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| **Title** | **Demonstrate advanced knowledge of electrical switchgear and switchboards** | | |
| **Level** | **5** | **Credits** | **5** |

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| **Purpose** | This unit standard is intended for the use in training and assessment of electricians beyond trade level. It covers electrical switchgear and switchboards including power-factor control, at a level more advanced than the requirements for the National Certificate in Electrical Engineering (Electrician for Registration) (Level 4) [Ref: 1195].<br><br>People credited with this unit standard are able to demonstrate advanced knowledge of:<br>– switchgear principles<br>– switchboard busbar sizes<br>– busbar mounting and spacing methods<br>– circuit breaker ratings<br>– power factor control<br>– industrial and commercial switchboards. |

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| **Classification** | Electrical Engineering > Electrical Installation and Maintenance |

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| **Available grade** | Achieved |

**Guidance Information**

1 Recommend skills and knowledge:
National Certificate in Electrical Engineering (Electrician for Registration) (Level 4) [Ref: 1195] or equivalent trade qualification for electricians.

2 This unit standard has been developed for learning and assessment off-job.

3 Reference
Hazardous Substances and New Organisms Act 1996
and all subsequent amendments and replacements.

4 Definitions
*Industry practice* – those practices that competent practitioners within the industry recognise as current industry best practice.
*ACB* – air circuit breaker.
*HFR* – harmonic filter reactors.
*MCCB* – moulded case circuit breaker.
*MVA* – megavolt ampere.
*PCB* – polychlorinated biphenyls.
*VSD* – variable speed drive.

## Outcomes and performance criteria

### Outcome 1

Demonstrate advanced knowledge of switchgear principles.

**Performance criteria**

1.1 Terms associated with power switching are defined in accordance with current industry practice.

Range terms – switchgear, ACB, MCCB, fuse switch, fuse disconnect, isolator, mains to generator changeover switches, power contactor, power factor switching contactors, control relays, solid state relays.

1.2 Principles of arc initiation and extinction are explained in terms of the properties of an arc.

### Outcome 2

Demonstrate advanced knowledge of switchboard busbar sizes.

Range three different busbars specified on switchboard drawings provided by the assessor.

**Performance criteria**

2.1 Busbar ratings are calculated from provided drawings and specifications.

Range current, voltage, fault level, temperature, derating, ambient temperature.

2.2 Busbar sizes are calculated from the rating in accordance with specifications and industry practice.

### Outcome 3

Demonstrate advanced knowledge of busbar mounting and spacing methods.

**Performance criteria**

3.1 Suitability of different fixing methods for two different busbar mounting applications is described in accordance with industry practice.

3.2 Methods of maintaining busbar insulation integrity during mounting are explained in accordance with industry practice.

3.3 Three methods of maintaining mechanical clearances between busbars are described and reasons for the need to maintain the clearances are explained in accordance with industry practice.

3.4 Methods for determining the clearance between busbar fixings are described and reasons for the need to maintain the clearance are explained in accordance with industry practice.

**Outcome 4**

Demonstrate advanced knowledge of circuit breaker ratings.

**Performance criteria**

4.1 Circuit breaker ratings are defined in accordance with industry practice.

Range voltage rating, full load current rating, breaking capacity.

4.2 Circuit breaker breaking capacity in MVA is calculated for given data in accordance with industry practice.

Range given data – voltage and short circuit current, percentage impedance, percentage regulation.

**Outcome 5**

Demonstrate advanced knowledge of power factor control.

**Performance criteria**

5.1 Installation, calibration, and maintenance of power factor equipment in industrial and commercial electrical installations is described in accordance with industry practice.

Range auto controller setup, method of optimum setup for individual plant, monitoring of power factor over a given period.

5.2 Selection of power factor equipment for an industrial or commercial electrical installation is explained.

Range selection of capacitors, high or low voltage, protection and selection of the contactors with damping resistors, use of surge protection.

5.3 Methods for identifying, removing, and disposing of PCB-filled capacitors are described in accordance with the Hazardous Substances and New Organisms Act 1996 and industry practice.

5.4 The use of HFRs is described in terms of the effect that VSDs and other electronic equipment have on power factors, and the reasons for these effects are explained.

**Outcome 6**

Demonstrate advanced knowledge of industrial and commercial switchboards.

**Performance criteria**

6.1 The purpose and functions of different types of switchboards are identified in accordance with industry practice.

Range distribution switchboards – main, submain, distribution; control and indication switchboards – control panels, control desk, motor control centre, power factor switchboards.

6.2 Relationships between switchboards in a large installation are explained using a line diagram, in accordance with current regulations and industry practice.

6.3 Different methods of switchboard construction are outlined in accordance with industry practice.

Range cubicle, enclosed modular, cabinet.

6.4 Methods used to plan layout of switchboards for a particular installation are outlined in accordance with manufacturers' data.

Range standard modular cubicles, jigsaw planners, plug-in modules.

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**This unit standard is expiring. Assessment against the standard must take place by the last date for assessment set out below.**

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

| Process | Version | Date | Last Date for Assessment |
|---|---|---|---|
| Registration | 1 | 26 February 2002 | 31 December 2013 |
| Review | 2 | 19 June 2009 | 31 December 2025 |
| Rollover and Revision | 3 | 15 March 2012 | 31 December 2025 |
| Revision | 4 | 15 January 2014 | 31 December 2025 |
| Rollover and Revision | 5 | 28 January 2021 | 31 December 2025 |
| Review | 6 | 27 April 2023 | 31 December 2025 |

| Consent and Moderation Requirements (CMR) reference | 0003 |
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This CMR can be accessed at http://www.nzqa.govt.nz/framework/search/index.do.