Australian Government

UEENEEG149A Provide engineering solutions to problems in complex polyphase power circuits

Release: 3

INDUSTRY SKILLS COUNCILS
Creating Australia's Future

UEENEEG149A Provide engineering solutions to problems in complex polyphase power circuits

Modification History

Not Applicable

Unit Descriptor

Unit Descriptor **1)**

1.1) Descriptor

This unit covers determining correct operation of complex polyphase power circuits and providing solutions as they apply to electrical power engineering work functions. It encompasses working safely, problem solving procedures, including using electrical measuring devices, applying appropriate circuit theorems and providing solutions derived from measurements and calculations and justification for such solutions.

Application of the Unit

Application of the Unit **4)**

This unit is intended to augment formally acquired competencies. It is suitable for employment-based programs under an approved contract of training.

Licensing/Regulatory Information

1.2) License to practice

The skills and knowledge described in this unit require a license to practice in the workplace where plant and equipment operate at voltage above 50 V a.c. or 120 V d.c. However other conditions may apply in some jurisdictions subject to regulations related to electrical work. Practice in the workplace and during training is also subject to regulations directly related to occupational health and safety and where applicable contracts of training such as apprenticeships.

Pre-Requisites

Prerequisite Unit(s) **2)**

2.1) Competencies

Granting competency in this unit shall be made only after competency in the following unit(s) has/have been confirmed.

UEENEEE125A	Provide engineering solutions for problems in complex multiple path circuits

and

UEENEEG102A	Solve problems in low voltage a.c. circuits

Employability Skills Information

Employability Skills **3)**

This unit contains Employability Skills

The required outcomes described in this unit of competency contain applicable facets of Employability Skills. The Employability Skills Summary of the qualification in which this unit of competency is packaged will assist in identifying Employability Skill requirements.

Elements and Performance Criteria Pre-Content

6) Elements describe the essential outcomes of a unit of competency

Performance criteria describe the required performance needed to demonstrate achievement of the Element. Assessment of performance is to be consistent with the evidence guide.

Elements and Performance Criteria

ELEMENT	PERFORMANCE CRITERIA	
1 Prepare to provide engineering solutions to problems in complex polyphase power circuits.	1.1	OHS procedures for a given work area are identified, obtained and understood.
	1.2	OHS risk control work preparation measures and procedures are followed.
	1.3	The nature of the circuit(s) problem is obtained from documentation or from work supervisor to establish the scope of work to be undertaken.
	1.4	Advice is sought from the work supervisor to ensure the work is coordinated effectively with others.
	1.5	Sources of materials that may be required for the work are established in accordance with established procedures.
	1.6	Tools, equipment and testing devices needed to carry out the work are obtained and checked for correct

ELEMENT	PERFORMANCE CRITERIA	
		operation and safety.
2 Provide engineering solutions to problems in complex polyphase \ power circuits.	2.1	OHS risk control work measures and procedures are followed.
	2.2	The need to test or measure live is determined in strict accordance with OHS requirements and when necessary conducted within established safety procedures.
	2.3	Circuits are checked as being isolated where necessary in strict accordance OHS requirements and procedures.
	2.4	Established methods are used for solving circuit problems from measure and calculated values as they apply to complex polyphase power circuits.
	2.5	Unexpected situations are dealt with safely and with the approval of an authorised person.
	2.6	Problems are solved without damage to apparatus, circuits, the surrounding environment or services and using sustainable energy practices.
3 Complete work and document solutions for problem solving activities.	3.1	OHS work completion risk control measures and procedures are followed.
	3.2	Work site is cleaned and made safe in accordance with established procedures.
	3.3	Justification for solutions used to solve circuit problems is documented.
	3.4	Work completion is documented and an appropriate person or persons notified in accordance with established procedures.

Required Skills and Knowledge

REQUIRED SKILLS AND KNOWLEDGE

7) This describes the essential skills and knowledge and their level, required for this unit.

Evidence shall show that knowledge has been acquired of safe working practices and providing solutions for problems in complex polyphase power circuits.

All knowledge and skills detailed in this unit should be contextualised to current industry practices and technologies.

KS01-EG149A Polyphase power circuit analysis

Evidence shall show an understanding of polyphase power circuit analysis to an extent indicated by the following aspects:

T1 Polyphase supply system encompassing:

- advantage of three phase system compared to single phase systems
- double subscript notation
- phase sequence
- 120 degree operator
- given circuit component parameters, solve practically based problems using:
- equivalent circuits of transformers, lines and loads.
- component values using rectangular and polar notation.
- current divider and potential divider rules using complex impedances.
- The "per unit" values of voltage, current, VA and impedance to a common VA base.

T2 Types of three phase system connections encompassing:

- supply to balanced star, 3 and 4 wire loads
- supply to delta connected loads
- effects of phase reversal
- representation of currents and voltages as complex phasors for 3 phase and 3 phase and neutral quantities.
- calculation the values of and draw labeled phasor diagrams, not to scale, to represent complex values of current and voltage for balanced and unbalanced loads for star and delta systems.
- calculation of values of P, Q and S for balanced and unbalanced systems.
- draw and label single phase diagrams to represent 1 phase of a complex 3 phase system.
- represent unbalanced voltages or currents as symmetrical components.
- Phase to phase currents
- Phase to neutral/earth currents.

T3 Balanced three phase loads encompassing:

REQUIRED SKILLS AND KNOWLEDGE

- calculations of balanced loads connected in star
- calculations of balanced loads connected in delta
- calculation of steady state values of fault current for various configurations.
- evaluation of the symmetrical component impedances for the various distribution system components. Transformers (earthed neutral case). Generators (high impedance earth)
- calculation of fault currents using the per unit approach.
- calculation using the "worst case" values based on transformer impedance only (ie., a short circuit fault)
- estimation of peak values using accepted multipliers.
- effects of the d.c. component on the instantaneous magnitudes of fault currents in transformers and generators.

T4 Unbalanced three phase loads encompassing:

- Star – 4 wire systems
- Delta systems
- Star – 3 wire systems
- Star 4 wire with neutral impedance

T5 Power in three-phase circuits encompassing:

- summation of phase powers and power in balanced loads
- measurement of power in balanced loads – 2 Wattmeter methods

T6 Reactive three phase power encompassing:

- power triangle calculation
- measurement of VAR
- power factor correction

T7 Fault currents encompassing:

- symmetrical components
- positive, negative and zero sequence impedance
- fault current breaking and let-through energy capacities of circuit breakers, fuses
- importance of fault/arc impedance
- calculation of fault currents - phase-to-earth faults
- calculation of fault currents - phase-to-phase faults
- analysis of asymmetrical faults currents.

T8 Harmonics in three phase systems encompassing:

- presence of triple in harmonics in 3 phase systems
- effects of 3 phase harmonics for different star and delta connections.
- methods for reducing harmonics in three phase systems.

Evidence Guide

EVIDENCE GUIDE

9) The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Training Package.

The Evidence Guide forms an integral part of this unit. It must be used in conjunction with all parts of this unit and performed in accordance with the Assessment Guidelines of this Training Package.

Overview of Assessment

9.1)

Longitudinal competency development approaches to assessment, such as Profiling, require data to be reliably gathered in a form that can be consistently interpreted over time. This approach is best utilised in Apprenticeship programs and reduces assessment intervention. It is the Industry's preferred model for apprenticeships. However, where summative (or final) assessment is used it is to include the application of the competency in the normal work environment or, at a minimum, the application of the competency in a realistically simulated work environment. It is recognised that, in some circumstances, assessment in part or full can occur outside the workplace. However, it must be in accordance with industry and regulatory policy.

Methods chosen for a particular assessment will be influenced by various factors. These include the extent of the assessment, the most effective locations for the assessment activities to take place, access to physical resources, additional safety measures that may be required and the critical nature of the competencies being assessed.

The critical safety nature of working with electricity, electrical equipment, gas or any other hazardous substance/material carries risk in deeming a person competent. Sources of evidence need to be 'rich' in nature to minimise error in judgment.

Activities associated with normal every day work have a bearing on the decision as to how much and how detailed the data gathered will contribute to its 'richness'. Some skills are more critical to safety and operational requirements while the same skills may be more or less frequently practised. These points are raised for the assessors to consider when choosing an assessment method and developing assessment instruments. Sample assessment instruments are included for Assessors in the Assessment Guidelines of this Training Package.

Critical aspects of evidence required to demonstrate

9.2)

Before the critical aspects of evidence are considered all prerequisites shall be met.

EVIDENCE GUIDE

competency in this unit

Evidence for competence in this unit shall be considered holistically. Each element and associated performance criteria shall be demonstrated on at least two occasions in accordance with the 'Assessment Guidelines - UEE07'. Evidence shall also comprise:

- A representative body of work performance demonstrated within the timeframes typically expected of the discipline, work function and industrial environment. In particular this shall incorporate evidence that shows a candidate is able to:
  - Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range statement
  - Apply sustainable energy principles and practices as specified in the performance criteria and range statement
  - Demonstrate an understanding of the essential knowledge and associated skills as described in this unit . It may be required by some jurisdictions that RTOs provide a percentile graded result for the purpose of regulatory or licensing requirements.
  - Demonstrate an appropriate level of skills enabling employment
  - Conduct work observing the relevant Anti Discrimination legislation, regulations, polices and workplace procedures
- Demonstrated consistent performance across a representative range of contexts from the prescribed items below:
  - Solve problems in complex polyphase power circuits as described in 8) and including:

    A Determining the operating parameters of existing circuit.

    B Using established problem solving methods.

    C Taking relevant measurements accurately.

    D Interpreting measured values appropriately.

    E Providing effective solutions to circuit problems from measurements and calculations.

    F Giving written justification of solutions provided.

    G Dealing with unplanned events by drawing on essential knowledge and skills to provide appropriate solutions incorporated in the holistic assessment with the above

EVIDENCE GUIDE

listed items.

Context of and specific resources for assessment

9.3)

This unit should be assessed as it relates to normal work practice using procedures, information and resources typical of a workplace. This should include:

- OHS policy and work procedures and instructions.
- Suitable work environment, facilities, equipment and materials to undertake actual work as prescribed by this unit.

These should be part of the formal learning/assessment environment.

Note:

Where simulation is considered a suitable strategy for assessment, conditions must be authentic and as far as possible reproduce and replicate the workplace and be consistent with the approved industry simulation policy.

The resources used for assessment should reflect current industry practices in relation to providing engineering solutions for solving problems in complex polyphase power circuits.

Method of assessment

9.4)

This unit shall be assessed by methods given in Volume 1, Part 3 'Assessment Guidelines'.

Note:
Competent performance with inherent safe working practices is expected in the industry to which this unit applies. This requires assessment in a structured environment which is primarily intended for learning/assessment and incorporates all necessary equipment and facilities for learners to develop and demonstrate the essential knowledge and skills described in this unit.

Concurrent assessment and relationship with other units

9.5)

There are no concurrent assessment recommendations for this unit.

Range Statement

RANGE STATEMENT

8) This relates to the unit as a whole providing the range of contexts and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

This unit shall be demonstrated in relation to providing engineering solutions to complex polyphase power circuits as they apply to problems related to electrical power engineering diagnosis and development work functions in any of the following types of circuit problems:

- Determining the operating parameters of an existing complex circuit
- Altering an existing complex circuit to comply with specified operating parameters
- Developing complex circuits to comply with a specified function and operating parameters

Generic terms used throughout this Vocational Standard shall be regarded as part of the Range Statement in which competency is demonstrated. The definition of these and other terms that apply are given in Volume 2, Part 2.1.

Unit Sector(s)

Not Applicable

Competency Field

2.2) Literacy and numeracy skills

Participants are best equipped to achieve competency in this unit if they have reading, writing and numeracy skills indicated by the following scales. Description of each scale is given in Volume 2, Part 3 'Literacy and Numeracy'

Reading	5	Writing	5	Numeracy	5

2.2) Literacy and numeracy skills

Competency Field **5**)

Electrical