

Work in Substations - General

Summary

This document supports the Power System Safety Rules and its requirements assembled under 'Work in Substations – General'. It details the electrical hazards which must be managed to ensure the safety of personnel when working in switchyards, substations, high voltage areas including cable tunnels, general facilities and yard maintenance including low voltage electrical work such as air conditioning and construction activities.

Document Control

Revision no:	7	HP TRIM no:	D2012/07702	Approval/ Review date:	13/1/20
Business function:	Manage Health And Safety			Document type:	Corporate Work Instruction
Process owner:	Head of HSE				
Related Procedure/s:	Power System Safety Rules				
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1. Purpose

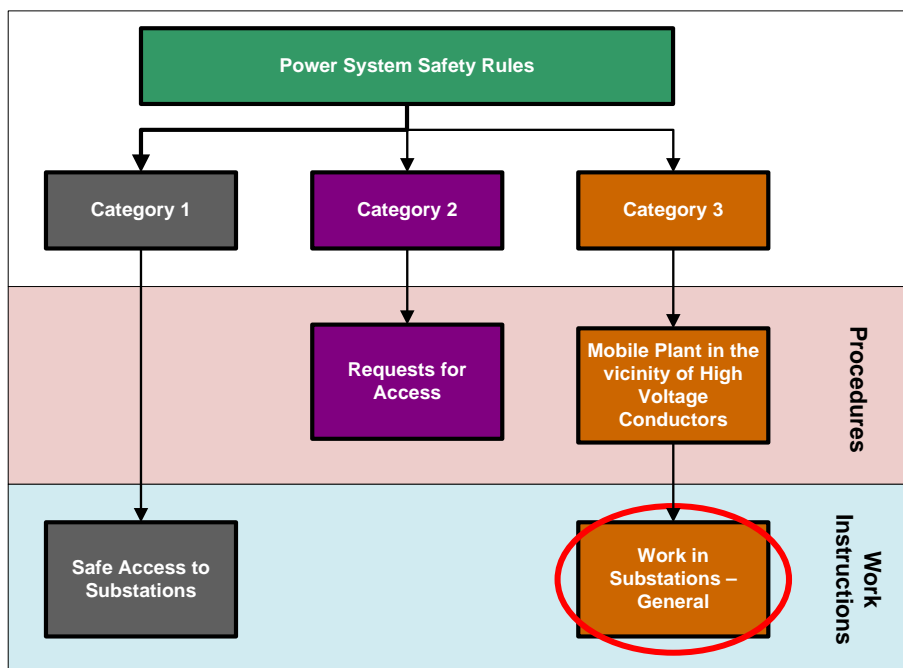
This document supports the Power System Safety Rules and its requirements assembled under 'Work in Substations – General' Category 3. The document describes instructions for general work in substations and is complementary to the Power System Safety Rules, advising on how to apply these principles for different types of work.

1.1 Scope

This work instruction applies to all persons working within substations and covers activities for work that will not affect the Power System. This includes general facilities and yard maintenance, including low voltage electrical work such as air conditioning, and construction activities. This is in addition to the requirements of any Legislation, Codes of Practice or Guidelines, as applicable.

1.2 Document Location

The following diagram describes the relationship between this and other relevant PSSR procedures.



2. Work in Substations - General

This instruction assembles knowledge required for personnel to be authorised Category 3 under the Rules.

The work instructions detailed in this document cover the following types of work:

- > Work within Substation Buildings and Car Parks (Cat 3.1)
- > Work in Switchyards and High Voltage Areas not affecting Substation Apparatus (Cat 3.2)
- > Work in Switchyards or High Voltage Areas affecting Substation Apparatus (Cat 3.3)

2.1 Personal Protective Equipment (PPE)

All persons shall observe the additional PPE requirements for work on site.

2.2 Fire Fighting Equipment

Substation auxiliary services buildings, communication sites, depots, workshops and office buildings may have active systems to manage uncontrolled fires (for example sprinkler systems) but will generally have a greater reliance on emergency response. Fires in these areas are likely to be smaller in size and able to be managed with hand held extinguishers. Personal safety is the major consideration when assessing the risk of

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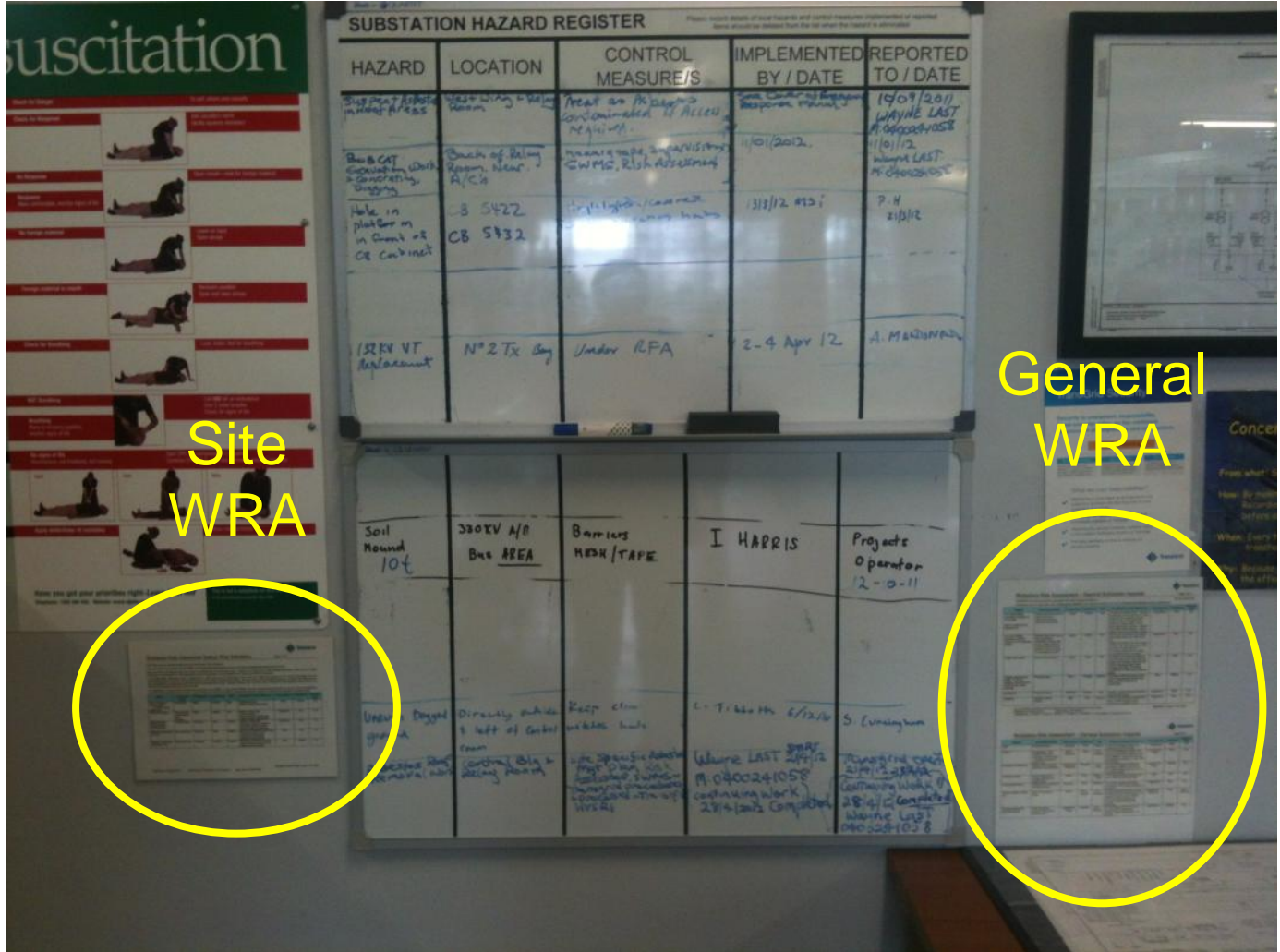
any uncontrolled fire. Persons are only to act within the limits of their training and abilities when fighting uncontrolled fires.

(Source: 'Fire Protection Manual Operations and Maintenance' GD HS G2 001)

2.3 Work Health and Safety (WHS)

2.3.1 Hazard Board

Each substation has a hazard board that lists any abnormal hazards that exist within the substation. The hazard board shall be reviewed prior to working in the substation.



2.3.2 Hazards and Unsafe Situations

Persons working in substations have a responsibility to report hazards and unsafe situations. Where practicable and if safe to do so persons are to make the hazard safe and report the occurrence to their supervisor. Abnormal substation hazards shall be noted on the substation hazard board.

2.3.3 Substation Workplace Risk Assessment (WRA)

Each substation has a workplace risk assessment that defines the control measures to be implemented by all personnel undertaking work on the site. This shall be reviewed prior to work commencing.

2.3.4 Documented Pre Work Risk Assessment (PWRA)

A documented risk assessment shall be completed prior to commencing any work and updated should any hazards change or new hazards arise. The documented risk assessment shall include a review of the substation workplace risk assessment and assessment of the risks associated with the tasks to be performed.

2.3.5 Emergency Response

All persons are required to be aware of the [Substation Emergency Response Manual](#). These are located at every site and are to be used to guide an emergency response at site.

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3. Work in Substations

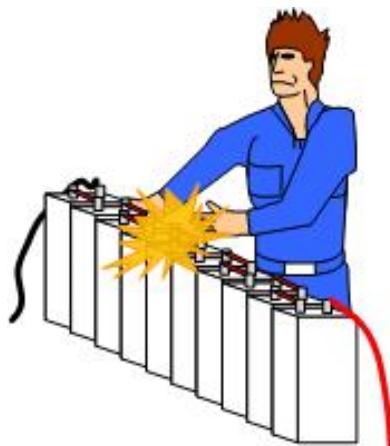
The following sections list the hazards encountered within substations and controls to be implemented.

3.1 Work within Substation Buildings and Car Parks

3.1.1 Substation Building Hazards and Controls 1 – 2

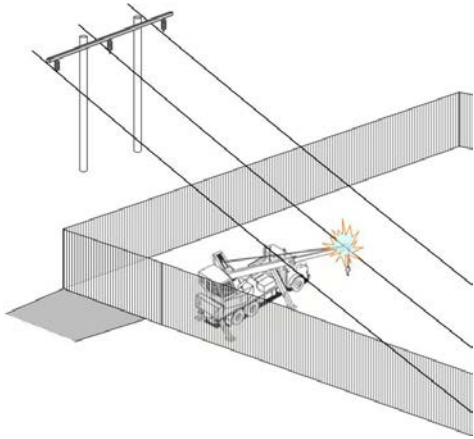
The hazards listed below shall be reviewed as part of the pre-work risk assessment for work in substation buildings.

No	Hazard	Risk	Control
1	Use of electrical leads and appliances	Electrocution or injury. Not all substation outlets are RCD protected.	<p>All electrical leads and appliances shall be tested and tagged.</p> <p>Portable RCD devices shall be used at all times.</p> <p>All damaged leads and appliances shall be removed from service and reported.</p>
2	Battery rooms & associated systems	Injury as a result of DC electrical contact, fumes in battery rooms or explosive battery failures.	<p>Ensure controls noted on battery room doors are implemented.</p> <p>Confirm ventilation is adequate prior to entry.</p> <p>Ensure eye wash provisions are available.</p> <p>Insulated tool use only.</p> <p>Tools which produce a gas ignition source should not be used.</p> <p>Review site Workplace Risk Assessment.</p>



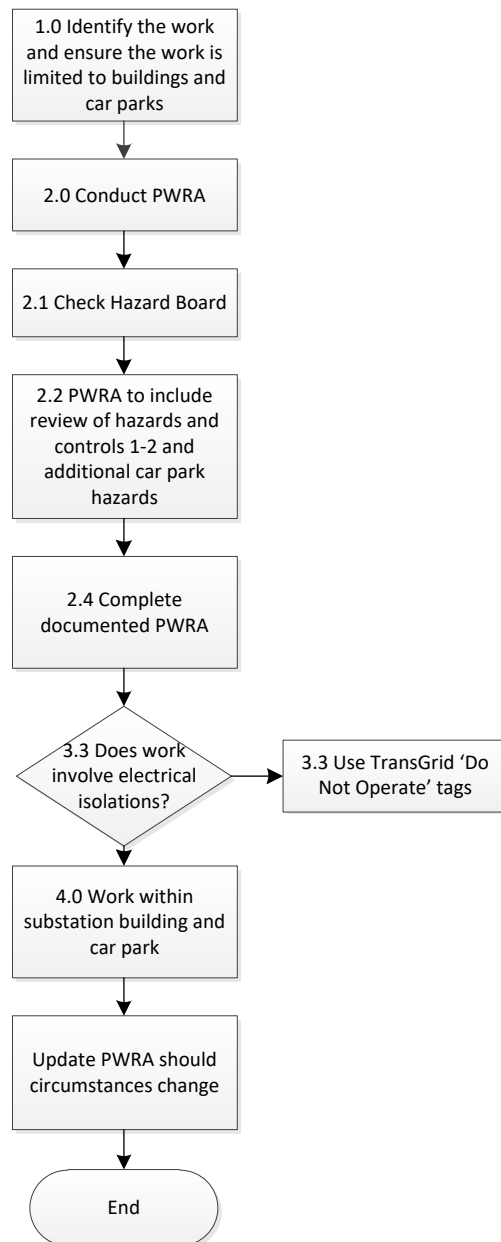
3.1.2 Additional Substation Car Park Hazards and Controls

The hazard listed below shall be reviewed as part of the pre-work risk assessment for Work in Substation Car Parks.

Hazard	Risk	Control
Overhead Lines	<p>Contact with or near approach to a live high voltage overhead line can cause severe injuries or death.</p>  <p>When vertically extendible equipment, such as cranes, elevated work platforms, etc. are being used in the vicinity of live high voltage exposed conductors, danger may arise due to the possibility of the equipment coming on or near these conductors.</p>	<p>Personnel and plant clearance distances shall be maintained as specified in 'Safe Approach Distances to exposed conductors' at all times.</p> <p>Refer to 'PSSR' Attachment B for further information and Mobile Plant In Vicinity of High Voltage Conductors.</p> <p>Laser range meters can be used to accurately measure safe approach distances.</p> <p>This is in addition to the requirements of any Legislation, Codes of Practice or Guidelines, including the need for a safety observer, as applicable.</p>

3.1.3 Work within Substation Buildings and Car Parks – Work assessment process and instruction

3.1.3.1 Work within Substation Buildings and Car Parks – Flow chart



3.1.3.1 Work within Substation Buildings and Car parks – Instruction


Step	Action	Resources
1.	<p>Identify the work and ensure the work is limited to buildings and car parks. Examples include:</p> <p>1.1 General facilities work</p> <ul style="list-style-type: none"> • Cleaning • Any other work that does not require excavation or access to the switchyard that can be undertaken without disturbing the operation of the substation. <p>1.2 Electrical Work</p> <ul style="list-style-type: none"> • Electronic gates; and • Work on building services not affecting the operation of the substation, such as air conditioning or indoor lighting. • Electrical work shall be conducted in accordance with PSSR 3.1.3. 	Person authorised 3.1
2.	<p>Conduct a Pre-Work Risk Assessment (PWRA)</p> <p>2.1 Check the local Hazard Identification Board for any temporary hazard notifications.</p> <p>2.2 Review substation hazards and controls 1 – 2 and additional substation car park hazards and controls</p> <p>2.3 Identify any additional hazards and apply appropriate control measures.</p> <p>2.4 Complete a documented pre-work risk assessment.</p> <p>2.5 Update PWRA if hazards change or new hazards arise</p>	Person authorised 3.1 Substation Building Hazards and Controls 1 – 2 Additional Substation Car Park Hazards and Controls
3.	<p>Electrical Work</p> <p>3.1 All low voltage electrical work shall be carried out in accordance with any Legislation, Codes of Practice or Guidelines, as applicable.</p> <p>3.2 Confirm the qualifications of persons performing electrical work are appropriate for the proposed work.</p> <p>3.3 If isolations are required use TransGrid Do Not Operate Tags.</p>	Code of Practice 'Managing Electrical Risks in the Workplace' Person authorised 3.1 Qualified and trained in Electrical Work.
4.	<p>Work within a substation building or car park</p> <p>4.1 Apply all of the controls and safe guards identified in the PWRA.</p> <p>4.2 Maintain safe approach distances at all times</p> <p>4.3 Comply with the requirements of Warning tags and Do Not Operate tags.</p> <p>4.4 Note any new hazards on the local Hazard Identification Board at the first reasonable opportunity.</p>	Person authorised 3.1

(Source: 'Power System Safety Rules' GD SR G1 100 & 'Health and Safety Risk Assessment')


3.2 Work in Switchyards and High Voltage Areas not affecting Substation Apparatus

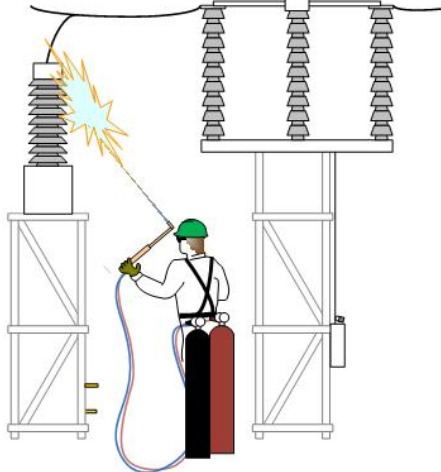
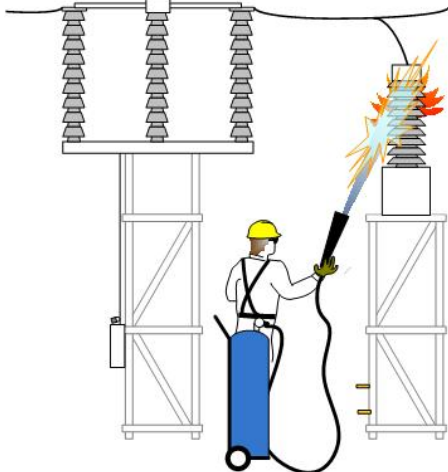
3.2.1 Switchyards and High Voltage Areas Hazards and Controls 3 – 11

The hazards listed below shall be reviewed as part of the pre-work risk assessment for Work in Switchyards or High Voltage Areas.

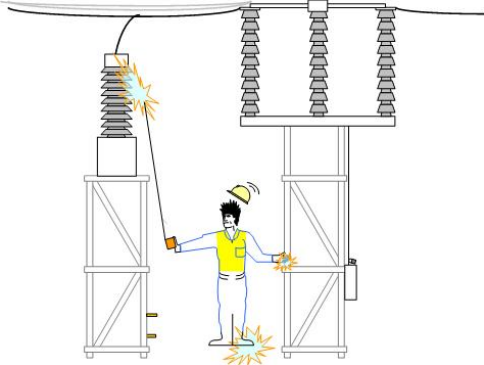
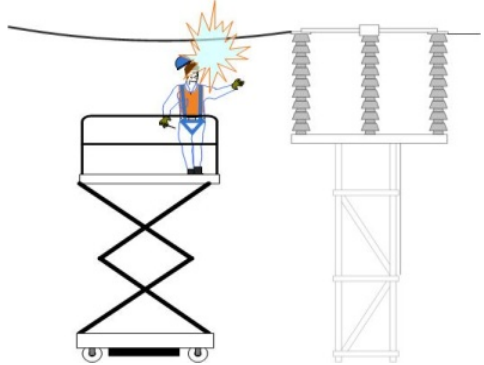
No	Hazard	Risk	Control
3	Enclosed Spaces including GIS switch rooms, basements and tunnels	Injuries may result in exposure to HV from cable sheaths, earthing systems, close proximity to moving parts on switchgear and possibility of engulfment due to release of SF6 gas.	<p>Site specific induction</p> <p>No works around SF6 equipment unless planned and documented risk assessments & control measures adopted.</p> <p>Report any incidental mechanical impacts on SF6 filled equipment and undertake appropriate corrective actions where necessary.</p>
4	Near Approach	<p>Contact with or near approach to a live high voltage exposed conductor can cause severe injuries or death, which can occur by the following means:</p> <ul style="list-style-type: none"> • By touching the live high voltage exposed conductor with any portion of the body. • By bringing any portion of the body so close to the live high voltage exposed conductor that an arc occurs between the conductor and the body. • By bringing close to or touching the live high voltage exposed conductor with material or equipment, other than equipment specially designed for such contact. 	<p>Personnel and plant clearance distances shall be maintained as specified in 'Safe Approach Distances to exposed conductors' at all times.</p> <p>Refer to 'PSSR' Attachment B for further information.</p>

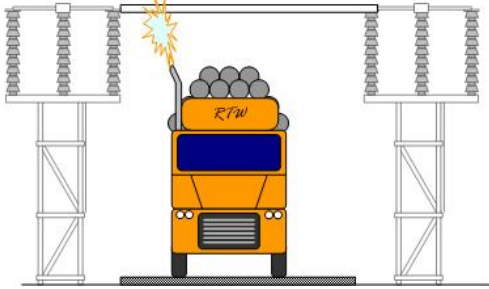
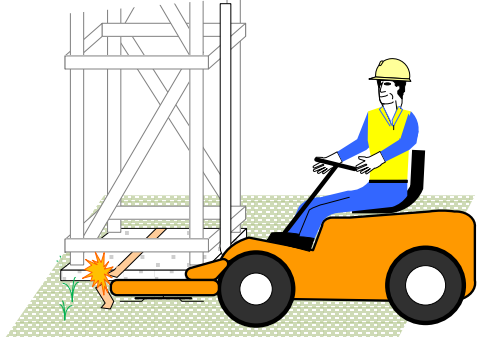
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No	Hazard	Risk	Control
5	Electric Arcs	<p>Serious injury can result from burns caused by electric arcs.</p>  <p>High voltage exposed conductors are arranged to be surrounded by sufficient air to prevent formation of an arc, but if an object moves to within a close proximity to a live conductor an arc will form.</p> <p>Arcs are avoided under normal switching practices methods, but may be formed during abnormal practices such as attempting to apply an earth to a live high voltage exposed conductor or by opening a disconnect which is carrying current (current is normally interrupted by a circuit breaker).</p> <p>Such electric arcs may be the source of an explosion which will scatter molten material and radiate intense light and heat and can seriously injure a person in the immediate vicinity by burns or by damage to the eyes.</p>	<p>Personnel and plant clearance distances shall be maintained as specified in 'Safe Approach Distances to exposed conductors' at all times.</p> <p>Refer to PSSR Attachment B for further information.</p>

No	Hazard	Risk	Control
6	Fire in the Vicinity of Live High Voltage Exposed conductors	<p>Fires in the vicinity of live high voltage exposed conductors can cause an arc to form along the path of the flame should a tongue of flame or vapour come near or make contact with these conductors (fire is conductive).</p>  <p>LPG equipment, welding torches and similar equipment can, under certain circumstances, throw a long stream of flame.</p>	<p>Personnel and plant clearance distances shall be maintained as specified in 'Safe Approach Distances to exposed conductors' at all times.</p> <p>Refer to 'PSSR' Attachment B for further information.</p> <p>Care shall be exercised when using flame-producing equipment near live high voltage exposed conductors.</p> <p>Firefighting equipment shall not be used unless the HV equipment has been made safe to do so.</p> <p>Persons are only to act within the limits of their training and abilities when fighting uncontrolled fires.</p> <p>The Fire Brigade shall not be given access unless the TransGrid site controller has given approval for access.</p>
7	Suitability of Fire Extinguishers	<p>Fire extinguishers which are marked 'Suitable for use on Electrical Fires' are intended for use on low voltage circuits only.</p> 	<p>Fire extinguishers shall not be used on High Voltage electrical fires.</p> <p>High Voltage electrical fires shall be reported and any firefighting shall be under the direction of a TransGrid controller.</p> <p>Persons are only to act within the limits of their training and abilities when fighting uncontrolled fires.</p>

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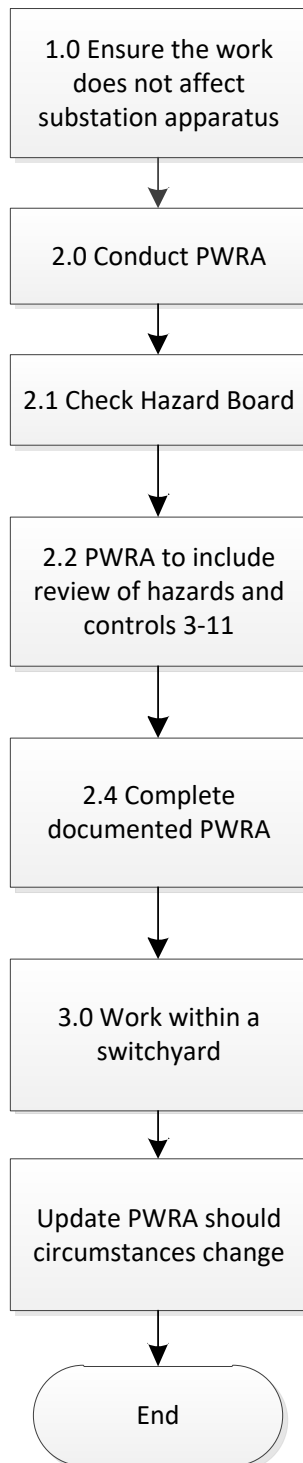
No	Hazard	Risk	Control
8	Use of Metallic Tapes and Other Conductive Equipment	<p>Danger can arise when making measurements using steel tapes, metal reinforced linen tapes and long steel rules in the vicinity of conductors.</p>  <p>Ladders, lengths of conduit or pipe and other similar long equipment can be a hazard if not handled correctly to keep them from coming near high voltage exposed conductors.</p>	<p>Steel measuring tapes, metal reinforced linen tapes and long steel rules are prohibited items and shall not be used in switchyards.</p> <p>Most linen tapes are metal reinforced and for this reason, shall also not be used in switchyards. Fibre glass non-conductive tapes shall be used in such locations.</p> <p>Ladders, lengths of conduit or pipe and other similar long equipment are to be carried below shoulder height. This may require two persons to manage.</p> <p>Personnel and plant clearance distances shall be maintained as specified in 'Safe Approach Distances to exposed conductors' at all times.</p> <p>Refer to PSSR Attachment B for further information.</p>
9	Use of Vertically Extendible Equipment	<p>When vertically extendible equipment, such as cranes, elevated work platforms, etc. are being used in the vicinity of live high voltage exposed conductors, danger may arise due to the possibility of the equipment coming on or near these conductors.</p>  <p>This may occur by the sudden unexpected movement of the equipment on unstable surfaces or by the misjudgement of safe approach distances.</p>	<p>Personnel and plant clearance distances shall be maintained as specified in 'Safe Approach Distances to exposed conductors' at all times.</p> <p>Refer to PSSR Attachment B and the procedure Mobile Plant in the Vicinity of High Voltage Conductors for further information.</p> <p>Laser range meters can be used to accurately measure safe approach distances.</p> <p>This is in addition to the requirements of any Legislation, Codes of Practice or Guidelines, including the need for a safety observer, as applicable.</p>

No	Hazard	Risk	Control
10	Large vehicles, vertically mounted exhausts and long antennae	<p>Large vehicles such as semi-trailers could potentially come within minimum safe approach distances while travelling through a switchyard. Similarly, long antennae may create a similar hazard in some circumstances.</p>  <p>The possibility of coming within safe approach distances is increased at lower voltage levels due to lower clearance.</p>	<p>Personnel and plant clearance distances shall be maintained as specified in 'Safe Approach Distances to exposed conductors' at all times.</p> <p>Refer to 'PSSR' Attachment B and the procedure Mobile Plant in the Vicinity of High Voltage Conductors for further information.</p> <p>Persons must be authorised to category 3.3 to supervise vehicles delivering goods, but shall consider the risks prior to allowing entry and during travel within the switchyard. The category 3.3 authorised person shall ensure that they are able to effectively supervise them at all times within the switchyard.</p> <p>Laser range meters can be used to accurately measure safe approach distances.</p>
11	Earthing Systems	<p>Damage to earthing system from grass cutting or digging.</p>  <p>If the earthing system is damaged dangerous voltages may occur.</p>	<p>No digging is permitted under the category 3.2 level of authorisation.</p> <p>Grass cutting height shall be adjusted so dirt is not exposed when cutting.</p> <p>Cutting blades shall be enclosed to ensure side contact is not possible.</p> <p>Care shall be take when cutting grass around all structure footings.</p> <p>Any damage to earthing systems must be reported immediately. Do not approach, touch or attempt repairs.</p>

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3.2.2 Work in Switchyards and High Voltage Areas not affecting Substation Apparatus - Work assessment process and instruction

3.2.2.1 Work in Switchyards and High Voltage Areas not affecting Substation Apparatus – Flow chart



3.2.3.1 Work in Switchyards or High Voltage Areas not affecting Substation Apparatus – Instruction


Step	Action	Resources
1.	<p>Ensure the work does not affect substation apparatus. Examples include:</p> <ul style="list-style-type: none"> 1.1 Grass cutting 1.2 Pest Control 1.3 Building maintenance 1.4 Painting 1.5 Plumbing 1.6 Fire protection maintenance 	Person Authorised 3.2
2.	<p>Conduct pre-work risk assessment</p> <ul style="list-style-type: none"> 2.1 Check the local Hazard Identification Board for any temporary hazard notifications. 2.2 Review switchyard hazards and controls 3 – 11. 2.3 Identify any additional hazards and control measures required. 2.4 Complete a documented pre-work risk assessment. 2.5 Update PWRA if hazards change or new hazards arise. 	Switchyard Hazards and Controls 3 – 11
3.	<p>Work within a switchyard</p> <ul style="list-style-type: none"> 3.1 Apply all of the controls and safe guards identified in the pre-work risk assessment. 3.2 Maintain safe approach distances. 3.3 Use tools and equipment in accordance with approved procedures. 3.4 All persons shall comply with the requirements of Warning tags and Do not operate tags. 3.5 Note any new hazards on the local Hazard Identification Board at the first reasonable opportunity. 	Person authorised 3.2

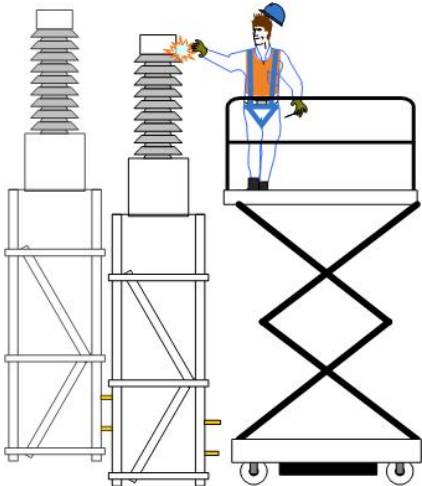
(Source: 'Power System Safety Rules' GD SR G1 100 & 'Health and Safety Risk Assessment')

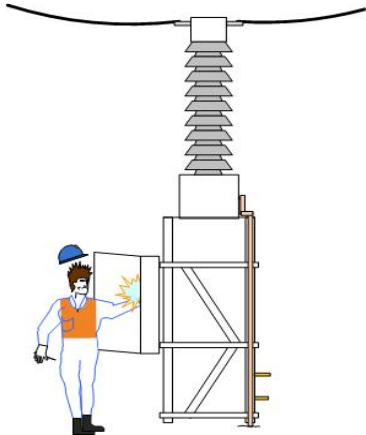
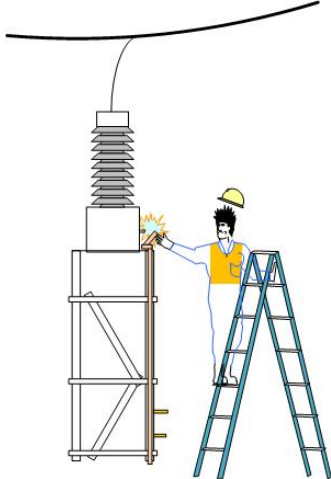
3.3 Work in Switchyards or High Voltage Areas affecting Substation Apparatus including earth grids

3.3.1 Switchyards or High Voltage Areas Hazards and Controls 12 – 19

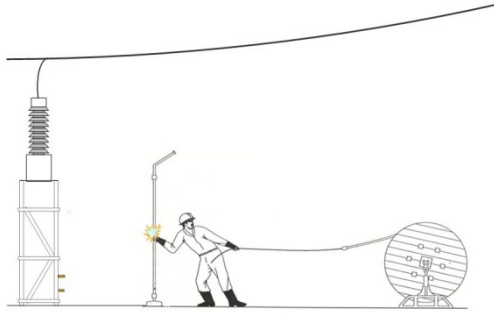

The additional hazards listed below shall be reviewed as part of the pre-work risk assessment for Work in Switchyards or High Voltage Areas affecting substation apparatus including earth grids.

No	Hazard	Risk	Control
12	Buried Services	<p>Any excavation or digging in a switchyard has the possible danger of contact with buried services including: HV or LV cables, earthing systems, gas, water, sewer, fire services and telecoms cables.</p>  <p>The diagram illustrates a safety hazard in a switchyard. On the left, a high-voltage conductor is supported by a metal structure. A yellow excavator is positioned to the right, with its bucket lowered into a hole in the ground. A blue lightning bolt symbol is shown near the excavator's bucket, indicating a risk of contact with buried services. A worker in a blue uniform and yellow hard hat is operating the excavator.</p>	<p>A TransGrid Excavation Permit is required for any excavation in TransGrid premises and excavating plant shall be earthed in an approved manner whilst digging in a switchyard.</p> <p>Affected services may need to be isolated and earthing grid may need to be bridged by Cat 5.5 person</p> <p>Refer to Section 5 and the procedure Mobile Plant in the Vicinity of High Voltage Conductors for further information.</p>

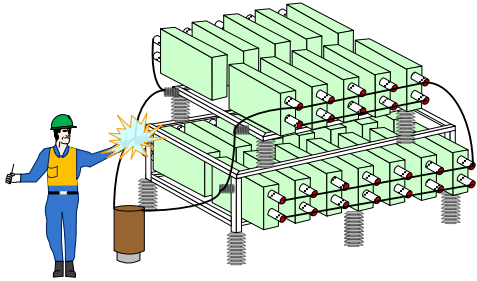
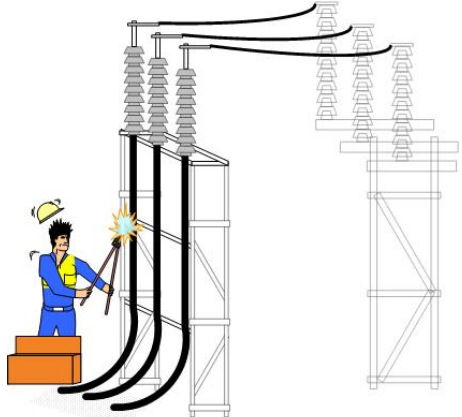
No	Hazard	Risk	Control
13	Induced Voltages	<p>There is a danger of induced voltages when carrying out work on isolated electrical apparatus that is located close to live electrical apparatus. Such induction may result either from in-service equipment, high voltage switching or electrical faults in adjacent equipment.</p> <p>The discharge of induced voltages can also cause sparks to be generated which could ignite combustible liquids in the vicinity of the spark.</p> 	<p>Avoid contact.</p> <p>Use an approved method to create and work in an insulated or equipotential area.</p> <p>Bonded work areas shall be created to ensure equipotential conditions are maintained.</p> <p>For example: support structures, scaffolding or elevating work platforms used to provide access to disconnected apparatus may require bonding to the equipment being worked on.</p> <p>Refer to Safe Work Practices on HV Substation Apparatus or a Category 5.5 authorised person for further information.</p> <p>Refuelling of equipment and plant should always be carried out in an area where induction from in-service equipment is not present. Equipment and plant should be checked prior to use for fuel levels and refuelled only at their storage locations, well away from the risk of induced voltages from the switchyard.</p> <p>If refuelling within a switchyard or an area where there is a risk of sparks being generated from static or induced voltages. A Static bonding kit must be used to eliminate ignition hazards during refuelling.</p>

No	Hazard	Risk	Control
14	High Voltages from Unusual Sources	<p>There are some ways in which High Voltage can occur on apparatus which normally carries Low Voltage and particular care is necessary to prevent this.</p>  <p>For example, dangerous voltages may exist on un-bonded cable sheaths or current transformer secondary circuits that are open circuit when the primary circuit is carrying current.</p>	<p>Care is necessary when working on low voltage equipment and circuits to ensure that nothing occurs which can bring about such a condition.</p> <p>Cables shall be fully discharged by a Category 5.5 authorised person using a suitable means of earthing before approaching, or working on or near the apparatus, and before working on the apparatus after electrical testing has been performed.</p> <p>Refer to a Category 5.5 authorised person for further information.</p>
15	Removal of Earth Connections	<p>If an earth connection is removed from High Voltage apparatus which is in service, a dangerous voltage may occur.</p>  <p>Apparatus includes: voltage transformers; the potential tapping's fitted to High Voltage bushings and current transformers; the neutral connections of power transformers; the earth connection of a HV cable sheath; and Surge diverters.</p>	<p>Earth connections between apparatus and the earthing system shall not be removed whilst the apparatus is in service.</p> <p>Isolation of the apparatus is required for this work.</p> <p>Refer to a Category 5.5 authorised person for further information.</p>

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No	Hazard	Risk	Control
16	Switchyard Earth Grid Voltage Rise & Transferred Earth Potentials	<p>Substations and the circuits connecting them may be subject to dangerous rises in electrical potential due to faults either locally or elsewhere in the power system.</p>  <p>Overhead conductors/earth wires, metallic communication, control and protection circuits, cable sheaths and pulling ropes, fences, water, sewage and storm water service pipes all provide a means for “remote” earth potentials to be transferred to or from these stations.</p>	<p>Equipment that may be subject to transferred earth potentials shall either be insulated, isolated, or otherwise rendered safe for work by a person authorised 5.5.</p> <p>Refer to Safe Work Practices on HV Substation Apparatus or a Category 5.5 authorised person for further information.</p>
17	Flexible Insulation is not Adequate Protection	<p>Tape, rubber or other fabric applied directly to high voltage conductors shall not be regarded as adequate electrical insulation.</p> 	<p>High voltage conductors covered by flexible insulation shall be treated as exposed high voltage conductors, except where the material is suitable under the relevant Australian Standard for the voltage concerned.</p> <p>Personnel and plant clearance distances shall be maintained as specified in ‘Safe Approach Distances to exposed conductors’ at all times.</p> <p>Refer to ‘ PSSR’ Attachment B and the procedure Mobile Plant in the Vicinity of High Voltage Conductors for further information.</p>

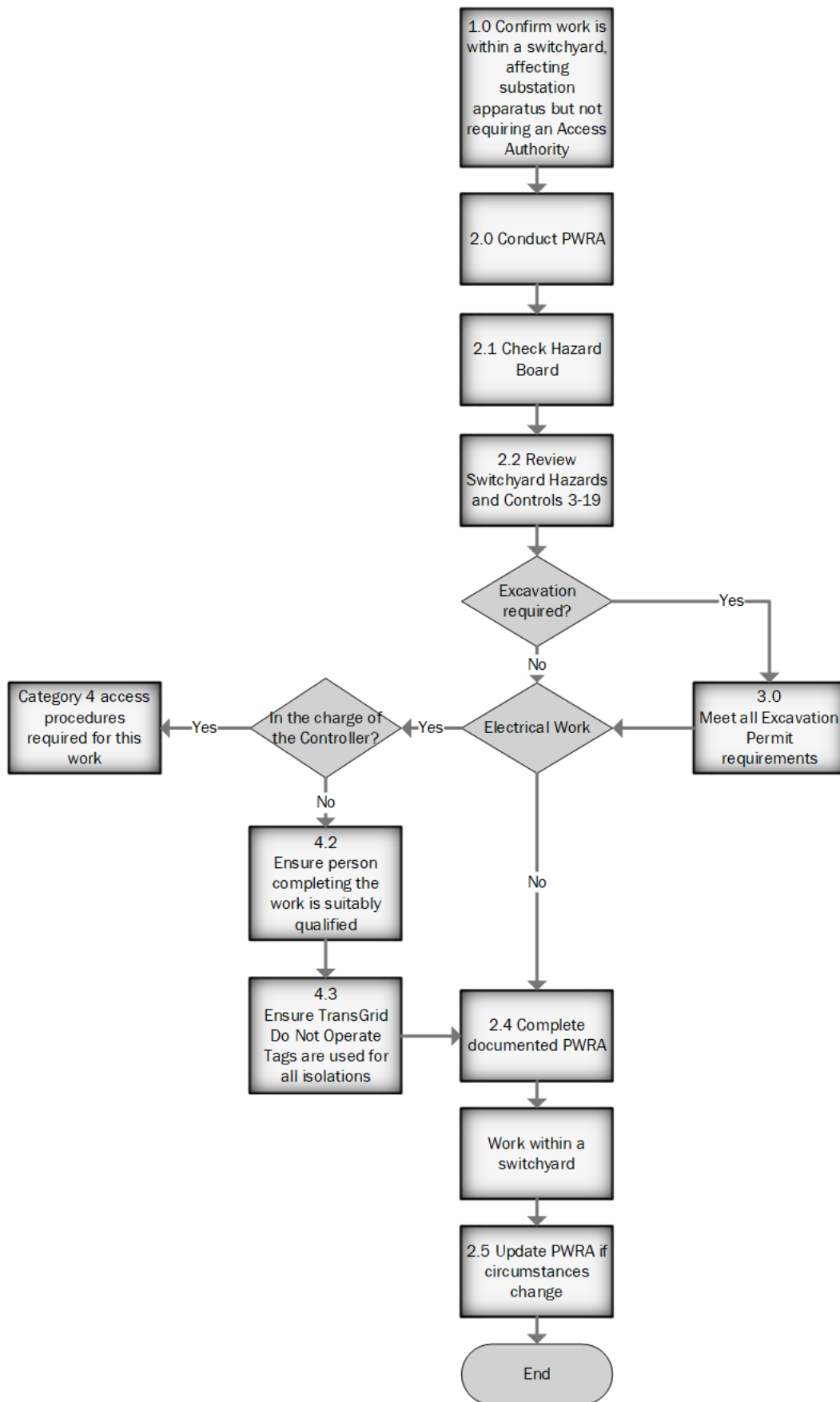
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No	Hazard	Risk	Control
18	Capacitance Associated With High Voltage Apparatus	<p>Capacitor banks as well as high voltage and low voltage cables may have significant capacitance. This apparatus is able to retain an electrical charge of sufficient magnitude to be hazardous to persons even after the apparatus has been isolated from the source of supply.</p> 	<p>Equipment shall be fully discharged by a person authorised 5.5 using a suitable means of earthing before approaching, or working on or near the apparatus, and before working on the apparatus after electrical testing has been performed.</p> <p>The above precautions shall also be taken by persons when working on high voltage or low voltage cables to avoid the dangers of induction from any nearby energised cables.</p> <p>Refer to Safe Work Practices on HV Cables for further information.</p>
19	Work in the vicinity of HV Cables and Sealing Ends	<p>Damage may result in exposure to HV from sheaths or cable failure.</p> 	<p>Keeping clear of installations.</p> <p>Use of approved work methods to ensure adequate protection & controls are implemented prior to works.</p> <p>Earth connections between apparatus and the earthing system shall not be removed whilst the apparatus is in service.</p> <p>Isolation of the apparatus is required for this work.</p>

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3.3.2 Work in Switchyards or High Voltage Areas affecting Substation Apparatus including earth grids – Work assessment process and instruction

3.3.2.1 Work in Switchyards or High Voltage Areas affecting Substation Apparatus – Flow chart



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3.3.2.2 Work in Switchyards or High Voltage Areas affecting Substation Apparatus including earth grids - Instruction

Step	Action	Resources
1.0	<p>Confirm work will not affect the Power System. Examples include:</p> <p>1.1 Civil and electrical construction activities 1.2 Excavation 1.3 Fencing 1.4 Electrical work within a switchyard on equipment not part the transmission network, such as lighting, security systems and CCTV.</p>	Person Authorised 3.3
2.0	<p>Conduct pre-work risk assessment</p> <p>2.1 Check the local Hazard Identification Board for any temporary hazard notifications. 2.2 Review switchyard hazards and controls 3 – 19. 2.3 Identify any additional hazards and control measures required. 2.4 Complete a documented pre-work risk assessment. 2.5 Update PWRA if hazards change or new hazards arise</p>	<p>Switchyard Hazards and Controls 3 – 11 Switchyard Hazards and Controls 12 – 19</p>
3.0	<p>Site preparation – Excavation Refer Appendix B - Excavation Permit Explanatory Notes Note: Affected services may need to be isolated as some buried low voltage A.C. lighting and power cables have no earth within the cable and may remain alive if accidentally damaged during excavation.</p>	Persons Authorised 3.3 and Person Authorised 5.5
4.0	<p>Electrical Work</p> <p>4.1 All low voltage electrical work shall be carried out in accordance with any Legislation, Codes of Practice or Guidelines, as applicable. 4.2 Confirm the qualifications of persons performing electrical work are consistent with the duties engaged. 4.3 If isolations are required use TransGrid approved Do Not Operate Tags.</p>	<p>Code of Practice 'Managing Electrical Risks in the Workplace'. Person authorised 3.3 Qualified & Trained in Electrical Work.</p>
5.0	<p>Work within a switchyard</p> <p>5.1 Comply with controls and safe guards identified in the PWRA. 5.2 Comply with precautions and warnings given under an excavation permit. 5.3 Maintain safe approach distances. 5.4 Comply with the requirements of Warning tags and Do Not Operate Tags. 5.5 Supervise instructed persons for the purposes of deliveries only. 5.6 Note any new hazards on the local Hazard Identification Board at the first reasonable opportunity.</p>	Authorised person 3.3

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4. Accountability

Title	Responsibilities and Accountabilities
Head of HSE	Ownership of this procedure
PSSR Manager	Maintenance of this procedure
Manager – Training	Implementation of training programs associated with this procedure
Authorised Persons	Comply with this procedure

5. Implementation

This procedure is to be implemented in conjunction with the implementation of TransGrid's Power System Safety Rules. It will be available as a resource, published on the Wire.

6. Monitoring and Review

The Head of HSE is responsible for the ongoing monitoring and review of the documents associated with the Power System Safety Rules. This can include but is not limited to:

- (a) Requesting regular feedback on the effectiveness of procedures and work instructions. Appropriate feedback tools include focus groups and WHS consultative committees;
- (b) Where a change has occurred in our processes; and
- (c) Recommendations arising from incidents.

7. Change from previous version

Revision no	Approved by	Amendment
4	Neil Smith GM/System Operations	<ul style="list-style-type: none">> Section order revised> Duplications from other safety documents deleted> References updated> Hazard/Risk diagrams added> Quick Reference Guide added
5	Neil Smith GM/System Operations	<ul style="list-style-type: none">> Revised Hazard 11 controls
6	Ken McCall, Manager/Health, Safety and Environment	<ul style="list-style-type: none">> Update of flowcharts to include requirement to update PWRA if circumstances change.> Update of position titles
7	Michael Gatt, EM, Works Delivery	<ul style="list-style-type: none">> Work instruction has been updated to the new template> Appendix B - Excavation Permit explanatory notes added.> Induced Voltage hazards and controls updated with flammable materials

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8. References

- > Power System Safety Rules
- > Safe Work Practices on High Voltage Substation Apparatus
- > Safe Work Practices on High Voltage Cables
- > Health and Safety Risk Assessment
- > Contractor Health, Safety and Environment Management
- > Mobile Plant in the Vicinity of High Voltage Conductors
- > Code of Practice – Managing electrical risks in the workplace

9. Attachments

Appendix A - PSSR Quick Reference Guide Category 3

Appendix B - Excavation Permit Explanatory Notes

Appendix A - PSSR Quick Reference Guide Category 3

AREA	WORK	3.1	3.2	3.3
CARPARKS AND BUILDINGS	Cleaning	✓	✓	✓
	Building maintenance	✓	✓	✓
	Pest control	✓	✓	✓
	Plumbing & fire system maintenance	✓	✓	✓
	Supervise delivery	✓	✓	✓
	Low voltage electrical (Qualified)	✓	✓	✓
	Excavation			✓
SWITCHYARD	Grass cutting		✓	✓
	Building maintenance		✓	✓
	Pest control		✓	✓
	Plumbing & fire system maintenance		✓	✓
	Fencing			✓
	Low voltage electrical (Qualified)			✓
	Excavation			✓
	Supervise delivery			✓
	Safety observer (Mobile plant)			✓
	General construction & demolition			✓

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Appendix B – Excavation Permit Explanatory Notes

An Excavation Permit is used to ensure the safety of workers and the integrity of assets when ground penetration or disturbance is occurring on TransGrid premises.

An excavation permit is a required control for ground penetration works. Therefore even though the following activities do not involve bulk excavation there is potential for hazards and damage to services so the excavation permit process must be followed. Non bulk excavation works requiring an excavation permit include: installation of star pickets and surface skimming prior to gravel installation.

The following notes provides detail on each section to assist you in the correct use of the permit document and execution of excavation activities.

It is intended that the person controlling the excavation permit will complete the necessary sections in the numerical order so that underground services are identified, risks are controlled and persons are informed of the requirements associated with the excavation permit prior to excavation commencing.

B.1 Header

- > This Permit applies to all excavation work on TransGrid premises or in the vicinity of an earthing grid.
- > A copy of this Permit plus all Safe Work Method Statements (SWMS) and Drawings shall be in the possession of the person controlling the works on site at all times.
- > Explanatory notes for this excavation permit form are provided in the PSSR Procedure "Work in Substations – General".
- > The person controlling the works and the TransGrid representative must be authorised a minimum of category 3.3

An excavation permit is intended for use in TransGrid premises such as substations, depots and radio repeater sites. It is not intended for use on transmission lines or high voltage cables outside substations.

Sections 6.1.2 and 6.1.4 of the PSSR, along with its supporting procedures are the relevant references to manage excavation on transmission lines. Section 7.1.4 of the PSSR, along with its supporting procedures are the relevant references to manage excavation around high voltage cables.

Management processes and requirements for excavations associated with Greenfield construction works are the responsibility of the Principal Contractor for those works.

B.2 Section 1

1. Location and purpose of excavation: (Attach a marked up copy of the General Arrangement drawing showing the proposed excavation area)	
Substation:	Project Name/Number:
<u>Description of Work:</u>	<u>Location (e.g. Bay No/ Site Location):</u>

In addition to the written description the general arrangement drawing of the site should be marked up with the intended excavation location to ensure clarity regarding the extent of the excavation.

B.3 Section 2

2. Identification of Services: The following drawings shall be used to identify services within the work area		
Drawing Number	Revision	Description
		Substation Earthing Grid Layout
		Underground electrical cables layout including communication services
		HV cable route/layout diagrams
		Water & Fire services layout
		Spill oil & Storm water drainage layouts
		Other Services (Eg. Security Fencing, security fencing conduit layouts, conduit and cable trench layout, Fibre Optic cable routes,)

Section 2 requires that all applicable drawings associated with services which could be located within the proposed excavation area to be located. The list on the form specifies common service drawings but should not be considered to be exhaustive. The person planning the excavation must ensure they locate all possible service drawings associated with the excavation area.

B.4 Sections 3

3. Risk Assessment and Safe Work Method Statements			
Have any of the following generic risks been identified within the Excavation area. If yes, safe work method statements covering those risks are required.			
Risk	Yes / No	SWMS/JSEA Number & Revision	Safe Work Method Statement Name
Earthing Grid (See Note 1)			
Note 1: As a minimum the SWMS for bridging and earthing grids must meet the requirements of the procedure 'Safe Work Requirements for Bridging and Repairing of Earthing Grids' work instruction.			
Buried cables			
Optic fibre			
Fire/Water services			
Overhead Conductors			
High voltage equipment			

Following review of the excavation location and the drawings, relevant hazards must be identified and control measures put in place to manage those hazards. The hazards and controls shall be listed in Safe Work Method statements which are linked to the excavation permit using these sections.

A Safe Work Method Statement for work on the earthing grid, which meets the minimum standard of the 'Safe Work Requirements for Bridging and Repairing of Earthing Grids' work instruction must be developed and included with the excavation permit.

B.5 Section 4

4. Desktop identification of services and safety documentation confirmation			
Sections 1 to 3 are complete and all documentation has been supplied and checked. Once signed by TransGrid representative on site works to locate identified services can commence.			
Person Controlling The Works:	_____	_____	____/____/____
	Signature	Name	Date
TransGrid Representative:	_____	_____	____/____/____
	Signature	Name	Date

In section 4 the TransGrid representative overseeing the works checks that sections 1-3 have been completed and the relevant documents including drawings and Safe Work Method statements have been attached. This check is to ensure that adequate information is available to commence the site exploration works in section 5.

The TransGrid representative confirming that the documentation is correct must be a minimum of PSSR Category 3.3 authorised and must not be the same person as the person controlling the works.

B.6 Section 5

5. On site service location and electrical safety requirements prior to excavation			
a)	All required/listed drawings and documentation are present and verified.		
b)	The full extent of the proposed excavation shall be marked on site and on the attached drawings, including General Arrangement (GA) drawings.		
c)	All known buried cables, earthing grid and other services within 1m of the proposed excavation (the Excavation Area) shall be highlighted on the drawings and marked on site prior to excavation.		
d)	Where the work involves the connection, cutting, disconnection or potential to break or damage any part of the earthing system, then prior to the work commencing a bridging lead is applied across the point of work by a person authorised PSSR category 5.5 in accordance with PSSR Section 5.5.5 'Bridging of Earthing Grids'.		
e)	Where no above ground earth exists to connect a temporary bridging earth to, non-destructive excavation methods (hand/hydro vac excavation) shall be used to expose the underground earthing grid to allow temporary bridging to be installed.		
f)	All known service routes within the Excavation Area shall be exposed using non-destructive excavation methods (hand/hydro vac excavation)		
g)	All equipment for repairing a broken earthing grid and installing new temporary bridging earths are available on site.		
Preparation Verified on site by the person Controlling the Works:			
	_____	_____	____/____/____
	Signature	Name	Date
			____:____
			Time

Site identification and exploratory works are a key control to ensure that any affected services are positively located prior to the excavation taking place. This allows control measures to be put in place to ensure the safety of workers and the integrity of services.

- **Excavation Area** - The excavation area encompasses the entire proposed excavation plus a one meter extension buffer in each direction. The extent of the excavation, and the proposed excavation area shall be marked on site.
- **Site Review** - Workers should not solely rely on drawings to locate services. The features of the area should be reviewed to ensure there is not likely to be other services not shown on the drawings. Examples of clues to potential services would be cable markers, the presence of equipment requiring services to operate correctly (e.g. light poles), cable pits, fire hydrants etc. Wherever there is any doubt about the location of services or there is a risk of unidentified services a cable locator should be used.
- **Non Destructive Digging** - Any services within the excavation area shall be positively identified using mechanisms which are not going to damage the service. Hydrovac and hand digging are considered

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non-destructive location methods. Appropriate hand digging tools and techniques must be used to ensure the service is not damaged.

- Additional Controls - Reasonably practical means should also be used to ensure that risks are controlled. E.g. it may be reasonably practical to isolate an electrical service running through the excavation area during the potholing process to reduce risk to workers.
- Services not likely to be affected - In some circumstances there may be services which run underneath the excavation area but which due to the depth of the intended excavation being shallower than the service it is not expected to damage it. In this instance locating potholing should be undertaken in strategic locations to obtain confirmation of the location and depth of the services is not going to be affected. Please see the following worked examples.

Example 1: During the drawing review it was identified that 415V cables run underneath the proposed excavation area. The drawing says the cables are buried at 2m below ground level. The maximum depth of the proposed excavation is 1m below ground level. A site services location is completed and the cable location is identified and the locator finds the cables at 1.8m below ground level through the excavation area. To confirm the cable locator's results, potholing of the identified cable location takes place at both ends of the proposed cable route through the excavation area. Potholing down to 1.2 m does not find any evidence of the cable. Based on this, confidence is obtained that the cable is not going to be affected by the 1m deep excavation. As an additional reasonably practical control the 415V supply is isolated for the duration of the excavation works.

Example 2: Geotechnical drilling for core samples down to 3m is required for a new substation reactor compound. The drawings are reviewed and suitable drilling locations away from services are identified. A services search takes place on site and the earth grid is located within 200mm of the proposed drilling location. The borehole location is then moved 1m north to get more clearance from the earth grid. No other services are located in close proximity to the proposed bore hole. Non-destructive digging is used to confirm there are no services down to 1m depth. From 1m depth the core drilling commences.

- Work with potential to affect the earthing system - The earth grid can carry dangerous currents. Any earthing grid which will potentially be damaged by the excavation must be bridged by a person authorised category 5.5 prior to the excavation works commencing. Where it is intended to remove, or reroute the earth grid from the excavation area, design advice must be obtained to ensure this does not introduce a step and touch potential risk.
- Stand Alone Radio Repeater Site earthing systems - Standalone radio repeater sites (meaning those radio repeater sites whose earthing system is not connected to a substation earthing system) are in place to manage the dissipation of lightning energy. They are not subject to the same level of hazard that the substation earthing system is. Bridging of the earthing system at these installations does not require a category 5.5 authorised person but it does require a suitable Safe Work Method Statement to ensure it is performed safely.

B.7 Section 6

6. Precautions and Warnings to be given to all persons working in the Excavation Area: Record in section 8											
a)	Other services, cables and earthing grid that are not shown on any drawings may exist. All reasonable care must be taken during excavation to avoid damage to these services.										
b)	Earthing grid shall not be deliberately broken unless appropriate bridging providing an alternative current path has been implemented by a person authorised category 5.5 under TransGrid's Power System Safety Rules.										
c)	If any part of an earthing system is inadvertently broken during work, all work in the vicinity shall cease until an assessment is made of the earthing arrangements: <ul style="list-style-type: none"> • If the broken earthing grid is covered by a temporary bridging earth, the broken earth shall be restored as soon as practicable but shall be repaired on the same day. • If the broken earthing grid is not covered by a temporary bridging earth, work cannot continue until additional safeguards have been implemented by a person authorised PSSR category 5.5 in accordance with PSSR Section 5.5.5 'Bridging of Earthing Grids'. The broken earth shall be restored as soon as practicable but shall be repaired on the same day. 										
d)	Temporary bridging earths (bridging leads) shall only be removed a person authorised category 5.5 under TransGrid's Power System Safety Rules after: <ul style="list-style-type: none"> • The parallel connection has been restored; or • Another bridging lead has been installed in parallel; or • It is known with certainty that this can be done with safety 										
Precautions and warnings verified on site by the person Controlling the Works: <table style="width: 100%; border: none;"> <tr> <td style="width: 33%; text-align: center;">_____</td> <td style="width: 33%; text-align: center;">_____</td> <td style="width: 15%; text-align: center;">____/____/____</td> <td style="width: 19%; text-align: center;">____:____</td> </tr> <tr> <td style="text-align: center;">Signature</td> <td style="text-align: center;">Name</td> <td style="text-align: center;">Date</td> <td style="text-align: center;">Time</td> </tr> </table>				_____	_____	____/____/____	____:____	Signature	Name	Date	Time
_____	_____	____/____/____	____:____								
Signature	Name	Date	Time								

Section 6 details the precautions and warnings which are to be given to all persons working in the excavation area. Once they have received the precautions and warnings they can sign onto the excavation permit in section 8.

B.8 Section 7

7. Permit Issue and approval to commence excavation			
Subject to all items (sections 5 and 6) being completed, the excavation may proceed under the supervision of a person who has been informed of, and acknowledges all of the conditions and site specific requirements of this excavation permit. Modification of the excavation area or excavation permit conditions requires re-issue of the excavation permit.			
Person Controlling The Works: (Accepting receipt of the Permit)	_____	_____	____/____/____
	Signature	Name	Date
TransGrid Representative (Approval to Issue Permit And Commence Excavation)	_____	_____	____/____/____
	Signature	Name	Date
Permit Issue will expire on: ____/____/____ (Maximum of 4 weeks from TransGrid Representative Signature Date)			

Once the person controlling the works is satisfied that all services have been marked and located they can request a TransGrid representative to review the preparations and if they see fit, to approve the excavation permit. The TransGrid representative issuing the permit must be authorised a minimum of Category 3.3 and must not be the person controlling the works.

Any change to the excavation area or excavation permit conditions will require the excavation permit to be re-issued.

Unknown services located - If any services are located that are not on existing drawings the details should be marked on an existing drawing and the table at the bottom of the excavation permit and submitted to design so that records can be updated and maintained.

B.9 Section 8

8. Excavation Permit Signature Sheet.						
Persons who have received the Precautions & Warnings allocated to work in this Excavation Area						
I understand the Precautions & Warnings given and my responsibilities under this Excavation Permit					Person Issuing Precautions and Warnings	
Name	Worker Role (eg. Plant Operator, Observer)	Signature	Time	Date	Name	Signature

Once a person has received the precautions and warnings they can sign onto the excavation permit in section 8.