



Government of **Western Australia**  
Department of **Commerce**  
**EnergySafety**



Guidelines for the  
**Safe management of high voltage  
electrical installations**

April 2014

## Preface

These guidelines for the safe management of high voltage electrical installations are issued under Section 33AA of the *Electricity Act 1945* (WA) by the Director of Energy Safety and are endorsed by WorkSafe.

The risks and potential consequences of an electrical incident involving high voltage are significantly higher than low voltage due to the much higher quantities of energy involved. This justifies stringent safety designs and operating procedures to prevent injury to persons and major damage to electrical installations and buildings.

I strongly recommend compliance with the practices and procedures set out in these guidelines. Should you have any suggestions and comments on these guidelines, please send them to me in writing and I will be pleased to consider them.



**Ken Bowron**

DIRECTOR OF ENERGY SAFETY

## ENDORSED:



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## Summary

- The “responsible persons” for premises with high voltage (HV) electrical installations are required to comply with all relevant technical and safety requirements for the duration of the operating life of the electrical plant, including:
  - design and construction;
  - maintenance; and
  - operation.
- These guidelines complement, and should be read together with, other related documents including (but not limited to):
  - Electricity (Licensing) Regulations 1991
  - The WA Electrical Requirements
  - Network operators’ technical rules
  - Relevant technical standards
  - *Occupational Safety and Health Act 1984*
  - Occupational Safety and Health Regulations 1996
  - The Western Australian Distribution Connections Manual
- Technical requirements for design purposes are covered by legislation and technical standards and are not repeated in these guidelines.
- Design proposals for all installations connected to a network at voltages greater than 1kV are required to be submitted to the network operator for assessment (“HV submission”).
- A comprehensive electrical safety management plan and safe working procedures should be developed and maintained for all HV installations.

## 1. Introduction

### 1.1 Duty of Care

The owners of premises or persons having control of a workplace (see definition of “responsible person” below) are responsible for the safety of people and property in relation to the management and conduct of undertakings at those premises.

### 1.2 Electrical Risks

The most common risks of death or injury caused directly or indirectly by electricity are:

- electric shock;
- arcing, explosion or fire; and
- ingestion of toxic materials released by burning and arcing associated with electrical equipment.

Electric shocks from faulty electrical equipment may also lead to related injuries, including falls from ladders, scaffolds or other elevated work platforms. Other injuries or illnesses may include muscle spasms, palpitations, nausea, vomiting, collapse and unconsciousness.

The electrical risks and consequences of an electrical incident involving high voltage may be significantly higher than for low voltage. Under fault conditions, the higher voltages and fault current levels can release massive quantities of energy. The inherent risks are therefore potentially very high and must be effectively managed.

Under occupational safety and health legislation, the responsible person has the primary duty to ensure, so far as is reasonably practicable, that workers and other persons at the workplace are not exposed to electrical risks. This duty requires eliminating or minimising and managing these risks.

These responsibilities include but are not limited to ensuring compliance with all relevant technical and safety requirements for the duration of the operating life of the electrical plant, including:

- design and construction;
- maintenance; and
- operation.

These guidelines complement, and should be read together with, other related documents including (but not limited to):

- Electricity (Licensing) Regulations 1991
- WA Electrical Requirements (“WAER”)
- Network operators’ technical rules
- Relevant electrical technical standards
- *Occupational Safety and Health Act 1984*

- Occupational Safety and Health Regulations 1996
- Western Australian Distribution Connections Manual (“WADCM”)<sup>1</sup>

The fundamental requirements specified in Regulation 49 of the Electricity (Licensing) Regulations 1991 must be observed to ensure that HV installations:

- are safe to use, maintain and operate, recognizing that higher voltages and related fault levels are more dangerous, demanding additional attention to manage the risks to an acceptable level; and
- are suitable for connection to an electricity supply network, where this is intended.

### 1.3 Definitions

For the purposes of these guidelines:

“**high voltage**” means an operating voltage of 1kV and higher.

“**network operator**” has the meaning given in the Electricity (Supply Standards and System Safety) Regulations 2001.

“**responsible person**” is the person responsible for the ongoing safety of people and property in relation to the management and conduct of undertakings at those premises. The *Occupational Safety and Health Act 1984* and the Occupational Safety and Health Regulations 1996 establish duties upon a number of persons in respect to workplaces.

“**professionally qualified engineer**” has the meaning given in Part 3 of the Electricity (Licensing) Regulations 1991.

### 1.4 Application

These guidelines do not apply to network operators’ HV installations which are covered by the Electricity (Supply Standards and System Safety) Regulations 2001.

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<sup>1</sup>Guidelines produced by Western Power and Horizon Power for connection to their distribution networks

## 2. Design and Construction

### 2.1 General

HV electrical installations (and subsequent major augmentations) must be designed and constructed to a standard consistent with good industry practice, with careful consideration of the ongoing safety of personnel and members of the public, integrity of equipment and risks to property.

### 2.2 Technical Requirements

The technical requirements for design purposes are adequately covered by various existing legislation and technical standards and are not repeated in this guideline.

The relevant documents include, but are not limited to:

- WAER (published by EnergySafety)
- Network operators' technical rules (published by network operators)
- Relevant electrical technical standards, including AS/NZS 2067, AS/NZS 3000 and AS/NZS 7000
- WADCM
- Other network operator connection requirements

Some HV installations, such as those on mine sites, are also subject to special technical safety requirements administered by the Resources Safety Division of the Department of Mines and Petroleum.

### 2.3 Submission of HV Design Proposal

For all proposed new HV installations and subsequent material augmentations, the WAER requires a HV installation design proposal to be developed and certified by a professionally qualified engineer as complying with all relevant technical requirements.

Where connection to a network is required, the design proposal must be submitted ("HV submission") to the network operator<sup>2</sup> in reasonable time for assessment prior to the connection proceeding.

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<sup>2</sup> In the case of mine sites, submission may also be required to the Resources Safety Division of the Department of Mines and Petroleum, in accordance with the Mines Safety and Inspection Regulations 1995.

## 2.4 HV Submission outline

The HV submission will typically include detailed design and performance information on the following:

- Site plan
- Single line diagram
- Electrical load
- Control of incoming supplies and metering arrangements
- Earthing system design
- Primary plant – generators, motors, power transformers, switches, current and voltage transformers
- Protection scheme
- Applicable technical standards
- Operating procedures
- Recommended equipment maintenance schedules
- Timeframe for initial commissioning supply and permanent connection

Further detailed requirements for HV submissions are provided in the WAER and the network operators' technical rules and connection requirements (including the WADCM). Network operators may also have additional requirements for specific connection locations.

## 2.5 Commissioning Tests

Notwithstanding the submission of the HV design proposal to the relevant network operator or technical safety regulator, final commissioning tests are also required to verify the performance of the installation design. These tests shall be performed by a competent testing organisation acceptable to the approving party.

In the case of network connections, satisfactory test results of all HV electrical equipment between the point of supply and the main switch shall be recorded and submitted to the network operator prior to permanent supply being made available.

Final certification is required by a professionally qualified engineer that the 'as commissioned' installation complies with the design and all relevant technical requirements. A copy of the final certification shall be given to the network operator (where connected to a network).



### 3. Maintenance

Responsible persons for premises with an electricity supply at high voltage shall ensure that their installation:

- safely performs the functions for which it is designed and intended;
- operates in accordance with the manufacturer requirements;
- is maintained in good order; and
- in the event of a fault or malfunction shall not create a hazard or cause interference to the network operator's distribution network.

The responsible person shall implement an effective written maintenance plan for the HV installation including the main incoming circuit breaker and protection system.

The protection and control systems associated with the installation shall be tested for correct operation in accordance with the manufacturer's specifications. The responsible person shall keep records of maintenance tests, and make them available to the network operator upon request.

Maintenance programs, frequencies and operations for particular item(s) of plant should be planned in consultation with the relevant manufacturers and the network operator.

Additionally, when conducting inspections of HV equipment, the condition of the following typically should be considered:

- External insulation
- Internal insulation, including oil where appropriate
- Contacts, interrupting devices and connections
- Earthing system and connections
- Operating mechanisms and their lubrication
- Weather seals and gaskets
- Protective finishes and signs of corrosion
- Legibility of labels and signage

Due consideration should be given to site conditions, with particular regard to airborne contaminants and dust.

Periodic inspections of switch rooms and switchgear enclosures are required to ensure:

- Emergency exits are not obstructed and panic release mechanisms are operational
- Presence and legibility of safety signs
- Integrity of security systems against unauthorised access
- Equipment labelling and operational diagrams are correct and legible
- No ingress of moisture or water
- No intrusion by rodents, birds or insects
- Any ventilation or fire suppression system is fully operational

Periodic inspections or examinations may give guidance on the intervals that should be allowed to elapse between future inspections, examination and overhaul operations with reference to particular operating conditions.

The following publications are relevant in this regard:

- AS/NZS 2067:2008 'Substations and high voltage installations exceeding 1kV a.c.'
- AS 1940:2004 'The storage and handling of flammable and combustible liquids'
- AS 2467:2008 'Maintenance of electrical switchgear'
- AS 1883:1992 'Guide to maintenance and supervision of insulating oils in service'
- AS 1767:1999 'Insulating oil for transformers and switchgear'
- AS/NZS 7000:2010 'Overhead line design – Detailed procedures'
- IEC 61230 'Live Working – Portable equipment for earthing or earthing and short-circuiting'

## 4. Operation

### 4.1 HV Operating Procedures & Safety Management Plan

Responsible persons shall have a set of operational procedures for HV installations incorporated into their site Safety Management Plan or a specific High Voltage Installation Safety Management Plan.

The procedures and plan shall ensure compliance with the requirements of the relevant legislation, codes, guides and Australian standards including, but not limited to, the following matters:

- Isolation procedures, including work permits, locking, testing and tagging
- Personnel competencies and electrical access authorisations
- Barriers for electrical, mechanical and personal protection
- Access to rotating machines and discharging of deactivated apparatus
- Earthing and short circuit requirements
- Provision and use of personal protective clothing and equipment
- Training, education and worksite safety briefings
- Internal and external communications including emergency personnel and network operator contact details
- Emergency and evacuation procedures

The procedures and plan shall be updated following any plant upgrades.

The responsible person shall, on request, provide a copy of the procedures and plan to the network operator.

### 4.2 High Voltage Switching Operators

The responsible person shall ensure that HV switches are operated only by persons selected, trained and authorised by the responsible person and, where required, by the network operator.

The responsible person shall ensure that its switching operator(s) are fully conversant with the operational procedures, safety management plan and the network operator's requirements.

Switching operators shall be trained and regularly assessed<sup>3</sup> as competent, by a registered training organisation (RTO), to perform the roles for which they are responsible including, but not limited to, the use of:

- Personal protective equipment
- HV testing equipment

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<sup>3</sup> HV switching operators are required to be assessed as being competent, and maintain currency, in units of switching contained in Industry Training Packages delivered by a Registered Training Organisation (RTO) approved to deliver Nationally Recognised Training within the Australian Qualifications Framework.

- HV earthing apparatus designed to facilitate the earthing of all types of HV equipment within the installation
- Insulating mats, screens and other similar equipment necessary for the safe operation of the HV installation

The switching operators shall coordinate their activities with the network operator and, where required, be responsible for the issuing of access permits authorising persons to work on isolated and earthed sections of the installation.

The responsible person shall establish (before commissioning) and maintain a register of all authorised persons with details of switching competencies and any restrictions.

If the contact details of the responsible person change, the network operator must be formally notified, as soon as is practical, but no later than one month from the date of the change.

Notifications shall be sent to the following relevant address:

**Horizon Power**

Horizon Power, Head Office  
 Stovehill Road  
 Karratha WA 6714  
 Ph: (08) 9159 7250 Fax: (08) 9159 7288  
 karratha@horizonpower.com.au

**Western Power**

Network Operations Manager  
 System Operations, Western Power  
 GPO Box L921, Perth WA 6842

**Rio Tinto Iron Ore**

Rio Tinto Iron Ore – Utilities  
 GPO Box A42  
 Perth WA 6837

**BHP Billiton Limited Nickel West Leinster**

Leinster Supply Authority Electrical Inspector's Office  
 PO Box 22  
 Leinster WA 6437  
 Ph: (08) 9026 5088 Fax: (08) 9026 5339

**BHP Billiton Iron Ore**

BHP Billiton Iron Ore Supply Authority  
 PO Box 65  
 Newman WA 6753  
 Email: supplyauthority@bhpbilliton.com

### 4.3 Switching Agreement

The responsible person must establish a switching agreement with the relevant network operator, prior to connection. The basic functions of a switching agreement are:

- assignment of accountabilities and obligations;
- exchange of contact details between the owner and the network operator; and
- to establish switching procedures for both routine and emergency operations.

The switching agreement shall specify the responsible person's obligations and responsibilities when undertaking switching activities as listed in the agreement within their HV installation/network in accordance with the agreed procedures and network operator directives.

The switching agreement shall include provisions to ensure that the responsible person:

- only performs switching operations on customer owned equipment as listed in the agreement;
- is not permitted to operate network operator owned equipment unless expressly mentioned in the special conditions of the agreement or as directed by the network operator; and
- provides 24 hour 7 day availability of a switching operator to undertake switching operations of the HV assets as required by the network operator for the purposes of inspection of HV metering, load shedding, routine maintenance or emergency repair of the incoming HV supply equipment.

The switching agreement shall also contain, where applicable, provisions that enable the network operator to operate customer owned equipment as nominated by the responsible person.

### 4.4 Basic Safety Requirements

#### 4.4.1 Access to Electrical Equipment

The HV operator must provide, in accordance with the responsible person's safety plan, "access permits" to facilitate the movement and monitoring of all persons accessing isolated sections of the electrical installation, to perform work and to ensure all such persons are clear prior to re-energising of the isolated section of the installation.

The HV operator must use appropriately coloured tape barriers and stands to display access permits clearly identifying isolated, proven de-energised and earthed sections of the HV installation on which work can safely be performed, and attain a minimum of two levels of personnel safety protection against inadvertent contact with live parts.

#### 4.4.2 Operating Equipment

Appropriately rated and tested HV safety apparatus and personal protective equipment shall be made readily available on site by the responsible person for use by its HV operator(s) and, where required, the network operator's personnel, in accordance with the responsible person's HV operating procedures and applicable legislation.

Safety apparatus shall include, but not be limited to:

- HV operating sticks
- Testing equipment to prove that HV apparatus has been de-energised
- Portable earthing equipment
- HV gloves
- Insulating mats
- Signage, barriers and tags

The responsible person shall provide labelled storage facilities, as close as practicable to the point of use, for the apparatus.

All operating equipment shall be maintained by the responsible person in a safe, fit-for-purpose condition for use at any time.

#### 4.4.3 **Operational Diagram**

A single-line schematic diagram of the complete installation showing all aspects of the HV installation (including normally open points) shall be provided in a suitable prominent and permanently displayed enclosure adjacent to all control and isolating switches within the electrical installation.

Where items of switchgear or equipment are remote from the main installation, the operating diagram shall also be permanently displayed at these locations.

#### 4.4.4 **Safety Signs**

Appropriate warning and safety signage shall be installed in accordance with the requirements of this guideline, AS 2067, AS/NZS 3000 and AS 1319.

In each location where HV equipment is present within the installation, a durable safety poster shall be displayed in a prominent and permanent position which outlines emergency resuscitation methods and provides instruction in the release of persons from contact with live conductors.

#### 4.4.5 **Applicable Guidelines**

Safety guidelines published by the Energy Networks Association relevant to this matter, include:

ENA Doc 001 - 2008 National Electricity Network Safety Code

ENA NENS 03 - 2006 National Guidelines for Safe Access to Electrical and Mechanical Apparatus

ENA NENS 04 - 2006 National Guidelines for Safe Approach Distances to Electrical Apparatus

ENA NENS 09 - 2004 National Guidelines for the Selection, Use and Maintenance of Personal Protective Equipment for Electrical Hazards

## 5. Audits

For HV installations, responsible persons should (as part of an effective safety management plan) conduct periodic audits as appropriate to ensure:

- Site Safety Management Plans or specific HV Installation Safety Management Plans are relevant, up-to-date and being applied in practice.
- HV installation maintenance plans are being followed and maintenance records are being maintained.
- Any HV installation augmentation has been appropriately integrated.
- Compliance with switching agreements.

Audits should be conducted by an appropriately qualified and experienced electrical engineer or electrician.

A copy of the audit report shall be provided to the network operator (where the installation is connected to a network).

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If you require the services of an interpreter, contact the Translating and Interpreting Services (TIS) on 131 450 and ask for connection to EnergySafety on 9422 5200.

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