

Disconnected Apparatus

Safe Work Handbook

Power System Safety Rules



This Handbook covers the Power System Safety Rules requirements for Disconnected Apparatus for substations, transmission lines and Transmission Cables. The handbook aims to help you be a safe worker and gain your authorisation to work on Transgrid's High Voltage (HV) network.

It has been written in plain, easy to understand language and is a working interpretation of the Power System Safety Rules (PSSR). The PSSR and this handbook are reviewed and updated periodically. Check our website at <https://www.Transgrid.com.au/working-at-Transgrid/workplace-safety> for the latest information.

In this handbook, the words 'must' or 'must not' are used for rules that you have to follow. The words 'should' or 'should not' are used when explaining safe and low-risk work practices.

Document Control					
Revision no:	1	TRIM no:	D2024/00209	Approval/ Review date:	29 February 2024
Business function:	Health, Safety & Environment			Document type:	Work Instruction
Process owner:	GM/Health, Safety & Environment				
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Introduction

The Disconnected Apparatus Handbook covers the Power System Safety Rules you need to know for Disconnected Apparatus for substations, transmission lines and Transmission Cables. It's essential reading for anyone who needs to:

- Declare HV apparatus disconnected from Transgrid's High Voltage (HV) network; or
- Approve the connection or reconnection of HV apparatus to Transgrid's High Voltage (HV) network.

This handbook is the main resource to get your Disconnected Apparatus authorisation via the Worker Safety Authorisation and Training (WSAT) system. It supports training courses, which you must pass to get your worker authorisation.

Read this handbook to check the rules, understand your responsibilities and learn safe working behaviour. There are also similar handbooks for Substations, Transmission Lines, Transmission Cables, Low Voltage Mechanical, Mobile Plant and Field Operations available at www.transgrid.com.au/working-at-transgrid/workplace-safety.

In this handbook, the words 'must' or 'must not' are used for rules that you have to follow. The words 'should' or 'should not' are used when explaining safe and low-risk work practices.

Remember, we all have a responsibility to work safely and look out for each other.

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Authorisations

Power System Access	Substations - HV	Transmission Lines	Transmission Cables
	Disconnect Substation HV Apparatus	Disconnect Transmission Lines	Issue a Cable Access Authority

The Power System Safety Rules (PSSR) authorisations are permissions to access an area, perform a type of work, apply a specific control, or execute a controlled process.

Getting your PSSR authorisation is a journey and depending where you will be working on our High Voltage Network, you might get one authorisation or many.

There are authorisations for Transmission Lines, Transmission Cables, Low Voltage Mechanical, Mobile Plant, Field Operations and more that can be found in the PSSR Authorisation Structure.

A PSSR authorisation gives you access to work but also brings responsibility. It's a commitment between you and Transgrid to work safely and look out for each other.

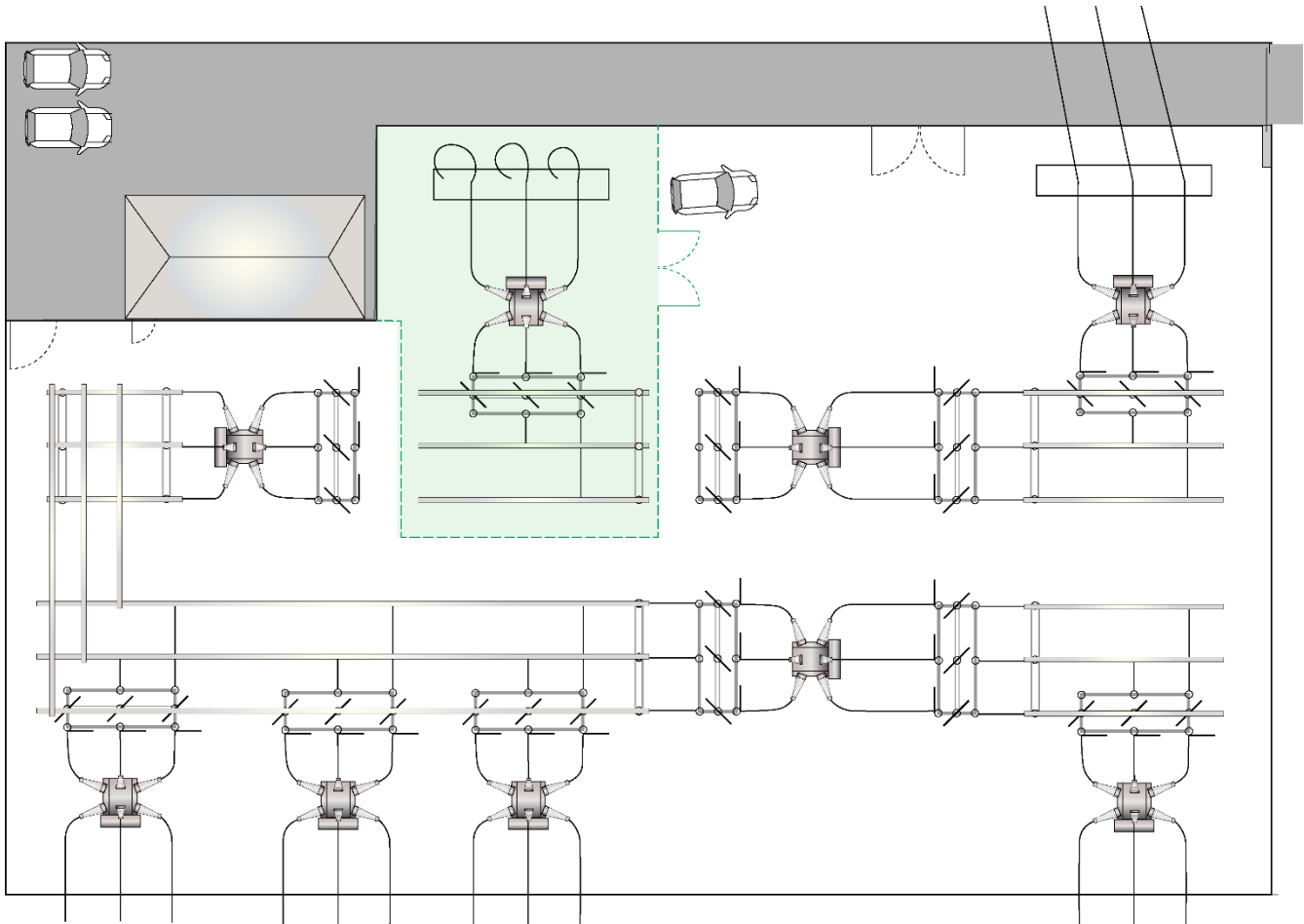
To help build understanding, authorisations and related training courses are in small modules that match the authorisation table shown here. You must be assessed competent in an authorisation before applying the skill.

When you get your authorisation, do not abuse, or misuse it. If you do, you may lose your authorisation and access to work at Transgrid.

If you are unsure of how to apply the PSSR correctly, STOP and seek assistance from one of our Safety team before doing your work.

1. Disconnected Apparatus – Substation HV Apparatus

Disconnected substation HV apparatus made safe for work and excluded from the Access Authority requirements of the PSSR must be approved by a person authorised **Disconnect Substation HV Apparatus**.



Installation of new HV apparatus within a substation is often done as Disconnected Apparatus. Disconnection of existing substation apparatus is normally made for:

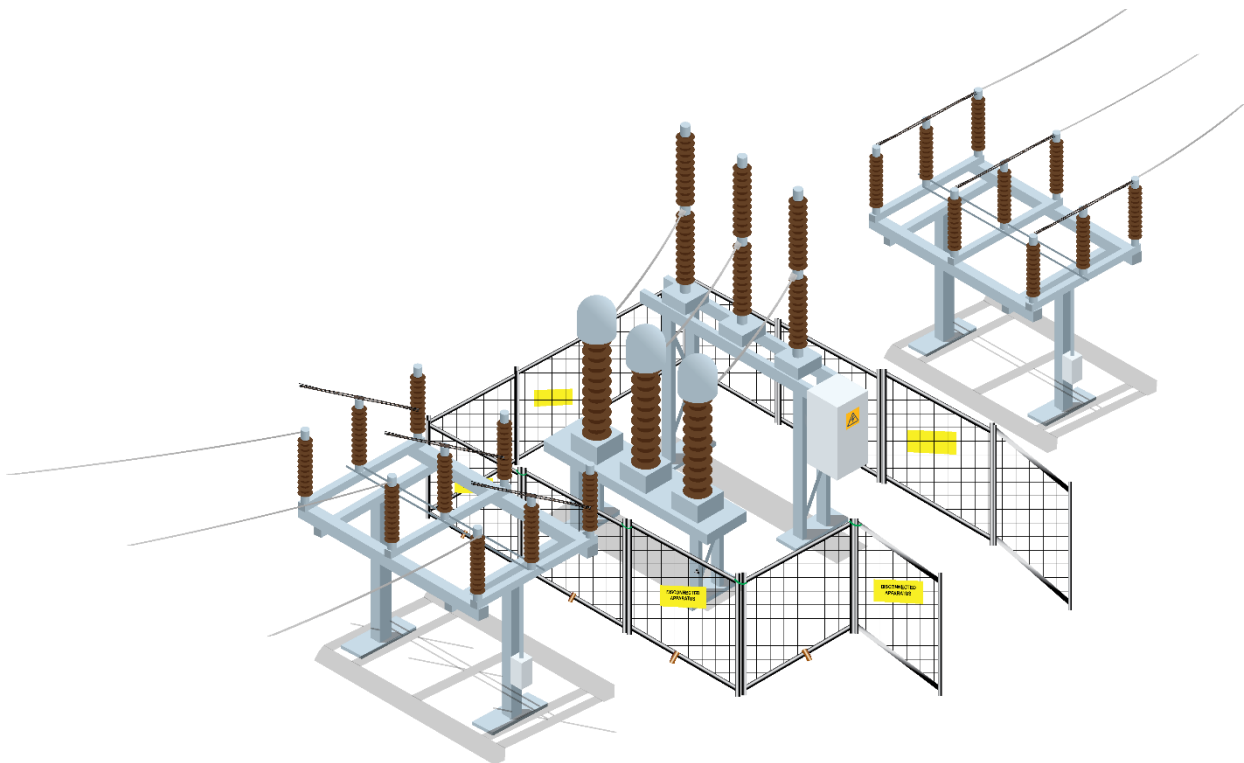
- Carrying out long-term activities, with the intent of returning apparatus to service on completion; or
- Dismantling apparatus for removal.

HV Apparatus being prepared for installation/transport or being stored is not required to be declared disconnected.

1.1. Disconnection of Substation HV Apparatus

Prior to HV Apparatus being declared Disconnected, a person authorised **Disconnect Substation HV Apparatus** must ensure the following conditions are met:

- (a) The HV apparatus is disconnected from all sources of HV electrical energy by the removal or absence of conductors and cannot be energised by electrical operating work;
- (b) Any risks associated with induced voltages or transferred potentials are appropriately controlled;
- (c) There is no possibility of coming on or near the HV exposed conductors of other HV electrical apparatus;
- (d) Appropriate LV/MECH isolations have been carried out in accordance with LV/MECH Field Operating requirements;
- (e) Exposed terminal connections of any cable or transmission line within the vicinity of the disconnected apparatus must be identified;
- (f) Disconnected substation HV apparatus – safe for work, must be identified within a switchyard by enclosing the apparatus within a rigid fence:
 - (i) At least 1800mm high;
 - (i) Connected to the substation earth grid in alignment to STD-859002;
 - (ii) With “Disconnected Apparatus” signs affixed at regular intervals facing outwards; and
 - (iii) Have secured entrances, with no more than one entrance open at a time.



Non high voltage structures such as fences, buildings and blast walls that prevent entry and exit of the work area may also be used as part of this barrier in method.

1.1.1. Additional requirements for GIS Apparatus

In addition to the general requirements, the person authorised **Disconnect Substation HV Apparatus** must ensure that the following conditions are met for GIS Apparatus:

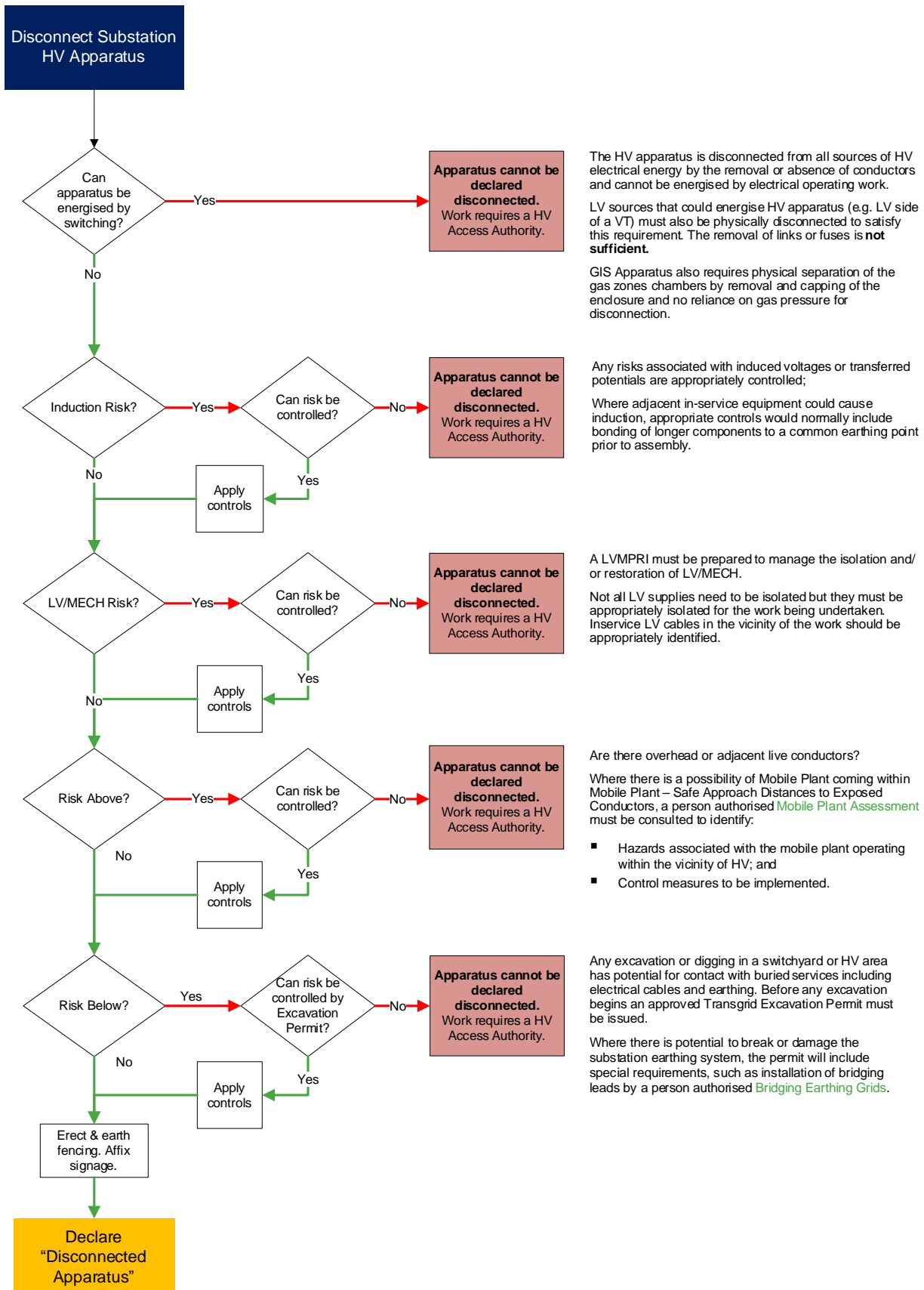
- (a) Physical separation of the gas zones chambers by removal and capping of the enclosure; and
- (b) No reliance on gas pressure for disconnection.

1.1.2. Checklist

[Declaring HV Substation Apparatus Disconnected](#)

The completed checklist must be displayed at the entrance to the Disconnected Apparatus work area.

1.1.3. Process to Declare Disconnected



1.2. Work on Disconnected Apparatus

The person in control of the work must ensure:

- (a) Work complies with control measures noted on the Disconnected Apparatus check sheet.
- (b) Low Voltage connections to apparatus that may cause conductors to be energised at high voltage, must not be completed until after the Disconnected Apparatus status is removed and Access Authority conditions are in place.
- (c) For the duration of any HV electrical testing:
 - (i) The entrance to the Disconnected Apparatus area is closed and an approved notice warning that electrical testing is in progress is erected at this closed entrance.
 - (ii) A person with sufficient knowledge of the work and the test devices is nominated to:
 - Instruct persons regarding work that may proceed safely during the testing and provide any additional warnings that may be applicable;
 - Direct the control of the switching of the test source energising the conductors;
 - Ensure adequate communications are maintained with all persons involved in the testing;
 - Warn any person in the vicinity of the conductors under test that voltage is to be applied and in return receive an assurance that such person will remain clear of such conductors during the test;
 - Confirm with any 3rd party carrying out the electrical test that the High Voltage conductors being tested are safe to be touched or approached whenever this becomes necessary during the progress of the electrical test.
 - Where induced or test voltages could be present, or if any earths are removed for testing, ensure that safe working methods are used which restrict persons coming within the Safe Approach Distance of energised conductors and any testing equipment or connection leads;
 - If any exposed conductors to which test voltages are to be applied are out of sight of the person controlling the test source, ensure that either:
 - > A person is posted to warn others not to approach the exposed conductors during the test; or
 - > Fences or equivalent barriers are erected, or shutters closed to prevent any person gaining inadvertent access to the exposed conductors.
- (d) Other relevant PSSR requirements for work in HV areas are complied with.

A Testing HV Access Authority is not required when testing disconnected substation HV apparatus.

1.3. Connection of Substation HV Apparatus

Prior to any disconnected substation HV Apparatus being connected or reconnected to the Power System, a person authorised **Disconnect Substation HV Apparatus** must confirm that:

- (a) All measures taken to identify the HV apparatus as disconnected apparatus are removed;
- (b) All necessary apparatus identification, warning signs, locks, fences, gates, etc., are in place;
- (c) [Advice](#) has been provided to all persons associated with the work that the apparatus is now in the charge of the Controller and an Access Authority is required for work on or near exposed conductors; and
- (d) The substation HV Apparatus is in a fit state to be connected to the Power System.

2. Disconnected Apparatus - Transmission Lines

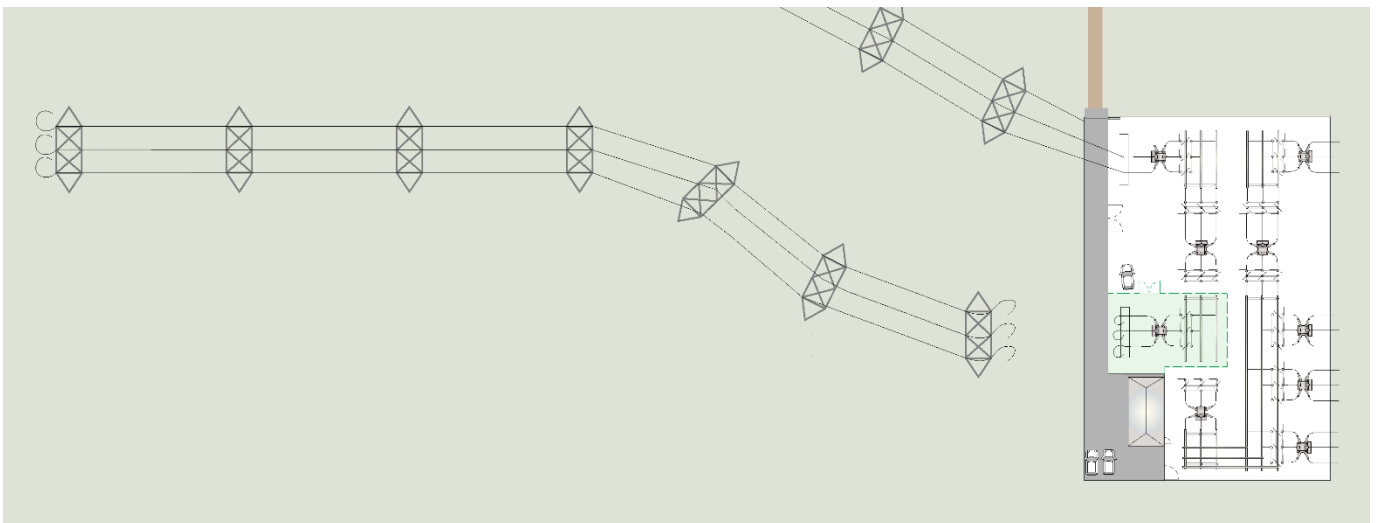
2.1. Disconnection of Transmission lines

Disconnected transmission lines made safe for work and excluded from the Access Authority requirements of the PSSR must be approved by a person authorised [Disconnect Transmission Lines](#).

Disconnection of existing transmission lines is normally made for:

- Carrying out long-term activities, with the intent of returning the transmission line to service on completion; or
- Dismantling the transmission line for removal.

Once a transmission line is declared Disconnected Apparatus, it may be worked on by ordinary persons without PSSR authorisation.



Prior to a Transmission Line being declared Disconnected, a person authorised [Disconnect Transmission Lines](#) must ensure the following conditions are met:

- The Transmission Line is disconnected from all sources of supply by the removal or absence of conductors and cannot be energised by electrical operating work;
- Any risks associated with induced voltages or transferred potentials are appropriately controlled;
- Any section of disconnected transmission line to be worked upon does not and will not, during the course of the work, come on or near any other High Voltage exposed conductors;
- For a single circuit of double circuit transmission line to be declared as disconnected apparatus, an approved hazard management plan is issued to ensure that the risks of working adjacent to an energised circuit appropriately controlled;
- Where practical, Disconnected Transmission Lines made safe for work, must be identified by “Disconnected apparatus” signs affixed at every structure and at substation boundaries.
 - Where it is not practical to affix a “Disconnected apparatus” sign at every structure on a section of disconnected transmission line, an approved method must be used to advise all persons involved in the work that the transmission line is disconnected.

2.2. Transmission Line - Disconnected Apparatus Hazard Management Plan

Whilst the intent of disconnecting a transmission line is to remove PSSR requirements related to Field Access Authorities, it does not remove other hazards such as induced voltages and currents, undercrossing and overcrossings.

Prior to declaring a transmission line as disconnected apparatus a “Disconnected Apparatus Hazard Management Plan” must be developed to specify how the hazards in the table below will be managed for the duration of the work on the disconnected transmission line and must outline who has responsibility for implementing the controls it lists and how workers will be made aware of the requirements of the plan.

Hazard	Requirements to be documented
Network disconnection and reconnection	How the process of disconnection and reconnection from the network will be managed and where the disconnection/reconnection will be. Must include consideration of whether the earth wire will remain connected or disconnected.
Induced Voltages and Currents	An Electrical Engineer must assess hazard levels and advise controls to be implemented.
Overcrossings	The location, conductor clearance, description and voltage of any overcrossings and controls to be implemented.
Undercrossings	The location, conductor clearance, description, and voltage of any undercrossings and controls to be implemented.
Transferred Earth Potentials	An Electrical Engineer must assess hazard levels and confirm controls to be implemented during disconnection or connection to substations.
Work on dual circuit structures, one circuit energised	How near approach to the to the energised circuit will be maintained. * Stringing works are not permitted unless the in-service circuit is under Field Access Authority conditions.
Identification of structures declared disconnected apparatus	The method which will be used to identify structures which are disconnected apparatus and how workers will be made aware of these arrangements.

2.2.1. Template

[Hazard management plan template](#) for working on a transmission line as Disconnected Apparatus.

2.2.2. Transmission lines which cross operational boundaries

Where a transmission line has joint ownership, the physical disconnection must be made in the portion of the line which is owned and managed by Transgrid.

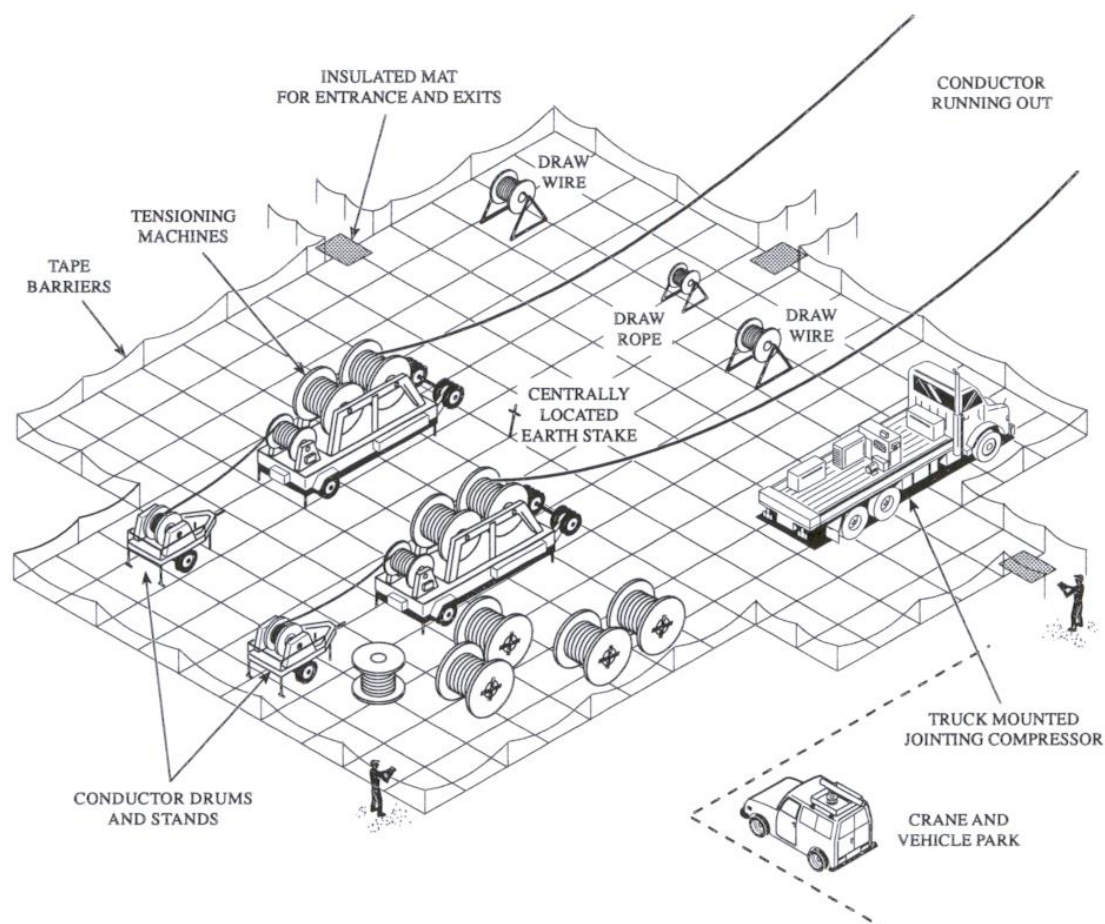
2.2.3. Transmission lines which cross substation boundaries

Where a transmission line crosses a substation boundary, for the line to be declared as disconnected apparatus, the substation apparatus/ bay which it is connected to must also be declared as disconnected apparatus by a person authorised [Disconnect Substation HV Apparatus](#).

A single hazard management plan may be prepared to encompass both the line and substation apparatus areas.

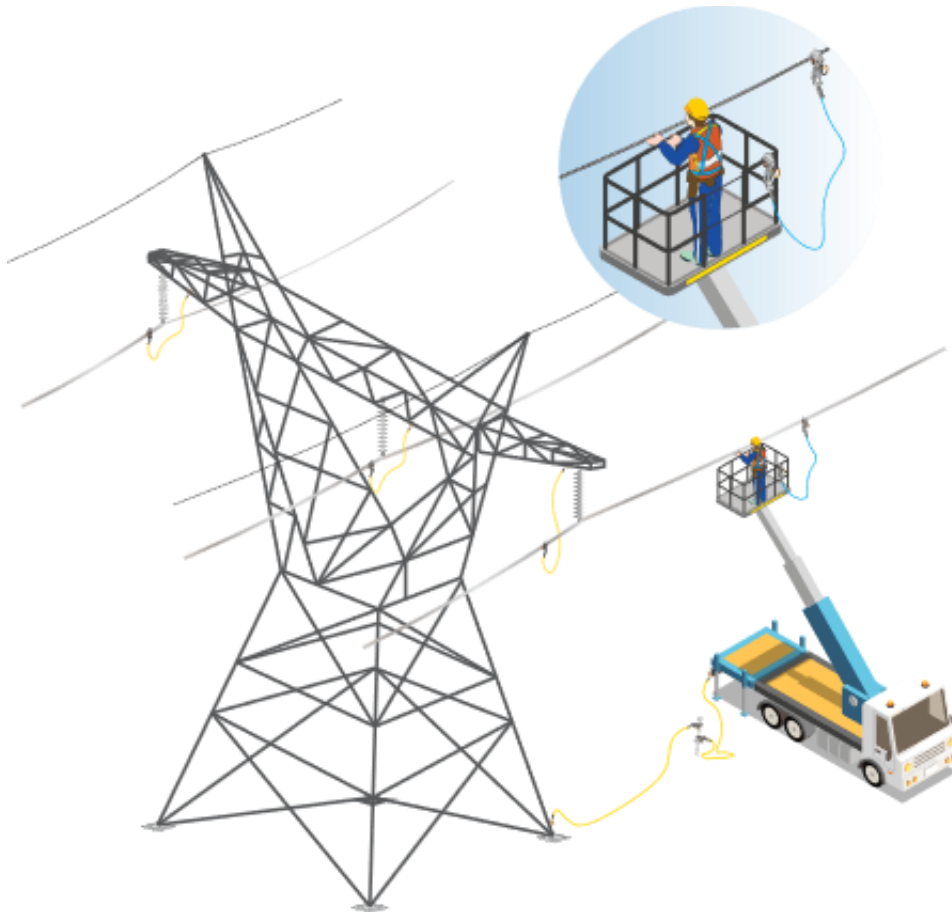
2.2.4. Induced voltages and currents

Stringing of conductors or OHEW on disconnected lines which run parallel to an in-service Transmission Line can be subject to significant induced voltages and currents. Effective earthing of draw wires, earth wires and conductors should be maintained throughout the duration of work.



Main work sites are normally established as a bonded work area. All material and equipment associated with the running of draw wires, earth wires and conductors are bonded to the work area. Entrance to or exit from the bonded work area is normally via insulating mats, with a taped barrier defining the edges of the bonded work area.

Bonding leads should be applied to ensure equipotential conditions are maintained between mobile plant and conductors during the work.



Bridging leads should be applied, to maintain a current path before a conductor is to be connected or disconnected.



2.2.5. Overcrossing and undercrossing risks and controls

Where undercrossing/overcrossing risks exist the hierarchy of controls should be followed to determine appropriate controls. Preference should be given to isolate and earth the line over engineering controls.

Where outages will be used to manage undercrossing/overcrossing, suitable precautions must be taken to ensure that work which could impact the undercrossing does not occur prior to the outage.

Outages on other organisation's lines should be arranged directly with the owning organisation. Notification of isolation and earthing will be in accordance with that organisation's requirements, e.g. Operating Agreement or Access Authority.

2.2.6. Transferred Earth Potentials

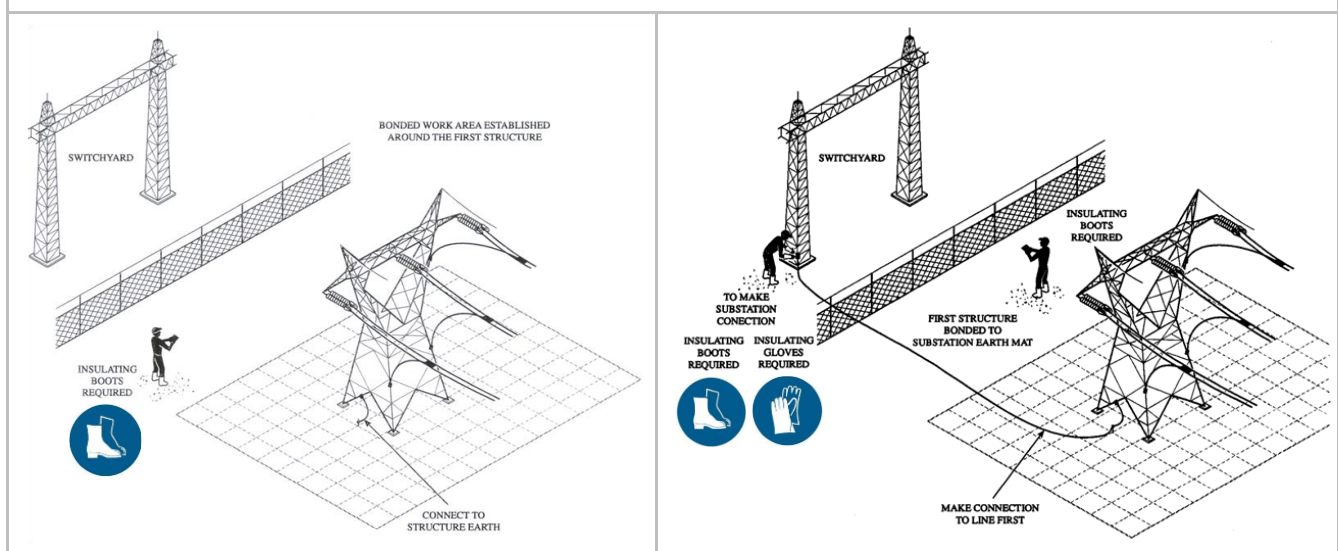
Persons working on the stringing of conductors and overhead earthwires up to the landing span in the switchyard can be subject to significant hazards from the rise in voltage of the substation earth grid under system fault conditions or system switching activities.

2.2.6.1. Recommended Controls

It is best practice for all work on the Transmission Line to be completed before the landing span is installed. If this cannot be done it may be necessary to temporarily install a single disc insulator in the overhead earth wire at the first structure and to leave the conductor jumpers completely disconnected or tied back onto the landing spans. The following precautions will limit the extent of transfer voltage effects.

Process for stringing landing spans:

1. A bonded work area must be established around the first structure and connected to the structure earth.
2. The first structure must be bonded to the switchyard earth grid using a portable earthing lead, the lead is connected to the first structure outside the switchyard and then run into the switchyard and connected to the switchyard earth grid.

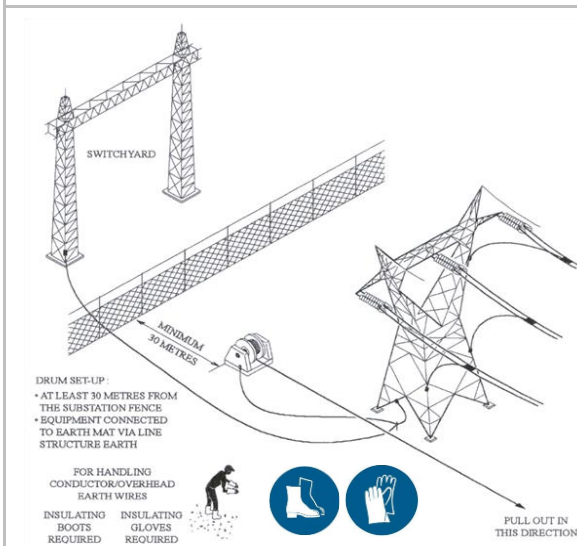


Winches, brakes and other equipment associated with the stringing operation are to be connected to the switchyard earth grid directly or via the earthing of the first structure using the process outlined above. The following options may be used:

Method A

The conductor or earthwire:

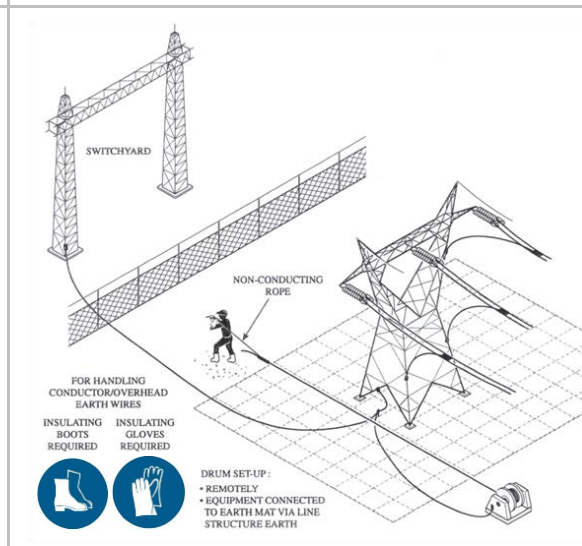
- (a) must be earthed (running or bonded).
- (b) drum must be set up at least 30 metres outside the switchyard fence.
- (c) must be pulled away from the switchyard.
- (d) termination must be attached to the first line structure outside the switchyard.



Method B

The conductor or earthwire:

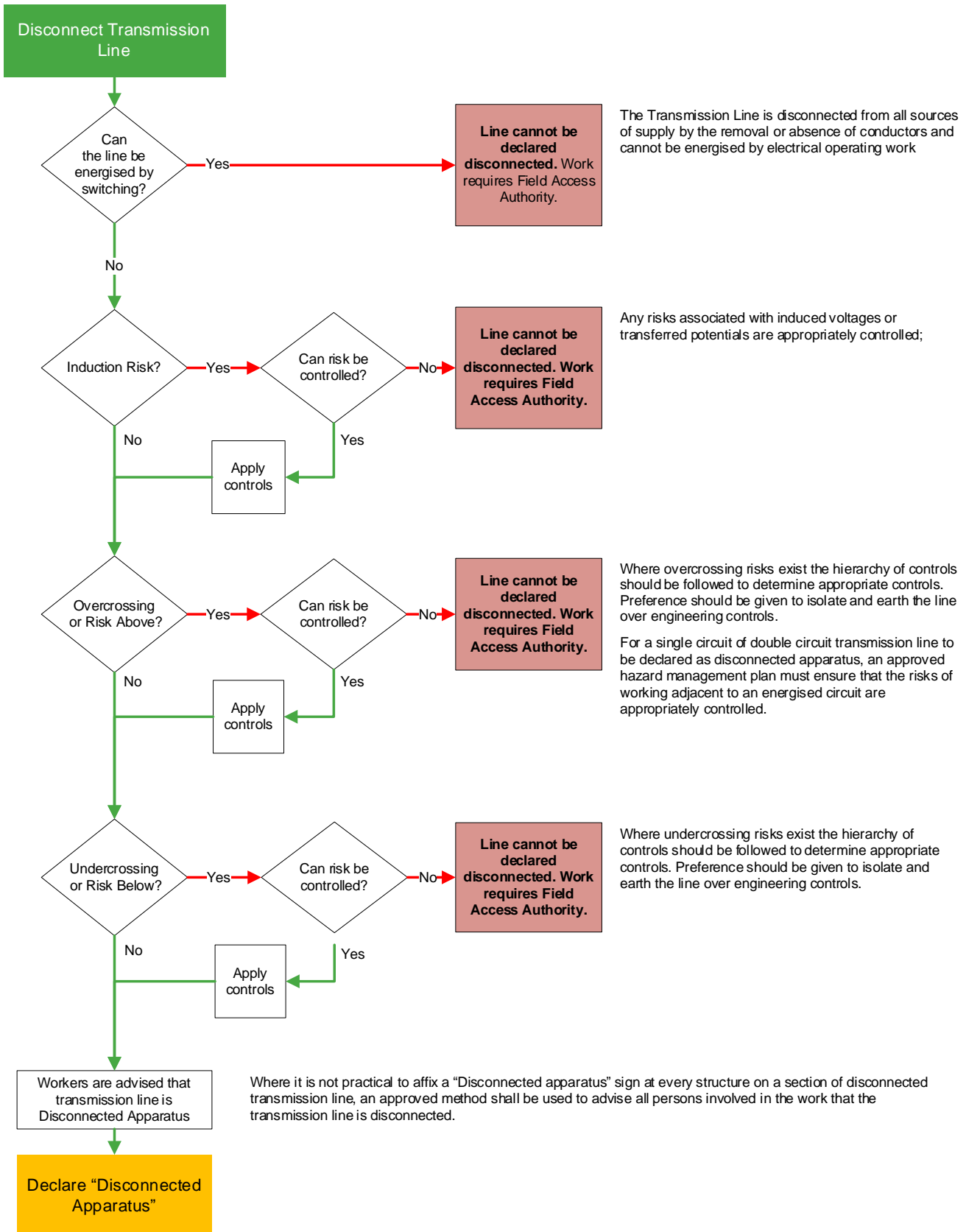
- (a) must be earthed (running or bonded).
- (b) drum must be set up remotely.
- (c) must be pulled towards and into the switchyard using a non-conducting rope (e.g. nylon) within the area extending 30 metres from the switchyard fence.
- (d) must be pulled into the switchyard manually.



Notes:

- (a) The connection and disconnection of jumpers is to be carried out using bridging processes.
- (b) All terminations to conductor or overhead earth wire made at ground level in the general vicinity of the landing spans are to be carried out under bonded work area conditions.
- (c) Stringing of each conductor or overhead earthwire must be carried out in such a way that neither the conductor nor the overhead earthwire contacts the switchyard earth grid whilst the conductor is being handled by persons outside the switchyard.
- (d) Where the profile of the terrain makes it impracticable to bond the first structure of the bonded work area to the switchyard earth-mat using a standard portable earthing lead, an overhead earthwire connection may be established as an alternative.

2.3. Process to Declare Disconnected



2.4. Connection of Disconnected Transmission lines

Prior to any disconnected Transmission Line being connected or reconnected to the Power System, a person authorised [Disconnect Transmission Lines](#) must confirm that:

- (a) All measures taken to identify the transmission line as disconnected apparatus are removed;
- (b) All necessary apparatus identification, warning signs, locks, fences, gates, etc., are in place;
- (c) [Advice](#) has been provided to all persons associated with the work that the Transmission Line is now in the charge of the Controller and an Access Authority is required for work on or near exposed conductors;
- (d) The Transmission Line is in a fit state to be connected to the Power System.

3. Disconnected Apparatus - Transmission Cables

3.1. Disconnection of Transmission Cables

Disconnected Transmission Cables made safe for work and excluded from the Access Authority requirements of the PSSR must be approved by a person authorised [Issue Cable Access Authority](#).

A Cable Testing Access Authority is not required when testing a disconnected Transmission Cable.

Disconnection of existing Transmission Cables is normally made for:

- Carrying out long-term activities, with the intent of returning the Transmission Cable to service on completion; or
- Dismantling the Transmission Cable for removal.

Once a Transmission Cable is declared Disconnected Apparatus, the sections of the disconnected Transmission Cable:

- Wholly outside substation boundaries may be approved safe for work to be undertaken by ordinary persons and excluded from the requirements of the PSSR.
- Located within a substation boundary may be made safe for work and excluded from the Access Authority requirements of the PSSR. All normal PSSR requirements for work in substations apply. These sections must be identified within a switchyard by enclosing the apparatus within a rigid fence:
 - (i) At least 1800mm high;
 - (ii) Connected to the substation earth grid in alignment to STD-859002;
 - (iii) With “Disconnected Apparatus” signs affixed at regular intervals facing outwards; and
 - (iv) Have secured entrances, with no more than one entrance open at a time.

Prior to a Transmission Cable being declared Disconnected, a person authorised [Issue Cable Access Authority](#) must ensure the following conditions are met:

- (a) The Transmission Cable is disconnected from all sources of electrical energy by the removal or absence of conductors and cannot be energised by electrical operating work;
- (b) Any risks associated with induced voltages or transferred potentials are appropriately controlled;
- (c) Any section of disconnected Transmission Cable to be worked upon does not and will not, during the course of the work, come on or near any other High Voltage exposed conductors;
- (d) Appropriate LV/MECH isolations have been carried out;
- (e) Exposed terminal connections of any Transmission Cable or line within the vicinity of the disconnected apparatus are identified.

3.2. Transmission Cable - Disconnected Apparatus Hazard Management Plan

Whilst the intent of disconnecting a Transmission Cable is to remove PSSR requirements related to Cable Access Authorities, it does not remove other hazards such as induced voltages and currents or transferred earth potentials.

Prior to declaring a Transmission Cable as disconnected apparatus a “Disconnected Apparatus Hazard Management Plan” must be developed to specify how the hazards in the table below will be managed for the duration of the work on the disconnected Transmission Cable and must outline who has responsibility for implementing the controls it lists.

Hazard	Requirements
Disconnection and Reconnection from the Network	How the process of disconnection and reconnection from the network will be managed and where the disconnection/reconnection will be.
Induced Voltages and Currents	An Electrical Engineer must assess hazard levels and advise controls to be implemented.
Transferred Earth Potentials	A chartered Electrical Engineer must assess hazard levels and advise controls to be implemented during disconnection or connection to substations.
Underground	Any risks associated with nearby services or other underground assets in the vicinity of the disconnected Transmission Cable and how these hazards will be controlled.
Other High Voltage	Confirm suitable clearances are available from transmission lines and other overhead conductors.
Sheath Earth and Sheath Earth Link Status	Define how status of the sheath earths and sheath earth links will be controlled.
Identification of Transmission Cable declared disconnected apparatus	This must describe the method which will be used to identify the disconnected Transmission Cable and associated equipment which are disconnected apparatus and how workers will be made aware of these arrangements.

3.2.1. Template

[Hazard management plan template](#) for working on a Transmission Cable as Disconnected Apparatus.

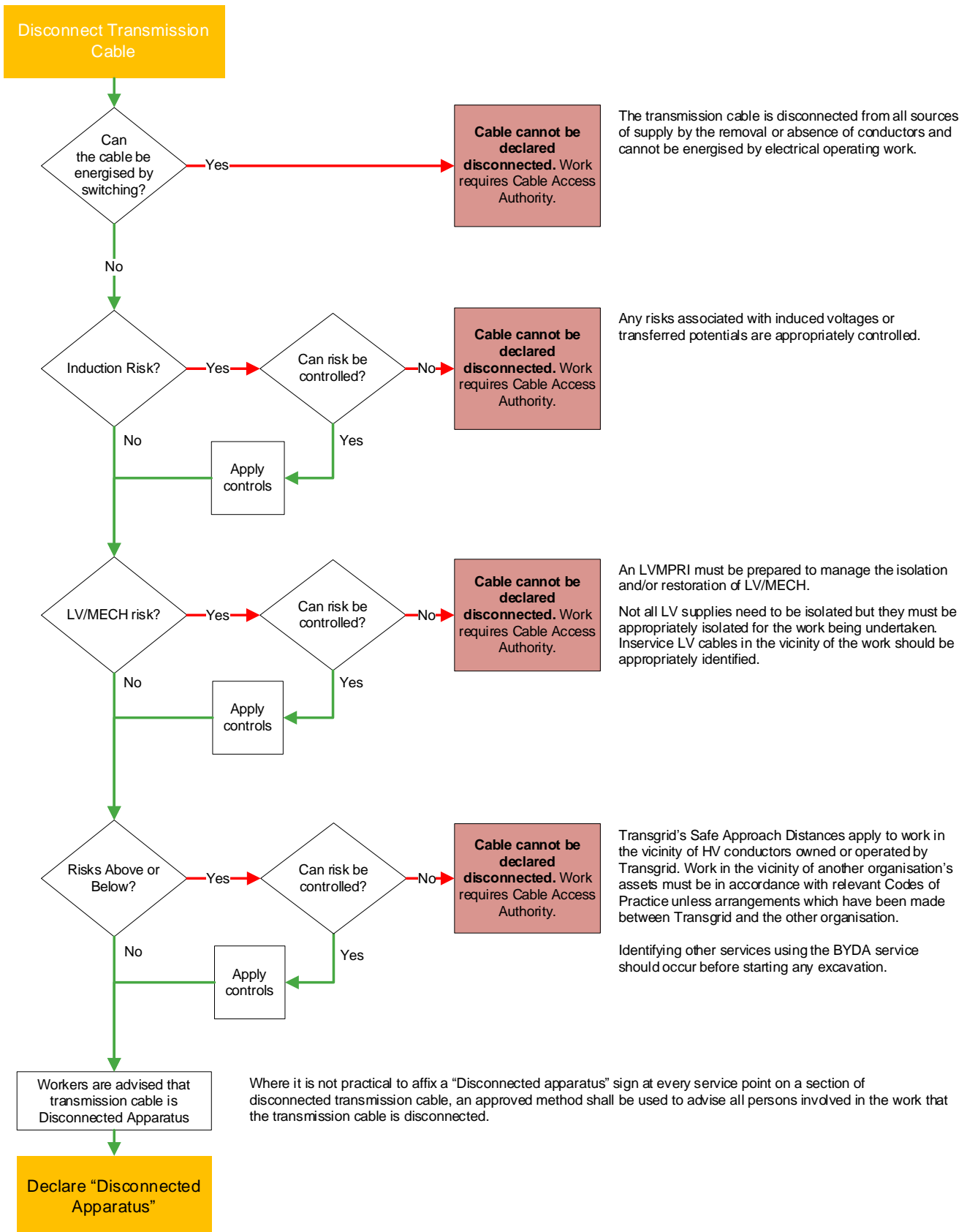
3.2.2. Transmission Cables which cross operational boundaries

Where a Transmission Cable has joint ownership, the physical disconnection must be made in the portion of the cable which is owned and managed by Transgrid.

3.2.3. Transmission Cables which cross substation boundaries

Where a Transmission Cable crosses a substation boundary, for the cable to be declared as disconnected apparatus, the substation apparatus/bay which it is connected to must also be declared as disconnected apparatus by a person authorised [Disconnect Substation HV Apparatus](#). A single hazard management plan may be prepared to encompass both the cable and substation apparatus areas.

3.3. Process to Declare Disconnected



3.3.1.1. Connection of Disconnected HV Cables

Prior to any disconnected Transmission Cable being connected or reconnected to the Power System, a person authorised [Issue Cable Access Authority](#) must ensure:

- (a) All measures taken to identify the Transmission Cable as disconnected apparatus are removed;
- (b) All necessary apparatus identification, warning signs, locks, fences, gates, etc., are in place;
- (c) [Advice](#) has been provided to all persons associated with the work that the Transmission Cable is now in the charge of the Controller and an Access Authority is required for work on or near exposed conductors.
- (d) The Transmission Cable is in a fit state to be connected to the Power System.

4. Assets Under Construction

Greenfield projects, including new transmission lines and cables are not required to be declared 'Disconnected Apparatus' and are normally constructed under the control of a Principal Contractor whose safety management system will be used for all aspects of safety during work on the sites under their control.

HV apparatus comes under the control of Transgrid's Controller when it is connected to a HV source. A new site will generally come under the PSSR for the first time just prior to work commencing on the Access Authority for making the first HV connection to the new site.

It may be necessary to make non-high voltage connections between assets under construction and assets under Transgrid's operational control prior to energisation. Any electrical connections (earthing, neutrals, etc.) between the new asset and Transgrid's in service asset should be avoided wherever possible. Electrical connections introduce a risk of transferred voltage hazards from the network to the assets under construction.

Where making an electrical connection is unavoidable, it is essential that the Principal Contractor of the asset under construction is aware of the risk introduced in making the connection, so they ensure suitable controls are in place to ensure the safety of the workers on the asset and workers making the connection.

Where an optical fibre connection is required for communications testing, the last section of the communications connection must be in non-metallic optical fibre to ensure electrical separation between the new asset and the in-service network.

4.1. Reversion to Assets Under Construction

Having the status of Disconnected Apparatus removes the need for Access Authorities. Other PSSR requirements may still apply to the Disconnected Apparatus.

In some circumstances it may be desirable to go beyond Disconnected Apparatus and remove all linkage to the Power System Safety Rules and hand control of the asset to a Principal Contractor for works to be performed. Such action will require consultation between the Principal Contractor and Transgrid to ensure clear delineation of responsibilities and clear communication of any remaining hazards. This will also necessitate clear communication to workers of both the Principal Contractor and Transgrid regarding the arrangements which will be put in place.

Change from previous revision

Revision no	Approved by	Amendment
1	J McMurtrie, GM/HSE	Significant revisions are highlighted in this version by a vertical red line. Links to external forms updated.



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