

## CS ENERGY PROCEDURE

# MAINTENANCE AND TESTING OF ENTITY WORKS, ELECTRICAL INSTALLATIONS AND ELECTRICAL EQUIPMENT CS-OHS-32

Responsible Officer: Electrical Engineering  
Responsible Manager: Asset Management  
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## 1 INTRODUCTION

### 1.1 Purpose

The purpose of this procedure is to detail specific electrical entity, installation and equipment compliance, inspection, testing and maintenance requirements. The procedure provides guidance and check sheets that are to be used to document the inspection and testing of modified or new electrical installations and provide evidence of compliance with AS/NZS 3000 – *Wiring Rules* and AS3017 – *Electrical Installations – Testing and Inspection Guidelines*.

### 1.2 Scope

This procedure is applicable to all electrical installations and equipment that are part of CS Energy Power Stations and workplaces, and all CS Energy employees and any other persons working at these locations.

This Procedure is to be used in conjunction with CS Energy *Modification Procedure (CS-AM-010)* and AS/NZS 3000, *Section 8* requirements.

### 1.3 Scope Exclusions

This Procedure does not address the specific inspection and testing frequencies of portable electrical equipment or the inspection and testing frequencies of residual current devices. Refer to CS Energy's CS-OHS-33 *Maintenance and Testing of Portable Electrical Equipment, RCDs and Tools procedure*.

## 2 MAINTAINING ENTITY WORKS

This section outlines the requirements associated with maintenance activities that interact, or are at risk of interacting with electrical assets, such as earthing systems, overhead lines, and underground cables.

### 2.1 General

#### 2.1.1 Safety

Management are responsible for ensuring that: CS Energy entity works, electrical installations, electrical equipment and associated equipment essential to generate and supply electricity are to be:

- electrically safe
- operated in a way that is electrically safe

#### 2.1.2 Requirements

The requirements for maintaining electrical installations as detailed in this procedure and the specific requirements as detailed in the *Electrical Safety Regulation – Part 9: Works of an Electricity Entity*, are to be complied with.

#### 2.1.3 Provisions

Provisions within this procedure address the following:

- electric lines and control cables
- clearance of overhead electric lines from ground
- clearance of overhead electric lines from structures
- building or adding to structure near electric line
- maintenance of works
- maintenance of integrity of insulation
- trimming of trees near overhead electric line

## 2.2 Safety and clearance requirements – design/construction/maintenance work

### 2.2.1 Compliance

CS Energy entity works, electrical installations, electrical equipment and associated equipment essential to generate and supply electricity are to:

- be designed, constructed and maintained to ensure they are electrically safe
- be operated in a way that is electrically safe
- meet thermal capacity to pass the electrical load for which they are designed
- have the capacity to pass short circuit currents to allow protective devices to operate correctly
- have enough mechanical strength to withstand anticipated mechanical stresses caused by environmental, construction or electrical service conditions
- restrict unauthorised access by persons to live exposed parts

### 2.2.2 Power Sites Maintenance Records

CS Energy power station sites must ensure the design, construction, operation and maintenance records necessary for the electrical safety of the works are be kept in an accessible form in the document management system.

### 2.2.3 Commissioning Tests

Electrical equipment must undergo commissioning tests to verify the equipment is suitable for service and can be operated safely when initially installed or altered.



**Requirement** – Labels are to clearly identify parts of the works where the identity or purpose is not obvious and are to be updated after any changes are made.

### 2.2.4 Line and Cable Clearance

Lines and cables are to be maintained so that clearances from the ground/roads and structures for low and high voltage cables are in accordance with the requirements of the Electrical Safety Regulations – Schedule 4 and 5.

## 2.3 Earthing and protection

### 2.3.1 Prevention of Injury System

Each power station site is to incorporate and maintain an earthing and protection system (to stop, as far as is practicable, a person suffering electric shock) capable of the following:

- reliable passage of fault current and operation of circuit protection devices
- safe step, touch and transfer potentials for all electrical equipment
- appropriate coordination with the earthing and protection systems of other entities
- protection against likely mechanical damage, inadvertent interference and chemical deterioration
- mechanical stability and integrity of connections
- effective earthing of neutral conductors (MEN system)
- earthing of each non-current carrying exposed conductive part of the generating plant

### **2.3.2 Permit Inclusions**

The Permit is to outline the measures taken to protect workers and the electrical works while the activities are being performed and to ensure the requirements for exclusion zones are complied with.

## **2.4 Vegetation Management**

### **2.4.1 Proximity to Power Lines**

Vegetation management is to be taken into account for trees and shrubs that are located at CS Energy Power Station sites and within close proximity of any overhead power lines associated with adjoining switchyards.

### **2.4.2 Monitoring Growth and Proximity**

Vegetation growth and work on or near the vegetation is to be monitored so that at any time, the growth of the trees or shrubs and/or a part of any person's body or anything they are holding or that is attached to their body, or anything they are using - in association with the vegetation - does not come within the exclusion zones.

### **2.4.3 When Not to Trim Vegetation**

A person is not to undertake tree trimming or vegetation management where:

- any part of the tree or vegetation to be treated or cut or otherwise worked with is within the exclusion zones
- any part of the tree or vegetation could fall or otherwise be carried within the safe approach distances

### **2.4.4 Formal Inspection Periods**

A formal documented inspection is to be undertaken of all site vegetation every six months to check if growth is within the exclusion zones.

## **2.4.5 PTW Requirements**

A Permit to Work is required for any work on or near vegetation that may be within the exclusion zones.

## **2.5 Hazard Identification**

### **2.5.1 Prerequisite Activities**

Before carrying out any vegetation management work, a JSEA is required to identify potential hazards and suitable control measures. Hazards to be considered include, but are not limited to, the following:

- proximity of vegetation and proposed work activity to electric lines (e.g. if the vegetation involved is located within exclusion zones)
- the vegetation or part of the vegetation may fall or otherwise be carried into the area within exclusion zones
- carrying out the task would cause a person or anything a person may be holding, or in contact with, to intrude into exclusion zones
- wind causing intermittent encroachment of vegetation into the exclusion zone or wet weather making the situation more dangerous
- fires and smoke associated with the vegetation may cause trips or damage to the overhead wires, towers and insulators
- cutting equipment such as chain saws, which may "kick back", causing equipment to move inadvertently

- site conditions such as weather (wind), terrain, vehicular and other traffic. For example, heavy traffic on an adjacent roadway could prevent safe access to vegetation
- operational characteristics of equipment eg length of boom and speed of movement of an elevating work platform (EWP). An example of an operational characteristic that may present a hazard is with knuckle boom EWPs, where convenient placement of the basket can have part of the boom intruding into roadways or other hazardous areas

## 2.6 Electrical Contractor Licensee (Qualified Technical Person)

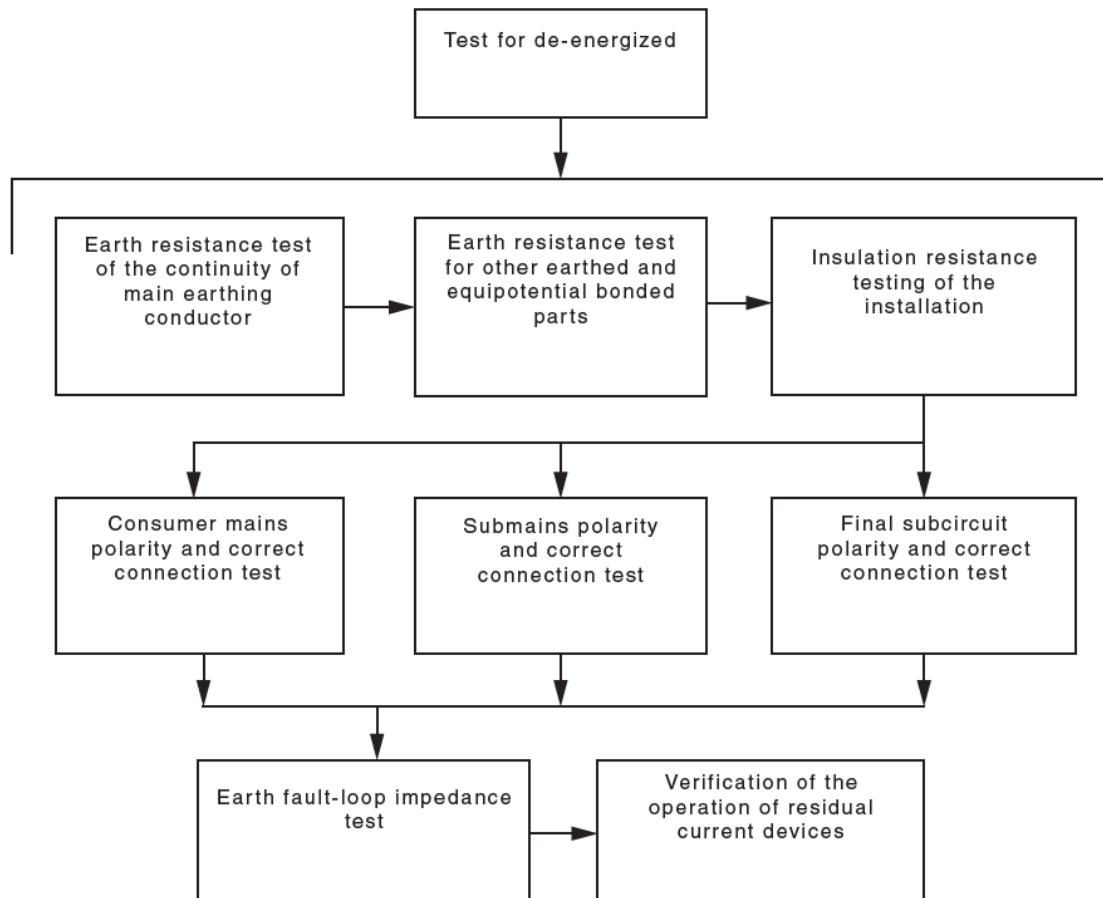
### 2.6.1 Inspect and Test

The Electrical Contractor Licensee is to inspect and test the electrical installation and ensure compliance to AS/NZS 3000 where electrical contracting work has been performed for a party other than CS Energy. The Electrical Contractor Licensee may allow another competent electrician to perform the inspection and tests', providing the Licensee coordinates such tasks and also endorses the result sheets.



**Important Note –** If the work is not contracting work for a party outside of CS Energy, the electrical worker is to ensure compliance and sign the test certificate. No further signature is required by the Licensee.

**Figure 1 Electrical Testing Flow Chart**



**NOTE** The sequence of tests shown in this figure is recommended. Tests performed out of sequence may result in invalid results for subsequent tests.

## 2.7 Recording of Inspections and Testing

### 2.7.1 Maintenance Activities

For maintenance activities, once the inspection and testing tasks are completed, the Electrical worker is to sign the Certificate of Testing and Compliance (S1975).

### 2.7.2 Schedule Records

Power Station specific cable schedule records are to be updated as appropriate and circuit schedules on switchboards are to be updated in a legible way. Consideration is to be given to re-typing circuit schedules on switchboards where a number of modifications have been made.

### 2.7.3 Testing and Compliance Certificate

The certificate of testing and compliance is to be filed in the site CS Energy file for that particular modification and/or in the site maintenance files.



- A second copy of the certificate may be stored in the sites central register for audit purposes.

## 3 SPECIFIC AS/NZS 3000 TESTING

Part of the verification process of electrical work, is inspections and tests. These inspections and tests are discussed in some detail here, as are the requirements for long term storage. Form S1975 is used to document that the inspections and tests have been performed.

### 3.1 Test for de-energised

#### 3.1.1 Australian Standards requirements

Before any electrical testing can be undertaken, the presence of any voltage shall be identified. Irrespective of the type of tests (continuity, insulation resistance) being performed, a test to confirm whether any voltage is present on the circuit(s) under test shall be performed before any further actions.

**Confirming the absence of supply voltage on active conductors is not sufficient.**

**WARNING: ALL ELECTRICAL CONDUCTORS, INCLUDING EARTHING CONDUCTORS, SHALL BE TREATED AS ENERGIZED UNTIL PROVEN DE-ENERGIZED.**

**Caution is needed when disconnecting an MEN link or connections of the main earthing conductor, in case either is carrying current.**

### 3.2 Earth Continuity & Resistance Test

#### 3.2.1 Requirements of Australian Standards

As AS/NZS 3000 does not specifically state a required impedance limit for earth conductors other than the main earth, the following method based on the required fault loop impedance is to be used.

#### 3.2.2 Mandatory Disconnection Times

The disconnection time required for each protective device is to be determined. For 230/240 Volts, AS/NZS 3000, Section 1.5.5.3 requires these to be:

- 0.4 seconds for socket outlets <63A, hand held Class I equipment, and portable equipment intended for manual movement during use.
- 5 seconds for sub-main and final sub-circuits supplying fixed or stationary equipment.

The circuit breaker type or fuse type and rating are to be confirmed.

Table 8.2 in AS/NZS 3000 is to be used to determine the maximum values of resistance of final subcircuits (for 415/240 V LV circuits) fed through miniature circuit breakers.

### **3.3      Equipment Bonding Conductor Test**

#### **3.3.1     Requirements of Australian Standards**

All equipotential bonding conductors shall not have a resistance exceeding  $0.5\Omega$ . Refer to Section 4.4.5.3 of AS/NZS 3017: for test procedure.

### **3.4      Earth Fault Loop Impedance (EFLI) Test**

#### **3.4.1     Australian Standards requirements**

EFLI testing is not required for RCD-protected socket-outlets.

Section 4.8.5 of AS/NZS 3017 outlines the test procedure for fault loop impedance. The maximum allowed fault loop impedance for 230/240 volts (400/415 volts 3 phase) is defined in Table 8.1 of AS/NZS 3000.

### **3.5      Inspection and maintenance of integrity of insulation**

#### **3.5.1     Insulation Integrity**

The integrity of the insulation of an electric line forming part of the power station site electrical works (entity works) is to be inspected and maintained at periodic intervals.

#### **3.5.2     Inspectors Obligations**

The person performing the inspections and maintenance work is to check the integrity of the electrical insulation where the line:

- forms parts of the entity works.
- is adjacent to a roof or structure.
- is in a position where it is likely that a person could come into contact with the line (e.g. cooling tower fan motor cables, Electric Feed Pump motor cables, Induced Draft fan motor cables, persons painting near cables, sections of conduit from underground cables to electric motors, sections of cable trays that are accessible).

#### **3.5.3     Maintenance Practice Inclusions**

Maintenance practices are to include visual inspections and Polarisation Index insulation resistance testing of cables at regular intervals – such as during an overhaul.

A compliant testing and maintenance routine/plan is to be implemented in SAP to reflect this requirement.

## 4 DEFINITIONS

Term	Definition
<b>Electrical Contractor Licensee</b>	A person nominated on CS Energy's Electrical Contractors Licence responsible for inspection and testing of electrical installations. Also called the Qualified Technical Person.
<b>Electrical Equipment</b>	<p>Is any apparatus, appliance, cable, conductor, fitting, insulator, material, meter or wire:</p> <ul style="list-style-type: none"> <li>• used for controlling, generating, supplying, transforming or transmitting electricity at a voltage greater than extra low voltage, or</li> <li>• operated by electricity at a voltage greater than extra low voltage, or</li> <li>• is part of an electrical installation located in an area in which the atmosphere presents a risk to health and safety from fire or explosion, or</li> <li>• is, or is part of, a cathodic protection system.</li> </ul> <p><b>Note</b></p> <p><i>Electrical equipment does not include any apparatus, appliance, cable, conductor, fitting, insulator, material, meter or wire that is part of a vehicle if the equipment is part of a unit of the vehicle that provides propulsion for the vehicle, or the electricity source for the equipment is a unit of the vehicle that provides propulsion to the vehicle</i></p>
<b>Electrical Installation</b>	<p>Is a group of items of electrical equipment that-</p> <ul style="list-style-type: none"> <li>• are permanently electrically connected together, and</li> <li>• do not include items that are works of an electricity entity, and</li> <li>• can be supplied with electricity from the works of an electricity entity or from a generating source.</li> </ul> <p><b>Note</b></p> <p><i>An item of "electrical equipment" may be part of more than 1 electrical installation and for item one above:</i></p> <ul style="list-style-type: none"> <li>• an item of electrical equipment connected to electricity by a plug and socket outlet is not permanently electrically connected, and</li> <li>• connection achieved through using works of an electricity entity is not a consideration in determining whether or not electrical equipment is electrically connected.</li> </ul>
<b>Modification Procedure</b>	Is the CS Energy Corporate Procedure (CS-AM-010), that detail specific process, documentation and approval requirements for undertaking modifications to plant and equipment.
<b>Residual Current Device (RCD)</b>	A mechanical switching device designed to make, carry and break currents under normal service conditions and to cause the opening of the contacts when the residual current attains a given value under specified conditions.
<b>Works of an Electricity Entity (Entity Works)</b>	<p>Means the electrical equipment, and electric line associated equipment, controlled or operated by the entity to generate, transform, transmit or supply electricity.</p> <p><b>Note</b></p> <p><i>Electrical equipment for circulating water pumps, conveyors, chemical plant, etc on site are works of an electricity entity, whereas appliances or fixed wiring in an electricity entity's workshop or office areas is not</i></p>

## 5 REFERENCES

Reference No	Reference Title	Author
	Electrical Safety Act 2002 (Qld)	Qld Govt
	Electrical Safety Regulation 2013 (Qld)	Qld Govt
<a href="#">Techstreet</a>	AS/NZS 3000 – Electrical Installations	Standards Aust
<a href="#">Techstreet</a>	AS/NZS 3008 – Electrical Installations – Selection of Cables	Standards Aust
<a href="#">Techstreet</a>	AS/NZS 3017 – Electrical Installations – Verification Guidelines	Standards Aust
<a href="#">Techstreet</a>	AS/NZS 3760 – In-service Safety Inspection and Testing of Electrical Equipment	Standards Aust
<a href="#">B/D/11/30957</a>	Procedure - CS-OHS-31 - Electrical Safety Management	CS Energy
<a href="#">B/D/11/30960</a>	Procedure - CS-OHS-34 - Selection, Maintenance and Use of Electrical Safety Equipment and PPE	CS Energy
<a href="#">B/D/10/7377</a>	Procedure - CS-AM-010 - Plant Modification Procedure	CS Energy
<a href="#">B/D/12/7183</a>	Form - S1975 - Electrical Certificate of Testing and Compliance (COT)	CS Energy
<a href="#">B/D/11/30959</a>	Procedure CS-OHS-33 – Maintenance and Testing of Portable Electrical Equipment, RCDs and Tools	CS Energy

## 6 RECORDS MANAGEMENT

In order to maintain continual improvement, suitability, safety and effectiveness of the organisation, registered documents will be reviewed on a two-yearly basis or at intervals specified by legislative or regulatory requirements. Review of controlled documents should occur where it has been identified that there are changes in technology, legislation, standards, regulation or where experience identifies the need for alteration to the content. Registered documents should also be reviewed following an incident, change management process, modification or where directed as part of a risk assessment process. A 'review' can simply mean that it has been identified, confirmed and appropriately recorded that no changes are required and that the existing process remains the same.

Government Owned Corporations must ensure that records are retained according to accountability, legal, administrative, financial, commercial and operational requirements and expectations. In compliance with records retention and disposal, all documentation created in relation to business must be retained in line with minimum retention periods as detailed in legal retention and disposal schedules.

## 7 CONVENTIONS USED IN THIS DOCUMENT

The following conventions and icons are used throughout this document to draw attention to critical information.

### Note – Highlight or Emphasis



- Include short note to highlight important information.

### Note – High Priority Focus



**Important Note – Insert key information requiring high priority focus.**

### Note – Reference Priority



**Refer to – XYZ external or internal reference document for further direction.**

### Note – Required Competency / Qualification Level



**Competency Level – Insert competency / qualification level.**

### Note – Rule or Requirement



**Requirement – Insert Business Rule or Industry Requirement**