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# **Safe Working on or near low voltage electrical installations & equipment**

**Guidance Notes**

**COR/15/21109**

**Version 1.11 – 28 June 2017**

**Gippsland Water**

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	<b>Name</b>	<b>Date</b>
<b>Written by</b>	Chris Madsen/Peter Jenkins	June 2015
<b>Reviewed by</b>	Review Working Team	June 2015
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## Document History

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1.1	27/08/2015	C Madsen	Updated with PPE requirements
1.2	21/09/2015	C Madsen	Final incorporating comments from review team
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1.4	May 2016	P Stewart	Updated definitions
1.5	June 2016	P Stewart	Updated with comments from Electrical Standards Committee
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1.7	September 2016	P Stewart	Updated with grammatical comments from Optec
1.8	December 2016	P Stewart	Updated level 2 fault level, removed list of sites, added air circuit breakers, updated PPE table, added reference to risk assessment
1.9	April 2017	P Stewart	Clarifies working live, PPE
1.10	May 2017	P Stewart	Added authorisation level 2C
1.11	28 June 2017	P Stewart	Updated competency requirements (licenses) for access levels 2 and 3.

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# 1 Introduction

## 1.1 Purpose

This document specifies the minimum requirements for low voltage electrical safe work practices to be applied to all works conducted by Gippsland Water employees and their contractors as a means of ensuring the safety of all personnel working in the vicinity of low voltage electrical equipment and / or apparatus.

Low voltage is defined as 50 to 1000 Volts AC or 120 to 1500 Volts DC (AS/NZS 4836:2011 Clause 1.6.28).

## 1.2 Key Definitions

*(AS/NZS 4836:2011 Section 1.6)*

For the purposes of this document, the following definitions apply:

**Electrical work** (AS/NZS 4836:2011 Clause 1.6.9):

“The actual physical work of installing, maintaining, repairing, altering, removing or adding to an electrical installation, or the supervising of that work.”

Electrical work does not include:

- Replacing electrical equipment or a component of electrical equipment if that task can be safely performed by a person who does not have expertise in carrying out electrical work (e.g. replacing shrouded fuses or light bulbs)
- Undertaking isolations for lock-out tag-out permits where there is no exposed live electrical equipment.
- Normal operation of plant using plant controls where there are no exposed conductive parts.

Note that electrical work on high voltage equipment is covered by the Victorian Code of Practice for Electrical safety on or near High Voltage - Blue Book, and other GW HV Procedures.

For extra low voltage electrical work these requirements are recommended but not mandatory.

**Electrical Fault Finding** (AS/NZS 4836:2011 Clause 1.6.14):

“The Process of taking measurements or carrying out tests on electrical installations and equipment to locate faults or prove operability. It may also include the process of applying testing instruments or devices to various parts of the electrical installations and equipment to determine how the electrical installation and equipment is operating.”

## 2 Application

This document provides safety guidance for Gippsland Water Employees and Contractors who work on or near low voltage electrical installations and assets, including access to electrical cubicles.

Gippsland Water has adopted AS/NZS 4836:2011 (Safe working on or near low-voltage electrical installation and equipment) as the standard which will provide a safe working environment for work on or near low-voltage electrical installations.

This document is to be read in conjunction with AS/NZS 4836:2011 and is designed to constitute a set of minimal recommended procedural and safety requirements for a safe working environment for all low voltage electrical work.

AS/NZS 4836:2011 outlines principles and procedures of safe work, organisation and performance on or near low-voltage electrical installations and equipment. The standard provides a minimum set of procedures, safety requirements and recommendations to manage the hazards associated with electricity, specifically arc flash and electric shock.

This Guidance document provides clarification in regard to a number of specific requirements of AS/NZS 4836:2011 where Gippsland Water has in house procedures and process that need to be stated to remove ambiguity or the risks associated with individual interpretation.

This guidance document takes lower precedence, where it is found to be in conflict with any Victorian Government Acts and statutory regulations or guidance documents issued by Energy Safe Victoria.

This guidance document is not intended to apply to work performed on Extra Low Voltage, High Voltage or supply distribution systems of Electrical Supply Companies. It also does not include work in the vicinity of overhead power lines where Worksafe 'No Go Zone' guidelines are to be applied.

This guidance document and AS/NZS 4836:2011 apply to all persons carrying out work on or near low-voltage electrical installations and equipment at Gippsland Water sites.

This guidance document also applies to construction and demolition sites, in conjunction with AS/NZS 3012 Electrical Installations – Construction and demolition sites. Further information about Construction work can be found in the WorkSafe Industry Standard, "Electrical installations on construction sites".

## 3 Authorisation & Competency

### 3.1 General

- All persons, including electrical workers, supervisors, safety observers and those assisting electrical workers working on or near electrical installations or equipment, shall understand the scope of work and the potential hazards and risks involved in working on or near electrical installations or equipment. They should be capable of always maintaining an adequate physical and mental ability when working on or near electrical installations and equipment. If personnel are temporarily or permanently physically or mentally impaired, e.g. under the influence of alcohol, drugs, fatigue or are injured to a level that adversely affects their work performance, they shall not participate in the work.

- Personnel working on or near exposed energised conductors or live conductive parts or electrical equipment must have appropriate training, be competent and familiar with the equipment and be aware of the potential risks involved. In some situations, specific training and authorisation might be required or necessary before proceeding with the work. Personnel must ensure that relevant authorisation has been granted before proceeding with the work
- All personnel and contractors undertaking electrical work must provide a copy of their current certificate of competency to GW upon request.
- Individuals and Supervisors are still responsible to conduct risk assessments and be familiar with the particular installation and equipment prior to commencing work.

### 3.2 Authorisation levels

Authorisation levels are:

- **Level 1** – allows access to level 1 labelled cabinets to operate plant controls, or switch miniature circuit breakers or moulded case circuit breakers, where there are no exposed live conductive parts (dead front) and there are no air circuit breakers.
- **Level 2** – allows level 1 access, and access to level 2 labelled cabinets with exposed electrical equipment to inspect, operate or reset miniature circuit breakers, thermal overloads, pushbuttons or instrument displays where required for operational purposes.
- **Level 2C** – allows access to level 2 cabinets to perform communications or instrumentation testing or configuration and plugging or unplugging cables. Does not allow fitting off cables or drilling or punching holes.
- **Level 3** – allows level 1 and 2 access, and authorised to inspect or conduct work on the installation, in accordance with the relevant electrician's license or restricted electrical worker's license (disconnect reconnect).

### 3.3 Training

#### Level 1

To be authorised for Level 1, individuals must complete the following:

- GW online induction

For level 1, GW will provide an induction card to contractors to certify that the online induction has been completed

#### Level 2

To be authorised for Level 2, individuals must complete the following:

- GW online induction
- Successfully complete training for level 2 electrical access that covers this guidance document.

For level 2 a register will be maintained by GW for employees (via ConnX) and contractors (training register) that appropriate training has been completed.

### **Level 2C**

To be authorised for Level 2C, individuals must complete the following:

- GW online induction
- Successfully complete training for level 2 electrical access that covers this guidance document.
- Provide evidence of competency in communications (registered cabler's license) or instrumentation work (instrument technician license).

For level 2C a register will be maintained by GW for employees (via ConnX) and contractors (training register) that appropriate training has been completed.

### **Level 3**

To be authorised for Level 3, individuals must complete the following:

- GW online induction (for awareness)
- Provide evidence of competency with an electrician's license or restricted electrical worker's license (disconnect reconnect).

Authorisations for all levels will be renewed every three years.

## **3.4 Labelling**

For cabinets within Gippsland Water fenced sites, every electrical cabinet hinged door shall be labelled:

A level 1 label shall be applied if behind the door is:

- A dead front AND
- There are no air circuit breakers

OR the cabinet only contains extra low voltage

A level 2 label shall be applied if behind the door is:

- Not level 1 access AND
- Meets IP2X protection from contact (including any door mounted equipment) AND
- The supply current (supply CB or fuse outside of compartment) doesn't exceed 100 Amps AND
- The fault level doesn't exceed 7 kA AND
- There is not a door mounted isolator AND
- There are no air circuit breakers

A level 3 label shall be applied if behind the door is:

- Not level 1 access AND

- Not level 2 access

Note: If there is an outer door and an escutcheon door, the outer door shall be labelled for what is behind it, and the escutcheon door shall be labelled for what is behind it. The outer door will usually have a lower access level.

For cabinets in public areas (outside Gippsland Water fenced sites), the control panel outer door, and the escutcheon door behind it shall be labelled, as per the criteria above. Also any doors which are level 1 access, eg dead front with instruments or circuit breakers.

Cabinets shall be assessed and labelled by a level 3 authorised person.

When labels are applied, a record shall be kept in the GW records management system.

Level 3 labels shall include the arc flash energy category (cal/cm<sup>2</sup>) on the label. These categories will be <1, 1-3, 3-8, >8.

## 4 Control Measures

### 4.1 Lock Out Tag Out and Permit to Work

All access to electrical cabinets shall be undertaken in accordance with the following:

- **Level 1** - Access for normal operation of plant and equipment, where the controls are located on a 'dead front' panel or escutcheon door does not require a JSEA/SWMS or work permit.
- **Level 2** - Access to cabinets with live exposed equipment (eg where there is no escutcheon door) for inspection or resetting of equipment must be undertaken in accordance with a written JSEA/SWMS or Standard Operating Procedure (SOP).
- **Level 3** - Access to cabinets with normally live equipment, for fault finding, testing or to undertake electrical work requires a JSEA/SWMS AND a work permit. All such work shall be carried out in accordance with the GW SWMS procedure (COR/07/25119) and the GW permit to work lock and tag out procedure (COR/09/5672).

### 4.2 Safety Observers

*(AS/NZS 4836:2011 Section 6)*

An assessment of all risks involved in undertaking work associated with either live (energised) or de-energised equipment must consider all factors which may have the potential to cause injury or damage. Should this potential exist, precautionary measures may include the use of an independent observer.

Where it is established via a risk assessment that an observer is deemed necessary for any work in close proximity to live electrical equipment then work must not be undertaken without the presence of an observer.

### 4.3 Basic Electrical Safety Principles

*(AS/NZS 4836:2011 Section 3.2)*

A person working on or preparing to work on or near exposed low voltage electrical equipment, conductors and / or apparatus shall treat all such equipment, conductors and / or apparatus as energised (live) until they are isolated and proved to be de-energised by a recognised test procedure.

**All electrical conductors and parts including neutral and earthing conductors shall be treated as energised until proven de-energised. "Test before you touch".**

### 4.4 Other Sources of Energy

Care must be taken to ensure all sources of energy have been isolated and/or discharged – eg capacitors, VSDs and Uninterruptible Power Supplies. A number of GW sites have dual supplies to items of equipment, and all sources of supplies must be checked and isolated before working on equipment.

## 4.5 Arc Flash and High Fault Currents

(AS/NZS 4836:2011 Section 2.3.3)

When working on live electrical equipment, fault currents up to 20 times the rated supply current of the transformer may occur during fault conditions. This has significant potential for injury to personnel and damage to equipment in the event of a fault. Arc energy under these conditions can cause an explosion and/or melt metallic cubicles and conductors and cause severe burns.

It is essential that electrical workers are familiar with the effects of high fault currents and that appropriate safe working procedures are adopted when working on electrical equipment, conductors or apparatus.

Precautions and safe working procedures include but are not limited to the following:

- Isolating the equipment from all sources of supply
- Keeping all covers in place and doors closed unless absolutely necessary
- Using suitable insulated tools including mats / covers and specially designed test equipment
- Wearing appropriate personal protective equipment (refer to section 8 on PPE)
- Earthing of equipment prior to commencing any work
- Use of a safety observer

### Air Circuit Breakers

Electrical installations with air circuit breakers (ACBs) conduct high currents and are capable of very high fault currents. Switching of ACBs is restricted to level 3 authorised persons, and then only if the ACB is on a dead front. ACBs cannot be switched if the dead front panel is opened. Refer to risk assessment COR/16/54603 for more information.

## 5 Working Live

(AS/NZS 4836:2011 Section 3.5)

Working on or near live equipment cannot be accepted as being as safe as working on isolated equipment. Note that fault finding, testing and inspection is not working live. Refer to definitions in section 1.2, and also the next section.

Working on live equipment is not allowed.

Working near (within 500mm) live equipment is strongly advised against and must only be considered as a last resort. Priority is to be given to scheduling the work when the power can be isolated. If work near live equipment is performed the following conditions must be met:

- A written risk assessment is to be completed prior to commencing work.
- No live work allowed on cabinets with supply current exceeding 100A, or fault level exceeding 7 kA, or where there are exposed conductors not meeting IP2X.
- Wear appropriate PPE and use only appropriate tools and equipment.
- Live work is not to be done alone.
- Consider the need for a safety observer.
- No live work allowed by restricted (disconnect/reconnect) electrical workers or apprentices.
- No drilling or cutting metal is allowed.
- Refer to flow chart in figure 3.1 of AS/NZS 4836:2011 for further guidance.

## 6 Fault Finding, Testing and Inspection

(AS/NZS 4836:2011 Section 3.3)

Isolating power should always be the first choice, however there may be instances when fault finding, testing and inspection and or obtaining test results is only possible whilst equipment is live, and other safety precautions need to be taken. Where fault finding is required on live equipment, the precautions listed in these guidance notes and Section 4.5 and in AS/NZS 4836:2011 Clause 3.3 shall apply.

In addition to complying with these guidance notes, any electrical fault finding, testing and inspection shall be carried out in accordance with the GW Low Voltage Electrical Fault Finding, Testing and Inspection Guidance Notes (refer Section 10.5).

## 7 Test Equipment & Tools

Test equipment including leads and probes must be appropriate for the tests being performed. The equipment must be suitable for use on the highest voltage likely to be encountered in accordance with its operating instructions. GW requires that a minimum of Cat III 600V test equipment shall be used.

Appropriate tools should be chosen to suit each particular job, and properly designed and correctly insulated tools must be used. All hand tools used in close

proximity to live electrical equipment and used in contact with live electrical equipment must be insulated to the highest potential voltage likely to be encountered. All tools and equipment must be in good order and regularly maintained

## 8 Personal Protective Equipment

(AS/NZS 4836:2011 Section 9)

All protective equipment (PPE) shall be selected in accordance with the risk assessment and with the type of work being performed. This table has been based on Table 9.2 of AS/NZS 4836:2011 and a risk assessment (COR/16/54603).

This table is provided to assist workers and supervisors understand the recommended personal protective clothing and equipment required for various types of electrical work.

### Level 1 and Level 2

Level	Task	PPE
1	Operation of plant controls, switching or isolating (Dead Front)	Non-flammable clothing preferred
2	Resetting, switching, isolating, Inspection or observing (Level 2 cabinet)	8 cal clothing Safety glasses Leather gloves

### Level 3

Where the arc flash energy has been calculated, it should be used to determine PPE. Where the arc flash energy has not been calculated, the fault level (prospective short circuit current) should be used to determine PPE. Where the arc flash energy and fault level have not been calculated, the supply current rating should be used to determine PPE.

Level	Arc flash energy	Up to 1 cal/cm <sup>2</sup>	1 to 3 cal/cm <sup>2</sup>	3 to 8 cal/cm <sup>2</sup>	Over 8 cal/cm <sup>2</sup>
	Fault level (prospective short circuit current)	Up to 7 kA	7 to 19 kA	19 to 45 kA	Over 45 kA
	Supply current rating	Up to 100 A	100 to 400 A	400 to 1400 A	Over 1400 A
3	Dead electrical work (isolated and verified)	Non-flammable clothing or 8 cal clothing			
	Switching or isolating (Dead Front)	Non-flammable clothing or 8 cal clothing	8 cal clothing Safety glasses	8 cal clothing Arc faceshield Leather gloves Hearing protection	Full covering rated to arc flash energy Hearing protection
	Testing or fault finding, removing fuses or links (Inside a live cabinet)	8 cal clothing Safety glasses Insulated gloves	8 cal clothing Safety glasses Insulated gloves	8 cal clothing Arc faceshield Insulated gloves with leather overgloves Hearing protection	Full covering rated to arc flash energy Hearing protection
	Live electrical work	8 cal clothing Arc faceshield Insulated gloves	Work not permitted		

#### Notes:

8 cal clothing refers to protective clothing with an arc thermal protective value (ATPV) of at least 8 cal/cm<sup>2</sup>. HRC2 arc rated clothing provides protection to at least 8 cal/cm<sup>2</sup>.

Insulated gloves refers to gloves complying with EN 60903 class 00 (500V) or class 0 (1000V). It is recommended that insulated gloves are worn with leather outers to prevent damage to the insulated gloves.

Arc faceshield (with chin cup) is to be rated to the arc flash energy of the switchboard being worked on.

## 9 Electrical Incident Reporting & Treatment

Gippsland Water requires that any person receiving an electric shock or involved in an electrical incident contributing to an injury shall be provided with medical attention immediately.

In accordance with requirements under the Victorian OH&S Act, the area where the incident occurred must be preserved so an investigation can be carried out. The scene must also be made safe to ensure other personnel cannot be injured.

Any person who sustains an electric shock must attend the nearest medical facility (e.g. hospital, medical centre, doctor, etc) as soon as possible after the incident. This is a precautionary medical assessment. This is imperative as the effects of electric shock can often only become apparent some time after the event.

All electrical incidents and electric shocks shall be reported immediately to a responsible person and to any organisation required by legislation (eg Worksafe and GW's notification protocols). Gippsland Water's supervisor or Contract Manager must also be notified immediately of the incident, so Gippsland Water can participate in any investigation or learnings.

It is important that incidents requiring statutory notification are reported in a consistent manner and are investigated in accordance with both Gippsland Water and legislative requirements. Contractors must keep Gippsland Water fully up to date with all aspects of their investigation and reporting, and any advice given to outside authorities.

Further details are contained in GW's Incident Reporting flowchart (COR/12/5967).

## 10 References

Electrical Work, and Electrical Fault Finding, Testing and Inspection will be carried out in accordance with this document, and the following references:

- AS/NZS 4836:2011 – Safe working on or near low-voltage electrical installations and equipment.
- AS/NZS 3000 Wiring Rules
- AS/NZS 3012 – Electrical installations – Construction and demolition sites.
- Gippsland Water Permit to Work – Tag & Lock out procedure – COR/09/5672
- Low Voltage Electrical Fault Finding Testing and Inspection Guidance Notes – COR/15/30786
- Risk Assessment to support Low Voltage Guidance Notes – COR/16/54603
- GW SWMS Procedure – COR/07/25119
- GW Incident Reporting Flowchart – COR/12/5967