

**1. Module details****Module name****Power System Components****Module duration**

It is expected that students with the appropriate entry knowledge and skills will successfully complete this module in 36 – 40 hours.

**Module code**

NUE205

**Discipline code**

0703130

**2. Module purpose**

This module is designed to provide knowledge of the equipment and arrangements used in a large electrical supply system. The module overviews the entire electrical supply grid from generation through transmission to distribution and the consumer. It covers the equipment, voltage levels, system arrangements, underground systems, overhead systems, substations, transformers and associated equipment, accessories and connection. The legislation and Acts relating to the different sections that have produced this system are discussed to understand the evolution and future trends.

**3. Prerequisites**

NE162 Electrical Principles 3.

**4. Relationship to competency standards**

This module addresses Units 3.5-3.10 and 3.13-3.16 of the E.S.I. National Competency Standards for Overhead Line Work and Cable Jointing and Units 5.2, 5.5, 6.1 and 6.2 of the Electrical Contracting Industry Award Standard (Volume 8).

**5. Content****Generation**

definition

primary energy sources

power stations

power station output

acts and legislation relating to generation

cogeneration

**Transmission**

system requirements

principal components of a power system

voltage levels

grid systems

acts/legislation relating to transmission

future trends

**Distribution**

high voltage distribution systems

medium/low voltage distribution system

radial feeders

parallel feeders  
 ring main feeders  
 acts/legislation relating to distribution  
 earthing systems

**Substations**

purpose  
 location  
 layout

**Transformers**

principles, basic construction and operation  
 double wound and auto-transformer types  
 instrument transformers  
 tappings  
 insulation resistance  
 continuity  
 winding identification and polarity marks  
 nameplate data  
 voltage regulation  
 tap changing devices (types / maintenance)  
 losses & efficiency  
 cooling (methods of cooling - natural / forced)  
 auxiliary equipment (breathers / dessicator, gauges, vents,  
 electrical/mechanical safety devices)  
 connections (methods, identifying connections, vector  
 groupings, tertiary windings, harmonics)  
 parallel operation  
 testing and fault finding

**Overhead and underground systems**

relative merits  
 applications  
 planning  
 installation

**6. Assessment strategy**

**Assessment methods**

Short answer questions (written, oral or graphic or computer based), multiple choice questions, oral questions, observations, assignments, other recognised methods.  
 Suitable practical exercises which assess the skills required of each learning outcome.

**Conditions of assessment**

Theory room for written tests together with practical field observation.

## 7. Learning outcome details

### Learning outcome 1

**Describe generation and name predominant types of generating systems used in Australia and the reasons for their adoption.**

### Assessment criteria

- 1.1 Define generation.
- 1.2 State the types of power station in use in Australia.
- 1.3 Explain the reasons for power station location.
- 1.4 Describe the overall layout of thermal and hydroelectric power stations.
- 1.5 Explain how power control is achieved to meet load requirements in both thermal and hydroelectric generating systems.
- 1.6 State the typical operating speeds for the thermal and hydroelectric generating sets.
- 1.7 State typical generator voltage levels and output ratings.
- 1.8 Name the body responsible for generation in a given state.
- 1.9 State the purpose of and describe typical types of co-generation systems.

### Learning outcome 2

**Explain the function of the transmission system within an overall power system.**

### Assessment criteria

- 2.1 State the basic requirements of a transmission system.
- 2.2 Name the principal components of a power system.
- 2.3 State the typical voltage levels for primary and secondary transmission.
- 2.4 Explain the advantages of a grid type transmission system.
- 2.5 Interpret information from a single line diagram of a transmission system.
- 2.6 Name the body responsible for transmission in a given state.

**Learning outcome 3****Describe the need for a distribution system within an overall power system.****Assessment criteria**

- 3.1 Describe two methods of high voltage distribution.
- 3.2 Describe four methods of medium/low voltage distribution
- 3.3 Identify radial, parallel and ring main feeders from a single diagram.
- 3.4 State the advantages and disadvantages of radial, parallel and ring main feeders.
- 3.5 Name the body responsible for distribution in a given state/area.
- 3.6 Earthing.

**Learning outcome 4****Explain the need for and the purpose of substations within the overall power system.****Assessment criteria**

- 4.1 State the reasons for incorporating substations in a power system.
- 4.2 Describe how substations are located in relation to load centres.
- 4.3 Describe the layout of high voltage equipment in a substation.
- 4.4 List the auxiliary equipment used in substations.
- 4.5 Interpret information from a single line diagram of the high-voltage equipment of a substation.

**Learning outcome 5****Explain the need for, applications and characteristics of power transformers and reactors.****Assessment criteria**

- 5.1 Describe the construction of a distribution transformer.
- 5.2 State significance of nameplate data items.
- 5.3 Describe the operation of a transformer under load/no load conditions.
- 5.4 Describe types of tap changing switches and the methods of operation.
- 5.5 Describe the function and operation of solid state tap changing equipment.

- 5.6 Calculate efficiency given losses.
- 5.7 Describe methods of natural and forced cooling.
- 5.8 State the function and describe the operation of various auxiliary equipment used on transformers.
- 5.9 State the vector group of a transformer from a connection diagram.
- 5.10 Connect a three-phase transformer to create a particular vector group.
- 5.11 State conditions/restrictions for parallel operation of transformers.
- 5.12 State the problems caused by harmonics in transformers and state methods used to overcome harmonics them.
- 5.13 Conduct tests and fault find on a transformer.
- 5.14 Describe the purpose and application of reactors.

**Learning outcome 6**

**Describe the relative advantages and disadvantages of overhead and underground supply systems within a power system.**

**Assessment criteria**

- 6.1 Describe the relative merits of overhead and underground systems.
- 6.2 List applications for overhead systems in the areas of transmission and distribution.
- 6.3 List applications for underground systems in the areas of transmission and distribution.
- 6.4 State the basic steps involved in the planning of an overhead and an underground distribution line.
- 6.5 State the basic steps involved in the installation of an overhead and an underground distribution line.

**8. Delivery of the module**

**Delivery strategy**

Delivery strategies must be suitable for both theoretical and/or practical learning and module purpose. It is recommended that learning and assessment be facilitated in a holistic manner which may require a learning sequence other than indicated in the body of this module descriptor.

**Resource requirements**

Relevant Australian Standards.  
Enterprise work manuals and standing instructions, diagrams and layouts.  
Relevant manufacturers' equipment/component/instrument manuals.

**Occupational health and safety requirements**

Students should be made aware of Occupational Health and Safety issues in all situations and be expected to demonstrate safe working practices at all times. Electrical safety must be emphasised.