:

- Design a three-phase photovoltaic power system.
- Troubleshoot and repair PV systems.
- Integrate standby generator and/ or PV generator in a grid-tied system.
- Select a back-up generator for a stand-alone renewable energy system.
- Commission a PV system.

Assessment criteria identify the specific skills, knowledge, and behaviours necessary to achieve the learning outcomes. It makes it clear to learners what they are expected to do. It demonstrates to learners how to achieve the learning outcomes. It also contains range statements.

- Own work is planned and scheduled in terms of productivity, safety, health and the environment.
- A variety of common problems, both familiar and unfamiliar are solved by applying knowledge of advanced Solar Photovoltaic Installation and Maintenance theory and practice.
- Responsibility for own actions is demonstrated within sphere of operation.
- Effective interaction and communication is conducted with clients, colleagues and management.
- Knowledge of and application of statutory requirements is demonstrated as they relate to integrated systems.

Components of Qualifications

The components of the qualification which, in their combination, make up the complete qualification.

ID	Unit Standard	Level	Credit
EE415	Interpret basic financial statements	4	6
EE416	Manage work time efficiently	4	4
EE413	Produce business plans for a new venture	4	6
EE414	Tender to secure a new venture	4	6
RE412	Resolve client request and queries	4	5
RE418	Write a technical report	4	8
PVI400	Design a three-phase photovoltaic power system	4	10

PVI401	Troubleshoot and repair PV systems	4	15
PVI402	Select a back-up generator for a stand-alone renewable energy system	4	5
PVI403	Apply and demonstrate understanding of national grid codes, international technical standards and regulatory frameworks	4	10
PVI404	Commission a PV system	4	15
PVI405	Demonstrate an understanding and implement environmental initiatives on a construction project	4	6
PVI406	Demonstrate and apply knowledge of stand-alone renewable energy system components and operation	4	15
PVI407	Integrate standby generator and/ or PV generator in a grid-tied system	4	15
Total Number of Credits			126

Rules of Combination

Specific rules? The learner should be competent in all units in this qualification
Compulsory modules, units learning? All units are compulsory in this qualifications
Any subminimum credits to be achieved? The learner should acquire all 126 credits in this qualifications

Integrated Assessment

How will assessment be done? This qualification will have compulsory theory and practice
How often will the assessment be done? • Trade testing • Institutional theory exams and practice • Formative assessment for apprenticeship training through log books and institutional evidence of theory training
Who will be responsible for assessment? • DIVT • Vocational training institutions • There will be collective awarding of certificates for institutional learners

International Comparability

SADC	This qualification aligns with the level descriptors in the SADC Qualifications Framework
African Continent	N/A
Globally, including TQF	N/A

Articulation Possibilities/Learning Pathways

A provision to learners, on successful completion of accredited prerequisites, to move between components of the delivery system.

Vertical	Solar PV Installation and Maintenance Level 5
Horizontal	No match
Diagonal	No match

Notes

Could be used by the office to let the public know the status of various issues. Here are 3 possibilities.

Programmes recorded against this registered qualification
N/A
Accredited Providers
N/A
Registered, re-registered, de-registered?
N/A

Name of Registered Provider

Information on all providers accredited to offer this qualification must be indicated here. In the final database this information must be updatable.

Name:	DIVT
Address:	P. O. Box 1218 Mbabane

UNIT STANDARDS

EE413: Produce business plans for a new venture

Title		Produce business plans for a new venture			
Domain		Physical Planning and Construction			
Subfield		Electrical Engineering Elective			
SZNQF Level	4	Unit ID	EE413	Credits	6

Purpose

This unit standard specifies the competencies required to produce business plans for a new venture. It includes identifying, gathering and analysing the relevant information needed to compile a business plan; formulating an ethical framework for the operational plans of a new venture; establishing and prioritising business, financial and/or operational goals and objectives for a new venture and; designing and presenting the business financial and/or marketing plans. This unit standard is for Electrician 4.

Special Notes

1. Entry Requirement/Pre-requisites

None
2. This unit standard is to be delivered and assessed in the context of the Electrical Utilisation and should be assessed in conjunction with other relevant technical unit standards selected from this domain.
3. Assessment may be conducted at a real workplace or simulated workplace, or an appropriately realistic environment in which electrical utilisation is carried out.
4. Legal registrations include PAYE, VAT, etc.
5. Legislation applicable to the sector in which the new venture is situated.
6. Non-statutory regulations include but not limited to applicable codes of ethics and conduct, values, cultural dimension to the business type and sector.
7. Regulations and legislation relevant to this unit standard may include but not limited to the following:
 - Occupational Health and Safety Act 2001
 - Worker's Compensation Act No.7 of 1983
 - SZNS SANS 10142-1
 - SZNS-SANS 10142-2and all subsequent amendments

Quality Assurance Requirements

This unit standard and others within this subfield may be awarded by institutions which comply with the accreditation, national assessment and moderation requirements set by Eswatini Higher Education Council.

Elements and Performance Criteria

Element 1: Identify, gather and analyse the relevant information needed to compile a plan for a new business venture

Performance Criteria

- 1.1 The purpose and importance of a business plan is discussed in terms of its contribution to a successful business.
- 1.2 The different elements of a successful business plan are listed and described with examples.
- 1.3 Information on the resources needed and procedures to be followed to achieve the plan is compiled.
- 1.4 The industry specific and legal requirements for own venture are identified and explained in terms of how they will affect the venture.

Element 2: Formulate an ethical framework for the operational plans of a venture

Performance Criteria

- 2.1 Legislation and relevant regulations relating to the type of venture are identified for use in drawing up a code of ethics for the business.
- 2.2 Non-statutory regulations applicable to the sector are identified and used for use in drawing up a code of ethics for the business
- 2.3 Codes of conduct that are used by similar organizations in the sector are evaluated and elements identified for inclusion in an ethical framework for the business.
- 2.4 Social and ethnic considerations are identified for inclusion in the ethical framework of a new venture.
- 2.5 Personal values are identified for modifying an ethical framework for a new venture.
- 2.6 An ethical framework and codes of ethics and conduct are drawn up for the new venture.

Element 3: Establish and prioritise business, financial and/or operations goals and objectives for a new venture

Performance Criteria

- 3.1 Personal objectives are clearly articulated and aligned to the plans of own venture.

- 3.2 Business objectives are analysed and specific goals formulated to achieve objectives set for own business.
- 3.3 A vision statement of a new venture is compiled to represent goals and objectives set out for own venture.
- 3.4 Specific short- and long-term goals are formulated allowing flexibility for possible changing circumstances.
- 3.5 Possible contribution to community and regional growth objectives are identified and considered.
- 3.6 Cultural values and beliefs of prospective employees and expected consumers are incorporated into the plans of own venture.

Element 4: Design and present business, financial and/or marketing plans based on a budget for a new venture

Performance Criteria

- 4.1 The business of the venture is introduced and described based on research and analyses of competitors.
- 4.2 Structure and layout of the business plan is designed to be compatible with the nature of own venture.
- 4.3 Marketing and promotion of the own venture is concisely presented in the business plan.
- 4.4 Finance requirements for the business are stated in the business plan.
- 4.5 The projected income and expense items for own venture are tabulated in the business plan.
- 4.6 The costs, risks and proposed infrastructure of the operations plan is presented in the business plan of own venture.
- 4.7 Relevant documentation is compiled to support the business plan.
- 4.8 Business plan information is presented in relevant and clear format.
- 4.9 Procedures to present the business plan for own venture to a financier is explained.

Registration Data

Date first registered	2022
Anticipated review	2027
Standard setting body (SSB)	Directorate of Industrial and Vocational Training (DIVT)
Body responsible for review	Directorate of Industrial and Vocational Training (DIVT)

EE414: Tender to secure a new venture

Title		Tender to secure a new venture			
Domain		Physical Planning and Construction			
Sub-field		Electrical Engineering Elective			
SZNQF Level	4	Unit ID	EE414	Credits	6

Purpose

This unit standard specifies the competencies required to tender to secure a new venture. It includes, identifying information sources of available business and new markets that can be assessed, analysing tender documents for viability in the new venture context, calculating costs, revenue and profits of a specific tender and completing the tender documents. This unit standard is for Electrical level 4.

Special Notes

1. Entry Requirements/Pre-requisites

None
2. This unit standard is to be delivered and assessed in the context of the Electrical Engineering and should be assessed in conjunction with other relevant technical unit standards selected from this domain.
3. Assessment may be conducted at a real workplace or simulated workplace, or an appropriately realistic environment in which electrical utilisation, generation, transmission and distribution is carried out.
4. Regulations and legislation relevant to this unit standard may include but not limited to the following:
 - Occupational Health and Safety Act 2001
 - Worker's Compensation Act No.7 of 1983
 - SZNS SANS 10142-1
 - SZNS-SANS 10142-2and all subsequent amendments

Quality Assurance Requirements

This unit standard and others within this subfield may be awarded by institutions which comply with the accreditation, national assessment and moderation requirements set by Eswatini Higher Education Council.

Elements and Performance Criteria

Element 1: Identify information sources of available business and new markets that can be accessed

Performance Criteria

- 1.1 Electronic and media sites are investigated for possible tenders
- 1.2 The printed media containing new business or calls for tenders for new business in are identified for own business context.
- 1.3 New markets are researched for potential tendering opportunities.
- 1.4 Other sources of information for tender opportunities are identified and investigated for own business opportunities.

Element 2: Tender documents are analysed for viability in the new venture context

Performance Criteria

- 2.1 Tenders for own business are identified with reasons why they suit own business.
- 2.2 The presentation methods and tender submissions procedures are explained with examples.
- 2.3 The business activity levels within a specific tender are recognised and limitations of own business capacity are specified in that context.
- 2.4 The internal and external factors of human resources capacity that impact on a specific tender are determined for own business.

Element 3: Calculation of costs, revenue and profit of a specific tender are carried out

Performance Criteria

- 3.1 Available costing methods are reviewed in relation to the tender specifications.
- 3.2 Product and/or services costs and prices applicable to the tender are calculated.
- 3.3 Internal factors impacting upon pricing decisions are identified and discussed in relation to the profitability of the tender.
- 3.4 External factors impacting upon pricing decisions are identified and discussed in relation to the profitability of the tender.
- 3.5 Variations in pricing decisions are calculated in terms of the impact on the break-even point.
- 3.6 Break-even point of the tender is determined for own business.
- 3.7 Profit mark-up is calculated and analysed for the tender.
- 3.8 Costing and pricing methods are reviewed to ensure it is as per application to tender specifications.
- 3.9 Expenses and revenue are classified and categorised for the specific tender.

- 3.10 Suppliers and new products are assessed in terms of potential contribution to profit securing the tender.
- 3.11 Competing products and or services are identified and considered in the tendering process.

Element 4: Complete tender documents

Performance Criteria

- 4.1 Tender documents are completed as per requirement.
- 4.2 Checks and balances are carried out on the costing and inputs into the document.
- 4.3 Dates and times of submitting tenders are adhered to.

Registration Data

Date first registered	2022
Anticipated review	2027
Standard setting body (SSB)	Directorate of Industrial and Vocational Training (DIVT)
Body responsible for review	Directorate of Industrial and Vocational Training (DIVT)

EE415: Interpret basic financial statements

Title		Interpret basic financial statements			
Domain		Physical Planning and Construction			
Sub-field		Electrical Engineering Elective			
SZNQF Level	4	Unit ID	EE415	Credits	6

Purpose

This unit standard specifies the competencies required to interpret basic financial statement. It includes, analysing the basic elements of an income and expenditure, analysing the basic elements of a balance sheet, compiling a personal assets and liabilities statement and using the evidence in financial statements to make a financial decision. This unit standard is for Electrician Level 4.

Special Notes

1. Entry Requirements/Pre-requisites

None

2. This unit standard is to be delivered and assessed in the context of the Electrical Engineering and should be assessed in conjunction with other relevant technical unit standards selected from this domain.
3. Assessment may be conducted at a real workplace or simulated workplace, or an appropriately realistic environment in which electrical utilisation, generation, transmission and distribution is carried out.
4. The typical scope of this unit standard covers different types of financial statements including business, personal and organisation. It also covers enterprises such as school, body corporate, club, small business, etc.
5. Regulations and legislation relevant to this unit standard may include but not limited to the following:
- Occupational Health and Safety Act 2001
 - Worker's Compensation Act No.7 of 1983
- and all subsequent amendments.

Quality Assurance Requirements

This unit standard and others within this subfield may be awarded by institutions which comply with the accreditation, national assessment and moderation requirements set by Eswatini Higher Education Council.

Elements and Performance Criteria

Element 1: Analyse the basic elements of an income and expenditure statement

Performance Criteria

- 1.1 The purpose of an income and expenditure statement is explained and an indication is given of how often these statements are required for two case studies.
- 1.2 Sources of income and expenditure are identified for three different kinds of financial statements.
- 1.3 Sources of income and expenditure are explained with reference to an income and expenditure statements.
- 1.4 Three income and expenditure are examined and evaluated in terms of financial viability of the enterprise.

Element 2: Analyse the basic elements of a balance sheet

Performance Criteria

- 2.1 The purpose of a balance sheet is explained and an indication is given of how often a balance sheet is necessary for two case studies.
- 2.2 A balance sheet is analysed and evaluated in terms of equity or financial net worth.
- 2.3 The concept of an asset is explained and the assets in a balance sheet are classified in terms of fixed and current assets.
- 2.4 The concept of an asset is explained and the liabilities in a balance sheet are classified in terms of long term and current assets.
- 2.5 Balance sheets for an entity are compared and evaluated in terms of performance over two years and a decision is made based on evidence in the balance sheet.

Element 3: Compile a personal assets and liabilities statements

Performance Criteria

- 3.1 A personal assets and liabilities statement is compiled based on own financial situation over the past year.
- 3.2 The situations when assets and liabilities statement are required are listed and an indication is given of the advantages of keeping such records.

Element 4: Use the evidence in financial statements to make a financial decision

Performance Criteria

- 4.1 The financial strengths and weaknesses of are analysed and suggestions are made of ways to improve income and reduce costs.

- 4.2 The concept of cost to income ratio is explained and suggestions are made on how to improve the ratio.
- 4.3 The relation between turnover, income, revenue, sales or earnings and profit is explained with examples.
- 4.4 The concept of cash flow is explained in terms of liquidity.

Registration Data

Date first registered	2022
Anticipated review	2027
Standard setting body (SSB)	Directorate of Industrial and Vocational Training (DIVT)
Body responsible for review	Directorate of Industrial and Vocational Training (DIVT)

EE416: Manage work time efficiently

Title		Manage work time efficiently			
Domain		Physical Planning and Construction			
Sub-field		Electrical Engineering Core			
SZNQF Level		Unit ID	EE416	Credits	4

Purpose

This unit standard specifies the competencies required to manage work time efficiently. This includes demonstrating understanding of the concept “time management in a 24 hour day world”, describing the difference between urgent and important and prioritising daily activities and estimating time spent on a task and drawing up a general day, week and month planner to manage time efficiently. This unit standard is for Electrician level 3.

Special Notes

1. Entry Requirement/Pre-requisites

None

2. This unit standard is to be delivered and assessed in the context of the Electrical Engineering and should be assessed in conjunction with other relevant technical unit standards selected from this domain.
3. Assessment may be conducted at a real workplace or simulated workplace, or an appropriately realistic electrical working environment.
4. Regulations and legislation relevant to this unit standard may include but not limited to the following:
 - Occupational Health and Safety Act 2001
 - Worker’s Compensation Act No.7 of 1983
 and all subsequent amendments

Quality Assurance Requirements

This unit standard and others within this subfield may be awarded by institutions which comply with the accreditation, national assessment and moderation requirements set by Eswatini Higher Education Council.

Elements and Performance Criteria**Element 1: Demonstrate understanding of the concept “time management in a 24 hour day world.”**
Performance Criteria

- 1.1 The different concepts used in the external environment to measure are listed.
- 1.2 The concept time management is explained in the learner’s own words.

1.3 The importance of time management in the work environment is debated.

Element 2: Describe the difference between urgent and important prioritising daily activities

Performance Criteria

2.1 Typical daily activities in the workplace are listed and ranked according to urgency and importance.

2.2 The listed activities are used to plan a typical day in the workplace.

Element 3: Estimate time spent on a task and draw up a general day, week and month planner to manage time effectively

Performance Criteria

3.1 Estimated time spent on each task is allocated to different activities.

3.2 A general day, week and month planner is drawn up.

3.3 Provision is made for unexpected incidents and crises management.

Registration Data

Date first registered	2022
Anticipated review	2027
Standard setting body (SSB)	Directorate of Industrial and Vocational Training (DIVT)
Body responsible for review	Directorate of Industrial and Vocational Training (DIVT)

PVI400: Design three phase photovoltaic power systems

Title		Design three-phase photovoltaic power systems			
Domain		Physical Planning and Construction			
Sub-field		Electrical Engineering			
SZNQF Level	4	Unit ID	PVI 400	Credits	10

Purpose

This unit standard specifies the competencies required to determine design requirements for a PV system, perform a site survey for a PV system and record findings, specify and design a stand-alone PV power system for residential or commercial premises, specify and design a residential grid connected PV system without battery storage; and specify and design a residential grid connected PV system with battery storage. This unit standard is for Solar PV Installation and Maintenance Level 4.

Special Notes

1. Entry Requirement/Pre-requisites
None
2. Assessment may be conducted at a real workplace or simulated workplace, or an appropriately realistic environment in which Solar PV Installation is carried out.
3. Regulations and legislation relevant to this unit standard may include but not limited to the following:
 - Occupational Health and Safety Act 2001
 - Worker's Compensation Act No.7 of 1983
 - SZNS-SANS 10142
 - SZNS-SANS 10400
 - SZNS-SANS 10252
 - SZNS-SANS 10254
 - NRS 052
 and all subsequent amendments
4. The range of ancillary components is limited to switchboard or distribution board, cabling, inverter (max 1100V) or charge controller, regulator, array junction box, backup battery, backup generator cabling hardware, protection and isolation devices, electrical enclosures.
5. Load assessment include but not limited to total daily energy, maximum demand, surge demand, load management requirements.

Quality Assurance Requirements

This unit standard and others within this subfield may be awarded by institutions which comply with the accreditation, national assessment and moderation requirements set by the Eswatini Qualification Authority.

Elements and Performance Criteria

Element 1: Determine design requirements for a PV system

Performance Criteria

- 1.1 Describe factors that impact on the implementation of a PV system
- 1.2 Determine system design requirements in consultation with client.
- 1.3 Assess end-user services and energy demand for each service.
- 1.4 Perform a detailed load assessment in accordance with Standards.
- 1.5 Establish load management and logging equipment requirements.
- 1.6 Produce load profiles from usage data for all electrical loads including expected variations to establish average and maximum demands.
- 1.7 Determine load management strategies and/or energy source switching options to reduce maximum and surge demand based on load profile analysis.

Element 2: Perform a site survey for a PV system and record findings

Performance Criteria

- 2.1 Estimate solar availability for the site.
- 2.2 Determine locations for monitoring panels or screens in accordance with the site owner's specification.
- 2.3 Determine suitability of the roof or other selected platform for mounting the array.
- 2.4 Determine the method for mounting PV modules.
- 2.5 Determine location of ancillary components.
- 2.6 Determine cabling routes and estimate cable lengths.

Element 3: Specify and design a stand-alone PV power system for residential or commercial premises

Performance Criteria

- 3.1 Describe the operation of a stand-alone PV power system for residential or commercial premises.
- 3.2 Compare costs of a stand-alone PV system with other power supply options.
- 3.3 Perform a detailed load assessment consistent with Standards.
- 3.4 Calculate system voltage and main component sizes including minimum and maximum number of PV modules in a string for the specified voltage.
- 3.5 Determine the operating window of the inverter for the expected minimum and maximum effective cell temperatures.
- 3.6 Select and size an inverter rating with respect to the output power of the array.
- 3.7 Develop a system specification based on site and customer requirements.

- 3.8 Select a PV array that meets the design requirements in accordance with the specification and Standards.
- 3.9 Select ancillary components in accordance with the specification and Standards.
- 3.10 Select PV array mounting frame design and materials in accordance with the specification and Standards.
- 3.11 Design battery accommodation in accordance with the specification and Standards.
- 3.12 Produce a schematic diagram of the grid-connected inverter circuit configuration including metering arrangements, isolation and connection with respect to RCDs.
- 3.13 Perform energy calculations for the system.
- 3.14 Produce a design for the PV power system that uses a series or switched configuration in accordance with the specification and Standards.
- 3.15 Estimate the capital cost and running costs for the PV system.
- 3.16 Produce a manual for the PV system in accordance with Standards.
- 3.17 Produce an installation specification for the residential grid connected PV system.

Element 4: Specify and design a residential grid connected PV system without battery storage

Performance Criteria

- 4.1 Describe the operation of a grid connected PV power system without energy storage.
- 4.2 Compare costs of grid connected PV power system without energy storage with other power supply options.
- 4.3 Perform a detailed load assessment consistent with Standards.
- 4.4 Calculate system voltage and main component sizes including minimum and maximum number of PV modules in a string for the specified voltage.
- 4.5 Determine the operating window of the inverter for the expected minimum and maximum effective cell temperatures.
- 4.6 Select and size an inverter rating with respect to the output power of the array.
- 4.7 Develop a system specification based on site and customer requirements.
- 4.8 Select a PV array that meets the design requirements in accordance with the specification and Standards.
- 4.9 Select ancillary components in accordance with the specification and Standards.
- 4.10 Select PV array mounting frame design and materials in accordance with the specification and Standards.
- 4.11 Produce a schematic diagram of the grid-connected inverter circuit configuration including metering arrangements, isolation and connection with respect to RCDs.
- 4.12 Perform energy calculations for the system.
- 4.13 Produce a design for the PV power system that uses a series or switched configuration in accordance with the specification and Standards.

- 4.14 Estimate the capital cost and running costs for the PV system.
- 4.15 Produce a manual for the PV system in accordance with Standards.
- 4.16 Produce an installation specification for the residential grid connected PV system.

Element 5: Specify and design a residential grid connected PV system with battery storage

Performance Criteria

- 5.1 Describe the operation of a grid connected PV power system with energy storage.
- 5.2 Compare costs of grid connected PV power system with energy storage with other power supply options.
- 5.3 Perform a detailed load assessment consistent with Standards.
- 5.4 Calculate system voltage and main component sizes including minimum and maximum number of PV modules in a string for the specified voltage.
- 5.5 Determine the operating window of the inverter for the expected minimum and maximum effective cell temperatures.
- 5.6 Select and size an inverter rating with respect to the output power of the array.
- 5.7 Develop a system specification based on site and customer requirements.
- 5.8 Select a PV array that meets the design requirements in accordance with the specification and Standards.
- 5.9 Select ancillary components in accordance with the specification and Standards.
- 5.10 Select PV array mounting frame design and materials in accordance with the specification and Standards.
- 5.11 Design battery accommodation in accordance with the specification and Standards.
- 5.12 Produce a schematic diagram of the grid-connected inverter circuit configuration including metering arrangements, isolation and connection with respect to RCDs.
- 5.13 Perform energy calculations for the system.
- 5.14 Produce a design for the PV power system that uses a series or switched configuration in accordance with the specification and Standards.
- 5.15 Estimate the capital cost and running costs for the PV system.
- 5.16 Produce a manual for the PV system in accordance with Standards.
- 5.17 Produce an installation specification for the residential grid connected PV system with battery storage.

Registration Data

Date first registered	2024
Anticipated review	2029
Standard setting body (SSB)	Directorate of Industrial and Vocational Training (DIVT)
Body responsible for review	Directorate of Industrial and Vocational Training (DIVT)

PVI401: Troubleshoot and repair PV systems

Title		Troubleshoot and repair PV systems			
Domain		Physical Planning and Construction			
Sub-field		Electrical Engineering			
SZNQF Level	4	Unit ID	PVI 401	Credits	15

Purpose

This unit standard specifies the competencies required to do fault-finding, repairing faults and maintaining a stand-alone battery charging wind turbine according to applicable drawings and statutory requirements to ensure continuous operation. This unit standard is for Solar PV Installation Level 4.

Special Notes

1. Entry Requirement/Pre-requisites

None

- Assessment may be conducted at a real workplace or simulated workplace, or an appropriately realistic environment in which Solar PV Installation is carried out.
- Regulations and legislation relevant to this unit standard may include but not limited to the following:
 - Occupational Health and Safety Act 2001
 - Worker's Compensation Act No.7 of 1983
 - SZNS-SANS 10142, SZNS-SANS 10400, SZNS-SANS 10252, SZNS-SANS 10254 and all subsequent amendments
- PV System components include but not limited to: PV Module, Support structures, charge Controller, Battery/battery bank, Inverter/converter, Lighting fixtures and accessories, Convenience outlets for appliances and devices, Wires and cables, Fastening fixture.
- The PV System can be DC only, AC only or AC/DC.
- Troubleshooting checklist include but not limited to: mode failure, total shutdown, decreased capacity, intermittent power, no output, time of failure and frequency, usage prior to failure/breakdown, lightning storm, long rainy days, cloud cover.
- Personal Protective Equipment include but not limited to: safety goggles, gloves, folding ladder, safety harness, first aid kit, safety shoes, apron leather, safety belts, electrician holster kit.

Quality Assurance Requirements

This unit standard and others within this subfield may be awarded by institutions which comply with the accreditation, national assessment and moderation requirements set by the Eswatini Qualification Authority.

Elements and Performance Criteria

Element 1: Prepare for troubleshooting activities

Performance Criteria

- 1.1 Personal protective equipment is prepared in line with job order requirement.
- 1.2 Sequence of troubleshooting activities outlined in accordance with the maintenance manual and customer complaint.
- 1.3 Tools, measuring instruments, and materials are selected in accordance with job order requirements.

Element 2: Troubleshoot a PV System

Performance Criteria

- 2.1 Customer interviewed based on Troubleshooting Checklist.
- 2.2 System components are checked using isolation technique based on maintenance procedures.
- 2.3 Isolation points of electrical circuits identified as per circuit diagrams.
- 2.4 Isolation undertaken safely and according to worksite or manufacture specifications.
- 2.5 Safety and / or security lockout systems applied according to worksite procedures and safety practices.
- 2.6 Reasons for having isolation points in certain areas explained.
- 2.7 The importance of verification when isolating circuits explained.
- 2.8 Location and purpose of installing warning signs to be explained.

Element 3: Repair/replace faulty PV component

Performance Criteria

- 3.1 Photovoltaic system components and accessories are repaired/replaced.
- 3.2 PV system is checked for any more defects based on procedures.
- 3.3 Rectification of any malfunctions/deficiencies is performed based on set procedures.
- 3.4 PV system parameters are tested to comply within the nominal range.
- 3.5 Repair and services are accomplished and recorded in the logbook.

Element 4: Debrief Customer

Performance Criteria

- 4.1 Causes of PV system faults and effects are explained according to company standard operating procedure.
- 4.2 Preventive measures are recommended based on the diagnosis.

Element 5: Complete the work task

Performance Criteria

- 5.1 Work area is cleared and cleaned on completion of task according to housekeeping requirements.
- 5.2 Waste materials disposed of according to site specific standards, procedures and environmental policies.
- 5.3 Electrical circuits re-commissioned on completion of task as per operational standards
- 5.4 Quality checks conducted and corrective action taken where required as per quality standards
- 5.5 Panel / enclosure doors, covers properly secured or locked to restrict unauthorised access as per safety standard.
- 5.6 Lockout devices and warning signs removed.
- 5.7 Job cards / work orders and check sheets correctly completed and maintenance reports submitted.

Registration Data

Date first registered	2025
Anticipated review	2030
Standard setting body (SSB)	Directorate of Industrial and Vocational Training (DIVT)
Body responsible for review	Directorate of Industrial and Vocational Training (DIVT)

PVI402: Select a back-up generator for a stand-alone renewable energy system

Title		Select a back-up generator for a stand-alone renewable energy system			
Domain		Physical Planning and Construction			
Sub-field		Electrical Engineering			
SZNQF Level	4	Unit ID	PV 403	Credits	5

Purpose

This unit standard specifies the competencies required to assess solar data and the load to determine the need for a standby generator; determine the rating of a standby generator and make provision for the logistics in respect of a standby generator. This unit standard is for Solar PV Installation Level 4.

Special Notes**1 Entry Requirement/Pre-requisites**

None

2 Assessment may be conducted at a real workplace or simulated workplace, or an appropriately realistic environment in which Solar PV Installation is carried out.**3 Regulations and legislation relevant to this unit standard may include but not limited to the following:**

- Occupational Health and Safety Act 2001
- Worker's Compensation Act No.7 of 1983
- SZNS-SANS 10142
- SZNS-SANS 10400
- SZNS-SANS 10252
- SZNS-SANS 10254
- NRS 052

and all subsequent amendments

4 Standby generator refers to a petrol, diesel or gas, internal combustion driven generator.**5 Critical and strategic applications include but not limited to: clinics and hospitals, medicine and vaccine storage, food storage, security systems and lighting, emergency radios.****Quality Assurance Requirements**

This unit standard and others within this subfield may be awarded by institutions which comply with the accreditation, national assessment and moderation requirements set by the Eswatini Qualification Authority.

Elements and Performance Criteria

Element 1: Assess solar data to determine the need for a standby generator

Performance Criteria

- 1.1 Solar data is assessed in terms of the reliability thereof and explained
- 1.2 Renewable energy system autonomy is assessed in terms of the battery ampere-hour rating and cost.
- 1.3 The need for a standby generator is assessed in terms of on resource reliability, autonomy and cost.

Element 2: Assess the load to determine the need for a standby generator

Performance Criteria

- 2.1 The load is assessed in terms of short-term peak demand periods.
- 2.2 The load is assessed in terms of longer-term peak demand periods.
- 2.3 The load is assessed in terms of critical and strategic applications.
- 2.4 The battery charge current is assessed as a critical load in terms of battery characteristics and limitations.

Element 3: Determine the rating of a standby generator

Performance Criteria

- 3.1 The maximum rating is determined in terms of the value and duration of the critical peak load and the battery rating.
- 3.2 The standby generator usage is estimated in terms of the potential duty cycle, the battery storage capacity and the system autonomy.
- 3.3 A safety margin is determined in terms of the potential duty cycle, the battery storage capacity, the system autonomy and the solar resource.
- 3.4 An economic assessment is made in terms of fuel consumption, generator rating, system size, battery ampere-hour rating and system autonomy.

Element 4: Understand and make provision for the logistics in respect of a standby generator

Performance Criteria

- 4.1 The standby generator is selected in terms of the logistics with regard to diesel, gas or petrol.
- 4.2 The standby generator is selected in terms of the type, service, manufacturer and availability of spares.
- 4.3 First line maintenance is carried out in terms of the owner's manual.
- 4.4 First line maintenance spares are identified and selected in terms of owner's manual.

Registration Data

Date first registered	2025
Anticipated review	2030
Standard setting body (SSB)	Directorate of Industrial and Vocational Training (DIVT)
Body responsible for review	Directorate of Industrial and Vocational Training (DIVT)

PVI403: Apply and demonstrate understanding of national grid codes, international technical standards and regulatory frameworks

Title		Apply and demonstrate understanding of national grid codes, international technical standards and regulatory frameworks			
Domain		Physical Planning and Construction			
Sub-field		Electrical Engineering			
SZNQF Level	4	Unit ID	PVI 403	Credits	10

Purpose

This unit standard specifies the competencies to have the knowledge and skills to interpret, apply, and comply with national grid codes, international technical standards, and regulatory frameworks relevant to the design, installation, commissioning, and maintenance of solar photovoltaic (PV) systems. Solar PV installers will demonstrate competence in ensuring safe, efficient, and legally compliant solar PV installations.

Special Notes

1 Entry Requirement/Pre-requisites

None

2 Assessment may be conducted at a real workplace or an appropriately realistic environment in which Solar PV Installation is carried out.

3 Regulations and legislation relevant to this unit standard may include but not limited to the following:

- Occupational Health and Safety Act 2001
- Worker's Compensation Act No.7 of 1983
- SZNS-SANS 10142
- SZNRS 097
- SZNS 028
- SZNS PAS 076
- SZNS 077
- IEC 62446
- IEC 61724
- Environmental Management Act 2002
- Ozone Depletion Substances Regulations 2003

And all subsequent amendments

4 National grid codes: Includes connection agreements, power quality requirements, safety protocols, and metering standards.

5 International standards: IEC 62446 (grid-connected systems), IEC 61724 (performance monitoring), NEC Article 690 (electrical safety), and SZNS ISO 9001 (quality management).

- 6 Regulatory frameworks: Permitting processes, building codes, environmental regulations, and utility interconnection requirements.
- 7 Systems refers to Grid-tied, hybrid, and off-grid solar PV installations.

Quality Assurance Requirements

This unit standard and others within this subfield may be awarded by institutions which comply with the accreditation, national assessment and moderation requirements set by the Eswatini Qualification Authority.

Elements and Performance Criteria

Element 1: Interpret national grid codes and international technical standards for solar PV systems

Performance Criteria

- 1.1 Explain the purpose and key requirements of national grid codes.
- 1.2 Compare and contrast international standards with local regulations.
- 1.3 Identify the implications of non-compliance with codes and standards.

Element 2: Apply grid codes and standards during the installation, testing, and commissioning of solar PV systems

Performance Criteria

- 2.1 Select components and design systems that meet national and international technical specifications.
- 2.2 Demonstrate safe installation practices in compliance with grid code requirements (e.g., anti-islanding, voltage regulation).
- 2.3 Conduct pre-commissioning tests (e.g., insulation resistance, polarity checks) using standardized procedures.

Element 3: Ensure compliance with regulatory frameworks governing solar PV installations

Performance Criteria

- 3.1 Prepare documentation (e.g., permits, inspection reports) required by local authorities.
- 3.2 Describe the roles of regulatory bodies and certification agencies in solar PV projects.
- 3.3 Implement environmental and occupational health regulations.

Element 4: Maintain systems in accordance with evolving technical and regulatory requirements

Performance Criteria

- 4.1 Perform periodic inspections and maintenance in line with updated standards and manufacturers specifications.
- 4.2 Update system documentation to reflect regulatory changes.
- 4.3 Troubleshoot non-compliant systems and recommend corrective actions.

Registration Data

Date first registered	2025
Anticipated review	2030
Standard setting body (SSB)	Directorate of Industrial and Vocational Training (DIVT)
Body responsible for review	Directorate of Industrial and Vocational Training (DIVT)

PVI404 : Commission a PV System

Title		Commission a PV system			
Domain		Physical Planning and Construction			
Sub-field		Electrical Engineering			
SZNQF Level	4	Unit ID	PVI 404	Credits	15

Purpose

This unit standard is designed for individuals working in the renewable energy sector who are responsible for commissioning photovoltaic (PV) systems. Solar PV installers will gain the knowledge and practical skills to safely and effectively commission grid-connected or off-grid PV systems, ensuring compliance with technical, safety, and regulatory standards.

Special Notes

- 1 Entry Requirement/Pre-requisites
None
- 2 Assessment may be conducted at a real workplace or an appropriately realistic environment in which Solar PV Installation is carried out.
- 3 Regulations and legislation relevant to this unit standard may include but not limited to the following:
 - Occupational Health and Safety Act 2001
 - Worker's Compensation Act No.7 of 1983
 - SZNS-SANS 10142
 - SZNRS 097
 - SZNS 028
 - SZNS PAS 076
 - SZNS 077
 - IEC 62446
 - IEC 61724
 - Environmental Management Act 2002
 - Ozone Depletion Substances Regulations 2003and all subsequent amendments
- 4 PV systems may include standalone or non-standalone grid-connected, hybrid, or off-grid systems with battery storage.
- 5 Tools and equipment may include multi-meters, insulation testers, IV curve tracers, irradiance sensors, and data logging software.
- 6 Documentation must align with industry standards and regulatory frameworks.

Quality Assurance Requirements

This unit standard and others within this subfield may be awarded by institutions which comply with the accreditation, national assessment and moderation requirements set by the Eswatini Qualification Authority.

Elements and Performance Criteria

Element 1: Plan and prepare for the commissioning of a PV system

Performance Criteria

- 1.1 Review system design specifications, schematics, and commissioning protocols.
- 1.2 Identify tools, equipment, and safety gear required for commissioning.
- 1.3 Develop a commissioning plan aligned with manufacturer guidelines and industry standards.

Element 2: Inspect and verify the PV system installation prior to commissioning

Performance Criteria

- 2.1 Confirm the PV array, mounting structure, wiring, and earthing meet design specifications.
- 2.2 Verify inverters, charge controllers, batteries (if applicable), and protection devices are installed correctly.
- 2.3 Check compliance with electrical codes, safety standards, and local regulations.

Element 3: Configure and test system components to ensure optimal performance

Performance Criteria

- 3.1 Configure inverter settings (e.g., grid parameters, voltage thresholds) for system type (grid-tied, hybrid, or off-grid).
- 3.2 Test maximum power point tracking (MPPT) functionality and DC/AC conversion efficiency.
- 3.3 Validate communication interfaces (e.g., monitoring systems, data loggers).

Element 4: Conduct performance and safety tests on the PV system

Performance Criteria

- 4.1 Perform insulation resistance, polarity, and continuity tests on electrical circuits.
- 4.2 Measure open-circuit voltage, short-circuit current, and operating parameters under load.
- 4.3 Test safety mechanisms (e.g., isolation devices, surge protection, emergency shutdown).

Element 5: Document commissioning processes and outcomes

Performance Criteria

- 5.1 Record test results, system performance data, and deviations from design specifications.
- 5.2 Complete commissioning certificates, compliance reports, and handover documentation.

5.3 Provide end-user documentation (e.g., operation manuals, maintenance schedules).

Element 6: Comply with health, safety, and regulatory requirements

Performance Criteria

- 6.1 Adhere lockout/tagout (LOTO) procedures during commissioning.
- 6.2 Adhere to personal protective equipment (PPE) requirements and hazard mitigation practices.
- 6.3 Ensure compliance with national standards (e.g., IEC 62446, NEC Article 690) and local grid codes.

Registration Data

Date first registered	2025
Anticipated review	2030
Standard setting body (SSB)	Directorate of Industrial and Vocational Training (DIVT)
Body responsible for review	Directorate of Industrial and Vocational Training (DIVT)

PVI405 : Demonstrate an understanding and implement environmental initiatives on a construction project

Title		Demonstrate an understanding and implement environmental initiatives on a construction of a PV plant			
Domain		Physical Planning and Construction			
Sub-field		Electrical Engineering			
SZNQF Level	4	Unit ID	PVI 405	Credits	6

Purpose

This unit standard specifies the competencies required to demonstrate an understanding of the value of environmental management, implement initiatives of during pre-construction and post construction activities. This unit standard is for Solar PV Installation Level 4.

Special Notes

1 Entry Requirement/Pre-requisites

None

2 Assessment may be conducted at a real workplace or simulated workplace, or an appropriately realistic environment in which Solar PV Installation is carried out.

3 Regulations and legislation relevant to this unit standard may include but not limited to the following:

- Occupational Health and Safety Act 2001
- Worker's Compensation Act No.7 of 1983
- SZNS-SANS 10142
- SZNS-SANS 10400
- SZNS-SANS 10252
- SZNS-SANS 10254
- Environmental Management Act 2002
- Ozone Depletion Substances Regulations 2003

and all subsequent amendments

4 Environmental management relates to the management of the interaction between the holistic construction process and the environment. The "environment" includes the physical environment and natural resources, as well as social-cultural issues and the interaction of the afore mentioned with economic systems.

5 Types of pollution intended for this unit standard is limited to noise, waste and hazardous/toxic materials.

Quality Assurance Requirements

This unit standard and others within this subfield may be awarded by institutions which comply with the accreditation, national assessment and moderation requirements set by the Eswatini Qualification Authority.

Elements and Performance Criteria

Element 1: Demonstrate an understanding of the value of environmental management

Performance Criteria

- 1.1 The benefits and importance of environmentally orientated construction activities are explained.
- 1.2 The purpose of the environmental impact assessment, as well as the environmental management plan is explained.
- 1.3 The value of upgrading as opposed to renewing is explained.
- 1.4 The value of historical building substance is explained.
- 1.5 The importance of material sustainability is explained.
- 1.6 Socio-cultural values and perceptions with regard to construction materials; energy; and construction methods are described.

Element 2: Implement environmental management initiatives during pre-construction activities

Performance Criteria

- 2.1 The costs and benefits of traditional and indigenous building methodologies and materials are compared with current technologies.
- 2.2 Local resources (including skills) are identified and considered in the construction planning process.
- 2.3 Means of community participation, as well as awareness programmes are identified.

Element 3: Implement environmental management initiatives during construction activities

Performance Criteria

- 3.1 Construction based pollution reduction measures are implemented.
- 3.2 Disease prevention and hygiene measures are implemented during construction activities.
- 3.3 Measures to conserve water and energy are implemented.
- 3.4 Construction activities are executed in accordance with relevant environmental legislation and relevant regulations.
- 3.5 Adherence to the environmental management plan is ensured.

Element 4: Implement environmental management initiatives during post- construction activities

Performance Criteria

Maintenance schedules are executed.

4.2 The construction site is rehabilitated and dumping of waste is monitored.

4.3 Resource recycling is maximized.

Registration Data

Date first registered	2025
Anticipated review	2030
Standard setting body (SSB)	Directorate of Industrial and Vocational Training (DIVT)
Body responsible for review	Directorate of Industrial and Vocational Training (DIVT)

PVI406 : Demonstrate and apply knowledge of stand-alone renewable energy system components and operation

Title		Demonstrate and apply knowledge of stand-alone renewable energy system components and operation			
Domain		Physical Planning and Construction			
Sub-field		Electrical Engineering			
SZNQF Level	4	Unit ID	PVI 406	Credits	15

Purpose

This unit standard specifies the competencies required to demonstrate knowledge of standalone renewable energy power systems schematic diagrams, the operation and performance of batteries for renewable power system applications; and system components and common loads for standalone RES. This unit standard is for Solar PV Installation Level 4.

Special Notes

1. Entry Requirement/Pre-requisites

None

2. Assessment may be conducted at a real workplace or an appropriately realistic environment in which Solar PV Installation is carried out.

3. Regulations and legislation relevant to this unit standard may include but not limited to the following:

- Occupational Health and Safety Act 2001
- Worker's Compensation Act No.7 of 1983
- SZNS-SANS 10142
- SZNS-SANS 10400
- SZNS-SANS 10252
- SZNS-SANS 10254
- Environmental Management Act 2002
- Ozone Depletion Substances Regulations 2003

and all subsequent amendments

4. Definitions

MPPT- maximum power point tracking

PV – photovoltaic

RES – renewable energy source

PWM – Pulse Width Modulation

5. Schematic diagrams may include but is not limited to – functional block diagram, circuit schematic, a.c., d.c., control board wiring diagram, site diagram.

6. Terms used in this standard for battery condition may include but not limited to nominal voltage, cell, primary and secondary cells, battery, charge and discharge rate, amp hour capacity, watt hour capacity,

state of charge (SOC), depth of discharge (DOD), specific gravity (SG), watt hour and amp hour efficiency, cycle life, peuket effect.

7. Batteries may include but not limited to lead-acid, lithium ion, Gel etc.

Quality Assurance Requirements

This unit standard and others within this subfield may be awarded by institutions which comply with the accreditation, national assessment and moderation requirements set by the Eswatini Qualification Authority.

Elements and Performance Criteria

Element 1: Demonstrate knowledge of standalone renewable energy power systems schematic diagrams

Performance Criteria

- 1.1 Represent typical stand-alone renewable power system configurations on functional block diagrams.
- 1.2 Draw and label circuit schematics of all major components of typical renewable power systems supplying d.c. and a.c. loads.
- 1.3 Draw and label a wiring diagram for a typical renewable stand-alone power system d.c. control switch board.
- 1.4 Mark up architectural and site diagrams to show the locations of equipment, fittings and cabling.
- 1.5 Connect an electronic device to a computer using cable and cable connectors.

Element 2: Demonstrate knowledge of the operation and performance of batteries for renewable power system applications

Performance Criteria

- 2.1 Define terms related to batteries.
- 2.2 Outline major features for each of the major types of commercially available batteries for stand-alone power system applications.
- 2.3 Outline factors affecting the life of a battery.
- 2.4 Describe the causes, effects, methods of prevention or reduction of sulphation and stratification in lead acid batteries.
- 2.5 Describe the effect that discharge depth and temperature have on the capacity and life of batteries.
- 2.6 Describe major specification requirements for batteries used in a stand-alone power system application.
- 2.7 Describe methods of determining the state of charge of a battery or battery system of specific gravity (lead and battery voltage).
- 2.8 Describe the main features of charging regimes suitable for the major types of stand-alone power system batteries using real examples.
- 2.9 Estimate the life of a standalone power system battery in years based on manufacturer's cycle life data and given capacity, configuration and operating conditions.

- 2.10 Outline the precautions required when handling, installing and maintaining lead-acid batteries.
- 2.11 Outline the procedures required for safe disposal of batteries.

Element 3: Demonstrate knowledge of system components and common loads for standalone RES

Performance Criteria

- 3.1 Compare features, applications, and differences of commercially available inverters suitable for use in stand-alone RES.
- 3.2 Measure major operating parameters of an inverter over a range of loads up to five-minute ratings.
- 3.3 Describe effects of non-sine wave power supply on typical loads and the solutions used to overcome them.
- 3.4 Describe the significance of low power factor loads for inverter systems and the principle of power factor correction.
- 3.5 Describe operation of the major types of regulators for use in stand-alone renewable power systems using commercially available equipment as examples.
- 3.6 Measure current versus voltage characteristics, efficiency, and charging voltage waveform of battery chargers suitable for use in stand-alone RES.
- 3.7 Outline operation of MPPTs, PWMs and their applications.
- 3.8 Outline basic operation, advantages, and disadvantages of mechanical tracking devices for PV arrays.
- 3.9 Read and set control parameters or data using digital displays on inverters, regulators, or controllers.

Registration Data

Date first registered	2025
Anticipated review	2030
Standard setting body (SSB)	Directorate of Industrial and Vocational Training (DIVT)
Body responsible for review	Directorate of Industrial and Vocational Training (DIVT)

PVI407: Integrate a Diesel Generator and or PV Generator in a grid-tied system

Title	Integrate a Diesel Generator and/ or PV Generator in a grid-tied system				
Domain	Physical Planning and Construction				
Sub-field	Electrical Engineering				
SZNQF Level	4	Unit ID	PVI 407	Credits	15

Purpose

This unit standard specifies the competencies required to design, install, configure, and maintain hybrid power systems combining diesel generator and or photovoltaic (PV) generator in a grid-tied systems that has no battery as back-up system. It emphasizes safety, efficiency, and compliance with industry standards, preparing individuals to support sustainable energy solutions in diverse settings like off-grid or backup power.

Special Notes

- 1 Entry Requirement/Pre-requisites
None
- 2 Assessment may be conducted at a real workplace or an appropriately realistic environment in which Solar PV Installation is carried out.
- 3 Regulations and legislation relevant to this unit standard may include but not limited to the following:
 - Occupational Health and Safety Act 2001
 - Worker's Compensation Act No.7 of 1983
 - SZNS-SANS 10142
 - SZNRS 097
 - SZNS 075
 - SZNS 028
 - SZNS PAS 076
 - SZNS 077
 - Environmental Management Act 2002and all subsequent amendments
- 4 The System is limited to Residential and commercial, or industrial applications and does not have battery storage.
- 5 Load types may include but not limited to Critical (hospitals), non-critical (lighting), or variable (industrial machinery).
- 6 Environmental factors are limited to Extreme weather, grid stability and noise restrictions.
- 7 Safety considerations are limited to electrical hazards, fuel storage and fire prevention.

Quality Assurance Requirements

This unit standard and others within this subfield may be awarded by institutions which comply with the accreditation, national assessment and moderation requirements set by the Eswatini Qualification Authority.

Elements and Performance Criteria

Element 1: Plan the Hybrid System Integration

Performance Criteria

- 1.1 Assess site requirements, including energy demand, solar irradiance, and spatial constraints.
- 1.2 Analyze load profiles to determine optimal diesel-PV capacity ratios.
- 1.3 Select components (e.g., inverters, controllers, batteries) compatible with both generators.
- 1.4 Design system layout adhering to electrical standards, codes and environmental regulations.
- 1.5 Document safety protocols for installation and operation.

Element 2: Install System Components

Performance Criteria

- 2.1 Safely mount PV system components as per manufacturers specifications.
- 2.2 Connect electrical interfaces (e.g., AC/DC coupling, synchronizing controllers).
- 2.3 Integrate energy storage systems (batteries) and protection devices (circuit breakers, surge protectors).
- 2.4 Install monitoring/control systems for seamless power source switching.

Element 3: Configure and Test the System

Performance Criteria

- 3.1 Configure controllers to ensure there is no feedback to the diesel generator.
- 3.2 Test system under varying loads and environmental conditions (e.g., cloud cover, grid failure).
- 3.3 Troubleshoot voltage fluctuations, synchronization errors, or communication faults.
- 3.4 Validate compliance with performance benchmarks (e.g., efficiency, emissions).

Element 4: Maintain and Optimize the System

Performance Criteria

- 4.1 Conduct routine system inspections.
- 4.2 Diagnose and repair faults in PV system.
- 4.3 Update system settings based on seasonal energy demand or component upgrades.
- 4.4 Maintain logs of maintenance activities and performance data.

Registration Data

Date first registered	2025
Anticipated review	2030
Standard setting body (SSB)	Directorate of Industrial and Vocational Training (DIVT)
Body responsible for review	Directorate of Industrial and Vocational Training (DIVT)

RE412: Resolve client requests and queries

Title		Resolve client request and queries			
Field		Physical Planning and Construction			
Domain		Manufacturing , Engineering and Technology			
Subfield		Refrigeration and Air-conditioning Engineering			
SZNQF Level	4	Unit ID	RE412	Credits	5

Purpose

This unit standard specifies the competencies required to identify customer service problems, select the best solution to resolve customer service problems and implement the solution to customer service problems.

This unit standard is intended for those who work as HVACR mechanic.

Special Notes

1. Entry information/Prerequisite

None

2. Assessment evidence may be collected from a real workplace or a simulated real workplace or an appropriate simulated realistic environment in which Heating, ventilation, air-conditioning and refrigeration operations are carried out.

3. Glossary of terms:

‘Specifications’ refers to all or any of the following: manufacturers’ specifications and recommendations, workplace specific requirements etc. ‘

HVACR system’ refers to Heating, ventilation, Air-conditioning and Refrigeration systems.

4. All inspection, operation and maintenance procedures associated with the use of tools and equipment shall comply with manufacturers’ specifications and/or company’s guidelines and instructions.

5. Regulations and legislation relevant to this unit standard include but not limited to the following:

- Labour Act 2005
- Workmen’s Compensation Act No.7 of 1983
- SANS
- Occupational Health and Safety(OHS) Act 2001
And all subsequent amendments

6. Performance of all elements in this unit standard must comply with industry standards

7. Unit standard range may include but not limited to power circuits from three to five loads, of which complex motor starters constitute a single load on the control circuit.

Quality Assurance Requirements

This unit standard and others within this subfield may be awarded by institutions which comply with the accreditation, national assessment and moderation requirements set by Eswatini Higher Education Council.

Elements and Performance Criteria

Element 1: Identify customer service problems.

Performance Criteria

- 1.1 Information from customers about problems they have raised is gathered and interpreted according to organisational requirements.
- 1.2 Customers are asked appropriate questions to check understanding of their problems.
- 1.3 Recurring problems are identified and the appropriate authority alerted to the need to seek solutions to the problem.
- 1.4 Customer feedback is shared with colleagues to help identify potential problems before they occur.
- 1.5 Problems with systems and procedures are identified before they begin to affect the customers.

Element 2: Select the best solution to resolve customer service problems. _

Range

Performance Criteria:

- 2.1 Available options for solving customer service problems are identified from the range of options available within/for the organisation.
- 2.2 Colleagues are consulted with to identify and confirm the options available to solve problems
- 2.3 Advantages and disadvantages of each option for the customer and organisation are worked out so that a decision can be made as to the most appropriate option.
- 2.4 The best overall option for the customer and organisation is selected together with a motivation for the choice.
- 2.5 Other ways of resolving problems are suggested to the customer, should the organisation/the adviser not be able to help.

Element 3: Implement the solution to customer service problems.

Performance Criteria:

- 3.1 The proposed option for solving the problem is discussed and agreed with the customer.

- 3.2 Action is taken to implement the option agreed with the customer.
- 3.3 Promises relating to solving the problem are kept in a manner that they are easily retrievable for future reference.
- 3.4 Customers are kept fully informed about what is happening to solve problems.
- 3.5 Customers are communicated with to make sure the problem has been solved to their satisfaction.
- 3.6 Compromises are negotiated with customers when the problem has not been solved to their satisfaction.

Registration Data

Date first registered:	
Anticipated review:	
Body responsible for review:	Directorate of Industrial and Vocational Training (DIVT)

RE418: Write a technical report

Title		Write a technical report			
Field		Physical Planning and Construction			
Domain		Manufacturing , Engineering and Technology			
Subfield		Refrigeration and Air-conditioning Engineering			
SZNQF Level	4	Unit ID	RE418	Credits	4

Purpose

This unit standard specifies the competencies required to write a clear, complete and correct technical report, which contains all the necessary information and which is easy to understand. This unit standard is intended for those who work as HVAC Mechanic Level 4.

Special Notes

1. Entry information/Prerequisite

RE 312 Write a technical report

2. Assessment evidence may be collected from a real workplace or a simulated real workplace or an appropriate simulated realistic environment in which Heating, ventilation, air-conditioning and refrigeration operations are carried out.

3. Glossary of terms:

‘Specifications’ refers to all or any of the following: manufacturers’ specifications and recommendations, workplace specific requirements etc. ‘

4. HVACR system’ refers to Heating, ventilation, Air-conditioning and Refrigeration systems.

5. All inspection, operation and maintenance procedures associated with the use of tools and equipment shall comply with manufacturers’ specifications and/or company’s guidelines and instructions.

6. Regulations and legislation relevant to this unit standard include but not limited to the following:

- Labour Act 2005
 - Workmen’s Compensation Act No.7 of 1983
 - SANS 10142-1
 - Occupational Health and Safety (OHS) Act 2001
- And all subsequent amendments

7. Performance of all elements in this unit standard must comply with industry standards

Quality Assurance Requirements

This unit standard and others within this subfield may be awarded by institutions which comply with the accreditation, national assessment and moderation requirements set by Eswatini Higher Education Council.

Elements and Performance Criteria

Element 1: Collect information for writing the report.

Performance Criteria

- 1.1 The purpose of the report is determined and clearly defined.
- 1.2 The purpose of the report is determined and clearly defined.
- 1.3 The correct equipment and/or tools required to ascertain the facts are selected.
- 1.4 Those facts to be presented in the report are selected and put in the order of presentation.
- 1.5 Those facts to be presented in the report are selected and put in the order of presentation.
- 1.6 The consequences of providing incorrect information are listed and explained.

Element 2: Plan the writing of the report.

Range

High pressure, low pressure, oil pressure and condensing pressure control switches to be set according to worksite procedures.

Performance Criteria

- 2.1 The order of presentation of the facts is determined.
- 2.2 Appropriate headings are selected for the report.
- 2.3 Only those facts, which are necessary for the report to achieve its purpose are selected.
- 2.4 All facts and figures are put together in a way the reader will be able to understand.
- 2.5 The cut-in and cut-out pressures for condenser fan control switches are correctly determined and set.

Element 3: Write the report.

Range

The reports include introduction, body, conclusion and recommendation.

Performance Criteria

- 3.1 The wording and phraseology is appropriate for the recipient.
- 3.2 The layout of the report is correct.
- 3.3 The report contains the correct headings.
- 3.4 Introduction, body, conclusion and recommendation.
- 3.5 The operation of the defrost systems is checked against specifications or worksite standards.
- 3.6 Results are recorded and reported according to worksite procedures.
- 3.7 The report is checked to ensure it is clear, concise, complete and correct.

Registration Data

Date first registered:	
Date this version registered:	
Anticipated review:	
Body responsible for review:	Directorate of Industrial and Vocational Training (DIVT)