| | | | |
|---|---|---|---|
| **Title** | **Demonstrate and apply knowledge of power system protection in the electricity supply industry** | | |
| **Level** | **6** | **Credits** | **15** |

| | |
|---|---|
| **Purpose** | People credited with this unit standard are able to:<br>• demonstrate knowledge of naming schemes used with protection relays<br>• describe and apply knowledge of protection scheme testing<br>• apply knowledge of the fault types identifiable in schemes used in power protection systems<br>• apply knowledge of the types, ratios, and classes of protection and instrument transformers used for measuring currents and voltages<br>• develop a single line diagram for a MV/HV substation.<br><br>This standard provides electricity supply industry power technicians with the fundamental knowledge of power protection and control network theory, and hardware. |

| | |
|---|---|
| **Classification** | Electricity Supply > Electricity Supply - Power System Maintenance |

| | |
|---|---|
| **Available grade** | Achieved |

**Guidance Information**

1 Evidence presented for assessment against this unit standard must be consistent with safe working practices and be in accordance with applicable legislative and industry requirements.

2 Legislation, regulations, and /or industry standards relevant to this unit standard include but are not limited to:
- Electricity Act 1992
- Health and Safety at Work Act 2015
- Electricity supply industry codes of practice and documented enterprise procedures, including *Safety Manual – Electricity Industry* (SM-EI) and relevant EEA guides available at www.eea.co.nz

and any subsequent amendments and replacements.

3 Abbreviations
*ANSI* – American National Standards Institute
*CT* – current transformer
*CVT* – capacitor voltage transformer
*DIN* – Deutsches Institut für Normung (German Institute for Standardization)
*DMT* – definite minimum time
*HV* – high voltage
*IDMT* – inverse definite minimum time
*IEC* – International Electrotechnical Commission
*MV* – medium voltage
*MVA* – mega volt ampere
*NER* – neutral earthing resistor
*PSM* – plug setting multiplier
*VT* – voltage transformer.

4 It is recommended that Unit 29732*, Demonstrate knowledge of electrical principles in power engineering*, and Unit 29734, *Demonstrate knowledge of power engineering mathematics* be achieved, or equivalent knowledge and skills are demonstrated, prior to assessment of this standard.

## Outcomes and performance criteria

### Outcome 1

Demonstrate knowledge of naming schemes used with protection relays.

### Performance criteria

1.1 Naming schemes as they apply to the IEC, ANSI and DIN standards, and the relationship between the standards, are identified and described.

1.2 Naming schemes as they apply to the IEC and DIN standards are coded and the significance of each flag is explained.

Range includes but is not limited to – instantaneous overcurrent, instantaneous earth fault, definite time, tripping auxiliary, inverse time overcurrent, inverse time earth fault, pilot wire, distance, under impedance, positive sequence, negative sequence, differential, directional (other than earth fault), temperature, change over, directional earth fault, differential earth fault, under voltage, over voltage, unidirectional (protection signalling), frequency, reverse power, oscillator lockout, bus supervision, busbar protection.

**Outcome 2**

Describe and apply knowledge of protection scheme testing.

Range must include three of – basic concepts of overcurrent relay DMT, IDMT), directional overcurrents, basic concept of earth fault protection and restricted earth fault protection, basic concept differential, basic distance protection, flash detection, circuit breaker fail, digital fibre, earth testing substation sites, NER and Peterson coils, trip circuit supervision.

**Performance criteria**

2.1 A test plan is developed for a simple distribution protection scheme.

2.2 Functional checks for one digital or electro-mechanical or solid-state protection relay are described and applied.

Range setup PSM, settings and curves, burdens.

**Outcome 3**

Apply knowledge of the fault types identifiable in schemes used in power protection systems.

Range includes but is not limited to – transient faults, high resistance faults, cross country faults incidence of faults on power system equipment.

**Performance criteria**

3.1 The common types of faults that can occur on electrical equipment are identified and named.

Range includes – generators, overhead power lines, power cables, transformers, busbars and motors, reactive power equipment.

3.2 The types of earthing systems are identified and the effect of a phase to earth fault on the electricity power system is described.

3.3 A protection proposal is developed to provide for the protection against earth faults.

3.4 A method of fault detection and clearance is described.

3.5 The effects of faults on the electricity power system, electricity power system stability, overloads and the effects of loss of supply are described.

3.6 The prospective fault MVA levels of a power system are calculated.

Range generators, feeders, transformers.

**Outcome 4**

Apply knowledge of the types, ratios, and classes of protection and instrument transformers used for measuring currents and voltages.

**Performance criteria**

4.1 The different types, ratios and classes of CTs, VTs and CVTs used for protection systems are described.

4.2 Protection CT and VT specifications, primary currents, and circuit burden are used to calculate functional operation of CTs and VTs.

Range includes but is not limited to – magnetisation curves, knee point saturation, protection versus metering types, ratios.

4.3 Safe working practices and precautions with CTs, VTs and CVTs are explained and applied.

4.4 Discrimination when using CTs and VTs is explained.

Range includes but is not limited to – supply networks, motors, transformers, generators.

4.5 The role and function of instrument transformers are described.

Range different classes, accuracy classifications, acceptance testing, earthing of secondaries.

4.6 Interconnection protection diagrams are drawn.

Range CT, VT, CVT.

**Outcome 5**

Develop a single line diagram for a MV/HV substation.

Range circuit breakers, disconnectors, earth switches, protection zones, feeders, CTs, VTs, bus zones.

**Performance criteria**

5.1 A simple power system single line diagram is developed.

| | |
|---|---|
| **Planned review date** | 31 December 2025 |

**Status information and last date for assessment for superseded versions**

| Process | Version | Date | Last Date for Assessment |
|---|---|---|---|
| Registration | 1 | 20 July 2017 | N/A |
| Rollover and Revision | 2 | 2 March 2023 | N/A |

| Consent and Moderation Requirements (CMR) reference | 0120 |
|---|---|

This CMR can be accessed at http://www.nzqa.govt.nz/framework/search/index.do.

**Comments on this unit standard**

Please contact Waihanga Ara Rau Construction and Infrastructure Workforce Development Council at qualifications@WaihangaAraRau.nz if you wish to suggest changes to the content of this unit standard.