Operating Process for Access to Gas Insulated Switchgear

Summary

This document supports the Power System Safety Rules and its requirements assembled under Operate Gas Insulated Switchgear - Category 5.6

Document Control

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1. Overview

1.1. Purpose

This document provides approved procedures for Isolating and Earthing High Voltage GIS Equipment in accordance with the Power System Safety Rules – Category 5.6.

1.2. Policy Base

Document
Power System Safety Rules

1.3. Reference Documents

Document
Access for Work on High Voltage Apparatus

1.4. Scope

This document supports the Power System Safety Rules and its requirements assembled under Operate Gas Insulated Switchgear - Category 5.6Accountability

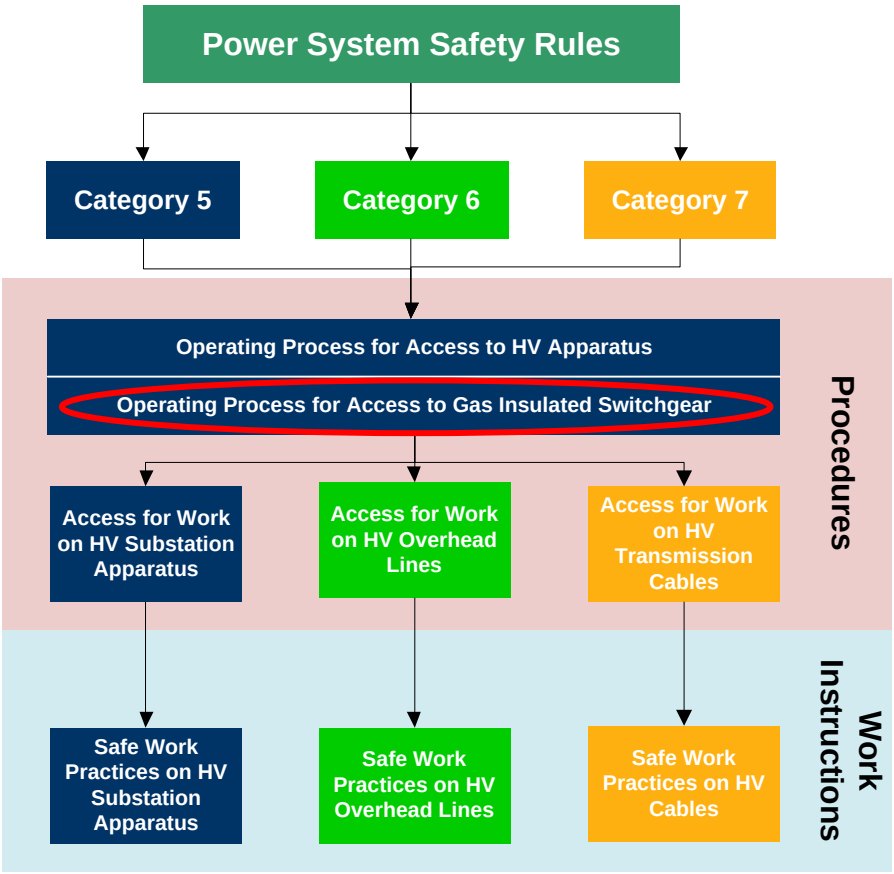
Responsible person	Responsibility
Manager/Health Safety and Environment	Ownership of this procedure
PSSR Manager	Maintenance of this procedure
Manager – Training	Implementation of training programs associated with this procedure
Authorised persons	Comply with this procedure

1.5. 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.

1.6. Document Location

Block diagram showing location of document in relation to others.



2. Making GIS Equipment Safe for Work

2.1. Power System Safety Rules Requirements

The Power System Safety Rules require that:

> **5.6.1 Making GIS Safe for Work**
>
> - For normal switching operations, GIS shall be operated remotely using the substation Human machine Interface (HMI) or other remote control facility; and
> - Manual operation of GIS for switching purposes shall not be considered when equipment is energised, as this will bypass all interlocking.

Normally GIS switchgear must be operated remotely. **Operation from the local control cubicle is not considered to be remote operation** therefore if remote operation is not possible then addition precautions are required as detailed in Section 2.4.

In addition to these requirements, all workers shall vacate the GIS hall during switching operations.

2.2. General Requirements

2.2.1. Electrical and Mechanical Safety features

Extensive interlocking is provided at GIS substations to inhibit the closing of an earth onto live High Voltage conductors. Safety may also be provided by three-position switches that are mechanically designed to prevent any individual phase from being in more than one state at any one time, i.e. a phase that switches to earth cannot physically also be in the closed position at the same time.

Characteristics of equipment specific to individual sites are provided in Appendix A.

2.2.2. Defeating of Interlocks during Operational Switching

Where the nature of the work requires the defeating of interlocks during operational switching Rules 5.6.8 and 5.6.9 of the Power System Safety Rules shall apply.

2.2.3. Defeating of Interlocks during work under an Access Authority

Following the issue of an access authority, defeat of interlocking on equipment under the work party's control as part of the access authority is permitted. Defeating of interlocking shall be performed by a person familiar with the operation of the equipment and the interlocks. In normal circumstances this would be a person authorised category 5.6. Interlocks defeated during the currency of the access authority must be restored prior to the cancellation of the access authority.

2.2.4. Preparation of Switching Instructions

The High Voltage Switching Instruction will not be written in a manner that prescribes remote or local operation for each step. This will assist the work where remote operation is unexpectedly unavailable. It will be the responsibility of the authorised person performing the switching to comply with the requirements of section 2.3 and 2.4 of this procedure.

Example switching sequences that are written in this style are provided in Appendix B.

2.2.5. Order of Switching Operations

All switching shall be carried out in accordance with all the normal rules and conventions except:

- Earths may be applied prior to isolating VT secondary circuits and will be the normal practice;
- Visual checking of individual switchgear status using the mechanical indication is not required.

Locking and tagging of apparatus shall be undertaken when convenient, rather than immediately after completing each individual operation. This is to allow the switcher to complete a number of remote operations before returning to the switchgear.

Note: For certain types of switchgear it is necessary to lock the isolators before closing the earths.

2.3. Making GIS Equipment Safe for Work using Remote Operation

Where Remote operation of GIS switchgear is available the requirements of this section apply.

An example switching sequence that complies with this procedure is provided in Appendix B.

2.3.1. Isolation

Isolation will be in accordance with Rule 5.6.2(a) of the Safety Rules. The switchgear position on the HMI satisfies the requirements of this rule.

2.3.2. Earthing

The application of HV Access Authority earths shall be in accordance with Rule 5.6.3 of the Power System Safety Rules. An approved earthing method shall be used that ensures:

- Earthing switches shall only be closed onto High Voltage conductors that are identified as de-energised from all sources by voltage and/or disconnector indication.
- Earthing switches may be applied to High Voltage conductors that are identified as de-energised if the earth is already in place and is being extended to other conductors by the closure of a circuit breaker.

2.3.3. Securing the Isolation and Earthing

This is to be done on the switchgear level by locking / tagging effective points of isolation in their open positions and locking / tagging effective earthing switches in their closed positions

2.4. Making GIS Equipment Safe to Work where Local operation is required

When there is no capability to operate the GIS equipment remotely or the remote capability is not functioning then Rule 5.6.6 of the Power System Safety Rules applies. The additional safety precautions applicable in such circumstances are as follows:

2.4.1. Isolation

The indication of the switchgear position must be established **visually**, either directly or by using appropriate cameras. The gas pressure must also be confirmed as satisfactory.

2.4.2. Earthing

There are no additional requirements when earthing locally.

3. Definitions

Nil

4. Change history

Revision no	Approved by	Amendment
0	EGM/Network Services & Operations	Superseded document GD HS G3 001, Procedure updated and restructured to include: - Beaconsfield North and Beaconsfield South 132kV GIS (including renaming of the Procedure) - Correction to EnergyAustralia references - References to current version of the Power System Safety Rules
1	Ken McCall, Manager/Health Safety and Environment	Procedure updated to include Holroyd and Rookwood Rd GIS Inclusion of section to cover defeating of interlocks during maintenance activities
2	Ken McCall, Manager/Health Safety and Environment	All significant new additions and alterations to Revision 1 have been highlighted in this version by a red vertical sidebar. Editorial changes (where the intent has not been changed) have not been highlighted. The following has also been changed: - Scope revised to be generic to GIS sites; - Duplication of PSSR requirements removed; - Section 2.1 - Section 2.3.2 revised
3	David Donehue, Acting Manager/Health, Safety and Environment	Section 2.2.3 updated to clarify that defeating of interlocks when equipment is under access authority is acceptable for activities not limited solely to maintenance and clarifies the correct person to defeat the interlocks.

5. Monitoring and Review

The Manager/Health Safety and Environment 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 online assessments;

(b) Where a change has occurred in our processes; and

(c) Recommendations arising from incidents.

6. Appendix A: Equipment Features at TransGrid GIS Substations

6.1. Haymarket 132kV GIS

The 132kV GIS at Haymarket is totally enclosed, three phase encapsulated SF_6 insulated with the following features:

- All High Voltage switching operations can be carried out from the substation control room as well as from the local control panels on the equipment floor. It is only necessary to go to the equipment floor for switching purposes to carry out low voltage/mechanical isolations to render equipment inoperable, to apply locks and to apply tags.
- The disconnector/earthing switches are three position switches. They are essentially a rotating switch that has the states closed / open / earthed, but they are polarised in that only one side of the switch can be earthed. The mechanical design of the switch prevents any phase being in the closed and earthed position simultaneously.
- A self-checking system is provided on the three-position switches to monitor drive motor current; if the current is outside the normal operating range, the system renders the switch inoperable and alarms the unhealthy condition. This is designed to detect mechanical problems such as failure of the drive shaft between phases that could result in (say) 2 phases being in the earthed position and 1 phase being in the closed position.
- Fault-making high speed earthing switches on all cables (line side of line disconnector only) and on all transformers (transformer side of transformer disconnector only).
- Non fault-making earthing switches in all 3-position switches and on all 132kV bus sections.
- The electrical interlock system consists of hardwiring between auxiliary contacts at the GIS and is separate from the substation control system. A mal-operation of the substation control system will not affect the GIS interlocking system.

  The interlocking is functional for both local and remote electrical operation. **Manual operation of the devices over-rides all interlocking**. Manual operation facilities are intended and designed for maintenance purposes only, after isolation and earthing has been completed. Manual operation facilities are neither intended nor designed to be used for High Voltage switching purposes.

  The electrical interlock system incorporates the following design philosophy:

  - Earthing switch operation is inhibited unless all of the associated disconnectors are open
  - Earthing switch operation is inhibited when the equipment to be earthed is energised. For cables and bus sections three phase VT secondary voltages are used for this check.
  - Disconnector operation is inhibited when the disconnector is under load, unless there are two other local parallel circuits closed.
  - Disconnector operation is inhibited from applying an earth to an unearthed section of switchgear.
  - Circuit breaker close operation is inhibited when associated disconnectors are in transit.
  - The position of the equipment is determined by the use of auxiliary contacts connected to the operating shaft.
- Mechanical status indication is available on the front panel of all device operating mechanisms. Due to the physical arrangement of the GIS this will not be visible on all circuit breakers.
- Viewing of contact position is provided on all disconnectors and earthing switches via windows fitted to the GIS chambers using fixed or portable cameras depending on accessibility of the window. The camera view can be difficult to interpret and the ongoing reliability of the cameras and optical fibre cabling has not been warranted by the manufacturer.

- Proving de-energised facilities have been provided adjacent to all earthing switches using capacitive coupling to detect High Voltage. Due to the extremely limited accessibility of some of these points, coaxial cables have been used to provide access to them for operating purposes. The ongoing reliability of the fixed coaxial cables provided for proving de-energised equipment has not been warranted by the manufacturer.
- Explosion venting has been designed such that the GIS may be operated safely from the local control panel.

6.2. Haymarket 330kV GIS

Totally enclosed Gas Insulated Switchgear (GIS) is used at Haymarket 330/132kV Substation for 330kV transformer bays and the 330kV cable 42 to Sydney South substation.

The 330kV GIS at Haymarket is totally enclosed, single phase encapsulated SF_6 insulated with the following features:

- All High Voltage switching operations can be carried out from the substation control room as well as from the local control panels on the equipment floor. It is only necessary to go to the equipment floor for switching purposes to carry out low voltage/mechanical isolations to render equipment inoperable, to apply locks and to apply tags.
- Disconnectors and non-fault making earthing switches have a single motorised operating mechanism per three-phase set.
- High-speed fault making earthing switches have a single motorised operating mechanism per phase and may be operated individually.
- A self-checking system is provided on each disconnector and earthing switch drive, to monitor drive motor current; if the current is outside the normal operating range, the system renders the switch inoperable and alarms the unhealthy condition. This is designed to detect mechanical problems such as failure of the drive shaft between phases that could result in (say) 2 phases being in the open position and 1 phase being in the closed position.
- Fault-making high-speed earthing switches are directly connected to 42 cable and each transformer. All other earthing switches are not fault-making.
- The electrical interlocking system consists of hardwiring between auxiliary contacts at the GIS and is separate from the substation control system. A mal-operation of the substation control system will not affect the GIS interlocking system.

  The General De-Interlocking key switch at the local control panel overrides all interlocking for switchgear in that bay. Interlocking functions shall be active for all High Voltage switching purposes.

  The electrical interlocking system is functional for both local and remote electrical operation. **Manual operation of the devices overrides all interlocking**. Manual operation facilities are intended and designed for maintenance purposes only, after isolation and earthing has been completed. Manual operation facilities are neither intended nor designed to be used for High Voltage switching purposes.

  The electrical interlocking system incorporates the following design philosophy:

  - Earthing switch operation is inhibited unless all of the associated disconnectors are open, including on the 132kV side of the transformer for transformer earthing switches.
  - Disconnector operation is inhibited when the associated circuit breaker is closed.
  - Disconnector operation is inhibited from extending an earth to an unearthed section of switchgear.
  - Circuit breaker close operation is inhibited when associated disconnectors are in transit.
  - The position of the equipment is determined by the use of auxiliary contacts driven by the operating shaft.
- Mechanical status indication is available at each phase of all equipment and is readily visible.

- Viewing of contact position is provided on all disconnectors and earthing switches via windows fitted to the GIS chambers using portable cameras. Viewing of the contacts using the naked eye is not recommended due to the proximity to some windows of moving, external linkages of the operating mechanism.
- There is no provision for proving de-energised on the 330kV GIS.
- The local control panels are located several metres from the switchgear.
- Explosion venting has been designed such that the GIS may be operated safely from the local control panel.

6.3. Beaconsfield South and Beaconsfield North 132kV GIS

The 132kV GIS at Beaconsfield South and Beaconsfield North substations is totally enclosed, three phase encapsulated SF_6 insulated with the following features:

- All High Voltage switching operations can be carried out from the substation control room as well as from the local control panels on the equipment floor. It is only necessary to go to the equipment floor for switching purposes to carry out low voltage/mechanical isolations to render equipment inoperable, to apply locks and to apply tags.
- The disconnector/earthing switches are three position switches. They consist of a single plunger that can only move lengthwise – one direction moving it towards the earthing position, the other direction moving it towards the isolator closed position. The mechanical design of the switch prevents any phase being in the closed and earthed position simultaneously.
- A mal-operation on the three-position switches is indicated on the control system by being in the Intermediate position. The interlocking system ensures that further operation of this equipment is not possible if it is in the intermediate position. This status indicator is available on the substation control system.
- Fault-making high speed earthing switches are on:
    - all cables (line side of line disconnector only)
    - all transformers (transformer side of transformer disconnector only).
    - All bus section connections (bus side of isolators only)
- Non fault-making earthing switches in all 3-position switches and on all 132kV bus sections.
- The electrical interlock system consists of hardwiring between auxiliary contacts at the GIS and is separate from the substation control system. A mal-operation of the substation control system will not affect the GIS interlocking system.

  The position of the equipment is determined by the use of auxiliary contacts connected to the operating shaft.

  The interlocking is functional for both local and remote electrical operation. **Manual operation of the devices over-rides all interlocking**, blocking operation of all equipment that is dependent on its state. Manual operation facilities are intended and designed for maintenance purposes only after isolation and earthing has been completed. Manual operation facilities are neither intended nor designed to be used for High Voltage switching purposes.

  The electrical interlock system incorporates the following design philosophy:

  (a) For Line/Cable bays:

  - Earthing switch operation is inhibited unless all of the associated disconnectors are open
  - Line Earthing switch operation is inhibited when the equipment to be earthed is energised. Three phase VT secondary voltages are used for this check.
  - Bus earthing switch operation is inhibited unless all sources of supply are isolated
  - Circuit breaker close operation is inhibited when associated disconnectors are in transit or in an intermediate state

- Cable bay Isolators are inhibited from operation unless all bay Earth Switches are open

(b) For Bus Couplers and bus section connectors :

- Earthing switch operation is inhibited unless all of the associated disconnectors are open
- Circuit breaker close operation is inhibited when associated disconnectors are in transit or in an intermediate state.
- Cable bay Isolators are inhibited from operation unless both coupler Earth Switches are open.

- Mechanical status indication is available on the Local Control Cubicle. The status of all HV equipment that can be operated and the HV equipment on which its operation depends (according to the interlocks) is available from the Substation Control System.
- Viewing of contact position is provided on all disconnectors and earthing switches via windows fitted to the GIS chambers using portable cameras and light sources.
- Specific Proving de-energised facilities have not been provided. The only indicators are:
  - Visual indication via the windows;
  - Electrical indication at the substation level (No Volts/No Current); and
  - Use of VT Secondaries and/or HVDS system where fitted.
- Explosion venting has been designed such that the GIS may be operated safely from the local control panel.

6.4. Holroyd 330kV GIS

Totally enclosed Gas Insulated Switchgear (GIS) is used at Holroyd 330/132kV Substation for 330kV transformer bays, the 330kV lines 1C and 1F to Sydney West substation and the 330kV Cables 43 and 44 to Rookwood Rd.

The 330kV GIS at Holroyd is totally enclosed, single phase encapsulated SF_6 insulated with the following features:

- All High Voltage switching operations can be carried out from the substation control room as well as from the local control panels on the equipment floor. It is only necessary to go to the equipment floor for switching purposes to carry out low voltage/mechanical isolations to render equipment inoperable, to apply locks and to apply tags.
- Disconnectors and non-fault making earthing switches have a single motorised operating mechanism per three-phase set.
- High speed fault making earthing switches have a single motorised operating mechanism per three phase set.
- A self-checking system is provided on each disconnector and earthing switch drive, to monitor drive motor current; if the current is outside the normal operating range, the system renders the switch inoperable and alarms the unhealthy condition. This is designed to detect mechanical problems such as failure of the drive shaft between phases that could result in (say) 2 phases being in the open position and 1 phase being in the closed position.
- Fault-making high-speed earthing switches are directly connected to:
  - No.1 and No.2 330/132kV transformers (ESw 5410, 5420)
  - 1F and 1C 330kV lines (ESw 1C0, 1F0)
  - 43 and 44 330kV cables (ESw 430, 440)
  - No.1 Capacitor (ESw 5710)
  - 5X1 Spare Bay (ESw 5X10)
  - Bus Sections – Earthing Switches 5110, 5120, 5130, 5140.

All other earthing switches are not fault-making.

- The electrical interlocking system consists of hardwiring between auxiliary contacts at the GIS and is separate from the substation control system. A mal-operation of the substation control system will not affect the GIS interlocking system.

  The General De-Interlocking key switch at the local control panel overrides all interlocking for switchgear in that bay. Interlocking functions shall be active for all High Voltage switching purposes.

  The electrical interlocking system is functional for both local and remote electrical operation. Manual operation of the devices overrides all interlocking. Manual operation facilities are intended and designed for maintenance purposes only, after isolation and earthing has been completed. Manual operation facilities are neither intended nor designed to be used for High Voltage switching purposes.

  The electrical interlocking system incorporates the following design philosophy:

  - Earthing switch operation is inhibited unless all of the associated GIS disconnectors are open. This does not include the 132kV side of the transformer for transformer earthing switches.
  - Disconnector operation is inhibited when the associated circuit breaker is closed.
  - Circuit breaker close operation is inhibited when associated disconnectors are in transit.
  - The position of the equipment is determined by the use of auxiliary contacts driven by the operating shaft.
- Mechanical status indication is available on a single phase only per three phase set and is readily visible.
- Viewing of contact position is provided on all disconnectors and earthing switches via windows fitted to the GIS chambers where accessible. Viewing of the contacts using the naked eye is not recommended due to the proximity to some windows of moving, external linkages of the operating mechanism.
- There is no provision for proving de-energised on the 330kV GIS.
- The local control panels are located a few metres from the switchgear.
- Explosion venting has been designed such that the GIS may be operated safely from the local control panel.
- Local locking and tagging of a disconnector is required after opening of a disconnector and prior to closing an adjacent earthing switch.

6.5. Rookwood Rd 330kV GIS

Totally enclosed Gas Insulated Switchgear (GIS) is used at Rookwood Rd 330/132kV Substation for 330kV transformer bays, the 330kV cables 43 and 44 to Holroyd substation, and No. 4 Reactor Bay.

The 330kV GIS at Rookwood Rd is totally enclosed, single phase encapsulated SF_6 insulated with the following features:

- All High Voltage switching operations can be carried out from the substation control room as well as from the local control panels on the equipment floor. It is only necessary to go to the equipment floor for switching purposes to carry out low voltage/mechanical isolations to render equipment inoperable, to apply locks and to apply tags.
- Disconnectors and non-fault making earthing switches have a single motorised operating mechanism per three-phase set.
- High speed fault making earthing switches have a single motorised operating mechanism per three phase set.
- A self-checking system is provided on each disconnector and earthing switch drive, to monitor drive motor current; if the current is outside the normal operating range, the system renders the switch inoperable and alarms the unhealthy condition. This is designed to detect mechanical problems such as failure of the drive shaft between phases that could result in (say) 2 phases being in the open position and 1 phase being in the closed position.
- Fault-making high-speed earthing switches are directly connected to:
  - No.1, No.2 and No.3 330/132kV transformers (ESw 5410, 5420, 5430)

- 43 and 44 330kV cables (ESw 430, 440)
- No.4 Reactor (ESw 5940/1)
- Bus Sections – Earthing Switches 5110, 5110/1, 5130, 5130/1.

All other earthing switches are not fault-making.

- The electrical interlocking system consists of hardwiring between auxiliary contacts at the GIS and is separate from the substation control system. A mal-operation of the substation control system will not affect the GIS interlocking system.

  The General De-Interlocking key switch at the local control panel overrides all interlocking for switchgear in that bay. Interlocking functions shall be active for all High Voltage switching purposes.

  The electrical interlocking system is functional for both local and remote electrical operation**. Manual operation of the devices overrides all interlocking**. Manual operation facilities are intended and designed for maintenance purposes only, after isolation and earthing has been completed. Manual operation facilities are neither intended nor designed to be used for High Voltage switching purposes.

  The electrical interlocking system incorporates the following design philosophy:

  - Earthing switch operation is inhibited unless all of the associated GIS disconnectors are open. This does not include the 132kV side of the transformer for transformer earthing switches.
  - Disconnector operation is inhibited when the associated circuit breaker is closed.
  - Circuit breaker close operation is inhibited when associated disconnectors are in transit.
  - The position of the equipment is determined by the use of auxiliary contacts driven by the operating shaft.
- Mechanical status indication is available on a single phase only per three phase set and is readily visible.
- Viewing of contact position is provided on all disconnectors and earthing switches via windows fitted to the GIS chambers where accessible. Viewing of the contacts using the naked eye is not recommended due to the proximity to some windows of moving, external linkages of the operating mechanism.
- There is no provision for proving de-energised on the 330kV GIS.
- The local control panels are located a few metres from the switchgear.
- Explosion venting has been designed such that the GIS may be operated safely from the local control panel.
- Local locking and tagging of a disconnector is required after opening of a disconnector and prior to closing an adjacent earthing switch.

6.6. Rookwood Rd 132kV GIS

The 132kV GIS at Rookwood Rd substation is totally enclosed, three phase encapsulated SF_6 insulated with the following features:

- All High Voltage switching operations can be carried out from the substation control room as well as from the local control panels on the equipment floor. It is only necessary to go to the equipment floor for switching purposes to carry out low voltage/mechanical isolations to render equipment inoperable, to apply locks and to apply tags.

- The disconnector/earthing switches are three position switches. They consist of a single plunger that can only move lengthwise – one direction moving it towards the earthing position, the other direction moving it towards the isolator closed position. The mechanical design of the switch prevents any phase being in the closed and earthed position simultaneously.
- A mal-operation on the three-position switches is indicated on the control system by being in the Intermediate position. The interlocking system ensures that further operation of this equipment is not possible if it is in the intermediate position. This status indicator is available on the substation control system.
- Fault-making high speed earthing switches are on:
    - all lines, cables and reactor bays (line side of line disconnector only)
    - all transformers (transformer side of transformer disconnector only).
    - All bus section connections (ESw 4110, 4110/2, 4120, 4120/2, 4130, 4130/2). They are not 3 position switches.
- All other Earthing Switches are not fault-making earthing switches.
- The electrical interlock system consists of hardwiring between auxiliary contacts at the GIS and is separate from the substation control system. A mal-operation of the substation control system will not affect the GIS interlocking system.

  The position of the equipment is determined by the use of auxiliary contacts connected to the operating shaft.

  The interlocking is functional for both local and remote electrical operation. **Manual operation of the devices over-rides all interlocking**, blocking operation of all equipment that is dependent on its state. Manual operation facilities are intended and designed for maintenance purposes only after isolation and earthing has been completed. Manual operation facilities are neither intended nor designed to be used for High Voltage switching purposes.

  The Interlocking system prevents the simultaneous operation of apparatus, and will block the operation of other HV equipment if the status of any monitored HV equipment is in an intermediate position.

  The electrical interlock system incorporates the following design philosophy:

  (a) For Transformer bays:

  - Transformer Earthing switch operation is inhibited when the transformer is not isolated on the 132kV and 330kV side.

  (b) For Line bays:

  - Earthing switch operation is inhibited unless all of the adjacent disconnectors are open
  - Bus earthing switch operation is inhibited unless all sources of supply are isolated
  - Circuit breaker close operation is inhibited when associated disconnectors are in transit or in an intermediate state

  (c) For Bus Couplers:

  - Earthing switch operation is inhibited unless all of the associated disconnectors are open
  - Circuit breaker close operation is inhibited when associated disconnectors are in transit or in an intermediate state.
  - Line bay Isolators are inhibited from operation unless both coupler Earth Switches are open.
- Mechanical status indication is available on all CB's, Disconnectors and earthing switches. The status of all HV equipment that can be operated and the HV equipment on which its operation depends (according to the interlocks) is available from the Substation Control System.
- Viewing of contact position is provided on all disconnectors and earthing switches via windows fitted to the GIS chambers using portable cameras and light sources.
- Specific Proving de-energised facilities have not been provided. The only indicators are:

- Visual indication via the windows;
- Electrical indication at the substation level (No Volts/No Current); and
- Use of VT Secondaries and/or HVDS system where fitted.

➢ Explosion venting has been designed such that the GIS may be operated safely from the local control panel.

6.7. Taree GIS

TBA

6.8. Orange GIS

TBA

6.9. Sapphire GIS

TBA

6.10. Appendix B: Example Switching Sequences

6.11. Haymarket 132kV GIS - Feeder Bay Equipment Only (9SC feeder)

Refer to Haymarket HVOD diagram HYM 809067.

The following switching sequence is an example that applies the principles for isolation and earthing when using remote or local operation of switchgear. Manual operation is prohibited.

It is assumed that the feeder and both bus sections will remain energised during an outage of the bay equipment.

Note that there are no integral earthing and short-circuiting equipment with adequate fault making capacity within the area to be isolated so the requirements of Sections 2.3.2 and 2.4.2 apply.

All local and remote operations are common except those specifically stated as “Local Operation” or “Remote Operation”.

Switching to Isolate and Earth

Operative step	Operating function	Secondary action and explanation
	OFF-LOAD 9SC	
Open CB 9SC2		Use CB status indication
	ISOLATE AND EARTH	
Open Disc 9SC5		**Local Operation** : Ensure visible break exists **Remote Operation** : Use disconnector status indication to check change of status
Open Disc 9SC6		**Local Operation** : Ensure visible break exists **Remote Operation** : Use disconnector status indication to check change of status
Open Disc 9SC1		**Local Operation** : Ensure visible break exists **Remote Operation** : Use disconnector status indication to check change of status
	Check open CB 9SC2	Use CB status indication
Close E/S 9SC0/2	(Note 1)	Use earthing switch status indication to check change of status
Close CB 9SC2	(Note 2)	Use CB status indication to check change of status
Close E/S 9SC0/A3	(Note 3)	Use earthing switch status indication to check change of status
Close E/S 9SC0/B3	(Note 3)	Use earthing switch status indication to check change of status
	Normal condition on completion of PRI	
All three isolation points are now considered confirmed and earths have been applied		

Notes:

(a) Earthing switch 9SC0/2 may be closed because the HV conductors are indicated as de- energised from the:

- busbars by bus disconnector indication (or visible break if operating locally), and
- cable by cable disconnector indication (or visible break if operating locally).

Following closure of this earthing switch, earths are considered to have been applied to the conductors between the line disconnector and the circuit breaker. If the line disconnector had not opened successfully the interlocking would have prevented the earths from being applied. The mechanical design of the 3-position switch prevents any one phase from being in the closed and earthed positions simultaneously.

(b) Closing circuit breaker 9SC2 extends the earths from E/S 9SC0/2 up to the isolation points at 9SC5 and 9SC6. This confirms that bus disconnectors 9SC5 and 9SC6 are open on the conductors that 9SC0/2 has earthed. The isolation points 9SC5 and 9SC6 are now considered confirmed.

(c) Either earthing switch 9SC0/A3 or 9SC0/B3 may be closed because the open conditions of 9SC6 and 9SC5 have already been confirmed (de-energised from the busbars) and Disc 9SC1 is indicated as open (de-energised from the cable).

Secure the Isolation and Earthing This is to be done on the switchgear level by securing the three position switches 9SC1, 9SC5 and 96C6 in their open positions and securing earthing switches 9SC0/2, 9SC0/A3 and 9SC0/B3 in their closed positions

Access to three position switches 9SC1, 9SC5 and 9SC6 is not provided in the above switching sequence and therefore the manual operation of the switches is not available and the locks provided on the manual operation points shall remain intact with appropriate tags applied. Electrical operation of all 3-position switches shall be disabled in the local control cubicle by the opening of links and application of tags.

Prepare the Area for Access Authority Issue

If earths are required to be removed to enable testing of the above equipment, high voltage access to the 3-position switch will need to be requested or (and more likely) the external earth connections to the GIS may be removed. These shall only be removed under testing high voltage access conditions.

6.12. Haymarket 132kV GIS - Feeder Only (9SC feeder)

Refer to Haymarket HVOD diagram HYM 809067.

The following switching sequence is an example that applies the principles for isolation and earthing when using remote or local operation of switchgear.

This switching sequence assumes that the feeder will be offloaded by TransGrid, isolated at the remote end by AusGrid, then isolated and earthed by TransGrid and finally earthed by AusGrid.

Note: All checks of isolation shall be performed using ALL three phases.

All local and remote operations are common except those specifically stated as “Local Operation” or “Remote Operation”

Switching to Isolate and Earth

Operative step	Operating function	Secondary action and explanation
	OFF-LOAD 9SC	
Open CB 9SC2		Use CB status and current indications to ensure off-load
Request AusGrid to Isolate 9SC feeder within their system	AusGrid are required to isolate the transmission line from all sources of supply within their system using a procedure acceptable to TransGrid.	
Receive clearance from AusGrid that 9SC feeder is isolated within their system		
	ISOLATE AND EARTH	
Open Disc 9SC1	(Note 1)	**Local Operation** : Ensure visible break exists **Remote Operation** : Use disconnector status indication to check change of status
	Check feeder de-energised	Use feeder voltage indication
Open CB 9SC2	(Note 2)	Use CB status indication to check change of status
Close E/S 9SC0	(Note 3)	Use earthing switch status indication to check change of status

NOTES:

(a) The effectiveness of the 9SC1 point of isolation is confirmed by:

- The switch position indication (or visible break if operating locally),

(b) Circuit breaker 9SC2 may be left in either the open or closed position as far as this procedure is concerned.

(c) Earthing switch 9SC0 is an integral earthing and short-circuiting device with adequate fault making capacity. Earthing switch 9SC0 may be closed because the HV conductors are indicated as de- energised from the:

- Busbars by disconnector indication or visible break; and
- Transmission line by the isolation clearance from AusGrid

Secure the Isolation and Earthing This is to be done on the switchgear level by securing the three position switch 9SC1 in the open position, securing earthing switch 9SC0 in the closed position and isolating the feeder CVT.

Access to three position switch 9SC1 is not provided in the above switching sequence and therefore the manual operation of the switch is not available and the locks provided at the manual operation point shall remain intact with appropriate tags applied. Electrical operation of the 3-position switch and earthing switch shall be disabled in the local control cubicle by the opening of links and application of tags.

Advise AusGrid that the transmission line is isolated and earthed.

This switching sequence only provides access to the transmission line, if access is required to the TransGrid bay equipment further isolation and earthing steps will be required.

6.13. Haymarket 330kV GIS - Bay Equipment Only (CB 5412A)

Refer to Haymarket HVOD diagram HYM 809067.

The following switching sequence is an example that applies the principles for isolation and earthing when using remote or local operation of switchgear. All checks of isolation shall be performed using ALL three phases.

This example assumes that the No.1 and No.3 transformers will remain energised during an outage of the bay equipment.

All local and remote operations are common except those specifically stated as “Local Operation” or “Remote Operation”

Switching to Isolate and Earth

Operative step	Operating function	Secondary action and explanation
	OFF-LOAD CB5412A BAY	
Open CB 5412A		Use CB status + current indications to ensure off-load
	ISOLATE AND EARTH	
Open Disc 5417	(Note 1)	**Local Operation** : Ensure visible break exists **Remote Operation** : Use disconnector status indication to check change of status
Open Disc 5437		**Local Operation** : Ensure visible break exists **Remote Operation** : Use disconnector status indication to check change of status
Close E/S 5410/A2	(Note 2)	Use earthing switch status indication to check change to closed status
Close E/S 5410/A3		Use earthing switch status indication to check change to closed status

NOTES:

(a) The effectiveness of the 5417 and 5437 points of isolation are confirmed by:

- The switch position indication (or visible break if operating locally),

(b) Earthing switches 5410/A2 and 5410/A3 are integral earthing and short-circuiting devices with adequate fault making capacity. Earthing switch 5410/A2 may be closed because the HV conductors are indicated as de-energised from:

- No.3 Tx by disconnector indication or visible break, and
- No.1 Tx by disconnector indication or visible break.

Secure the Isolation and Earthing This is to be done on the switchgear level by securing the disconnectors 5417 and 5437 in their open positions and securing earthing switches 5410/A2 and 5410/A3 in their closed positions.