



# ELECTRICAL SYSTEM SAFETY RULES (ESSR)



2016 Edition

V1.1

## Brief description

The Electrical System Safety Rules (ESSR) outline the minimum electrical safety standards for personnel working on, near or in the vicinity of Western Power's electrical network and associated apparatus in Western Australia.

## Related policies

This Management Standard supports Western Power's Safety, Health and Environment (SHE) Policy.

## Introduction

These rules are to be read in conjunction with Western Power's Work Instructions/Practices, Operating Procedures, Workplace Risk Assessment Plans (WRAP) and Golden Safety Rules approved under the SHE Management Standard.

These rules and associated documents are intended to specify the safe working requirements and minimum standards that will ensure Western Power's electricity network is operated and maintained in accordance



with AS 5577 (2013) Electricity Network Safety Management Systems, the Occupational Safety and Health Act (1984) and Regulation (1996), relevant Energy Network Association (ENA) Codes of Practice and other applicable Standards and Codes.

## Scope

The intention of the ESSR is to provide Western Power with a standard set of rules that govern access to the electricity network and define minimum electrical safety requirements for all personnel to comply with.

All work shall be carried out in accordance with the ESSR and Western Power approved Procedures, Work Instructions/Practices, Workplace Risk Assessment Plans, Network Instructions and Golden Safety Rules.

Western Power's electrical system incorporates the South West Interconnected Networks in their entirety.

The ESSR is issued to personnel required to work on or near electrical apparatus and conductors. The ESSR must be issued to staff prior to any network authorisation being granted.

The ESSR, as well as any additional related documentation and amendments, must be kept in good condition so that they can be used as a reference.

All personnel have access to the ESSR electronically.

The ESSR is a Management Standard within the Western Power document architecture.

Any safety related objections to carrying out these rules and procedures must be immediately reported.

# Golden Safety Rules (GSR)

The Golden Safety Rules are the product of an examination of the work we do and the way we manage the associated risks. The Golden Safety Rules define the minimum non-negotiable safety requirements and critical controls for each of the nine high risk activities that have the potential to cause us the greatest harm. Identifying these high risk activities affords us the opportunity to take a step back and have a think before starting work.

These Golden Safety Rules were designed to ensure the safety and wellbeing of personnel undertaking high risk activities.

The Golden Safety Rules shall be considered prior to undertaking any of the nine high risk tasks covered by the Golden Safety Rules. Western Power expects that if any of these critical controls are not in place that you stop work immediately and ensure controls are implemented.

All personnel are empowered to make decisions that will create a safe working environment and any person working for, or on behalf of Western Power, has the right to stop work immediately if they believe it is unsafe to continue. When stop work has been applied, all personnel have the obligation to report the situation to the responsible person.

The Golden Safety Rules complement the existing Standards, Procedures, Work Instructions/Practices and Workplace Risk Assessment Plans and as such they should be used to support operational requirements within these documents.

# Nine high risk work activities



Working on the High Voltage (HV) Network



Working on the Low Voltage (LV) Network



Operating Mobile Plant Near the Network



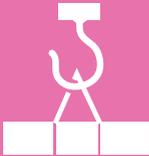
Excavation and Trenching



Working in a Confined Space



Working at Heights



Lifting Operations



Driving



Concurrent Activities

The associated Golden Safety Rules for each of these nine high risk activities are listed in the Golden Safety Rules handbook (EDM #41205405).

Contact the SEQT function for a printed copy.

# Contents

<b>1. Common Safety Rules</b>	<b>7</b>
1.1 Clear communication	7
1.2 Job briefing	8
1.3 Workplace Risk Assessment Plan	8
1.4 Personal Protective Clothing and Equipment (PPC & PPE)	9
1.5 Tools and equipment	9
1.6 Working safely at heights and drop/exclusion zones	9
1.7 Electrical forms and work permits	10
1.8 Electrical tags	10
1.9 Qualifications and authorisations	12
1.10 People: Authorised/Ordinary, Safety Observer and Supervision	12
1.11 Emergency response and emergency services	14
1.12 Public and third party work on Western Power assets	15
1.13 Work on other authorities apparatus	15
<b>2 Approach distances to electrical apparatus</b>	<b>17</b>
2.1 Electrical hazards and emergencies	17
2.2 Danger zone	20
2.3 Minimum approach distance	21
2.4 Approach distances – general	22
2.5 Approach distances for persons	23
2.6 Approach distances for plant, equipment and vehicles	25
2.7 Approach distances to insulated cables	27
<b>3 Operating and accessing the network</b>	<b>29</b>
3.1 Roles and responsibilities associated with operating and accessing the network	29
3.2 Switching	32
3.3 Isolation of electrical apparatus	37
3.4 Power system earthing	39
3.5 Accessing the high voltage network	45
3.6 High voltage (HV) live work	56

3.8 Working on low voltage networks	63
3.9 Controlling the network	64
3.11 Operating agreements	67
<b>4 Testing and commissioning</b>	<b>69</b>
4.1 Minimum requirements	69
4.2 Identification and spiking of cables	70
4.3 Commissioning general	71
<b>5 Electrical substations and specialised network apparatus</b>	<b>75</b>
5.1 Electrical substation entry and security	75
5.2 Hazards in electrical substations	76
5.3 Specialised network apparatus	77
5.4 Protection control and automation	81
<b>6 Vegetation works</b>	<b>83</b>
6.1 Vegetation works near the network	83
6.2 Line workers undertaking vegetation management	88
<b>7 Streetlighting and public lighting</b>	<b>91</b>
7.1 General	91
7.2 Testing streetlight columns	91
7.3 Streetlighting and Powerwatch security lighting work from an elevated work platform (EWP)	93
<b>8 Consumer Installations</b>	<b>95</b>
8.1 Managing connections to the network	95
8.2 Meter maintenance, removal and replacement	97
<b>9 Dictionary</b>	<b>99</b>
<b>Appendix 1 – RACI matrix</b>	<b>108</b>
<b>Appendix 2 – Safety Observer Matrix</b>	<b>109</b>
<b>Appendix 3 - Distribution Switching Levels</b>	<b>110</b>
<b>Appendix 4 - Transmission Switching Levels</b>	<b>112</b>



# Common Safety Rules

# 1. Common Safety Rules

## 1.1 Clear communication

It is essential that effective communication takes place between all personnel.

Adherence to the communication protocol is essential to maintain safety and prevent incidents.

The communication protocol involves three steps:

**Clear** – Ensure that what you say is easy to understand and is not confusing;

**Concise** – Minimise banter and use proper and specific terms; and

**Confirmed** – Information must be repeated by the receiver for confirmation.

Written documents must be clear and legible. They must be filled-in in accordance with Western Power's official terminology and instructions.

### 1.1.1 Verbal communication

It is essential to speak clearly, listen carefully, and thoroughly understand verbal communications. The communication protocol is shown in figure 1.1.

	Stage	Purpose /Outcomes
1	Introduction	Greeting
2	Confirm	The scope of the work and that both parties are working on the same task
3	Context	Establish the present status of the job/work
4	Communicate	Clearly and concisely communicate and confirm the tasks are understood
5	Close out of job	Ensures that job is formally completed and that all parties acknowledge job status.



**Figure 1.1: Clear, concise and confirmed communication protocol**

Verbal instructions and statements must be confirmed by repeating them back to the communicator. This prevents misunderstandings between parties.

## 1.2 Job briefing

The job briefing process must be performed before the commencement of any task and as required throughout the duration of the task and if the task changes. The process of thinking through a task in advance improves the efficiency and can result in decisions that will prevent serious injury and/or damage.

This process outlines the tasks that are to be accomplished, the location, tools, equipment and material requirements and safety rules or procedures that apply.

Key elements of the job briefing process include:

- i. adherence to permit procedures;
- ii. Work Instructions/Practices and task procedures that are involved;
- iii. roles of each team member and task allocation;
- iv. allocation of identification of hazards;
- v. hazards associated with the task and the control measures;
- vi. work area establishment and set up; and
- vii. emergency response plan.

## 1.3 Workplace Risk Assessment Plan

A workplace risk assessment plan must be performed on all worksites prior to the work task commencing and shall include:

- i. identifying all hazards that are associated with the tasks;
- ii. assessing the risks and the likelihood of it happening;
- iii. eliminating or control the risks to the lowest level possible; and
- iv. reviewing the control measures continually and revisit them.

All members of the work team must sign onto the document and it must be signed off by the site co-ordinator.

## **1.4 Personal Protective Clothing and Equipment (PPC & PPE)**

Wearing approved PPC and PPE specified for a task or work area is mandatory and must not be altered or substituted without authorisation by Western Power. Before undertaking any work, each person must check to ensure that their PPC and PPE is in satisfactory condition and is appropriate for the work being done. Any defective PPC and PPE must be immediately removed from use/service. Refer to relevant Procedure for detailed PPC and PPE requirements.

## **1.5 Tools and equipment**

Only approved plant, tools and equipment are to be used and must not be altered or substituted without authorisation by Western Power. All plant, tools and equipment must be operated and maintained in accordance with Western Power procedures and/or manufacturers' recommendations. Defective plant, tools or equipment must not be used.

## **1.6 Working safely at heights and drop/exclusion zones**

Where the workplace risk assessment identifies that a person could fall from one level to another, suitable control measures must be considered, such as:

- i. use of a fall arrest/prevention system;
- ii. installing edge protection;
- iii. planning work to minimise the work time in an elevated area;
- iv. reviewing applicable procedures and Workplace Risk Assessment Plans (WRAP) to guide the risk assessment process;
- v. ensuring all personnel comply with the minimum PPC/PPE requirements;
- vi. visually inspecting fall prevention systems for serviceability and to ensure the apparatus is within date;
- vii. the use of a spotter;
- viii. establishing a drop zone before commencing work; and
- ix. establishing an exclusion zone whenever there is any movement of objects over the worksite that could endanger workers.

## 1.7 Electrical forms and work permits

Western power uses a permit to work system when accessing certain parts of the network. Work permits are issued by persons with relevant competencies and authorisations in accordance with specific requirements of each work permit. The purpose of the work permit is to declare that status of the network and to define the work that is allowed under the conditions of that access.

**Table 1.1: Electrical forms and permits**

Electrical forms and permits	Description
Vicinity Authority Permit (VA)	Working near the Network, outside of MAD or working to approved HV live techniques (see section 3.5.1 for detail)
Electrical Access Permit (EAP)	Working on the Network (see section 3.5.1 for detail)
Sanction to Test (STT)	Working on the Network for the purposes of testing (see section 3.5.1 for more detail).
Hand Over Certificate	A handover certificate is a formal document by which control and responsibility for equipment is transferred from one authority to another (see section 3.10 for detail)
Operating Agreement (OA)	An operating agreement is a formal agreement between two Operating Authorities (see section 3.11 for detail)

## 1.8 Electrical tags

All personnel working with a danger, out of service or restricted use tagged electrical apparatus must comply with any instruction or information on the tag prior to commencing any tasks associated with the apparatus.

Only tags approved by Western Power are permitted for use. Changing the purpose, colour and/or wording of a tag is prohibited without the approval of the Network Control. When applying tags, the correct electrical tag must be used for the type of work being carried out.

Tags must contain adequate information to inform others of their purpose. It is the responsibility of the person applying the tag to comply with the following requirements:

- i. Fill the tag out fully and correctly with detailed information, e.g. switching schedule number, work permit number or reason and reference depending on tag type;
- ii. Include their identity and contact details, e.g. name, NAC number, two-way radio number, phone number etc.;
- iii. Ensure the tag is clean and in good condition; and
- iv. Correctly attach the tag to the equipment or asset.

Tags associated with a work permit and/or risk assessment must be recorded on the corresponding work permit and/or Workplace Risk Assessment Plan.

For all devices where the auto reclose has been disabled by tele-control switching, a control inhibit would be applied by the controller and therefore no tag would need to be fitted on site.

Where an auto re-closing device is disabled locally, the switching operator must apply an 'Information' caution tag.

The four tags in use at Western Power are:

- i. 'Do not operate' danger tag
- ii. 'Restricted use' danger tag
- iii. 'Out of service' warning tag
- iv. 'Information' caution tag

Network controllers apply electronic/virtual tags that contain information relevant to their application.

Further information regarding the types, use and authorisations required to fit and remove tags and labels can be found in the relevant Work Instruction/Practice.

### 1.8.1 Non Western Power tags

Tags that are the property of other organisations must not be removed without direct consultation with the appropriate organisation.

## 1.9 Qualifications and authorisations

Persons who are required to work on or near Western Power's network must:

- i. Be appropriately trained for the work they intend to do; and
- ii. Be authorised by Western Power to carry out that work.

Further information regarding qualification and authorisation processes can be found on busbar or via the Authorisation team.

## 1.10 People: Authorised/Ordinary, Safety Observer and Supervision

### 1.10.1 Authorised persons

Authorised persons are competent persons with the delegated authority to perform the duty concerned on behalf of Western Power.

Authorised persons includes Issuing Officers, Recipients in Charge (RIC's), Testers in Charge (TIC's) and Recipients.

### 1.10.2 Ordinary persons

Ordinary persons cannot enter a worksite or sign onto a work permit unless under the direct supervision of an authorised person.

Ordinary persons must have an authorised RIC on site and being directly supervised when undertaking work inside a danger zone.

**Note:** Trained and authorised Western Power vegetation workers (including contractors) are not considered ordinary persons.

### **1.10.3 Safety observer**

A safety observer must be appointed when personnel are working on or operating mobile plant near live electrical apparatus. They are assigned by the person in charge and their sole function is to observe and warn against unsafe approach to live electrical apparatus and other unsafe conditions. Work must cease if the safety observer's view of the work is impaired. For further information refer to the Safety Observer Matrix (appendix 2) and the Safety Observer Work Instruction/Practice.

### **1.10.4 Immediate supervision**

Immediate supervision requires the authorised person to be at the work position with the person/trainee supervising them on a one-to-one basis.

### **1.10.5 Direct (constant) supervision**

Direct supervision requires the authorised person supervising the person/trainee to remain at the worksite and in close proximity to the person/trainee. The authorised person must be within sight of, and able to communicate directly with, the person/trainee, however, the authorised person does not necessarily have to be standing alongside the person/trainee. The ratio of network employee to trainee must not exceed a one-to-two ratio.

*Note: "Direct" and "Constant" supervision can be used interchangeably.*

### **1.10.6 General supervision**

General supervision must be given by an authorised person; however, this does not need to be through constant attendance (effective supervision must be maintained). Tasks must be explained clearly to ensure the person/trainee understands what is to be carried out. The nature of the work and the competence of the person/trainee must be considered to ensure safe and satisfactory work practices are maintained.

## 1.11 Emergency response and emergency services

Any Western Power authorised person, whether on or off duty, who finds or is advised of a hazard to public safety caused by Western Power's electrical supply system, must:

- i. Take immediate steps to protect the public;
- ii. Seek assistance;
- iii. Where possible, instruct a willing ordinary person to stand in a suitable position to warn the public of the hazard. This instructed ordinary person must be willing to remain until the return of the authorised person, or until other assistance arrives;
- iv. Set up a NO-GO zone (as a guide emergency services personnel will set up a no go zone of at least 8m from any electrical hazard source); and
- v. Notify Network Control.

In extreme emergencies that present an immediate threat to life, property or the environment:

- i. Switching to remove the threat can only be performed by an authorised person. Any emergency switching must be reported to Network Control as soon as the switching has taken place; and
- ii. Switching can be performed by a person not authorised to switch when under instruction from an appropriately authorised switching operator or controller. This unauthorised person has the right to refuse this task.

De-energisation is mandatory if emergency services personnel have to attend the hazard. No attempts to de-energise the hazard in the immediate vicinity of the reported hazard, for example within a common cubicle, can be made.

Under the direction of an authorised Western Power person, emergency service personnel are permitted to enter de-energised Western Power facilities, or extinguish de-energised line equipment fires. In extreme emergencies, electrical fires can be extinguished by authorised emergency service personnel after the network is proven to be de-energised.

## **1.12 Public and third party work on Western Power assets**

It is the responsibility of the site owner, company or contractor to ensure that all work near overhead powerlines and/or underground cables is carried out safely. Work near powerlines and other electrical installations must be well planned to:

- i. Comply with WorkSafe WA and electrical clearance requirements; and
- ii. Ensure adequate separation between the work and the adjacent line. Western Power can provide assistance to determine whether there will be adequate separation between the work and any adjacent powerlines.

## **1.13 Work on other authorities apparatus**

Occasionally Western Power employees are required to work on or near electrical systems and associated plant/apparatus that are not owned or controlled by Western Power. Prior to starting any such work there must be a clear agreement of the rules, documents and procedures that are to be used by all working parties. All employees concerned must be informed.

In the event that rules/policies are provided by a third party, these rules must be confirmed to at least comply with the ESSR. In the case where no external-party rules, documents or procedures apply, Western Power's ESSR and related documentation must be used.





# Approach distances to electrical apparatus

# 2 Approach distances to electrical apparatus

## 2.1 Electrical hazards and emergencies

Electrical hazards pose a significant threat to the safety and health of employees, contractors, and the general public.

Some common sources of electrical hazard include:

- i. Inadvertent contact with live equipment;
- ii. Unauthorised work within the danger zone;
- iii. Faults, breakdown in insulation systems and equipment defects;
- iv. Electromagnetic induction;
- v. Effects of direct and indirect lightning storms; and
- vi. Equipment becoming inadvertently live due to induced voltages or interference.

### 2.1.1 Electric shock

Electric shock is the unwanted flow of electricity through the body. Typically it occurs when the human body creates a path between a live conductor and an earth. Electric shock can cause severe electrical burns, internal tissue damage and/or ventricular fibrillation. Electric shock can stop the human heart on impact and cause death. Electric shock hazards can occur through step and touch in the vicinity of faulty electrical apparatus (see section 2.1.4 and section 2.1.5).

### 2.1.2 Arc flash

An arc flash is the heat and light energy released when an insulator or apparatus fails and current flows through a normally nonconductive media such as air. The flash produced due to this breakdown produces light and intense heat that may cause severe burns, especially to unprotected flesh and eyes. The result of the violent arc flash can also cause destruction of equipment involved, fire, and injury to bystanders.

### 2.1.3 Blast

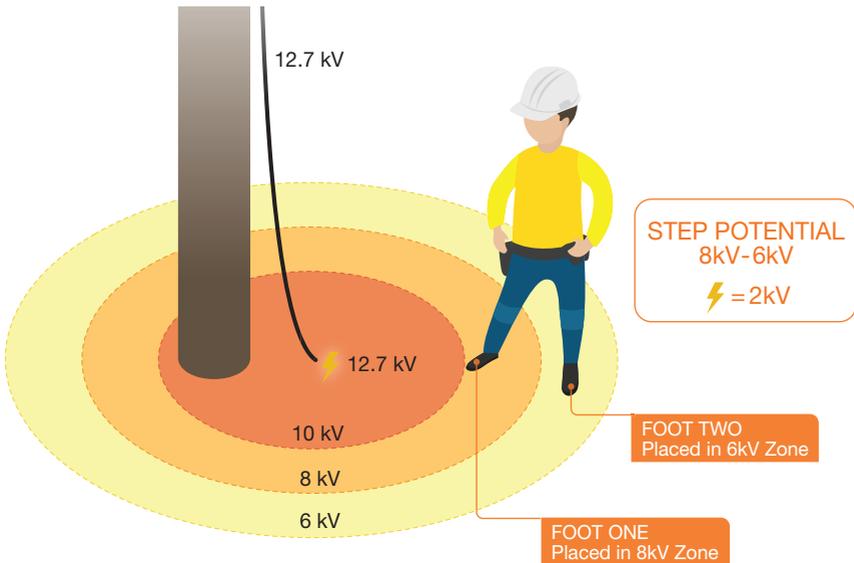
A blast is an arc flash that yields an explosion (a massive amount of energy that rapidly vaporises metal conductors, blasting molten metal and superheated material (plasma) outward with extreme force). This violent event can cause destruction of switchgear and nearby equipment. The high velocities of molten metal particles can cause severe burns, blindness, internal organ damage or death through inhalation.

### 2.1.4 Step potential

In the case of a ground fault, for example a fallen conductor, electricity will pass into the soil/ground and fan outwards with diminishing voltages.

Step potential is an electric shock hazard that occurs when a person is close to or steps towards an energised contact site. The step voltage that passes through the body is calculated by the difference in voltage of the energised soil between their feet.

In figure 2.1 below, fault current is travelling down a conductor to the ground. This conductor is energising the surrounding ground, diminishing in voltage as it moves from the contact site. Standing with one foot in the 8 kV voltage zone (determined by the distance from contact site), and a second foot within the 6 kV voltage zone, this person would experience a hazardous electric shock of 2 kV (2000 volts).



**Figure 2.1: Step potential.**

### 2.1.5 Touch potential

Touch voltage is experienced when contact is made with an energised object. The touch voltage that passes through the body is equal to the difference between the voltage of the energised object and the voltage of the zone where the feet are placed, remembering that voltages diminish in a radial pattern from the contact site.

In figure 2.2 below, touching the 12.7 kV conductor while standing within the 10 kV voltage zone (determined by the distance from contact site) would yield a hazardous electric shock of 2.7 kV.

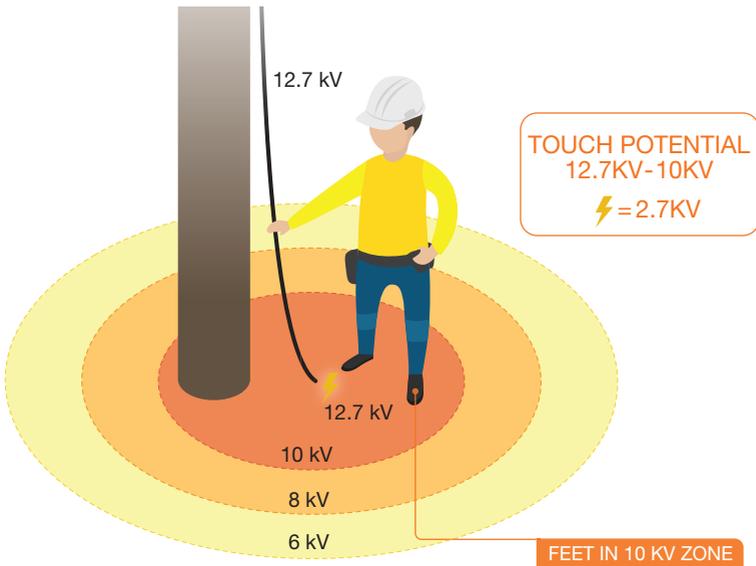


Figure 2.2: Touch potential.

## 2.2 Danger zone

A danger zone is a specific area surrounding live electrical apparatus that ordinary persons, equipment and materials must not enter. The size of the danger zone is determined by the voltage of the electrical apparatus.

A danger zone means anywhere that:

- i. Is within 0.5 metres of a live insulated overhead power line or aerial bundled conductor line of a voltage of not more than 1,000 volts;
- ii. Is within 1.0 metre of a live uninsulated overhead power line of a voltage of not more than 1,000 volts;
- iii. Is within 3.0 metres of a live overhead power line whether insulated or not, of a voltage exceeding 1,000 volts but not more than 33,000 volts; or
- iv. Is within 6.0 metres of a live overhead power line whether insulated or not, of a voltage exceeding 33,000 volts.

The location/position of a danger zone is relevant to the position of the electrical apparatus. If an electrical apparatus, such as a live conductor, moves, the danger zone moves with it. This change of danger zone can place persons, tools, equipment, apparatus, branches and other items at risk if not carefully planned for.

The normal danger zone distances for HV underground insulated conductors are generally not appropriate unless the cores are exposed due to the cable sheath or insulation being damaged or removed. In cases where they are damaged or removed, standard danger zone rules and distances apply.

All cables must be treated as live, especially cables which are either damaged or have exposed conductors, until proved de-energised by an approved procedure. No person is to work on any insulation which covers any HV conductor unless de-energised, isolated, earthed, and an appropriate work permit issued.

The danger zone also applies to overhead power lines, where plant or equipment such as scaffold components, roofing or other building materials, cranes or irrigation equipment are operated or moved under or in the vicinity of the lines.

## 2.3 Minimum approach distance

Minimum Approach Distance (MAD) is the distance an authorised person, vehicle, mobile plant (including its load, controlling ropes and any other accessories) or object (other than insulated objects designed for contact with live conductors) must maintain when:

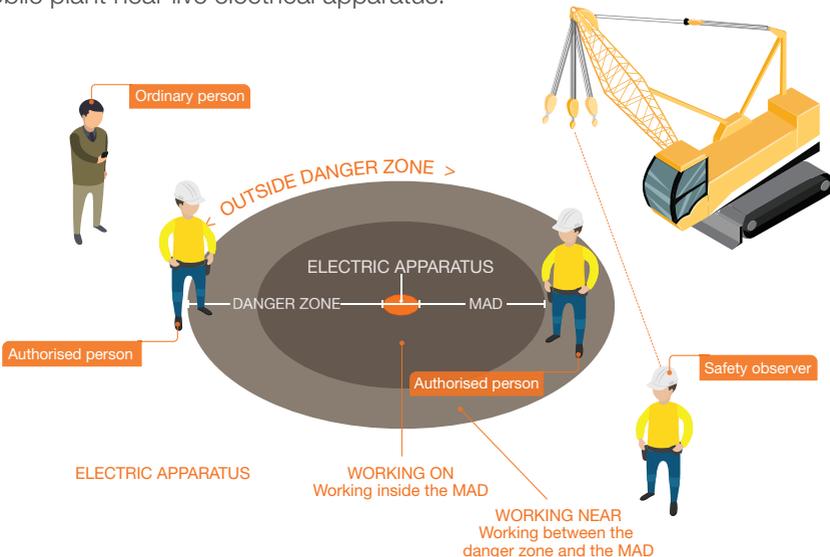
- i. Working on or near uninsulated electrical apparatus; and
- ii. Operating vehicles or mobile plant on or near electrical apparatus.

Authorised persons may enter the danger zone, however, they must not enter the MAD zone. Only specially trained live line authorised personnel may enter the MAD zone while following the appropriate live line procedures.

All care must be taken to ensure that the inadvertent movement of persons, tools, equipment, apparatus, branches and other items does not encroach a zone for which they do not have authorisation.

Figure 2.3 shows how inadvertent movement of persons, tools, equipment, apparatus, branches and other items into unauthorised zones can place a person in danger. Unauthorised entry into the MAD could result in death.

A safety observer must be appointed when persons are working on or operating a mobile plant near live electrical apparatus.



**Figure 2.3: Working on or near uninsulated electrical apparatus.**

## 2.4 Approach distances – general

There are a number of approach standards available in the industry, varying in terminology and value (where numerical rounding and estimation occurs). The tables contained in this document represent Western Power's approach distances.

Western Power's minimum approach distances determine the MAD zone around live bare conductors. There is no differentiation between horizontal clearance and vertical clearance.

Where other authorised clearance tables exist, and/or further approved engineering studies support variations to Western Power's declared values, then alternative values are permitted to be used. This is most likely to occur where the electrical clearance value is reduced, but can also occur when a more conservative approach is preferred. Other authorised work procedures allow work and movement of plant and equipment nearer to the bare conductors than indicated. This authorised work procedure must be used in a way that is consistent with any other safety hazard assessment and control.

Common terminology used by Western Power when referring to electrical apparatus approach tables are: "minimum approach distance" (MAD), "safe working clearance", "horizontal clearance" (H), "vertical clearance" (V) and "section clearance" (S).

## 2.5 Approach distances for persons

### 2.5.1 Authorised persons

**Table 2.1: Approach distances for authorised persons**

Voltage	Distance (mm)
Up to 1,000	Avoid Contact
6,600	700
11,000	700
22,000	700
33,000	700
66,000	1,000
132,000	1,200
220,000	1,800
330,000	3,000

*Note:* These represent nominal minimum personal clearances. A reduction in the values shown in Table 2.1 is permitted where authorised work methods and/or barriers and/or insulation may be in use. Increases in these values may be required when the risk assessment and work methods support it.

*Note<sup>1</sup>:* For authorised Live Work, refer to the clearances from Western Power's High Voltage Live Work Manual.

## 2.5.2 Ordinary persons

**Table 2.2: Approach distances for ordinary persons**

Voltage	Distance (mm)	Distance (mm) <sup>1</sup>
Up to 1,000	1,000	1,000
6,600	3,000	2,000
11,000	3,000	2,000
22,000	3,000	2,000
33,000	3,000	2,000
66,000	6,000	Not Permitted Live
132,000	6,000	Not Permitted Live
220,000	6,000	Not Permitted Live
330,000	6,000	Not Permitted Live

*Note<sup>1</sup>: After consultation with Western Power, completion of a risk assessment and while under direct (constant) supervision of a duly authorised person.*

## 2.6 Approach distances for plant, equipment and vehicles

### 2.6.1 Approach distances for plant, equipment and vehicles operated by authorised persons

**Table 2.3: Approach distances for plant, equipment and vehicles operated by authorised persons**

Voltage	Mobile Plant		Vehicles
	Insulated Distance (mm)	Uninsulated Distance (mm)	Distance (mm)
Up to 1,000	Contact allowed	1,000	600
6,600	700	1,200	700
11,000	700	1,200	700
22,000	700	1,200	700
33,000	700	1,200	700
66,000	1,000	1,400	1,000
132,000	Not applicable	1,800	1,200
220,000	Not applicable	2,400	1,800
330,000	Not applicable	3,700	3,000

**Note:** A safety observer must be used according to approved procedures when working with vehicles and mobile plant on or near electrical apparatus.

**Note<sup>1</sup>:** For authorised live work refer to the clearances in Western Power's High Voltage Live Work Manual.

## 2.6.2 Approach distances for plant, equipment and vehicles operated by ordinary persons

*Table 2.4: Approach distances for plant, equipment and vehicles operated by ordinary persons*

	Mobile Plant	Vehicles
Voltage	Distance (mm)	Distance (mm)
Up to 1,000	1,000	600
6,600	3,000	900
11,000	3,000	900
22,000	3,000	900
33,000	3,000	900
66,000	6,000	2,100
132,000	6,000	2,100
220,000	6,000	2,900
330,000	6,000	3,400

## 2.7 Approach distances to insulated cables

In all circumstances insulated cables must be treated as live unless proved otherwise using approved procedures.

A VA permit must be issued prior to using a powered tool for excavation within the MAD or physically moving the high voltage cable to ensure that the controller is aware of the risk to the system.

Refer to the relevant Work Instruction/Practice for further information.

**Table 2.5: Minimum approach distances to insulated cables**

Nominal Voltage	Powered tool or plant (mm)	Non-powered hand tool/ non-destructive digging
Up to 1,000	300	Approach with care, avoid contact
1,000 to 33,000 <sup>1</sup>	500	Approach with care, avoid contact
66,000 to 330,000 <sup>2</sup>	3,000	Approach with care, avoid contact

*Note:* Powered tools may be used at distances of 1000mm or more from underground cables between 66,000 volts and 330,000 volts providing:

- i. Appropriate hazard identification and risk assessment methodology has been used
- ii. Potholing has identified the relevant cables; and
- iii. Non-powered hand tools can then be used from 1,000mm to the relevant cable/s.

*Note*<sup>1</sup>: Less than 500mm hand dig.

*Note*<sup>2</sup>: Less than 3,000mm: For distances less than 3,000m, an appropriate hazard identification and risk assessment methodology must be used and the cable's



# Operating and accessing the network

*location proven.*

## 3 Operating and accessing the network

### 3.1 Roles and responsibilities associated with operating and accessing the network

Western Power's Network Access system consists of a range of functional levels. These levels are used to authorise individuals to work on or near the network. All persons, including Controllers and Program Writers, working on or near Western Power's network must be appropriately authorised for their function and work level. Refer to Western Power's Authorisations team for detail.

#### 3.1.1 Controller

The controller must be authorised by Western Power and is responsible for co-ordinating switching activities on Western Power's electrical system. Responsibilities include:

- i. Co-ordinating high voltage switching activities;
- ii. Performing switching activities on SCADA controlled devices; and
- iii. Electronically record work permits to ensure compatibility of multiple work permits.

#### 3.1.2 Switching Operator

The switching operator must be authorised by Western Power and is responsible to undertake switching of electrical apparatus on Western Power's electrical system. Responsibilities include:

- i. Physical switching associated with isolation and earthing;
- ii. Flagging off and barricading the safe working area inside switchyards;
- iii. Installing appropriate signs; and
- iv. Confirming protection, control and automation isolations.

The switching operator cannot delegate accountability for any task but can directly supervise a person familiar with the task, e.g. an earth being applied from an EWP.

**Note:** *The switching operator is still required to sign the work permit in the 'placed*

*by' column.*

### **3.1.3 Issuing Officer (IO)**

The issuing officer must be authorised by Western Power and is responsible for issuing and cancelling work permits. It is common practice for the issuing officer to also carry out the role of the switching operator, if authorised to do so. An issuing officer may also be the RIC of the same work permit, but this practice must be avoided where possible. Responsibilities include:

- i. Writing a legible work permit with a precise description of the electrical apparatus and/or conductors, and the conditions under which it is issued and received;
- ii. Issuing a work permit to an RIC/TIC;
- iii. Registering and cancelling a work permit with Network Operations;
- iv. Describing and/or showing the RIC/TIC (and recipients where possible):
  - Isolation points;
  - Program earths;
  - Limits of the safe work area;
  - Locations of adjacent live points; and
  - Confirming protection, control and automation isolations.

Where multiple switching levels are involved in providing network access, the work permit should be issued by the Issuing Officer with the authority that covers the apparatus being accessed.

### **3.1.4 Recipient in charge (RIC)**

The RIC must be authorised by Western Power. All work under an EAP or VA permit is performed under the control of a RIC. Responsibilities include:

- i. Accepting and relinquishing EAP and VA work permits;
- ii. Ensuring all recipients understand and have signed on/off a work permit;

- iii. Ensuring all recipients are informed of the conditions of a work permit including:
  - Isolation points;
  - Program earths;
  - Limits of the safe work area;
- iv. Locations of adjacent live points;
- v. Protection, control and automation isolations; and
- vi. Actively managing the work to be performed ensures the work is performed safely within the conditions of the work permit.

An RIC cannot delegate the accountability of any task to another individual, however, they can directly supervise a person familiar with a relevant task, e.g., proving de-energisation and/or applying working earths. Regardless the RIC must sign the work permit.

*Note: A RIC cannot perform the function of a safety observer until all workers have signed onto the work permit and the work has started.*

### **3.1.5 Tester in charge (TIC)**

A TIC must be authorised by Western Power. All testing and commissioning work under an STT is performed under the control of a TIC. Responsibilities include:

- i. Accepting and relinquishing STT permits;
- ii. Ensuring all recipients are informed of the conditions of the work permit; and
- iii. Managing any testing to ensure that all work is performed safely under the conditions of the work permit.

A TIC cannot delegate the accountability of any task to another individual; however, they can directly supervise a person familiar with a relevant task. Regardless the TIC must sign the work permit.

*Note: A TIC cannot perform the function of a safety observer until all workers have signed onto the work permit and the work has started.*

### 3.1.6 Recipient

The recipient must be authorised by Western Power. Responsibilities include:

- i. Working safely under the conditions of the work permit and direction of the RIC/TIC;
- ii. Signing on to work permits before commencing work and signing off after work is complete; and
- iii. Understanding the conditions of the work permit which include:
  - Isolation points;
  - Program Earths;
  - Limits of the safe work area;
  - Locations of adjacent live points; and
  - Protection, control and automation isolations.

## 3.2 Switching

Western Power's network switching authorisations consists of a range of levels/categories. These are used to authorise switching operators to operate equipment at various voltages on the network. For switching authority levels refer to Western Power's Network Access team. Refer to section 3.8.1 for low voltage switching.

All switching operators must carry out a practical switching recertification to demonstrate competency every two years.

### 3.2.1 Transition from a live high voltage state to an earthed state for EAP process

For the network to transition from a live (hazardous) state, to a de-energised (off) state (see figure 3.1), there must be a gap (air or other rated insulation) created. This is typically achieved by opening a switch. To progress to an isolated network state, a visible break or other approved isolating switch must be opened, barriered, locked when locking facilities are available or by other means of rendering the network incapable of being inadvertently energised must be put into place and a danger tag attached.

An earthed state is then achieved following testing procedures and applying program earths.

### 3.2.2 Switching general

The Switching Operator(s) must contact Network Control prior to carrying out any switching on the network.

At each item on the switching schedule, and before performing an operation, the switching operator and/or controller must verify:

- i. The correct schedule for the planned work at the right time
- ii. The correct item number on the schedule;
- iii. The correct location;
- iv. The correct apparatus; and
- v. The apparatus is in the expected state prior to operation and is fit to be operated.

#### **Following the STOP, THINK, CHECK protocol is mandatory.**

After operating the electrical apparatus, the switching operator and/or controller must:

- i. Confirm any visible contacts are in the final desired position on each phase;
- ii. Use mechanical or other positive indications to visually confirm circuit breakers are off before operating the associated disconnectors (isolators) or racking withdrawable switchgear;
- iii. Record the exact time a switching operation is executed for each step of the switching schedule; and
- iv. Where available, voltage and current indicators must be used by the controller and/or switching operator to confirm switching and the apparatus' operational status.

As a safety precaution preference must be given to operating/energising/de-energising equipment from a distance, or via a remote means. When returning from a break, the switching operator must confirm with the Controller that they are still working from the correct schedule version and are at the right step.

When operating switchgear in a zone or terminal substation the switching operator must implement control measures. These control measures must include:

- When energising a newly commissioned equipment/device or switching for restoration after a major asset maintenance, an approved warning sign placed in a clearly visible position on the main entrance gate with the switching operator's contact phone number written in the space provided.
- For normal switching, a request for non-switching personnel to vacate the immediate area.

### **3.2.3 Switching schedules**

A switching schedule is a sequential, numbered list of precisely ordered switching operations (steps). A HV/LV electronic Network Access Request (eNAR) must be submitted to generate a switching schedule for planned work.

The process of creating, approving and executing HV and/or LV switching schedules must involve a minimum of two authorised persons. The first authorised person can complete more than one task in this process (if permitted to do so), but they must ensure that at least one step of the process is the responsibility of a second authorised person. This ensures program integrity.

In the event that amendments are required while a switching schedule is being run, all parties must agree to the changes prior to any changes being made on the switching schedule. The Controller has the responsibility and accountability for authorising any changes.

At the commencement of a schedule, the switching operator must verify the correct schedule version number (HV only) with Network Control. The switching operator must also refer to any current maps, schematics, diagrams and/or other operating instructions to confirm correct location and apparatus (STOP, THINK, CHECK, protocol). When ready to commence, the switching operator must contact Network Control for permission.

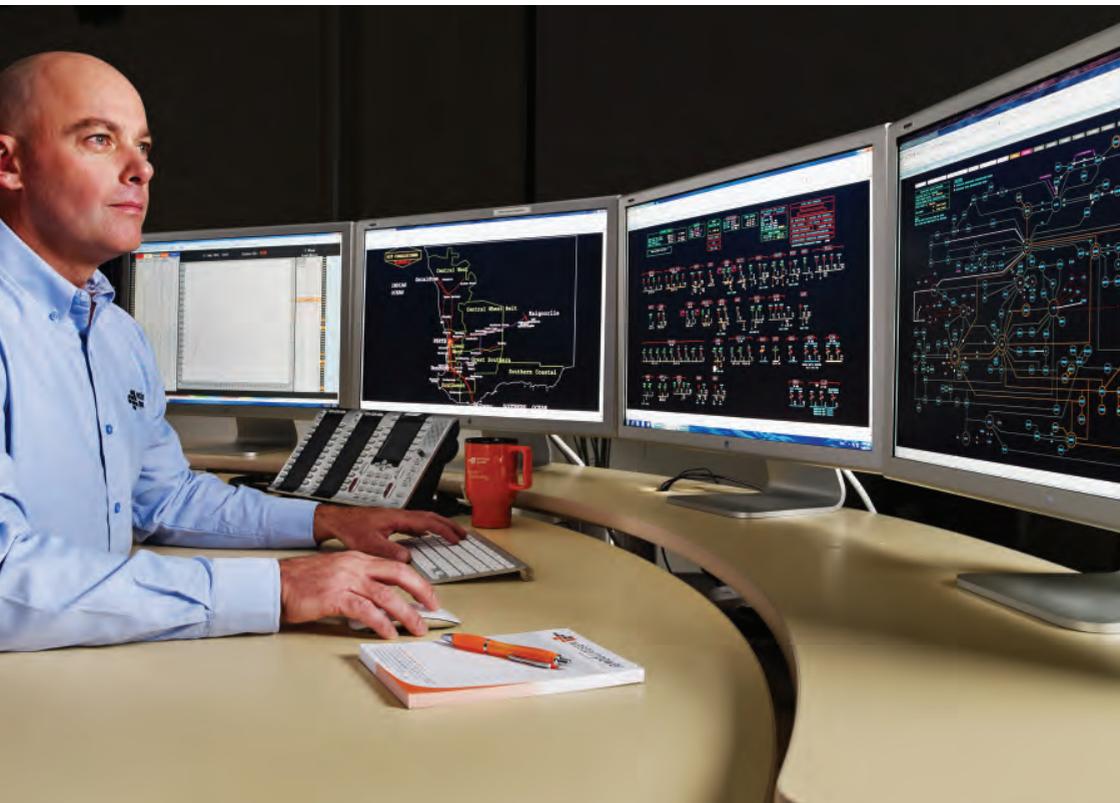
All planned switching operations carried out on the HV network will require a switching schedule which is created, checked and approved by authorised personnel.

For switching operations carried out under unplanned conditions (faults etc.) the Network Controller will create an unplanned Power on Fusion (PoF) switching schedule as required in conjunction with the authorised switching operator with each itemised step included in the schedule.

The following operations do not require a HV switching schedule:

- MVAR and voltage control operations, excluding the operation of cap and reactor circuit breakers;
- Replacing HV drop-out fuses; and
- Resetting of relay flags on feeder circuit breaker protections.

*When high voltage (HV) and low voltage (LV) switching is required, separate HV and LV switching schedules must be used.*



### 3.2.4 Tap removal

The removal of taps will be declared as switching steps on a switching schedule. Energising and de-energising conductors, cables and apparatus must only be undertaken as an item on a switching program issued by Network Operations.

The removal of single phase live line taps/clamps using a rated insulated stick is considered similar to removing a drop out fuse. A vicinity authority (VA) permit is therefore not required. This operation does not require the upstream protective device (recloser or circuit breaker) to be set to manual.

A VA permit is required when removing single phase solid taps off a single phase network, a single phase live line tap/clamp off a three phase network, or when removing three phase live line taps/clamps from a three phase network using glove and barrier or a distribution insulated stick.

When doing this work there must be a spotter on site, ensuring appropriate clearances are maintained while applying or removing HV live line taps.

Maximum lengths of network apply when removing taps on unloaded overhead aerial distribution lines. This is due to an increase in capacitance as the lengths increase. Maximum lengths for live line tap removal are:

- i. 11 kV = 15 km
- ii. 22 kV = 4 km
- iii. 33 kV = 1.5 km

If distances are exceeded, isolation must be achieved using a rated device.

### 3.2.5 Customer owned networks

These are networks owned, controlled and switched by third-parties. The customer is considered the 'Operating Authority' of their own network. A Western Power Network Control or switching operator is not authorised to switch in a customer network unless trained and formally authorised to do so.

### 3.3 Isolation of electrical apparatus

Isolation is the disconnection of electrical apparatus from source or sources of supply. Isolation points must be rendered incapable of being energised unintentionally.

The purpose of isolation is to safely disconnect electrical apparatus from all possible sources of electrical supply. Only approved electrical apparatus and methods of isolation can be used as isolation points. The following cannot be used as isolation points in switching schedules: zone substation circuit breakers (non-rackable), reclosers, load break switches and sectionalisers (without a visible break).

Isolation can be achieved by one or more of the following methods:

- i. Fully opening the contacts of an approved device to create a visible gap (air or other rated insulation) or operating a non-rackable switching device to the off position, using the mechanical indicator as proof of the opening operation, applying a lock where locking facilities are available, and applying a danger tag
- ii. Creating a visible gap (air or other rated insulation) by operating a rackable switching device to the off position and then racking it out to the fully withdrawn position, and locking the shutter(s) closed and applying danger tag(s) or racking to isolated position then locking and applying danger tag(s)
- iii. Creating a visible gap (air or other rated insulation) by the removal of fuses, links and/or connections, danger tagging and applying barriers as appropriate.

*Note<sup>1</sup>: Where shutters (or other apparatus) that are required as isolation points are rendered inaccessible by virtue of the positioning of circuit breakers (or other apparatus) which is in service in an alternative position, locked and danger tagged in that position, the shutters (or other apparatus) are considered isolated.*

Where a locking facility is available it must be used to lock the electrical apparatus in the isolated position and a danger tag fitted. If barriers are required to prevent unsafe access to live parts, only Western Power approved barriers can be used.

If an apparatus is to be used as a common isolation point for multiple work permits, a danger tag must be fitted for each isolated area with each danger tag indicating the work permit number associated with the isolated area. Situations where this may occur include line maintenance, line disconnector maintenance and circuit breaker maintenance.

A second isolation area cannot exist within another isolation area for the purposes of issuing another work permit.

### **3.3.1 Maintaining the integrity of isolation points**

Where a device or equipment that is being used as a point of isolation or a structure that supports a point of isolation for the purposes of the issuing of a work permit, the device, equipment or structure must not be worked on or interfered with if the interference will in any way compromise the integrity of the isolation point and endanger people working under the work permit.



## 3.4 Power system earthing

The purpose of earthing is to:

- i. Limit the rise in potential difference in the work area and trigger the protection equipment to disconnect supply if supply is inadvertently restored;
- ii. Control induction when used in conjunction with equipotential bonding techniques; and
- iii. Safely discharge electrical charges caused by lightning, wind, changes in ambient conditions or altitude.

Before electrical apparatus is earthed it must first be tested for de-energisation with an approved instrument.

The de-energised test is performed using the following sequence:

- i. The instrument is proved to be working;
- ii. The instrument is used to prove the circuit under test is de-energised; and
- iii. The instrument is proved to be working.

Earths must be applied immediately after the tests have proven de-energisation. This process must be repeated at all earthing points.

Insulated and un-insulated mobile plant is to be appropriately earthed when working on or near any overhead HV and LV wires/conductors (energised or de-energised).

For detailed information regarding the requirements associated with earthing, refer to the Earthing Work Instruction/Practice.

### 3.4.1 Program earths

Program earthing must be applied to protect the worksite against inadvertent energisation from all primary sources of supply (the worksite is the area inside the isolation points between the program earths). Earthing that does not achieve “boxing in” of the work area may only be used when approved by Network Control under exceptional circumstances.

Program earths as specified in the switching schedule shown at suitable junction points on the Power on Fusion (PoF) diagram are not physical locations. It is acceptable to place a program earth at a suitable point on an electrical circuit at any position between the point of isolation and the work area providing the boxing is followed. No other known sources of supply can exist between the isolation points and the work area.

The switching operator is accountable for the application and removal of program earths. The switching operator cannot delegate this responsibility but may directly and continuously supervise another authorised person required to perform this task.

When a program earth is applied, a danger tag must be prominently and robustly fitted. This includes portable and fixed program earths. A program earth with a danger tag attached can only be removed by a Switching Operator or with permission from Network Control. A restricted use tag can be attached in lieu of a danger tag when the program earths need to be temporarily removed for testing in conjunction with an STT permit or EAP issued under ESSR section 3.5.

Where a running earth is available, program or working earths must be applied by bonding each conductor to the running earth and earthing point. Earth switches must be used as program earths wherever possible.

The removal of program earths under a switching program, immediately following the cancellation of an EAP, must be signed-off on the EAP in the 'Removed by' column. This serves as an additional safety precaution and double-check that all program earths have been removed.

### **3.4.2 Program earthing dispensation on transmission stations**

Due to the complexity of some transmission switchyards, it is not always possible or practicable to safely achieve boxing in. The formally assessed risk of applying all the program earths at some of these sites is too onerous and outweighs the additional safety that would be achieved, therefore the next best alternative of single point earthing must be adopted.

Single point earthing is permissible by applying for written dispensation at the pre-job planning stage and must only be applied in the following circumstances:

- i. Where the primary conductor/busbar is to remain continuous at all times;
- ii. A formal recorded risk assessment has taken place and the risk assessment indicates that it is inherently more hazardous to attempt to comply with the boxing in process; and
- iii. Dispensation has been granted by Network Operations.

The maximum safe area for work when using single point earthing is up to nine metres from the applied program earth along a continuous primary conductor. No break must exist or be proposed in this conductor for this rule to apply.

When work is to take place on an indoor multi-panel switchboard, once all of the feeder, transformer and bus-section/coupler circuits have been isolated, it is essential to earth the busbar at a minimum of two points before any work permit is issued. Where two earthing points are not available, the single point earthing principle may be applicable.

In the event that the transformer/bus-section/bus-coupler circuit breaker are being maintained as part of the planned works, then an alternative circuit breaker must be used to earth the busbar to maintain the minimum of two earths.

### **3.4.3 Working earths**

Working earths are used as required to ensure earths covering all potential sources of possible supply are visible from the worksite. A working earth is not required when a program earth is visible from the worksite.

Working earths can only be applied after the program earths have been applied and an appropriate work permit issued. Working earths must be removed before the work permit is relinquished and before the program earths are to be removed.

The RIC is accountable for the application and removal of working earths. Recipients must not apply working earths without the approval of the RIC. All working earths fitted or removed must be noted on the work permit. Working earths can also be used to control induced and static voltages at the worksite.

### 3.4.4 Portable earths

A portable earth can be a program earth or a working earth. Where a permanently installed earth point is available, it must be used. Portable earthing apparatus must be appropriately fault rated for the location of their installation. The neutral conductor of the 415V LV system must not be used as a HV earth. When placing earth leads, the connection to the main earth must be made first and removed last.

The choice of connection for a portable earth should, where practicable, be made on the basis of the following order of preference.

**Table 3.1 Earthing hierarchy**

1	Permanently installed earthing system at the worksite
2	Permanently installed earthing system close as possible to the worksite
3	Earthing ferrule in concrete pole at the worksite
4	Earthing ferrule in concrete pole close as possible to the worksite
5	Permanently installed earthing system or concrete pole earthing ferrule within isolation area
6	Ground rod of installed pole stay or permanently driven pole earth stake or permanently driven "pole nail"
7	Temporary earth stake (driven to full depth) or otherwise firmly anchored

Options 6 or 7 should only be used for the first program earth if options 1 to 5 are not available

### **3.4.5 Location of earths**

Earths must be placed so that they remain effective even if the electrical apparatus covered by the work permit is disconnected.

Working earths should be installed as close as possible to either side of the work being carried out, preferably to a common working earthing point.

Lines and substation work areas must be earthed from all points of supply, excepting single point earthing.

### **3.4.6 Earthing equipment check**

Prior to commencing/recommencing work, the RIC must inspect the earthing equipment in use to make sure it is still correctly installed, particularly those installed on previous days.

### **3.4.7 Electromagnetic induction**

In situations where it is considered that program earths do not provide adequate protection from electromagnetic induction, additional working earths must be used.

For detailed information regarding the requirements associated with protecting personnel from the effects of electromagnetic induction refer to the Induction Work Instruction/Practice.

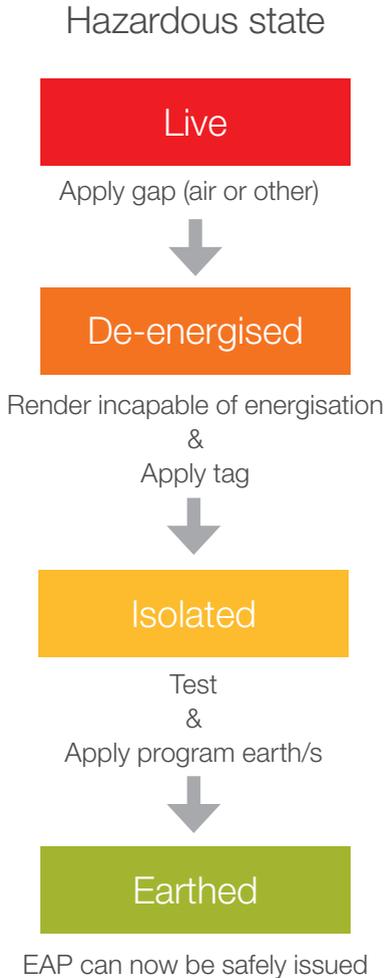
### **3.4.8 Equipotential bonding**

Equipotential bonding is the practice of intentionally electrically connecting all exposed metallic non-current carrying items together as protection from earth potential rise or stray voltage. Even if the connection to a distant earth ground is lost, protection from hazardous voltage differences is provided by creating an equal potential.

### 3.4.9 Earthing lines under construction or being dismantled

Due regard is to be given to conductor earthing on power lines under construction or being dismantled (both connectable and non-connectable to the network) due to the risk of electric shock associated with electromagnetic induction, static induction or lightning.

Where necessary formal control (such as a construction work permit) must be introduced.



**Figure 3.1 Transition from live to earthed network state for EAP (HV)**

## 3.5 Accessing the high voltage network

A work permit is required when accessing operational plant/equipment for work purposes and must be issued by an authorised person with the appropriate authorisation level. The permit to work process allows the authorisation of work to be performed on Western Power's electrical network.

### 3.5.1 Work permit types

#### 1. Authority to work in the vicinity of electrical apparatus (VA)

A VA permit is issued to a RIC to authorise:

- i. Work within the MAD using approved HV live techniques;
- ii. Work outside the MAD (but within the danger zone) on motor drives and/or operating mechanisms of energised electrical apparatus;
- iii. Excavating within the MAD or physically moving the high voltage cable; and
- iv. Work near live conductors or electrical apparatus by authorised persons where there is a possibility of encroachment into the MAD<sup>1</sup>.

A VA permit cannot be issued until all auto-reclosing features on electrical apparatus are made inoperative and tagged appropriately. SCADA controlled electrical apparatus must be tagged on the SCADA. Non-SCADA controlled electrical apparatus must be tagged directly on the field electrical apparatus.

All personnel working under a VA permit must sign onto the VA permit. This includes the issuing officer and/or switching operator. Once completed, work can then take place under the control of the RIC<sup>2</sup>.

#### 2. Electrical Access Permit (EAP)

An EAP authorises access to electrical apparatus or conductors that have been made safe by isolation and earthing. All personnel issuing and receiving EAPs must be qualified and authorised by Western Power.

All personnel working under an EAP must sign onto the EAP. This includes the issuing officer and/or switching operator. Once completed, work can then take place under the control of the recipient in charge (RIC)<sup>2</sup>.

### 3. Sanction to test (STT)

A STT permit authorises access to electrical apparatus and/or conductors for testing and commissioning. Only one STT can be issued on an electrical apparatus at any time.

All personnel working under an STT must sign onto the STT. Once in place, work can commence under the control of the Tester in Charge (TIC)<sup>2</sup>.

*Note<sup>1</sup>: Initial planning and the Risk Assessment will determine whether encroachment is likely.*

*Note<sup>2</sup>: The RIC/TIC must be on site at all times for work to take place.*

#### 3.5.2 Working under a permit

To gain access to a piece of electrical apparatus, all persons must understand the conditions of, and sign on to, an appropriate work permit before commencing work. Similarly, they must sign off the work permit when access to the electrical apparatus is no longer required. When work permit conditions need to change, the existing work permit must be relinquished and cancelled, and a new work permit must be issued. This does not apply to the application and removal of working earths which are under the control of the RIC.

The issuing officer must carry out a face-to-face transfer of the work permit from the issuing officer to the RIC/TIC, except in exceptional circumstances where the remote work permit issue process can be used.

All work permits under the control of Network Control must be registered with Network Control at the time of issue and cancellation. Network Control must maintain a log of all work permits over the entire lifecycle of the work permit. This includes 240V/415V LV work permits.

All relinquished work permits must be confirmed cancelled with Network Control before they will approve the return of the electrical apparatus to normal operation.

### **3.5.3 Right to refuse a work permit**

A RIC/TIC/recipient has the right to refuse a work permit if they have any safety concerns. These issues are to be resolved on site or referred to a higher authority for review.

### **3.5.4 Change/Transfer of RIC or TIC**

A RIC/TIC can transfer a work permit to a replacement RIC/TIC if the work permit has this provision. This must be carried out face-to-face, except for in exceptional circumstances where remote work permit transfer can be used.

To complete the transfer:

- i. The departing RIC/TIC signs off the work permit;
- ii. Prior to the departing RIC/TIC leaving site, the departing RIC/TIC shows the replacement RIC/TIC the isolations and earths;
- iii. The replacement RIC/TIC closely reads and understands the work permit conditions;
- iv. Once understood, the replacement RIC/TIC signs on to the work permit;
- v. The replacement RIC/TIC informs all recipients of the transfer; and
- vi. The replacement RIC/TIC informs Network Control of the transfer and provides them with their contact details.

Recipients cannot remain signed onto a work permit that does not have a signed on RIC/TIC

### **3.5.5 Multiple worksites**

The decision to split a worksite into multiple smaller worksites is best determined through pre-job planning. Whether a job needs to be split up into a series of sites is determined by the level of supervision required for the activities to be undertaken and the risks associated with those activities.

When a site is split and separate work parties are to undertake the work, a separate work permit must be issued for each separate site, including having a dedicated RIC/TIC at all times.

The degree to which safety control and supervision is maintained is influenced by:

- i. The proximity of the RIC/TIC to the work team;
- ii. How well defined the site boundaries are through the use of secure fencing, gates, or other prominent temporary limits marked by barriers and/or signs;
- iii. Whether the worksite has mixed live, de-energised and earthed equipment that may or may not have their limits made prominent through barriers and/or signs; and
- iv. The levels and degrees of compliance, competence and experience within the work team. This will be subject to the RIC/TIC's own judgement and situational awareness.

Pre-job planning will assist to determine whether the work is best conducted concurrently, or in stages, and this must be declared on the network access request (eNAR).

When direct access work is not involved, a roving RIC/TIC can be used. If there is any doubt about the safety of the work being completed at any site, a dedicated RIC/TIC must to be assigned to that site.

In the event that a single work team will work at multiple locations on the same single circuit, one work permit is sufficient to cover all of the individual worksites. The RIC/TIC is responsible for local safety and the issuing of working earths at each site as appropriate.

On many occasions a testing work team is split across multiple locations. This is safely managed by having one master STT and a coordinating TIC at the main test site (STT permit safety does not allow concurrent work permits on the same electrical apparatus).

At each worksite there must be a mirrored copy of the master STT. There must also be another authorised TIC who manages the work of the local work team and maintains communication with the coordinating TIC. All personnel, including the additional TIC, must sign onto the mirrored copy of the STT as recipients.

The coordinating TIC is accountable for all work at all test sites associated with the testing.

### **3.5.6 Concurrent work permits**

An EAP and STT cannot exist on the same primary electrical apparatus at the same time.

An STT can be issued on the secondary equipment associated with the primary electrical apparatus under an EAP, providing:

- i. The two work parties communicate, understand and agree to the extent of each other's work and the isolation/precautions taken;
- ii. Adequate secondary isolations have been carried out; and
- iii. The work does not interfere with the conditions of the EAP that is associated with the primary plant.

An EAP can be issued within the work area limits of a VA permit, provided the VA permit work does not compromise or take place on the isolation or program earthing points of the EAP.

A VA permit can be issued within the isolation points of an EAP provided work is not being carried out on the isolation points or program earthing points of the EAP.

### **3.5.7 Issuing a VA permit to provide isolation for an EAP**

When a VA permit is issued to remove taps on a three phase network, and those taps will provide a point of isolation for an EAP, the VA permit must be cancelled prior to the issue of the EAP. A second VA permit will be required after the cancellation of the EAP for the purpose of restoring the taps.

### **3.5.8 Work permits that run for more than one day**

Recipients must not recommence work without the approval of the RIC/TIC. Prior to the commencement of any work, the RIC/TIC must ensure:

- i. The conditions of the work permit haven't changed;
- ii. Isolation and earthing points are still intact and as described on the work permit. In the event that the isolation and/or earthing integrity has been compromised, work must not recommence until the integrity has been restored;
- iii. Site conditions are suitable for the work to recommence; and
- iv. All recipients are advised of any changes to conditions. This includes explaining to recipients face-to-face any new risks associated with the changes.

For a VA work that runs for a number of days, the VA must be issued face-to-face on the first day. For the subsequent days until completion, the VA can be issued remotely provided the RIC, scope of work and work area limits remain the same.

The Issuing Officer and the RIC must go through each of the conditions of the permit daily and ensure that clearances are not compromised.

The RIC must provide the Issuing Officer photo evidence showing recipients signed off after relinquishing the VA at the end of each day.

### 3.5.9 Remote work permit issue

Face-to-face work permit issue and receipt is always preferred to remote work permit issue and receipt

Whilst it is preferred that work permit issuing is completed face-to-face between the issuing officer and RIC/TIC, a work permit can be issued (in some circumstances) remotely using the remote issue process. The circumstances that allow remote work permit issue include:

- i. Where distance/weather conditions inhibit face-to-face contact;
- ii. Line patrol and line washing by helicopter, providing the RIC has a full copy of the work permit (VA) prepared in advance of the remote work permit issue;
- iii. Where a work permit change is required;
- iv. Under emergency situations; and
- v. Where multiple VA permit issue is required at different worksites (for example vegetation work).

*Note: For the distribution network, remote work permit issue is restricted to VA permits only.*

The process for the remote issue of a work permit is:

- i. The off-site Issuing Officer writes out their copy of the work permit;
- ii. The Issuing Officer verbally relays the details of the work permit to the on-site RIC, who writes out the field copy of the work permit  
OR  
the issuing officer forwards an advanced copy of details that are transcribed by the RIC on to the field copy of the work permit;
- iii. The RIC reads back the contents of the on-site work permit to the issuing officer who confirms the accuracy of all details on the RIC's copy;

- iv. The off-site and on-site work permit numbers are exchanged and recorded on the work permits;
- v. The Issuing Officer registers the on-site copy work permit number with Network Control; and
- vi. The RIC signs the field copy on behalf of the Issuing Officer, and then receives the work permit as the signed on RIC.

### **3.5.10 Accommodating extra recipients on work permits**

If the recipient 'sign on' section is full and cannot accommodate all of the recipients at a worksite, further work permit(s) must be issued. The following rules apply to all additional work permits:

- i. The same RIC must be used where multiple work permits are in force at a worksite;
- ii. The work permit forms need to be of the same type, e.g., all EAPs, VAs or STTs etc. and completed with the same conditions as the existing work permit. Simply cross-referencing the initial work permit is prohibited. The additional work permit forms must be completed by the Issuing Officer; and
- iii. The RIC/TIC is to notify the Issuing Officer of the requirement of additional work permit(s) and the new work permit number(s). If the Issuing Officer agrees to the new work permit(s), the Issuing Officer must notify the Operating Authority to log the new permit details.

### **3.5.11 Accommodating extra isolation points, shorting, earthing and conditions on work permits**

If work permit sections are full and cannot accommodate all isolation points, shorting, earthing and condition information, further permits must be used. The following rules apply to all additional permits:

- i. The first work permit is considered 'the master work permit'. It is to be filled in as per standard procedure;
- ii. Subsequent work permits must have their reference numbers crossed-out and replaced with the 'master work permit's' reference number;

- iii. On each subsequent work permit, continue to fill in only the overflow information. Do not duplicate information except for the work permit number. Cross out the sign on/sign off section on all subsequent work permits<sup>1</sup>. In cases where the recipient sign on section is full and cannot accommodate all recipients at a worksite, see section 3.5.10;
- iv. The total number of work permits used must be recorded on the 'master work permit'. For example 'page 1 of 3' should be written on the first or three work permits;
- v. Each subsequent work permit must then be given a page number, and this must be written on the front of each subsequent work permit. For example, if using two subsequent work permits, write 'page 2 of 3' on the second work permit and 'page 3 of 3' on the third work permit; and
- vi. Upon completion, the collection of all work permits are to be treated as one work permit by the work team.

*Note<sup>1</sup>: Recipients must look at all conditions on all work permit sheets, but limiting recipient information to "the master work permit" will make the sign on and sign off process safer and easier to reconcile.*

### **3.5.12 Leaving a worksite while under a work permit**

#### Recipients

- i. A recipient who is leaving the worksite must sign off the work permit; and
- ii. A recipient returning to a worksite must alert their RIC/TIC immediately, reconfirm all work permit conditions and sign onto the permit before starting work.

#### RIC/TIC

- i. An RIC/TIC who is temporarily leaving the worksite is not required to sign off the work permit<sup>1</sup>;
- ii. When an RIC/TIC returns to site after a departure they must reconfirm all work permit conditions before starting work; and
- iii. An RIC/TIC who is permanently ceasing work and departing a worksite must handover or relinquish the permit prior to their departure<sup>1</sup>.

When an RIC/TIC leaves the worksite due to an emergency and is unable to complete a transfer of the work permit to a new RIC/TIC:

- i. All work must stop on electrical apparatus;
- ii. Network Control must be notified by one of the work permit recipients;
- iii. Network Control will contact the issuing officer; and
- iv. The Issuing Officer will return to the worksite to handover or cancel the work permit.

*Note<sup>1</sup>: All recipients must stop all work on electrical apparatus under the control of a work permit if the RIC/TIC departs the worksite. This includes short term (anticipating a return) departures. The RIC/TIC must ensure all recipients have stopped work and are clear of electrical apparatus before they depart.*

### **3.5.13 Signing off an absent recipient**

A recipient that is absent or unavailable can be signed off the work permit by the RIC/TIC after:

- i. Reasonable attempts to contact the recipient are made. If all reasonable attempts have been made without success, follow normal escalation processes to speak to their formal leader;
- ii. The relevant Manager/Team Leader has been notified of the absence; and
- iii. The controller has been notified and approval has been granted.

### **3.5.14 Recall of work permits**

For operational reasons, Network Control may require an electrical apparatus to be returned to service earlier than the time indicated on the switching schedule. When this occurs, the RIC/TIC will be notified by Network Control to follow normal work permit procedures to relinquish the work permit to allow the return of the electrical apparatus to a serviceable condition.

### **3.5.15 Returning equipment to service without work permit cancellation**

Network Control may require an electrical apparatus and/or plant to be returned to service for operational reasons, without relinquishing recipients.

Network Control must ensure that the RIC/TIC is immediately informed of the changed conditions. The RIC/TIC must make arrangements to ensure that the returning work team is informed of the changed conditions. This must be through verbal contact and visual notification at the point of entry to the site.

This situation is limited to transmission apparatus where there is a recall condition available at the end of each day.

### **3.5.16 Transmission lines that cross overhead distribution lines**

Regardless of clearance distances, work and permit requirements must be approved by Network Control who will determine one of the following outcomes:

- i. The work is not allowed to proceed;
- ii. A VA permit is required as a precaution;
- iii. An EAP is required; or
- iv. No work permit is required.

Regardless of outcome, being aware that work is occurring at a crossover enables Network Control to coordinate all work safely.

## 3.6 High voltage (HV) live work

HV live work is any work (excluding switching) that is performed inside the MAD on any plant or electrical apparatus that is not de-energised, isolated and earthed as per work permit requirements.

The following procedures for undertaking live work are mandatory:

- i. All staff engaged on HV live work must be competent and must possess Western Power authorisation to undertake HV live work;
- ii. All live work must be completed under a VA permit and in accordance with the High Voltage Live Work Manual;
- iii. All tools and equipment must be approved, appropriately rated and tested for live work;
- iv. All protection must be enabled and auto reclose disabled; and
- v. Approved and appropriate PPC and PPE must be worn.

The safety observer must be authorised to carry out the work being observed, and have the authority to stop the work if required. Multiple safety observers may be required in some circumstances. The safety observer(s) must be positioned to view the work being done and must suspend work if their view of the activities becomes obscured.

HV live work must not be undertaken concurrently with other work on or near the same plant or electrical apparatus covered by another work permit.

### 3.6.1 Weather conditions for live work

HV live work must not take place in unfavourable weather (as defined by the HV Live Work Manual). If unfavourable weather develops, all work must stop.

If work is stopped, the HV line and equipment must be left in a safe condition, and Network Control must be informed.

### 3.7 Short-circuited low voltage

The purpose of LV shorting/bonding is to:

- i. Safely discharge induced or residual voltages;
- ii. Safely discharge electrical charges caused by lightning, wind, changes in ambient conditions or altitude; and
- iii. Limit the rise in potential difference in the work area if any connected weak energy sources are inadvertently energised (for example PV installations, small generators).

Short-circuited LV is achieved by bonding all phase and neutral conductors together using approved equipment and procedures.

Before electrical apparatus is short-circuited it must first be tested for de-energisation with an approved instrument.

The de-energised test is performed using the following sequence:

- i. The instrument is proved to be working;
- ii. The instrument is used to prove the circuit under test is de-energised; then
- iii. The instrument is proved to be working.

Short circuiting must be applied immediately after the test has proved de-energised. This process must be repeated for all short-circuited points.

Underground LV cable terminals that are unable to be shorted must be treated as live.

### 3.7.1 Isolated and short-circuited low voltage

No person can commence work on any isolated and short-circuited LV electrical apparatus until they have signed onto an EAP. All short-circuited or isolation points must be noted on the EAP.

When the LV electrical apparatus cannot be isolated and short-circuited, the electrical apparatus must be treated as live.

There are a number of options available to ensure the safety of the work team:

- i. Shorting between phases, and where possible, earth. This can be achieved using approved shorting equipment;
- ii. Where shorting is considered hazardous or not a practical solution, the area must be treated as live. Approved work methods and insulating precautions must be taken;
- iii. Isolating further towards the supply and extra shorting leads in the immediate worksite may be required where it is hazardous to fit barriers and shorting equipment at the immediate worksite. This option could result in extended customer outage and needs to be factored into outage planning; and
- iv. The LV must be treated as live until it is proved de-energised and shorted. Insulating gloves and outers must be worn during the switching and testing procedure and the application and removal of shorts. Risk assess the correct PPE relevant to the task when applying shorting leads on overhead LV equipment. The minimum requirement for underground LV equipment is level 2 PPE, to ensure the use of face shields when applying shorting leads.

Program shorts must be:

- i. Placed to ensure the work area is adequately protected. This may include a HV earth on the HV side of a transformer feeding the proposed LV circuit to be worked on; and
- ii. Applied and removed following the steps in an approved switching schedule by a Switching Operator acting within the limits of their authority.

Approved low voltage shorts must be inspected, maintained and utilised in accordance with operational Work Instructions/Practices.

## **3.8 Working on low voltage networks**

Safe working techniques must be implemented for work on or near LV electrical apparatus. All LV electrical apparatus must be treated as live unless it is isolated and short-circuited by an approved means.

Persons required to work on or near LV network assets must be appropriately trained and authorised. The description and location of the electrical apparatus to be worked on, and the safety measures to be taken, must be clearly understood by all authorised persons intending to work on the electrical apparatus.

### **3.8.1 Low voltage switching**

All switching operations must be performed by appropriately authorised switching operators using a switching schedule that has been created by one switching operator and checked by another switching operator of the same level.

The operation of the LV network is not co-ordinated or controlled in real time by Network Control. The switching operator is responsible for the local co-ordination and control of the LV network.

An LV switching schedule is required when a work permit is required to be issued to allow access to the LV network and when back-feeding the LV.

If the only switching required is to isolate at the LV disconnector, which is already part of a HV switching schedule, an LV switching schedule is not required.

LV switching schedules must be kept for audit purposes.

### **3.8.2 Electrical access permits – low voltage**

The permit to work process applies to gain access to the LV network. LV EAPs are required to be logged by the switching operator with Network Control.

### **3.8.3 Planned low voltage switching and interruption**

Planned LV switching, including life support equipment customers, requires:

- i. That customers are notified as per the requirements of the Electricity Industry (Network Quality and Reliability of Supply) Code 2005 and Code of Conduct for the Supply of Electricity to Small Use Customers;
- ii. An LV Electricity Network Access Request (eNAR) to be submitted; and
- iii. An EAP to be submitted and logged where applicable.

### **3.8.4 Transition from a live state to a short-circuited low voltage network status for the EAP process**

EAP techniques cannot be used unless the network meets the requirements of an EAP (isolated and short-circuited by an approved means).

For the network to transition from a live, hazardous state, to a de-energised state, there must be a gap (air or other rated insulation) inserted. This is typically achieved by opening a switch. To progress to an isolated network state, a barrier, lock or other means of rendering the network incapable of being inadvertently energised must be put into place. A danger tag and a high visibility wrap (when specified) is also required. A short-circuited state is then achieved by following the appropriate testing procedures and short-circuiting. Once completed, an EAP can be issued.

### **3.8.5 Low voltage isolation points**

Only approved electrical apparatus and methods of isolation can be used as isolation points. This is achieved by creating any of the following:

- i. A visible gap (air or other rated insulation) by the removal of fuses and/or links, and ensuring a barrier across the gap;
- ii. A visible gap (air or other rated insulation) by the removal of fuses and links (where equipment does not allow a barrier to be fitted); or
- iii. A visible gap (air or other rated insulation) removing 150mm of conductor.

Isolation points must be rendered incapable of being energised unintentionally. Where a locking facility is available it must be used to lock the electrical apparatus in the isolated position.

When barriers must be used to prevent unsafe access to live parts, only Western Power approved barriers are permitted for use.

When isolating equipment for an EAP, a danger tag must be fitted at each isolation point. When isolating equipment that is not available for service, a warning tag must be fitted at each isolation point. If an isolation point is used as a common isolation point, a tag must be fitted for each isolated area.

### **3.8.6 Interconnecting circuits**

When a distribution transformer is taken out of service for replacement or maintenance, the LV circuit normally supplied by that transformer may be fed from another source.

Before interconnecting LV circuits:

- i. Check whether two substation HV feeders are being paralleled together via the LV circuits. A feeder could become overloaded when trying to carry the full load in an interconnected LV system if the second feeder trips. This may cause major damage to transformers and LV conductors;
- ii. Check the load on both the transformer being taken out of service and the transformers being interconnected. Determine if there is enough capacity available from the adjacent transformers. If not, consider alternatives such as generators or customer outages;
- iii. Check for incorrect conductor size and long route lengths, as these may cause a volt drop or overload problems. Use the largest conductor(s) available and the shortest route length possible; and
- iv. Plan to interconnect the minimum number of transformers. The more transformers interconnected, the greater the fault current if a fault occurs in the interconnected area. Each connected transformer will share the fault current. The drop-out fuses protecting these transformers may not grade, as they may not 'see' the full overload current. This creates a potential hazard to personnel and can damage plant in the fault area.

When a HV feeder experiences an auto reclose, the transformers used within the interconnected area may be disconnected through drop-out fuse operation. Interconnecting two feeders through the LV network should be avoided. If paralleling feeders cannot be avoided, the operator must be aware of these potential outage risks.

Where the distribution transformers on the same HV circuit breaker have a recloser or protection device interspaced between them, and where they are being paralleled through the LV network interconnection, LV fused jumpers must be used.

Where the distribution transformers on different HV circuit breakers are paralleled through the LV overhead network interconnection, LV fused jumpers must be used.

The use of LV fused jumpers can be avoided in the following situations:

- i. If LV fuses exist at one or both of the sources of LV supply;
- ii. Reconfiguring the HV network such that the distribution transformers then paralleled through the network interconnections are on the same HV circuit breaker and are not interspaced by a recloser or protection operated device. This is good operational practice and is the preferred option;
- iii. A planned outage on the LV; and
- iv. If, during switching, the risk is considered to be for a short period only.

After interconnection check whether the voltage is within the statutory voltage limits at all interconnection points.

After restoration ensure that all disconnectors that were closed as part of the LV switching schedule have been opened. LV switches that remain in an abnormal state after the completion of the LV switching schedule must be recorded by approved procedures.

### **3.8.7 Low voltage generators**

Network Control must be notified before connecting or disconnecting LV generators to the LV network.

### **3.8.8 Live low voltage work and safety observer**

For all live LV work, strict live work techniques apply.

Approved precautions must be taken to prevent simultaneous contact with conductors or conducting objects at different potentials.

Approved insulating covers must be used to prevent inadvertent contact with live LV electrical apparatus, or conducting surfaces of different voltages, except where approved methods permit otherwise.

A VA permit is not required or applicable to LV.

When work is being carried out on live uninsulated LV electrical apparatus, a safety observer must be appointed. Exceptions to this rule are:

- i. Testing, removal and installation of meters and load loggers;
- ii. Inspection and replacement of fuses or links;
- iii. Maintenance of control circuits; and
- iv. Work carried out with operating sticks.

Prior to commencing any work, a risk assessment must be completed. The risk assessment will determine whether the work is classified as high-risk or low-risk. For example, if the risk assessment determines that LV switching/pillar link work is low-risk, the work can proceed without a safety observer. If the risk assessment deems the switching/pillar link work to be high-risk, a safety observer must be present.

For further information refer to Appendix 2 Safety Observer Matrix.

## **3.9 Controlling the network**

### **3.9.1 Operating authority**

All HV switching is coordinated through Western Power's Network Control.

### **3.9.2 Controlling authorities and connectable equipment**

In transmission and secondary systems, the demarcation between construction, commissioning and operating authorities has distinct handover points.

In distribution, the concept of and demarcation between the construction, commissioning and operating authorities is more difficult to apply.

To maintain safe management of all connectable equipment, there must be a distinction between the construction/commissioning authority and the Operating Authority.

### **3.9.3 Connectable equipment**

In order to achieve maximum safety for employees, contractors and the public, Network Control must have an accurate network model at all times. Therefore, additions, amendments and/or the removal of components from the network must be captured in real time in controlled diagrams.

All connectable equipment is controlled by Network Control.

All electrical apparatus connected to the load side of a switch that is off is connectable. Any cables and network that are tapped into the network are also connectable.

### **3.9.4 Precautions for differing network and phase voltages**

Where electrical apparatus have differing voltages or differing phases that can be interconnected, apparatus must be rendered incapable of switching and/or interconnection.

Where an out-of-phase point or differing voltage network exists either side of an open point, the open point must be locked in the open position with a warning tag and have adequate prominent signage posted to warn of the associated danger(s). The changed conditions must be communicated to Network Control and corresponding signs/tags applied to controlled diagrams.

### **3.9.5 Restoration of Feeders and Reclosers**

For details on the restoration process of supply to distribution circuits following a typical sustained supply interruption (fault), please refer to Standard Operating Procedure 164 (EDM#1530872). This document includes the actions and decisions to be made on whether or not to restore power to the protected section of the network.

### 3.10 Handover certificates

A handover certificate is a document by which control and responsibility for equipment is transferred from one authority to another. All persons working on the electrical apparatus at the time of handover must sign the handover certificate. This is to acknowledge that they understand the change in responsibility for control of that electrical apparatus.

All work permits issued for an electrical apparatus must be cancelled before the electrical apparatus is handed over to Network Control.

On completion of the handover the electrical apparatus is under the responsibility of Network Control and may be connected to Western Power’s electrical system.

**Table 3.2: Handover certificate requirements for transmission**

	Connectable	First Energisation	Normal Service	Disconnected
Green or Brownfield site	Yes. Must list restrictions	Comment on cancellation of STT "OK to energise"	Yes. Final handover with restrictions if applicable	Yes From SMD to construction or workgroup
RRST	Yes. Must list restrictions	Comment on cancellation of STT "OK to energise"	Yes. Final handover with restrictions if applicable	Yes From SMD to primary maintenance
Asset replacement	Not normally. As asset is already connected	Comment on cancellation of STT "OK to energise"	Yes. Final handover with restrictions if applicable	Not Normally

### 3.11 Operating agreements

An operating agreement (OA) is an agreement between two Operating Authorities. It is used to confirm that an electrical apparatus' operational state will be held in an agreed state until the OA is cancelled.

An OA is used when:

- i. One party needs to work on an item of plant or electrical apparatus which requires isolation and/or earthing from an adjacent Operating Authority; and
- ii. Work on secondary systems or mechanisms of primary electrical apparatus requires the apparatus to be held in a particular state for safety reasons.

An OA is not a work permit. It does not authorise work to be undertaken. A work permit must be issued to allow work to take place. The conditions stated on the work permit must reference the OA. An OA is issued by a switching operator or Issuing Officer.





# Testing and commissioning

# 4 Testing and commissioning

## 4.1 Minimum requirements

Electrical apparatus, conductors and wires shall be positively identified before connections to Western Power's Network are made.

Polarity, phase rotation and neutral continuity testing shall be carried out in accordance with relevant Work Instructions/Practices when undertaking testing and commissioning work.

Testing can vary from "simple tests" to very complex tests, which apply dangerous voltages to apparatus. Danger to personnel and the public must be considered and appropriate controls implemented. "Simple tests" are tests that do not require a STT permit, barriers or a safety observer.

### 4.1.1 Testing under an STT

The issuing officer of the STT has a duty to ensure that the condition of the equipment covered by the permit is safe for the proposed work to be undertaken.

Tests may be deferred in critical situations. If this is done, then the apparatus should be energised remotely if possible.

Upon receiving the STT, the TIC has the duty to avoid danger during testing by:

- i. Ensuring all test equipment is approved and test are carried out in accordance with the relevant procedures and Work Instructions/Practices;
- ii. Ensuring the electrical apparatus, and associated test equipment, leads and connections, are adequately guarded to prevent danger;
- iii. Limiting accessibility to the electrical apparatus for unauthorised persons and members of the public;
- iv. Posting relevant signs in obvious positions (throughout the entire period that the electrical apparatus may be subject to voltage);
- v. Ensuring all cables and capacitors are discharged before and after the application of test voltage;
- vi. Ensuring temporary conductors used for testing purposes must be of an adequate size and be easily visible; and
- vii. Ensuring effective communication within the work team.

Any electrical apparatus that has been isolated and earthed for testing under the terms of an STT must not be connected to the system until it has passed all approved tests, declared fit for return to service and the STT has been relinquished.

For vacuum insulated switchgear, testers must mitigate the danger of x-rays by maintaining a two metre radius for root mean square (RMS) test voltages less than or equal to 50 kV.

For gas insulated switchgear, ensure that the switchgear is in good order and that the gas gauge indicates a sufficient level of SF<sub>6</sub> gas to operate.

## 4.2 Identification and spiking of cables

Spiking is the process of creating a short circuit between a cable core(s) and the neutral/earth. It is completed using an approved spiking device to verify that the cable has no hazardous voltage present.

Before a cable is spiked the following measures must be taken:

- i. Where practical the electrical condition of the remote ends of the cable must be confirmed as isolated and earthed;
- ii. The person in charge must personally select the cable to be spiked after careful reference to the appropriate records and use of approved tests to verify location; and
- iii. Both in service and abandoned cables must be positively identified through existing records and authorised tests.

Spiking of cables can be undertaken as part of a switching schedule, or prior to cutting or moving abandoned or unidentified cables.

Spiking may not be required where the entire length of the cable can be positively identified by some other means, and the ends are verified as de-energised.

Only a person trained to operate a spiking device can operate a spiking device in accordance with approved procedures. An STT is required if the spiking requires a third party to conduct tests and/or remove earths.

## 4.3 Commissioning general

All new and repaired/maintained electrical apparatus connected to Western Power's HV and LV networks must be commissioned/re-commissioned using approved procedures. This process is necessary to:

- i. Check workmanship and that equipment has been installed as per Western Power standards and documentation
- ii. Check the condition of the new or repaired electrical apparatus, including labelling accuracy;
- iii. Ensuring any new cable to be joined to an existing cable is proven to be the correct cable to an end to end continuity test;
- iv. Ensure that the electrical apparatus is safe; and
- v. Ensure correct operation of the electrical apparatus.



Earth out cable cores or apparatus between tests and on completion of testing to dissipate any stored energy. Equipment should be left in an earthed state to eliminate any possible recovery voltage until reconnection is required.

Commissioning includes:

- i. Phasing out. If using neon phase indicator test points or other indirect methods to indicate cross phasing, then an alternative test method must be used to confirm that the phases are indeed crossed. (For an RMU, repeating the cable core identification test, phasing out across a PTS);
- ii. Phase rotation checking – this includes at feeder pillars, mini pillars and LV connection points as each cable is energised;
- iii. Service connection checks (use appropriate Service Connection Test Forms);
- iv. Commissioning of new plant (energise from a remote source and disable auto reclosing, or implement temporary improvement in protection sensitivity);
- v. No-load soaking;
- vi. On-load measurements;
- vii. Function checks (indication and interlocks);
- viii. Physical inspection for leaks, strange noises, odours and clearances;
- ix. Checking that any remote indication and alarms are accurate;
- x. Verifying labelling accuracy;
- xi. Ensuring the handover process has been complied with; and
- xii. Checking data sheets and as-built drawings.

The following HV cables must be commissioned:

- i. New installation feeder cables;
- ii. Distribution transformer cables with joints that are protected by a fuse; and
- iii. All new transmission cables up to 33 kV, including;
  - New transformer cables between transformer and switchboard;
  - New capacitor bank cables;
  - Local substation transformer cables;
  - Switchboard bus cables; and
  - Neutral earthing compensator cables.



# Electrical substations and specialised network apparatus

# 5 Electrical substations and specialised network apparatus

## 5.1 Electrical substation entry and security

Securing assets against unauthorised access and operation is critical for the safety of the public, personnel and operation of Western Power’s network.

All persons must use Western Power’s approved ‘check in check out’ system upon entry or departure of a substation site. This includes zone substations, terminal stations and associated relay/control rooms.

Network Control may require notification of entry or departure of specific distribution sites (CBD and remote controlled distribution HV substations).

*Note: “All persons” is inclusive of switching operators, personnel working on their own and work group representatives.*

To enter an electrical substation the following requirements must be met:

**Table 5.1: Substation entry requirements**

Western Power Substation (other than pad mounted distribution substations)	
Operational Worker	<ul style="list-style-type: none"><li>• NAC + substation entry; or</li><li>• NAC + immediate supervision; or</li><li>• Exemption + immediate supervision + site induction</li></ul>
Non-Operational Worker and/or Visitor	<ul style="list-style-type: none"><li>• Outside danger zone + 10m allowance for inadvertent movement of any tools or equipment etc. - direct supervision + site induction.</li><li>• Inside danger zone plus 10m allowance for inadvertent movement of any tools, equipment etc. – immediate supervision + site induction.</li></ul>

If there are other work parties in the substation, the new arrival must notify the Recipient in charge (RIC) or site supervisor of their presence and business.

If operational work is being done it must be recorded in the substation logbook.

### 5.1.1 Locks and keys

Substation sites must be locked at all times to prevent inadvertent access by members of the public and/or unauthorised persons.

Only appropriately authorised personnel are permitted to be issued master keys for site access and equipment operation. Substation Entry Level 1 is a prerequisite in qualifying for distribution and transmission substation secure keys. All master key holders are registered.

Master keys are issued to a specific individual and cannot be transferred from person to person. If a master key needs to be transferred it must be returned and then formally reissued. Master keys cannot be allocated to a job role.

Master keys that are lost, stolen, broken or damaged must be reported to Network Control immediately.

Transmission and distribution have separate master key systems.

Earthing keys can only be issued to appropriately authorised switching operators by their formal leader. These keys must only be used for securing lockable earth switches and indoor zone substation busbar shutters.

## **5.2 Hazards in electrical substations**

Personnel entering electrical sub-stations shall make themselves aware of any special hazards that exist and ensure appropriate controls are put in place to manage those hazards in accordance with procedures.

General work practices shall be consistent with documented Work Instructions/ Practices and procedures and ensure:

- i. Materials are not allowed to block points of egress, doorways, obstruct passageways, hinder normal operations, work or access to fire extinguishers, first aid kits, telephones and control switches or any operating equipment;
- ii. Long objects such as ladders, conduits, earthing rods, portable earthing devices etc. shall be handled with care in the vicinity of live exposed conductors. Where practicable, long objects shall be carried by two people, holding the objects below shoulder height in a horizontal position and as close as practical to the ends of the object, so as to maintain maximum control;
- iii. When mobile plant is being used within the confines of an electrical substation and is likely to come within less than twice the MAD as specified in Table 2.3, or when plant is carrying out excavation work, then the mobile plant shall be fitted with a trailing earth cable/bond attached.

- iv. Doors, panels or covers enclosing live equipment shall be kept closed except when work is being performed inside that enclosure and that the correct item of electrical apparatus is located and identified in accordance with procedures.

## 5.3 Specialised network apparatus

### 5.3.1 Electrical apparatus and conductors declared out of use

Network Control may declare electrical apparatus out-of-use by removing a permanent length of conductor from each source of electrical supply.

For HV, the length of conductor must be at least equal to the MAD for the voltage concerned. For LV, the minimum length of conductor needed is 150 mm.

*Note: Fuses, links, live line taps, switches or isolators must not be regarded as a permanent length of conductor.*

*Note<sup>1</sup>: Removal of taps is not considered out-of-use.*

Electrical apparatus declared out-of-use may be worked on without a work permit.

Even though an electrical apparatus is declared out-of-use, consideration must be given to induction, private generation back-feed, lightning strikes, static charges and the proximity of other live equipment.

Network Control is not the Operating Authority for equipment declared out-of-use. The holder of the handover certificate is the Control Authority of the equipment.

### 5.3.2 Remote control electrical apparatus

Prior to the issue of a permit to work on or near live electrical apparatus, remote or automatic function(s) must be made inoperative. This may include putting the device into local control and/or the Control Authority placing a control inhibit on the apparatus.

### 5.3.3 Rackable, withdrawable circuit breakers

When working on rackable, withdrawable circuit breakers:

- i. Ensure spout shutters are unlocked before racking circuit breaker in;
- ii. Ensure circuit breaker is off using approved procedures before racking in or out;
- iii. Ensure racking circuit breaker is in correct position;

- iv. Ensure remote control is disabled;
- v. Where the incoming circuit is live, disable auto reclose prior to racking in or out;
- vi. Where a circuit breaker is removed from service and is to be transported away from the switchyard for maintenance, a handover certificate must be issued from the Operating Authority to the Maintenance Authority; and
- vii. Where a circuit breaker is delivered to a switchyard for return to operational service, a handover certificate must be issued from the Maintenance Authority to the Operating Authority. The handover certificate or supplementary documentation must record the results of pre-commissioning tests and support the recommissioning of the circuit breaker.

An EAP must be issued for work on withdrawable circuit breakers when racked out. Busbar and circuit shutters must also be locked closed and danger tagged.

Due to the electrical separation and physical barrier provided by the busbar and circuit shutters, the fitting of program earths to the circuit breaker is not required.

On the EAP, within the “program earth” section, the switching operator is to write "program earth not fitted as per ESSR clause 5.3.3".

In the event that further invasive testing is required, an STT may be more appropriate. This may be a primary systems STT or a secondary systems STT.

### **5.3.4 Testing under an EAP for zone substation maintenance**

A range of simple tests – circuit breaker timing tests and insulation integrity tests requiring the removal of program earths fitted with restricted use tags for example - can be performed under an EAP only after:

- i. The issuing officer has granted permission, which is declared on the permit conditions;
- ii. All recipients of the EAP are notified by the RIC that tests are about to commence and have stopped work on the affected equipment;
- iii. The RIC of the EAP, or a competent person under their immediate direction, is responsible for the removal and reapplication of the program earths with the restricted use tag fitted;
- iv. The program earths must only be removed one phase at a time;

- v. The time period that the program earth is removed for must be kept to an absolute minimum to allow the testing to take place;
- vi. Work must not restart until the earths are reapplied and verified by the RIC (and restricted use tag reapplied if they were removed); and
- vii. All recipients of the EAP are notified by the RIC that testing is complete and work on the equipment can safely recommence.

*Note: Under no circumstance should a program earth outside the confines of the substation on the distribution feeder be fitted with a restricted use tag unless it is related to a STT.*

Refer to the relevant Work Instructions/Practices for further information.

### **5.3.5 Distribution regulators**

When it is necessary to bypass a regulator, the regulator must be set to manual and the neutral tap selected to equalise the input and output voltages. Failure to do so is likely to result in permanent damage to the regulator.

### **5.3.6 Spout shutters on high voltage switch gear**

Spout shutters that are accessible and are not required for immediate work/operation must be locked shut. If the spout shutters are inaccessible in normal circumstances, these spout shutters can remain unlocked. Where busbar shutters in dual busbar substations are inaccessible due to a circuit breaker being in service and on load, it is acceptable to lock (if possible) and danger tag the selector mechanism, or as a minimum, caution tag the selector mechanism to advise others of danger.

The danger tag on site must be appropriately secured to the selector mechanism in the event that it cannot be locked in place.

### **5.3.7 Transformers**

When working on the connections to, or the windings of, a transformer, the transformer must be isolated from all sources of supply, proven de-energised and earthed, and have an appropriate work permit issued. Winding and connections include ratio selectors and tap changers.

To prevent the possibility of the transformer being made live by back feed, all LV fuses or links on associated voltage transformers, auxiliary transformers and from low voltage networks, must be withdrawn.

A disconnected transmission system transformer primary terminal must be discharged to earth using approval procedures before being touched.

When it is necessary to carry out a tap change on a distribution transformer, it must be isolated, earthed and have a VA issued on a nearby apparatus.

### **5.3.8 High voltage capacitors**

Before any person touches de-energised capacitors, all conductors, including neutral conductors, must be discharged and earthed using approved procedures.

The same precautions must be taken with capacitors that are part of any electrical apparatus.

### **5.3.9 High voltage cables**

Before any person commences work on cables, all conductors, including screen conductors, must be discharged and earthed. (See Table 2.5 in Section 2.7 for information on approaching cables.)

### **5.3.10 Ferro resonance**

Ferro resonance may occur in three phase underground distribution systems when an unloaded delta/star distribution transformer becomes energised or de-energised by single phase switching.

Ferro resonance is a problem only when the length of cable exceeds the critical length for a given transformer.

The following methods are used to prevent ferro resonance:

- i. Three phase rather than single phase devices must be used for switching; and
- ii. A transformer may be energised using a single phase device provided that the actual load or simulated load is connected to that transformer.

### **5.3.11 Double circuit lines**

Where work is carried out on a double circuit line, the electrical apparatus to be worked on must be clearly and continuously identified in the approved manner to all persons covered by the permit. Refer to the relevant Work Instructions/Practices for further information.

## **5.4 Protection control and automation**

Field Protection and Telecom are the controlling authority and issue protection control permits. They are also the controlling authority for the pilot cable network.

Protection, control and automation include but are not limited to station LV supply, batteries and battery chargers, protection circuits, pilot cables, control and alarm circuits, SCADA and communications equipment.

### **5.4.1 Minimum rules for protection and automation work**

The following procedure for undertaking protection, control and automation work must be followed:

- i. All staff engaged to undertake protection, control and automation work must have received appropriate training and must possess authorisation from Western Power;
- ii. Protection, control and automation work must be done in accordance with approved procedures<sup>1</sup>;
- iii. Application of work permits apply to protection, control and automation work;
- iv. For any access to protection, control and automation that has operational impact, Network Operations must be notified and give approval according to approved procedures; and
- v. Approved engineering controls, procedures and instructions must be in place to prohibit inadvertent operation and energisation of the protection, control and automation being accessed (ensure safe isolation).

*Note<sup>1</sup>: Refer to relevant Work Instructions/Practices/Procedures.*



# Vegetation works

# 6 Vegetation works

Vegetation work must be done in accordance with approved vegetation management procedures and Work Instructions/Practices. It can only be undertaken by persons who have the appropriate training and authorisation.

As a minimum, the risk assessment for vegetation management must include:

- i. The likelihood of encroaching the approach distances;
- ii. Site weather conditions;
- iii. Traffic management;
- iv. Appointment of a safety observer; and
- v. Positive identification of the electrical apparatus and location on Western Power's network.

The limits of the work area(s) defined on the permit must be clearly understood by the work group and complied with at all times.

## 6.1 Vegetation works near the network

The running earth or return neutral conductor on high voltage single phase and three phase overhead power lines forms part of the HV system and the safe approach distances to these conductors will be 300mm. All distances are taken from the Code of Practice for Personnel Electrical Safety for Vegetation Control Work Near Live Power Lines (2014).

**Table 6.1 Approach distances and vegetation clearances for ground workers and ordinary persons**

Nominal phase to phase ac voltage	Person, tools and equipment (mm)	Mobile plant (mm)	Cannot cut vegetation that is closer than (mm)
Insulated LV	3,000	3,000	500
Bare LV	3,000	3,000	1,000
1-33kV	3,000	3,000	3,000
66-132kV	6,000	6,000	3,000
220kV	6,000	6,000	6,000
330kV	6,000	6,000	6,000

**Table 6.2: Approach distances and vegetation clearances for vegetation management workers**

Nominal phase to phase ac voltage	Vegetation management worker/ climber (mm) (A)	Insulated tool (mm) (B)	Uninsulated tool (mm) (C)	Vegetation clearances below and beside the overhead line (mm) (D)	Vegetation overhanging the overhead line (mm) (E)
Insulated LV	200	Physical clearance	200	No clearance	No clearance
Bare LV	1,000	200	1,000		Not permitted
6,600V	1,200	700	1,200	700	
11kV	1,200	700	1,200	700	
22kV	1,200	700	1,200	700	
33kV	1,200	700	1,200	700	
66kV	1,400	1,000	1,400	1,000	
132kV	1,800	1,200	1,800	1,800	
220kV	3,000	3,000*	3,000	3,000	
330kV	4,000	4,000*	4,000	4,000	

\*No tool or EWP is classified as insulated at 220kV and 330kV.

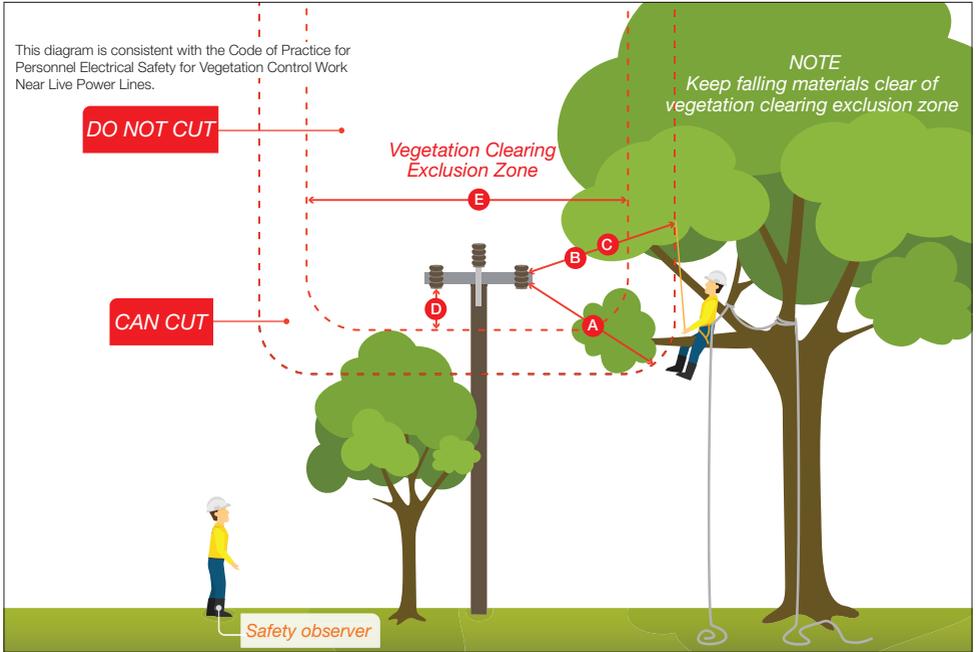
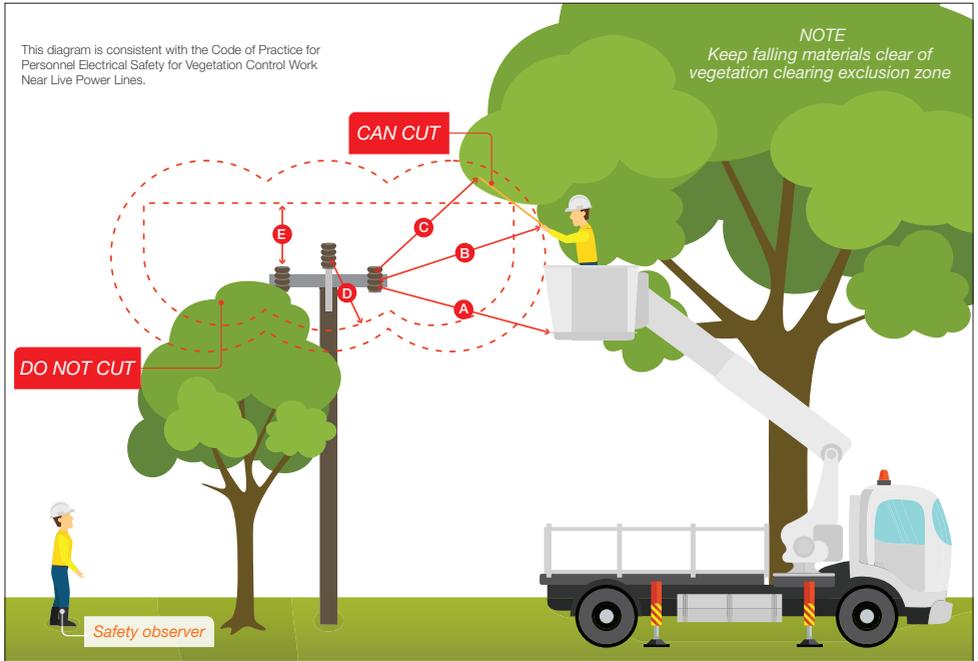


Figure 6.1: Clearances for vegetation management workers

**Table 6.3: Approach distances and vegetation clearances working from an EWP**

Nominal phase to phase ac voltage	Insulated mobile plant only (mm) (A)	Vegetation management worker (mm) (B)	Insulated mobile plant with... (C)		Vegetation below and beside overhead line (mm) (D)	Vegetation overhanging the overhead line must be with a VA (mm) (E)
			Insulated tools (mm)	Uninsulated tools (mm)		
Insulated LV	Physical clearance	200	No clearance	200	No clearance	No clearance
Bare LV	Physical clearance	700	Physical clearance	1,000	No clearance	No clearance
6,600V	700	1,000	300	1,200	100	700
11kV	700	1,000	300	1,200	100	700
22kV	700	1,000	350	1,200	150	700
33kV	700	1,000	400	1,200	200	700
66kV	1,000	1,200	600	1,400	400	1,000
132kV	1,200	1,400	800	1,800	800	1,200
220kV	3,000*	3,000	3,000*	3,000	3,000	Not permitted
330kV	4,000*	4,000	4,000*	4,000	4,000	Not permitted

\*No tool or EWP is classified as insulated at 220kV and 330kV.



**Figure 6.2: Approach distances when using insulated mobile plant**

**Note:**

- i. Overhanging vegetation must be cut under a VA permit;
- ii. Where the vegetation clearance to powerlines in Table 6.2 column D cannot be maintained an alternative work method must be considered (for example under a permit either VA or EAP). This applies to the approach clearances in Table 6.3 column D; and
- iii. Uninsulated tools are not permitted to cut overhanging vegetation.

## 6.2 Line workers undertaking vegetation management

Certificate III and HV live line workers are not trained as full vegetation management workers. This means that their role in cutting and removing vegetation should be limited to short duration work to assist in other tasks, such as;

- (i) Gaining access to pole or equipment;
- (ii) Raising conductors from the ground; and
- (iii) Removing vegetation from inside approach distances to allow vegetation management workers to undertake cutting safely.

**Table 6.4: Approach distances and vegetation clearances for Certificate III and HV live line workers**

Voltage	Insulated EWP (mm) (A)	Authorised person (mm) (B)	Insulated tool (mm) (C)	Vegetation below and beside overhead line* (mm) (D)	Vegetation overhanging the overhead line (mm) (E)
Insulated LV	Physical clearance	Physical clearance	No clearance	No clearance	No clearance
Bare LV	Physical clearance	Physical clearance	Physical clearance	No clearance	No clearance
6,600V	700	700	300	100	400
11kV	700	700	300	100	400
22kV	700	700	350	150	400
33kV	700	1,000	400	200	700
66kV	1,000	1,200	600	400	1,000
132kV	1,200	1,400	800	800	1,200
220kV	3,000*	3,000	3,000*	3,000	Not permitted
330kV	4,000*	4,000	4,000*	4,000	Not permitted

\*No tool or EWP is classified as insulated at 220kV and 330kV.





# Streetlighting and public lighting

# 7 Streetlighting and public lighting

## 7.1 General

Refer to the relevant Work Instructions/Practices when undertaking all work on streetlighting and public lighting.

Street lighting circuits and un-metered supply circuits are considered part of the LV network, however, electrical access and permit requirements for these circuits are not determined by the ESSR.

There are three types of streetlight pole designs in use:

- i. Frangible – impact absorbent octagonal pole (10.5m and 12.5m) with a split seam feature where all sides are intermittently slotted in the vehicle impact zone (this zone is up to four metres from 50mm above ground level);
- ii. Non-frangible – solid, one section pieces of octagonal pole with a continuous weld on seams, or a one-piece pipe pole; and
- iii. Decorative range – consists of powder coated steel poles of various sizes and may include decorative or standard luminaires.

## 7.2 Testing streetlight columns

Prior to the commencement of any work on a steel standard streetlight pole:

- i. Carry out a site risk assessment to identify and control all potential hazards;
- ii. If required, guard or barrier off the area to keep the public away from any potential hazards; and
- iii. Test the streetlight pole using an approved voltmeter (Cat. III – 1,000 volts or Cat. IV – 600 volts) and an independent earth to ensure it is not energised.

When fault finding, if it is identified that the streetlight supply cable is faulty within the section of cable set in the internal concrete reinforcing and cannot be removed, the following repairs can be made without the need to change the pole:

- i. Install a cable joint outside of the steel streetlight pole and securely attach external steel conduit to the pole with a steel junction box (for cable access) above the concrete reinforcing.

### **7.2.1 Damaged streetlight poles**

If a streetlight pole has any of the following damage, carry out a risk assessment to determine if the pole could fail:

- i. A frangible column with one or more seam welds broken;
- ii. A non-frangible column with more than one of the octagonal surfaces damaged;
- iii. The column is bent below ground level and/or leaning.

If the risk assessment determines that failure is possible, make the area safe then immediately arrange for its support and removal. Replace all damaged and removed poles as soon as reasonably practicable.

### **7.2.2 Fallen streetlight poles or those at risk of falling**

If a streetlight pole has fallen or is at risk of falling, immediately arrange traffic management measures, such as temporary barriers and warning signs, or arrange with police to prevent public access to the fall area:

- i. If still standing, immediately arrange for the support of the streetlight pole above the point of balance by means of a crane or Kevrek;
- ii. De-energise and isolate the supply to the damaged pole and applying an 'Out of Service' tag at the point of isolation in accordance with approved Work Instructions/Practices;
- iii. Remove and make safe the damaged streetlight pole;
- iv. Ensure the electrical connections remain safe until the pole can be replaced. The preferred method is to install a temporary mini pillar.
- v. In situations where the temporary mini pillar cannot be installed fit a temporary mini pillar cover, insulate all terminations and secure the area.

### **7.2.3 Lamp and fluorescent tube storage and disposal**

- i. Excluding Streetlight Services, all bagged globes, lamps or fluorescent tubes shall be stored in a labelled 'Globes, Lamps and Fluorescent Tubes' drum (sticker code: 18831394) located within the environmental shelter at the depot.
- ii. All four and five feet fluorescent tubes shall be stored in cardboard boxes (stock code: UA3163) within the environmental shelter at the depot.
- iii. When the designated globe recycling drum within the environmental shelter at the depot is three-quarters full, Facilities Management must be contacted to arrange pick up and recycling of the content.
- iv. Streetlight Services Section is responsible for the removal of bulk quantities of globes, lamps and fluorescent tubes and shall facilitate the transport of globes, lamps and fluorescent tubes to an approved Recovery Centre as soon as practicable.
- v. Waste lamps, globes and fluorescent tubes shall be placed in the box supplied with the replacement or the original package.
- vi. If the original package is not available or if the globe, lamp or fluorescent tube is broken, it shall be placed into a plastic globe bag and sealed (stock code: OC3107).
- vii. The boxed or bagged globes, lamps and fluorescent tubes shall be secured for transportation.

### **7.3 Streetlighting and Powerwatch security lighting work from an elevated work platform (EWP)**

All work on street lighting services and Powerwatch security lighting must be carried out from an insulated elevated work platform in accordance with relevant Work Instructions/Practices.



# Consumer installations

# 8 Consumer Installations

## 8.1 Managing connections to the network

Refer to the relevant Work Instructions/Practices when undertaking all work on consumer installations.

When damaged or degraded customer equipment is found at the installation, including the presence of Vulcanised India Rubber (VIR) insulated wiring, a Western Power Customer Pack must be issued to the customer.

### 8.1.1 Managing connections to the network - general

Before commencing work determine the status of services through voltage, polarity, phase rotation and continuity tests. Commissioning must be:

- i. Carried out by an authorised person in accordance with apparatus requirements; and
- ii. Be completed before any energisation begins.
- iii. Before energising, confirm that:
  - iv. An authorised person has completed all necessary documentation, e.g. SCT forms, commissioning sheets; and
  - v. The customer's equipment is safe.
  - vi. An SCT must be carried out to confirm that the supply has been correctly connected after completing the following work:
    - vii. Replacing or installing any service cables;
    - viii. Replacing or installing any neutral service connections;
    - ix. Replacing or installing any consumer revenue meters;

- x. Replacing or installing a mains connection box;
- xi. Carrying out any fault or maintenance work that removes or breaks the customer's service;
- xii. Carrying out any connection to an unmetered supply;
- xiii. Upgrading or changing over to single/three phase; and
- xiv. Relocating customer's equipment where connections have been broken.



## **8.2 Meter maintenance, removal and replacement**

Refer to the relevant Work Instructions/Practices when undertaking all work on metering equipment and meter panels.

Where signs of suspected meter tampering are visible do not proceed and contact your formal leader for advice.

### **8.2.1 Disconnecting and reconnecting the customer supply**

Only suitably trained and authorised Certificate III linespersons, Certificate III cable jointers and qualified licensed electricians employed or contracted by Western Power are permitted to disconnect and re-connect the customer's supply from the network.



# Dictionary

# 9 Dictionary

Defined term	Meaning
Approved	Having appropriate Western Power endorsement in writing for a specific function.
Authorised person	A competent person with the delegated authority to perform the duty concerned on behalf of Western Power.
Boxing in	Boxing in' is the application of program earth's at a location on an electrical circuit between points of isolation and the work area to create a situation where the work area is at a single potential and that in the case of an inadvertent energisation, the workers are protected.
Brownfield site	An operational site undergoing work (that remains under the overall control of a primary system operating authority) that has sections made non-connectable under an Electrical Access Permit by the physical removal of conductors. Control of that non-connectable plant may be delegated by the primary operating authority to either a construction or a commissioning authority via a formal handover certificate.
Caution tag	An approved notice that reads 'CAUTION'.
Competent person	A person having the skills, knowledge and attributes needed to safely complete a task.
Conductor	A wire, cable or form of metal designed for carrying electric current (includes neutral and earth).
Confined space	An enclosed or partially enclosed space that is not intended or designed primarily for human occupancy, where an oxygen deficient (or excess), toxic or flammable atmosphere may be present or engulfment may occur. Generally, confined spaces have restricted access or egress. See AS2865 for further information.
Connectable	Apparatus capable of being connected to the live system by the switching a device.
Connected	Joined together by a conductor capable of carrying electrical current for its required function or purpose by either physically clamping or bolting conductors together or closing a circuit breaker, switch or similar device.

Control Authority	<p>This is the representative authority responsible for the control of the apparatus. Typically this includes:</p> <ul style="list-style-type: none"> <li>• Construction Authority</li> <li>• Commissioning Authority</li> <li>• Operating Authority</li> <li>• Third party</li> </ul>
Controller	An authorised person who co-ordinates switching, performs switching by remote control, records and controls the issue of work permits.
Danger	The presence of risk to health and/or risk of bodily injury.
Danger tag	An approved notice that reads 'DANGER – DO NOT OPERATE'.
Danger zone	The area surrounding live electrical equipment (such as powerlines) that ordinary persons, other equipment and materials must not enter.
De-energised	The electrical supply to electrical apparatus has been switched off.
Discharged (electrical)	Conductors which have been connected to earth to remove any stored electrical energy.
Discharged (mechanical)	Mechanical, hydraulic, pneumatic or fuel energy apparatus which has had all stored energy removed.
Drop Zone	A drop zone is any area where it can be reasonably expected for an object to drop and fall and cause damage or harm.
Earth	The general conductive mass of the earth, the electric potential of which, at any point, is taken as zero.
Earthed	Electrically connected to earth in an approved manner by earthing conductors or switches.
Electrical Access Permit (EAP)	Western Power's standard form that authorises access to, and work on, an electrical apparatus that has been made safe through isolating and earthing (HV) or short-circuiting (LV).
Electrical apparatus	An item of electrical machinery or equipment (including primary and secondary) in which conductors are used, supported, or are contained within.
Emergency service personnel	Trained personnel from organisations which ensure public safety and health. This includes police, ambulance and fire & rescue services.
Equipotential bonding	Electrical connections intended to bring exposed conductive parts or extraneous conductive parts to the same or approximately the same potential, but not intended to carry current in normal service.

Emergency	Situation that presents an immediate threat to life, property or the environment
Greenfield site	A whole site that is not connectable to Western Power's operational network.
Handover certificate	Is used when responsibility for control of one or more items of plant, or an entire site, is transferred from one Control Authority to another.
High voltage (HV)	A voltage exceeding 1000 volts AC or 1500 volts DC.
Incident	<p>An unplanned event that causes or has the potential to cause harm to persons, the environment, assets or loss of supply. Incidents include near-hits and may include non-conformances.</p> <p>Incidents must be reported within 60 minutes by calling the Western Power hotline on 1300 225 597.</p>
Isolated	De-energised by an isolating device that prevents unintentional energisation of the electrical apparatus.
Isolating device	A device for rendering plant and electrical apparatus isolated.
Isolation point	An isolating device that has been positioned off, remote operation disabled, has a danger tag fitted and is assessed as a suitable step in the process of making safe for access purposes.
Issuing Officer (IO)	An authorised person who is responsible for issuing and cancelling work permits.
Label	Approved means of identification of circuit or apparatus.
Live	Energised or subject to hazardous induced or capacitive voltages.
Live work	All work performed on components of electrical apparatus not isolated, proved de-energised, short-circuited or earthed.
Low voltage (LV)	A voltage less than 1000 volts AC or 1500 volts DC
Minimum approach distance (MAD)	The minimum separation distance that must be maintained by a trained and competent person, mobile plant (including its load) or any object (other than insulated objects designed for contact with live conductors) from electrical apparatus. Formally replaces SAD.
Near	Outside the MAD where there is a reasonable possibility of a person, mobile plant or any object, either directly or through any conducting medium, coming within the MAD.

Network	An interconnected system of transmission and/or distribution conductors and electrical apparatus. <i>Note: “Network” and “system” can be used interchangeably.</i>
Network Authority/ Authorisation Card (NAC)	The NAC: <ul style="list-style-type: none"> <li>• is mandatory for the Network Total Workforce (NTW)</li> <li>• is issued by Western Power as evidence of a person’s authority to work on or near a Western Power construction site</li> <li>• provides written and photographic identification that a person has completed the Western Power Operational Induction.</li> </ul>
Network Control	The division responsible for the operation and control of the network.
On	Working anywhere inside the MAD.
Operating agreement (OA)	A formal agreement between two control authorities, which could include a customer owned and operated network, confirming that an electrical apparatus’ operational state will be held in an agreed state until the cancellation of the agreement. An OA is not a work permit and does not authorise work to be undertaken.
Operating Authority	The division or group responsible for that part of the network. This varies by characteristics of the network. For example, telecommunications.
Ordinary person	A person without sufficient training or experience to enable them to avoid the dangers that electrical apparatus may create. Any person who is not a competent or authorised person (as defined by the ESSR) is therefore an ordinary person.
Out of commission	Connected electrical apparatus that is unserviceable and/or has not been determined fit for its intended use/purpose/service in its current condition. A commissioning process is required before it can be returned to service.
Out of use	Electrical apparatus removed from its source of supply by the removal of a permanent length of conductor equal to or greater than the minimum approach distance for the voltage concerned. No permit is required for access. <i>Note: “Out of use” and “disconnected” can be used interchangeably.</i>
Permanently leaving site	RIC/TIC: the loss of control of a worksite under a work permit, requiring the formal transfer of RIC/TIC responsibilities. Recipient: leaving a worksite with the intention of no longer working on the relevant electrical apparatus’ under the work permit.
Person in charge	The person responsible for work being carried out by a work team.

Personal Protective Equipment & Clothing (PPE & PPC)	Approved clothing or similar items intended to protect a person from injury. Specifically approved for particular work types and/or work location.
Plant	Mechanical plant including all machinery and equipment not elsewhere defined as electrical apparatus.
Primary plant	Primary plant is all equipment which can be connected to HV levels (circuit breakers, isolators, and current transformers) and any equipment directly associated with the major plant (Buchholz relays on transformers, SF6 gas pressure switches on circuit breakers, etc.).
Program earth	Earthing equipment of an approved type applied as part of an electrical switching program/schedule.
Rapid response spare transformer (RRST)	A mobile zone substation transformer deployed at times of transformer failure.
Recipient	A person authorised by Western Power to sign on and sign off work permits.
Recipient In Charge (RIC)	The authorised person who is responsible for accepting and relinquishing EAPs and VA permits, managing work group activities to ensure compliance with the conditions of an EAP or VA permit and monitoring work group activities to ensure compliance with the requirements of the ESSR.
Restricted Use tag (RUT)	An approved notice that reads 'DANGER: RESTRICTED USE'.
Running earth	An aerial earthed conductor run, either above or below the active conductors.
Safety observer	A competent person (competent at safety observation) assigned by the person in charge whose sole function is to observe and warn against unsafe approach to live electrical apparatus or other unsafe conditions.
Sanction to Test (STT)	Western Power's standard form which authorises the testing of electrical apparatus.

Supervisory Control & Data Acquisition (SCADA)	A system of equipment that provides network operators at East Perth Control Centre real time remote visibility and control of the transmission and distribution electrical network. A SCADA system comprises of master station equipment installed at East Perth Control Centre, and remote equipment called Remote Terminal Units (RTUs) installed at terminals, zone and distribution substations.
Shall	Is to be interpreted as must
Short-circuited low voltage	The bonding of all phase and neutral conductors using approved equipment and procedures.
Should	Is to be interpreted as ‘advisory or discretionary’
Spotter	A person stationed to observe the work being completed to minimise the risk of accidents or injuries. A ‘spotter’ is not a ‘safety observer’ as a spotter does not have the same level of responsibility.
Standby person	A person assigned to continuously monitor the wellbeing of those participating or affected by a work task and initiate and participate in emergency response procedures when necessary. The standby person must understand the nature of the hazards associated with the work task, be able to recognise signs and symptoms that personnel may be in danger and is authorised to cease works.
Static charge	The build-up of potential from the environment.
Substation	Any yard, terminal, switchyard, zone substation or facility that transforms or switches high voltage.
Switching	The operation of circuit breakers, isolators, disconnectors, fuses or other methods of making or breaking an electrical circuit. This also includes the application and removal of program earths.
Switching device	Any item on the network capable of connecting and disconnecting electrical apparatus.
Switching operator’s authority	An authority that has been issued to give approval to perform switching operations.
Switching operator	A person authorised by the Operating Authority to carry out switching operations within the limits of their authorisation.

Switching program/schedule	A list of switching operations that are placed in a logical sequence to ensure the operation of electrical apparatus is carried out in a safe sequence. <i>Note: "Program" and "schedule" can be used interchangeably.</i>
System	See 'network'.
Tester In Charge (TIC)	The authorised person who is responsible for accepting and relinquishing Sanction to Test (STT) permits, managing work group activities to ensure compliance with the conditions of an STT, and ensuring all work activities comply with the requirements of the ESSR.
Temporarily leaving site	Departing a worksite with the intention of returning to work on the relevant electrical apparatus under the same work permit within the same day.
Under direction (a 'D' restriction)	An authorised switching operator who can carry out switching on their own; however, each item of a schedule requires direction by telephone or radio from an authorised switching operator.
Vehicle	A non-living means of transportation for people and cargo, with steering and driving capability.
Vicinity Authority/Authorisation (VA)	Western Power's standard form that authorises work near live electrical apparatus or electrical apparatus which must be treated as live.
Warning tag	An approved notice that reads 'WARNING: DO NOT USE OR OPERATE'.
Work	All activities undertaken in a field environment.
Work area	The location between program earths where, once a work permit has been issued, work and/or switching can take place. In the case of terminal and zone substations, this defined work area would normally be flagged and barriered.
Working earth	Applied during electrical access work to provide more obvious confirmation of program earths and/or to control induced and static voltages at the worksite.
Work permit	The formal document issued by an Operating Authority to grant access to equipment. The subsequent work to be undertaken within the restrictions and limitations specified by the Operating Authority is recorded on the permit.
Worksite	The general location where work and/or switching is to take place. The worksite surrounds the work area, e.g., a zone substation yard.

## Further information

For feedback and improvement suggestions, please use the feedback form (EDM #41304035) and submit it to:

[essr.feedback@westernpower.com.au](mailto:essr.feedback@westernpower.com.au)

## Content owner

The content owner is the Executive Manager of Asset Management.

## Accountabilities

### **Executive Manager Asset Management**

Accountable for approving the content of this Standard

### **General Counsel**

Accountable for publishing the approved version of this Standard in Western Power's corporate policies register.

A matrix summarising the respective roles and accountabilities in relation to this Standard is appended to this Standard (appendix 1).

## Review

This Standard will be reviewed and evaluated by the content owner at least once in every three year period taking into account the purpose of the Standard and the outcome of the compliance review.

# Related documents

**Safety, Health and Environment Policy** - EDM # 12059358

**Asset Management Policy** - EDM # 7471555

**Safety, Health and Environment Management Standard** - EDM # 12448794

# Approval history

Version	Approved by	Date of approval	Resolution no.	Notes
1	Executive Manager, Asset Management	25 October 2016	#41392645	Under delegation of the Board
2				
3				



.....  
**Seán Mc Goldrick**

Executive Manager, Asset Management

© 2016, Electrical Networks Corporation trading as Western Power.

Permission is granted to view, copy and print and use documents providing the information is not repacked or sold for commercial purposes, not any document graphics modified.

Refer to EDM or the Western Power website for the latest version of this document.

EDM #41392645 – 2016 Electrical System Safety Rules

## Appendix 1 – RACI matrix

<b>Responsible</b>	Head of Safety, Environment, Quality and Training
<b>Accountable</b>	Executive Manager Asset Management
<b>Consulted</b>	Relevant business SMEs
<b>Informed</b>	All Western Power personnel

# Appendix 2 – Safety Observer Matrix

Voltage	High Voltage - Live or de-energised			Low Voltage - Live or de-energised		
	Un-insulated overhead lines	All other un-insulated	Totally insulated OH and other	Un-insulated overhead lines	All other un-insulated	Totally insulated OH and other
working - live	Safety observer required	Not permitted	Not applicable - as per definition	Safety observer required	Safety observer required	Not applicable - as per definition
working - on	Not applicable - as per definition	Not applicable - as per definition	Not applicable - as per definition	Safety observer required	Risk assess	Not applicable - as per definition
working near	Safety observer required	Safety observer required	Risk assess	Safety observer required	Risk assess	Risk assess
Testing	Risk assess	Risk assess	Not applicable - due to insulation	Risk assess	Risk assess	Not applicable - due to insulation

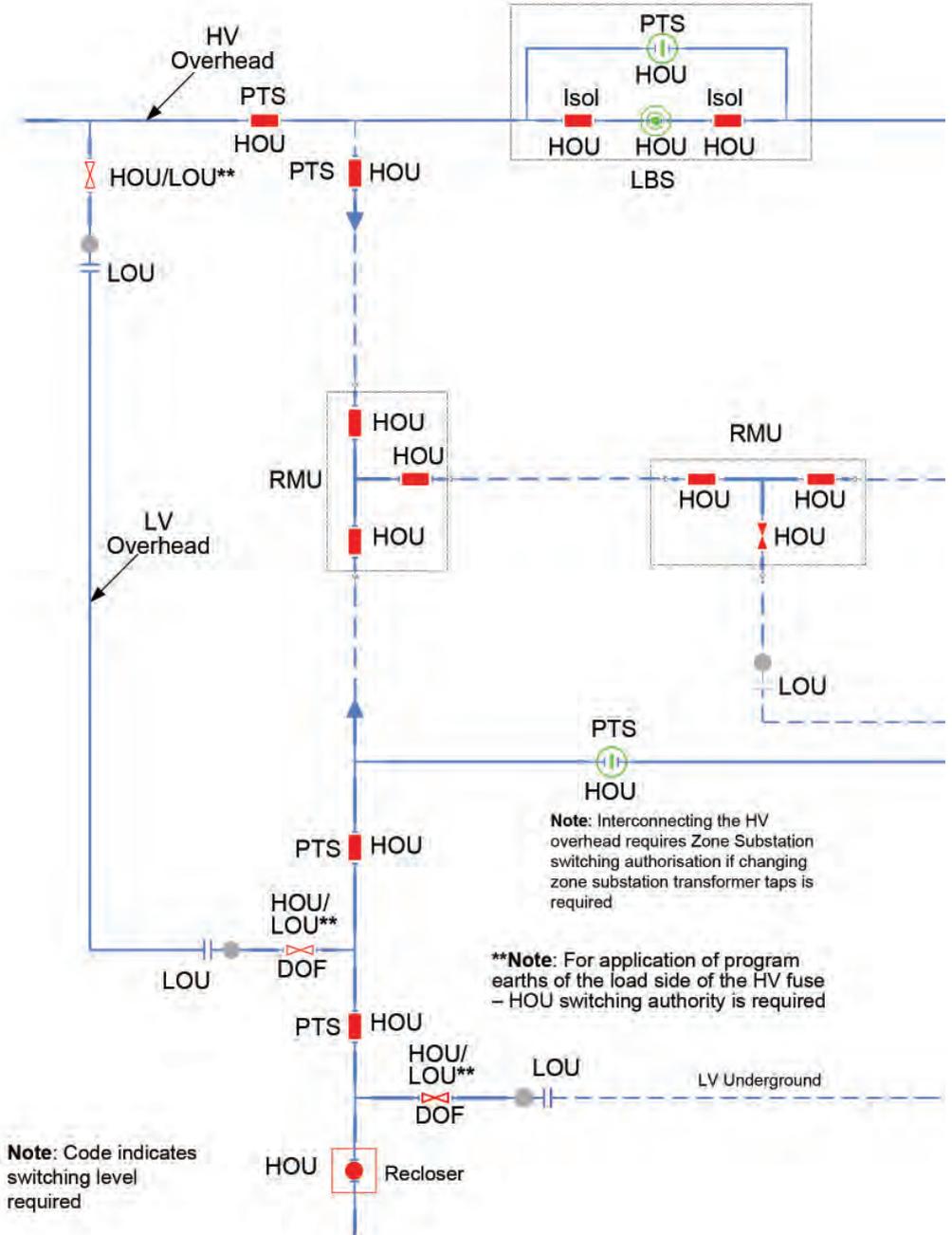
## Definitions

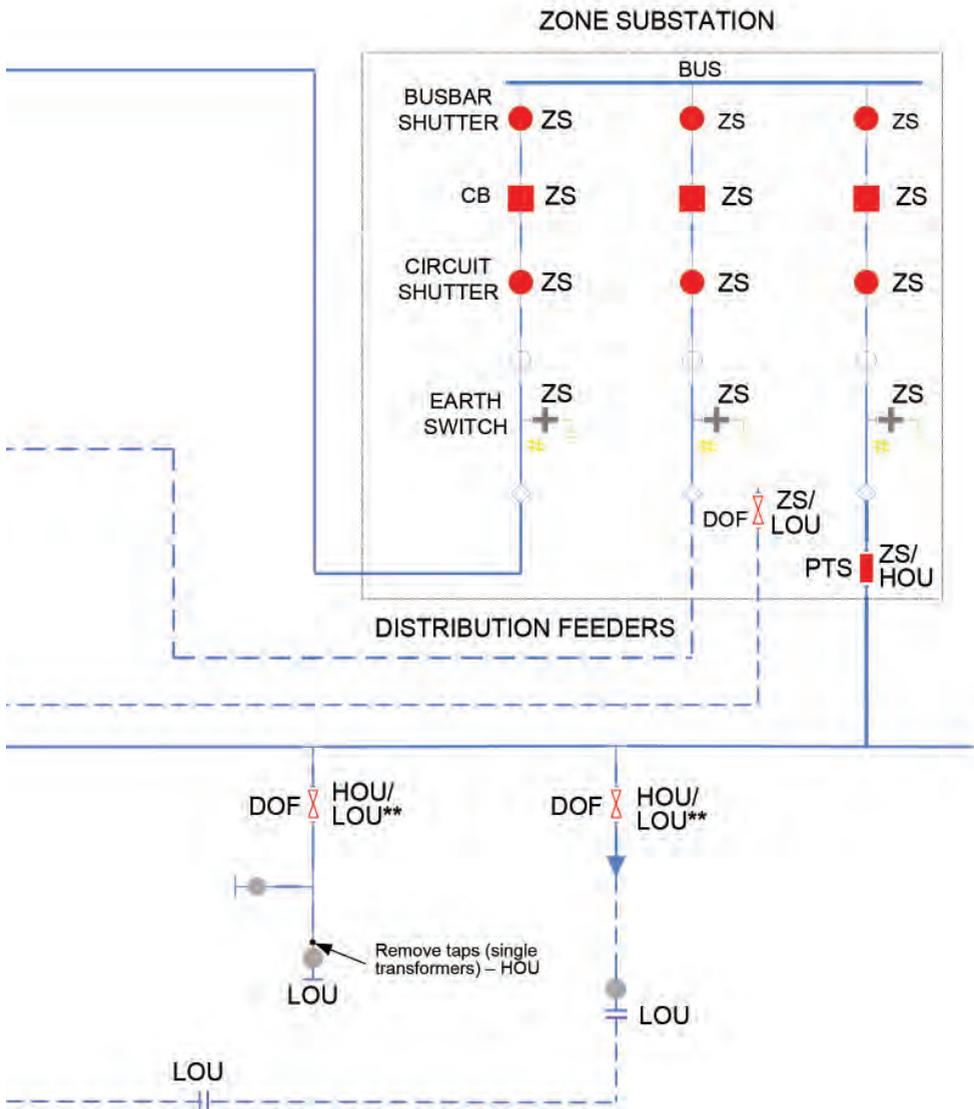
working - live	Moving and/or manipulating energised LV or HV uninsulated conductors, lines or apparatus.
working - on	Using insulated tools and the appropriate PPE to work on fixed uninsulated energised LV equipment.
working near	Outside the minimum approach distance (MAD) but where there is potential risk of persons, plant, tools or equipment coming within the MAD
Testing	Using approved insulated test equipment along with the appropriate PPE for the purpose of testing only,.
All other	All conductors and electrical apparatus other than overhead lines.
Totally insulated	Insulated conductors with no exposed uninsulated parts. Such as LV ABC, XPLE service cable and Hendrix (not touch safe)

## Key

Safety observer required	HV live work only (G&B, DIS and TIS) - trained and fully authorised HV live worker to be appointed as safety observer
Safety observer required	PIC to appoint safety observer that is fully aware of potential risks and hazards associated with the work being performed.
Risk assess	Conduct risk assessment to consider hazards and controls - appoint safety observer if risk assessment deems necessary.

# Appendix 3 - Distribution Switching Levels

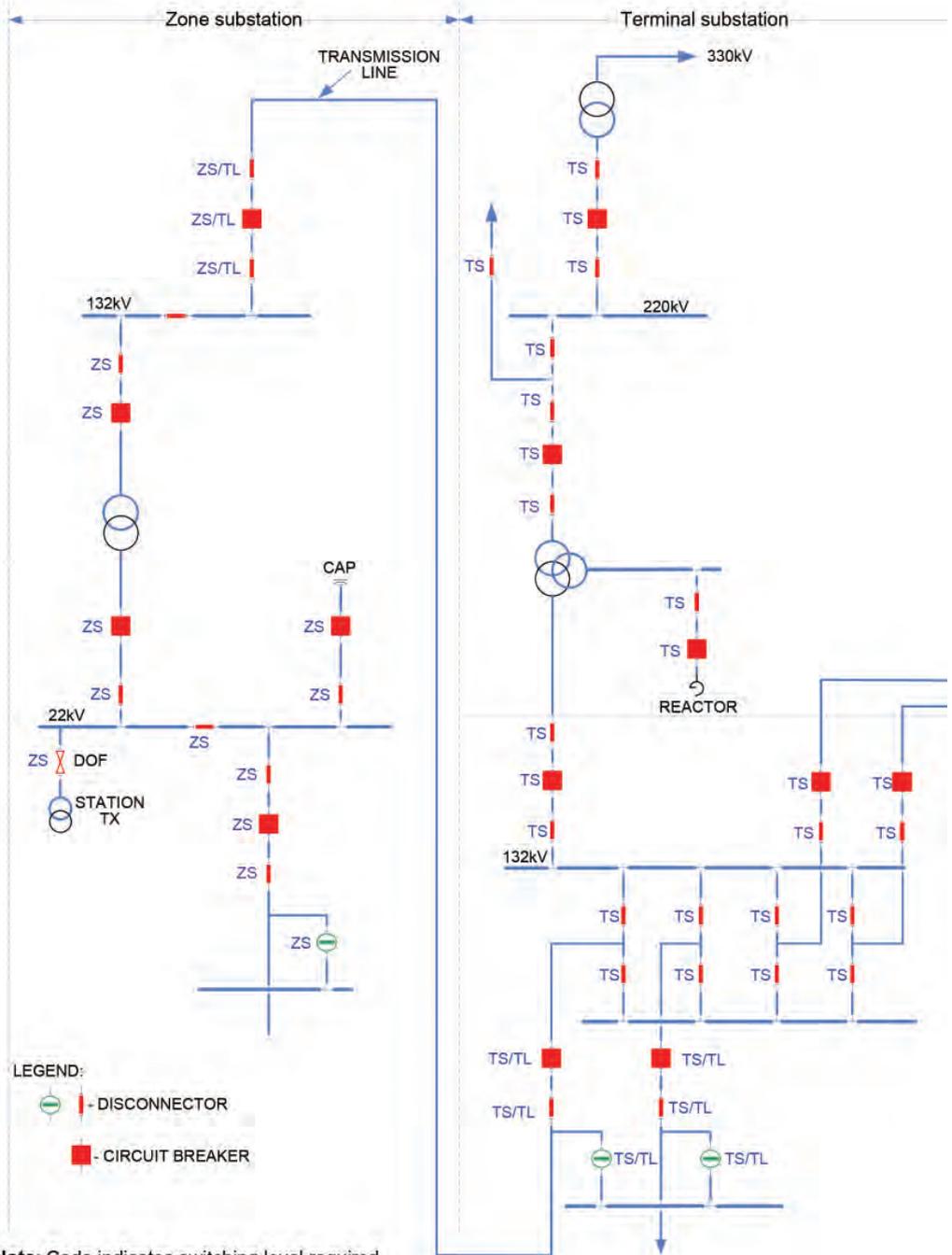


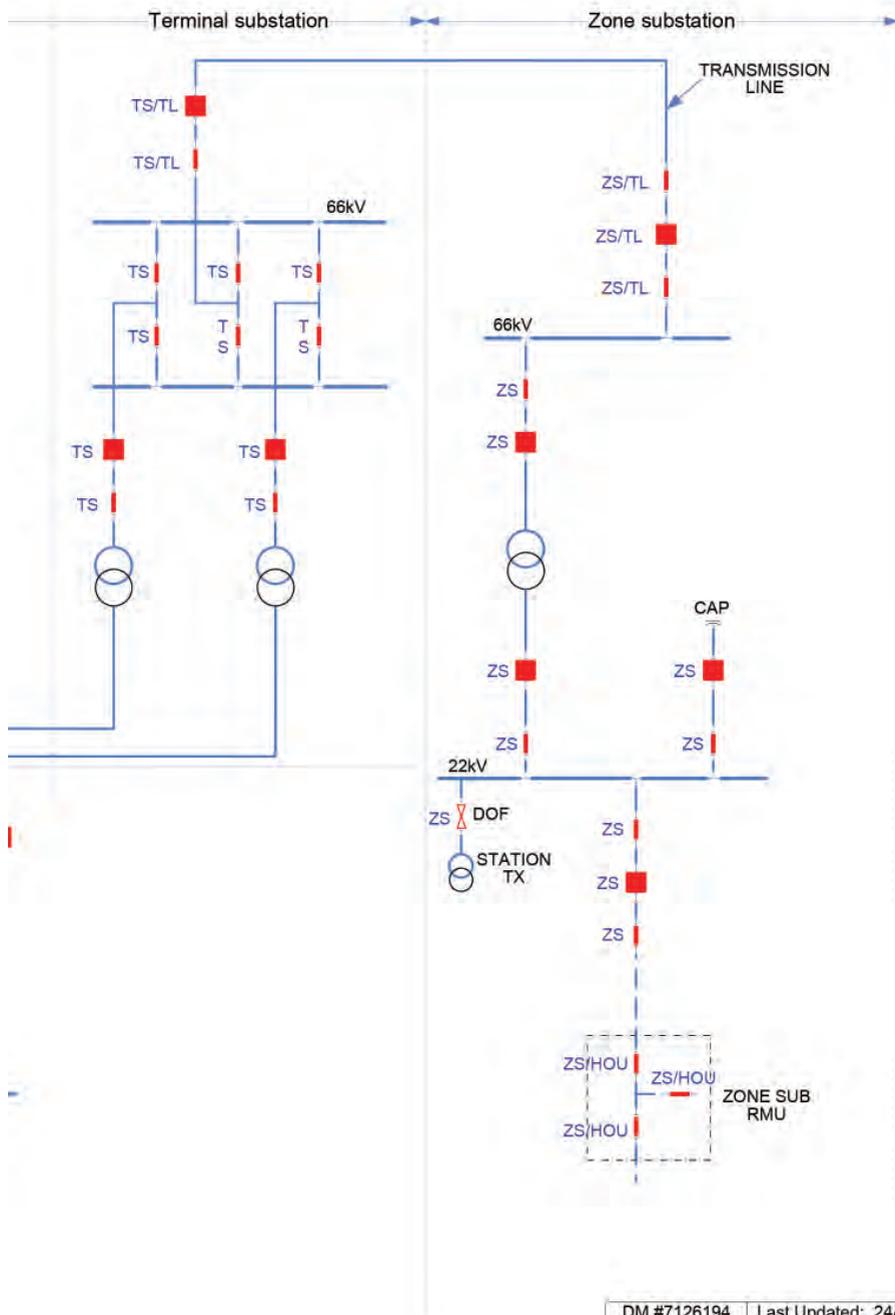


DM #7126194 Last Updated: 24/10/2016

**SWITCHING LEVELS  
ILLUSTRATION - DISTRIBUTION**

# Appendix 4 - Transmission Switching Levels





DM #7126194 | Last Updated: 24/10/2016

**SWITCHING LEVELS  
ILLUSTRATION - TRANSMISSION**



## Incident Hotline: 1300 225 597

It is a requirement to call the Western Power Incident Hotline as soon as practical, but within 60 minutes of an incident occurring.

363 Wellington Street  
Perth WA 6000  
GPO Box L921 Perth WA 6842

T13 10 87 | Fax 08 9225 2660  
TTY 1800 13 13 51 | TIS 13 14 50  
[enquiry@westernpower.com.au](mailto:enquiry@westernpower.com.au)  
[westernpower.com.au](http://westernpower.com.au)

Electricity Networks Corporation  
ABN 18 540 492 861