Work on Disconnected Apparatus

Summary

"Disconnected Apparatus" is a term used to refer to High Voltage Equipment which is not electrically connected to the high voltage network. It refers equally to equipment that has been connected previously and new installations.

This document supports the Power System Safety Rules and its requirements assembled under 'Disconnected Apparatus Category 5, Category 6 and Category 7.

This document applies to all persons working on Disconnected Apparatus.

Document Control

Revision no:	2	**HP TRIM no:**	D2013/05806	**Approval/ Review date:**	20/1/20
Business function:	Manage Health And Safety			**Document type:**	Corporate Work Instruction
Process owner:	Head of HSE				
Related Procedure/s:	Power Systems Safety Rules				
Author:	Kitchener Morris, PSSR Manager				
Reviewers:	Megan Calvert, HSE Systems Manager				
Approver:	Krista-Lee Fogarty, Head of HSE				

Contents

1. Overview 3

1.1 Purpose 3

1.2 Policy Base 3

1.3 Reference Documents 3

1.4 Scope 3

1.5 Accountability 3

1.6 Document Location 4

2. Introduction 4

3. Disconnected Apparatus - HV Substation Equipment 5

3.1 General Requirements for Making HV Equipment Disconnected Apparatus 5

3.2 Making Existing Substation Equipment “Disconnected Apparatus” 7

3.3 Installing New Substation Equipment as “Disconnected Apparatus” 8

3.4 Work That Can Be Carried Out on Disconnected Apparatus 8

3.5 Transition from “Disconnected Apparatus” to “HV Apparatus in the Charge of a Controller” 9

3.5.1 Equipment Entering Service 9

3.5.2 Equipment Not Entering Service 10

4. Disconnected Apparatus - Overhead Lines 10

4.1 General Requirements for Making Overhead Lines “Disconnected Apparatus” 10

4.2 Making Existing Overhead Lines “Disconnected Apparatus” 12

4.3 Making New Overhead Lines “Disconnected Apparatus” 13

4.4 Connecting “Disconnected Apparatus” (Overhead Lines) 13

5. Disconnected Apparatus - HV Cables 14

5.1 General Requirements for Making High Voltage Cables “Disconnected Apparatus” 14

5.2 Making Existing HV Cables “Disconnected Apparatus” 15

5.3 Making New HV Cables “Disconnected Apparatus” 16

5.4 Connecting “Disconnected Apparatus” (HV Cables) 16

6. Change history 17

7. Implementation 18

8. Monitoring and Review 18

9. Attachments 18

1. Overview

1.1 Purpose

This document supports the Power System Safety Rules and its requirements assembled under 'Disconnected Apparatus Category 5, Category 6 and Category 7. The document describes safe work practices for the control of hazardous situations.

1.2 Policy Base

Document No.	Document
D2012/15325	Power System Safety Rules

1.3 Reference Documents

Document No.	Document
D2004/10689	Safe Work Practices on HV Overhead Lines
D2005/01698	Safe Work Practices on HV Cables
D2012/07707	Safe Work Practices on HV Substation Apparatus
	High Voltage Network Alterations – Operational Requirements

1.4 Scope

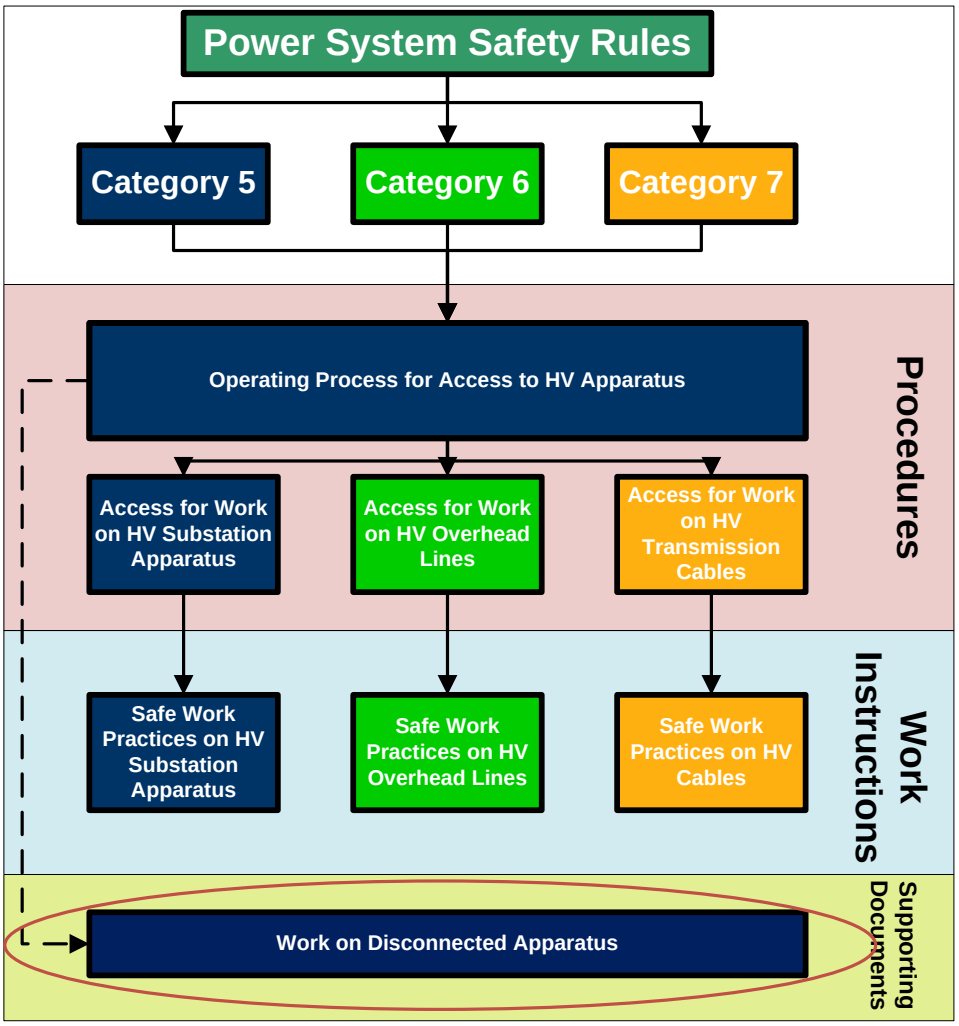
This standard applies to work practices on all Disconnected Apparatus.

1.5 Accountability

Responsible person	Responsibility
Head of HSE	Maintenance and ownership of this standard
Mgr – Training	Implementation of training programs associated with this standard
Authorised persons	Comply with this standard

1.6 Document Location

Block diagram showing location of document in relation to others.



2. Introduction

Work on high voltage equipment can be undertaken in two ways:-

1. Under an appropriate Access Authority
2. As “Disconnected Apparatus”.

This document is concerned with the second category and explains the process for:

- making equipment Disconnected Apparatus;
- working on Disconnected Apparatus; and
- re-establishing equipment when it is no longer required to be considered Disconnected Apparatus.

3. Disconnected Apparatus - HV Substation Equipment

3.1 General Requirements for Making HV Equipment Disconnected Apparatus

For work within a substation, the necessary conditions for equipment to be considered Disconnected Apparatus are given in section 5.5.3 of the Power System Safety Rules.

This flow diagram shows the process to be followed in order to determine whether a section of a HV switchyard can be considered “disconnected apparatus”. This means that the substation-specific hazards can be appropriately controlled. **It does not mean that all hazards can be removed**, so it is still necessary to carry out appropriate pre-work risk assessments.

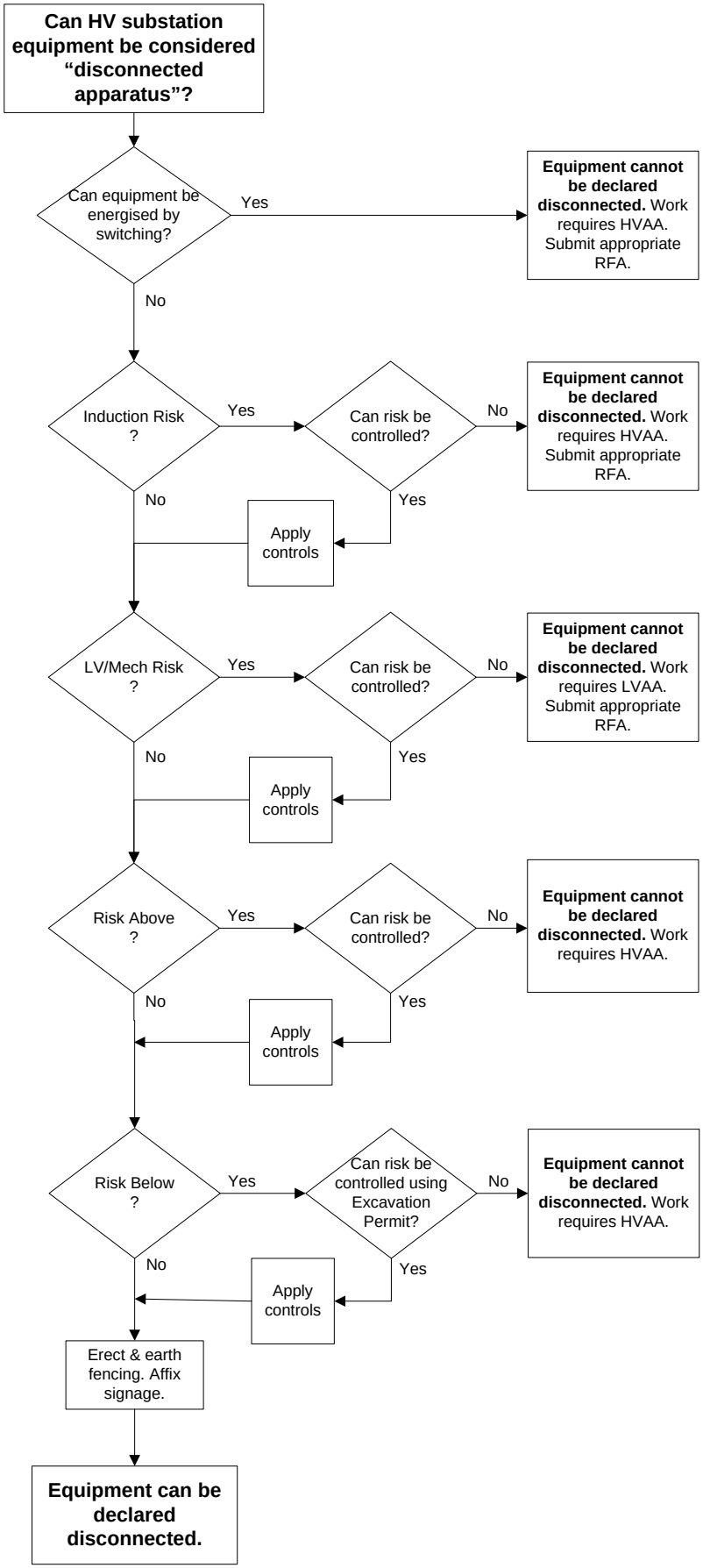
Within a substation, Disconnected Apparatus shall be surrounded by an appropriately earthed man-proof fence. Details for the fence are included as Attachment 1..

A checksheet for establishing HV substation equipment as Disconnected Apparatus is included as Attachment 2, which is to be completed by a person authorised category 5.5. Any control measures which apply (e.g. no vertically-extendable equipment, no mechanical excavations) shall be included on this sheet and included as part of the briefing given to instructed persons.

Once the checksheet is completed, it shall be placed in a waterproof cover and attached to the fence adjacent to the entrance, together with an excavation permit if required.

Work may be carried out within the fenced area by persons authorised cat 3.3, or instructed persons. The normal requirement for instructed persons to be supervised by someone authorised category 5.2 still applies, but the level of supervision required for this work (within the fenced area) could be substantially less than that required for work within the remainder of the substation. In practice, this requirement could usually be satisfied by delivering a daily briefing to all persons working in the area, confirming that the extent of the work and the method of working comply with the terms of the Disconnected Apparatus. The person supervising would need to be immediately contactable if any changes to the planned work occurred and must remain on site at all times.

Note that work by ordinary persons is not permitted.



5.5.3 (a) The *HV apparatus* is disconnected from all sources of *HV* electrical energy by the removal or absence of *conductor*s and cannot be *energised* by *electrical operating work*;

Note that LV sources that could energise HV equipment (e.g. the low voltage side of a Voltage Transformer) must also be physically disconnected to satisfy this requirement. The removal of links or fuses is **not sufficient.**

5.5.3 (b) Any risks associated with induced *voltage*s or transferred potentials are appropriately controlled;

Where adjacent in-service equipment could cause induction, appropriate controls would normally include bonding of longer components to a common earthing point prior to assembly.

5.5.3 (d) Appropriate *Low Voltage* or *mechanical isolations* have been carried out;

A LVMPRI should be prepared to manage the isolation of any LV supplies.
Note: this does not mean that all LV supplies have been removed. They are appropriately isolated for the purpose of the work being undertaken. Any live LV cables in the vicinity of the work should be appropriately marked.

5.5.3 (c) There is no possibility of coming on or *near* the *HV exposed conductors* of other *HV electrical apparatus*

Are there overhead or adjacent live conductors? If so, this constitutes "risk above". If any of the work could infringe safe clearances (e.g. by the use of vertically-extendable equipment) this means that the equipment **cannot** be considered "disconnected" and must be worked on using a HV Access Authority.
Note that in this context a Safety Observer is not an appropriate control measure . Devices to physically limit the vertical extent of the equipment would be required.

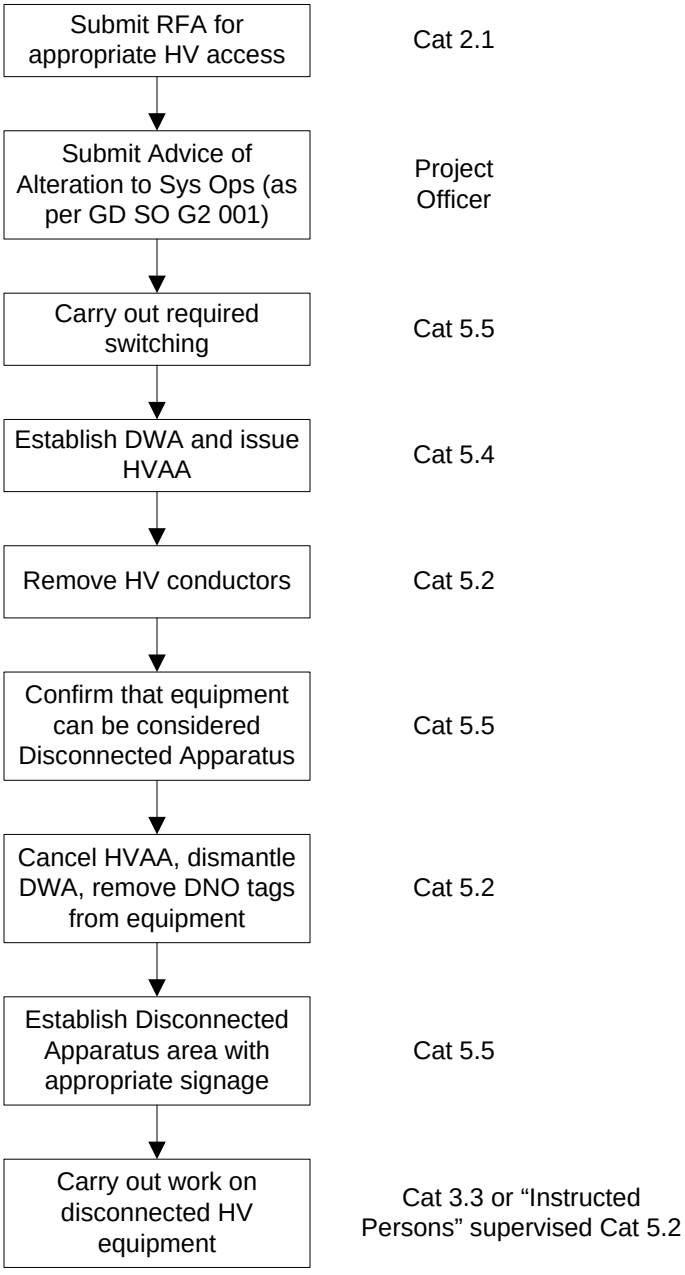
Does the work go below ground level (e.g. involve mechanical excavation)? If so, this constitutes "risk below". Before commencing the excavation, an Excavation Permit must be completed. If this positively establishes that there is no risk of damage to underground services or the earth grid, or that any risk can be adequately controlled before the commencement of work (e.g. by bridging the earth grid) then it is permissible to declare the equipment as "disconnected".

3.2 Making Existing Substation Equipment "Disconnected Apparatus"

Existing substation equipment can be made Disconnected Apparatus for two reasons:-

- Carrying out a major maintenance activity (with the intent of returning the equipment to service on completion); and
- Dismantling the equipment for removal from site.

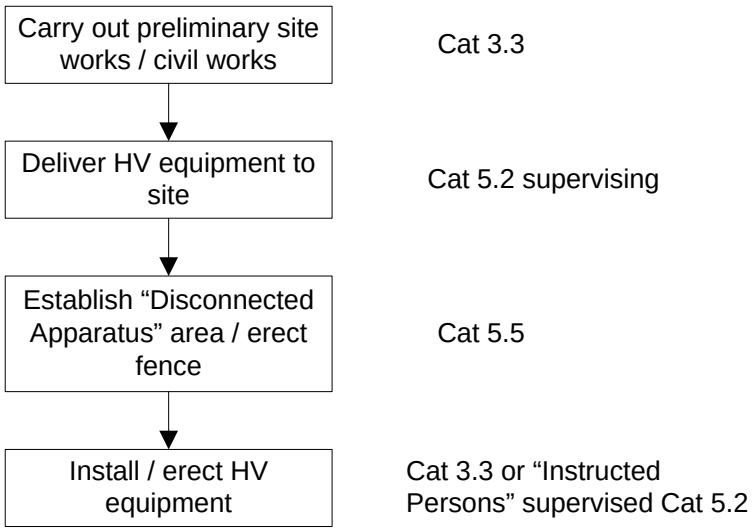
This flow chart explains the process for establishing existing equipment as Disconnected Apparatus:-



If the equipment is to be decommissioned and removed from site, then this can be carried out after the final step under the supervision of a person authorised cat 5.2, after which the fence can be removed.

3.3 Installing New Substation Equipment as “Disconnected Apparatus”

Installing new HV equipment within a substation will normally be done as Disconnected Apparatus. Work should typically be staged as described in this flow chart:-



If desired, it is acceptable to erect the fence earlier in the work sequence as a safety barrier whilst the civil works are carried out (provided it is appropriately earthed). However, the “Disconnected Apparatus” signs should only be affixed once the HV equipment has been delivered.

3.4 Work That Can Be Carried Out on Disconnected Apparatus

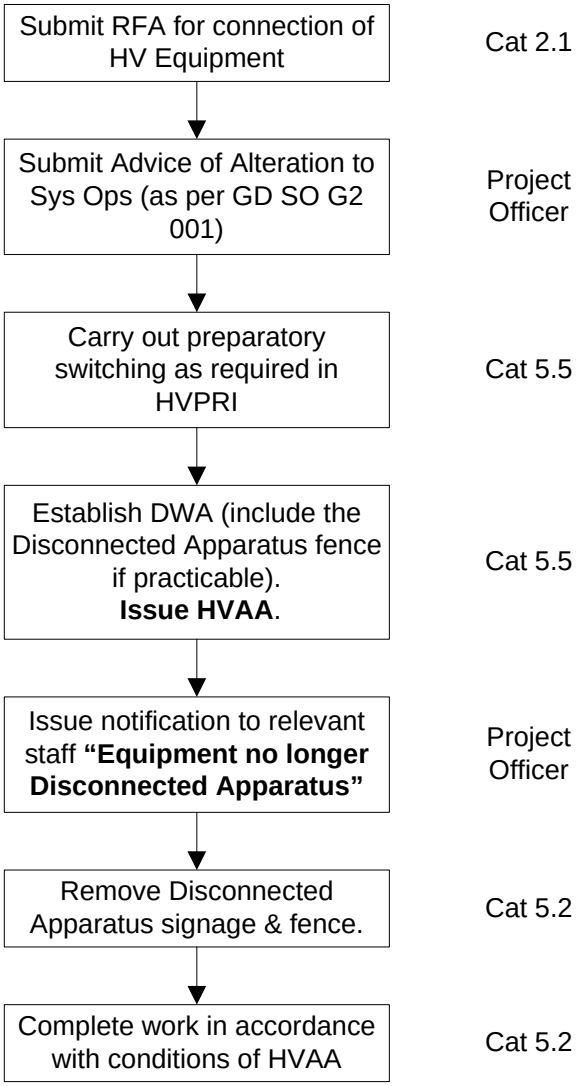
All work shall comply with the control measures stipulated on the Disconnected Apparatus check sheet. During the latter stages of installation work, it would be expected that LV supplies would be required to carry out testing etc. Any such supplies must be clearly identified and all staff made aware that live supplies have been brought into the area. This is the responsibility of the site supervisor (authorised Cat 5.2).
Control cabling capable of sending data through to the the Controller can also be commissioned, but the Controller must be advised. Where possible, such cabling should be isolated to reduce the occurrence of nuisance alarms. This is the responsibility of the site supervisor (authorised Cat 5.2).
High Voltage testing, where required, shall be carried out in accordance with the PSSR, para 5.3.1 (“Testing Disconnected HV Apparatus”) under the direction of a person authorised Cat 5.3.

3.5 Transition from "Disconnected Apparatus" to "HV Apparatus in the Charge of a Controller"

Once the work on the Disconnected Apparatus is completed, the equipment will either be entering service or will be remaining physically disconnected (pending some further works).

3.5.1 Equipment Entering Service

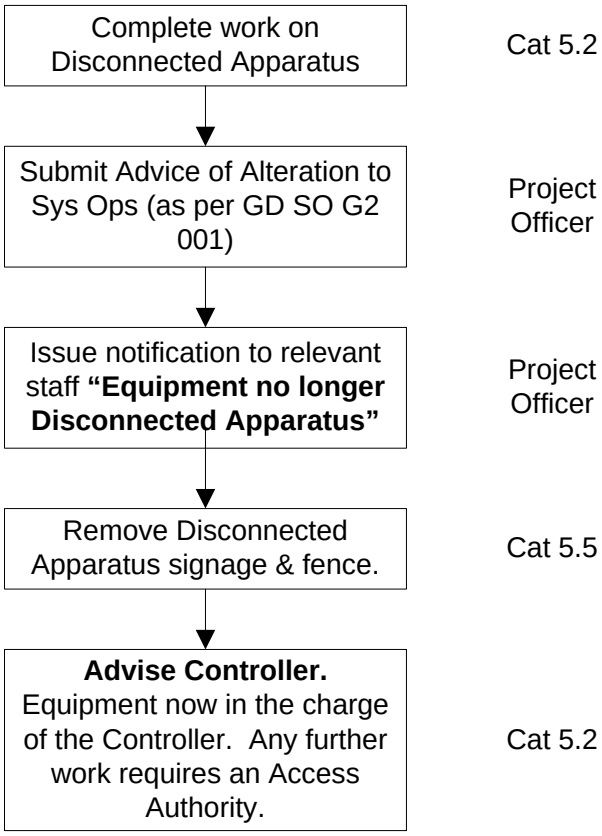
If the equipment is entering service, work will reach a stage when it can no longer be considered Disconnected Apparatus. Prior to this point being reached, a HV Access Authority is required:-



Note the requirement to establish the DWA outside the Disconnected Apparatus fence if practicable. This means that the fence can be removed under the control of the Access Authority, so that it is apparent to all staff that the equipment is always either Disconnected Apparatus or requires a HVAA for work.

3.5.2 Equipment Not Entering Service

If the equipment is not entering service immediately but will no longer be worked on as Disconnected Apparatus, it must be returned to the charge of the controller and no further work carried out unless under a HV Access Authority.



The advice to staff is extremely important, especially when a project team have been allowed full access previously and could believe the equipment to still be disconnected from the HV network.

4. Disconnected Apparatus - Overhead Lines

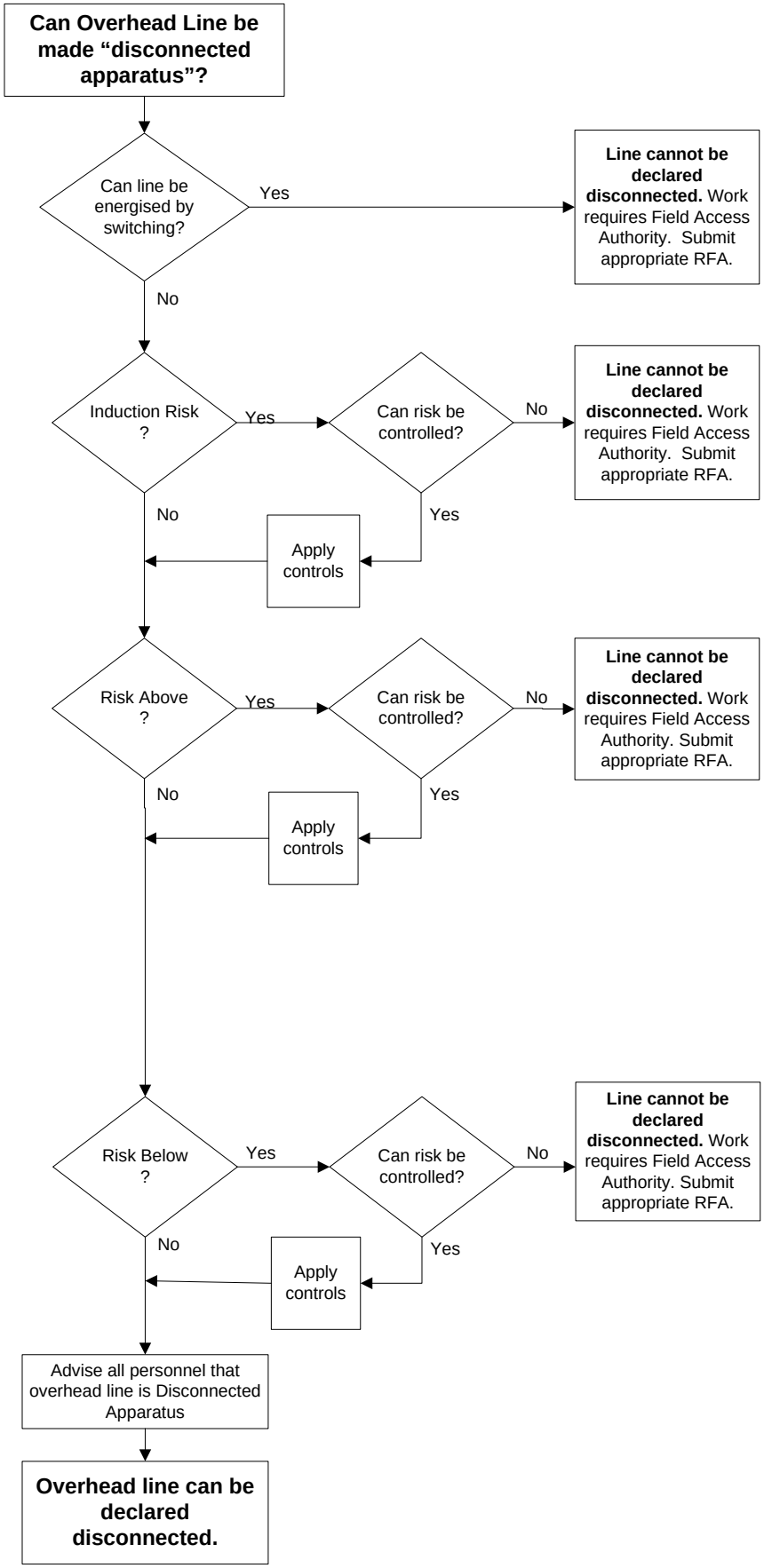
4.1 General Requirements for Making Overhead Lines "Disconnected Apparatus"

For work on overhead lines (outside a substation), the requirements for being considered Disconnected Apparatus are given in section 6.5.3 of the Power System Safety Rules.

This flow diagram shows the process to be followed in order to determine whether an overhead line can be considered "disconnected apparatus". This means that the high voltage hazards can be appropriately controlled. **It does not mean that all hazards can be removed**, so it is still necessary to carry out appropriate pre-work risk assessments.

A checksheet for establishing overhead lines as Disconnected Apparatus is included as Attachment 3, which is to be completed by a person authorised category 6.5. Any control measures which apply shall be included on this sheet and included as part of the briefing given to the work party.

Once an overhead line is established as Disconnected Apparatus, it can be worked on by Ordinary Persons.



6.5.3 (a) The *Overhead Line* is disconnected from all sources of electrical energy by the removal or absence of *conductor*s and cannot be *energised* by *electrical operating work*;

6.5.3 (b) Any risks associated with induced *voltage*s or transferred potentials are appropriately controlled;
6.5.3 (e) For a double circuit overhead line both circuits shall meet the requirements of this rule (i.e. it is not possible for just one circuit to be regarded as disconnected).

6.5.3 (c) There is no possibility of coming on or near the HV exposed conductors of other HV electrical apparatus;
6.5.3 (d) Any section of overhead line not electrically connected to be worked upon does not and will notm during the course of the work, come hear any high voltage exposed conductors

Are there live overcrossings or conductors in the vicinity of the work? If so, this constitutes "risk above". If any of the work could possibly infringe safe clearances (e.g. by the use of vertically-extendable equipment) this means that the equipment **cannot** be considered "disconnected" and must be worked on using a Field Access Authority.
Note that in this context a Safety Observer is not an appropriate control measure. Devices to physically limit the vertical extent of the equipment would be required.

6.5.3 (c) There is no possibility of coming on or near the HV exposed conductors of other HV electrical apparatus;

Are there live undercrossings which the line could possibly fall onto during the course of the work? If yes, then some control measure (e.g. hurdles) must be put in place before the line can be considered "disconnected". If this is not possible then the work must be conducted under a Field Access Authority (with undercrossings taken out of service).

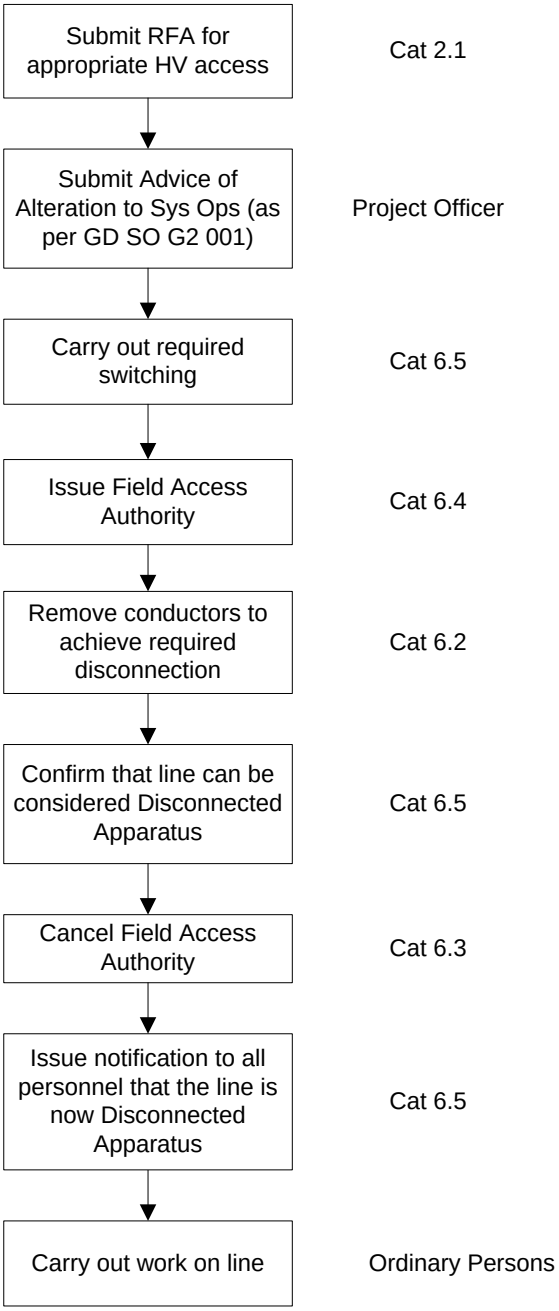
4.2 Making Existing Overhead Lines “Disconnected Apparatus”

Existing overhead lines can be made Disconnected Apparatus for two reasons:-

> Carrying out a major maintenance activity (with the intent of returning the line to service on completion); and

> Dismantling the line for removal.

This flow chart explains the process for establishing existing overhead lines as Disconnected Apparatus:-



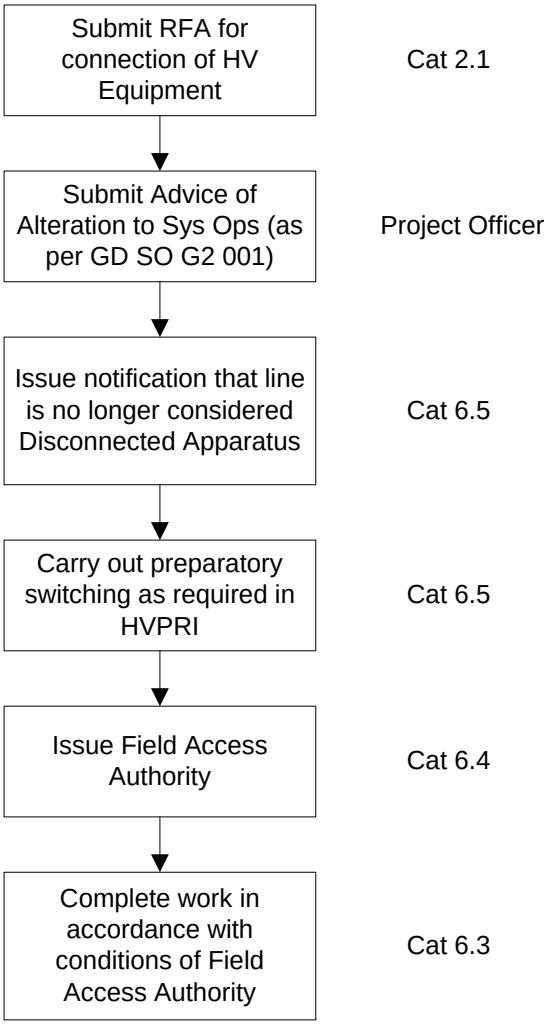
Note that reference to “ordinary persons” is only in the context of high voltage safety; all personnel should be appropriately authorised for working at heights etc.

4.3 Making New Overhead Lines “Disconnected Apparatus”

It is envisaged that all new overhead lines will be constructed using the principles of “disconnected apparatus”, with appropriate caution applied to over and undercrossings. Due to the nature of the work, it is not required to formally make the line under construction “disconnected apparatus”, but the broader principles should be used to assess the work method proposed.

4.4 Connecting “Disconnected Apparatus” (Overhead Lines)

Once the work on the “Disconnected Apparatus” overhead line is completed, the following flow chart explains the process for reconnecting the equipment:-



5. Disconnected Apparatus - HV Cables

5.1 General Requirements for Making High Voltage Cables "Disconnected Apparatus"

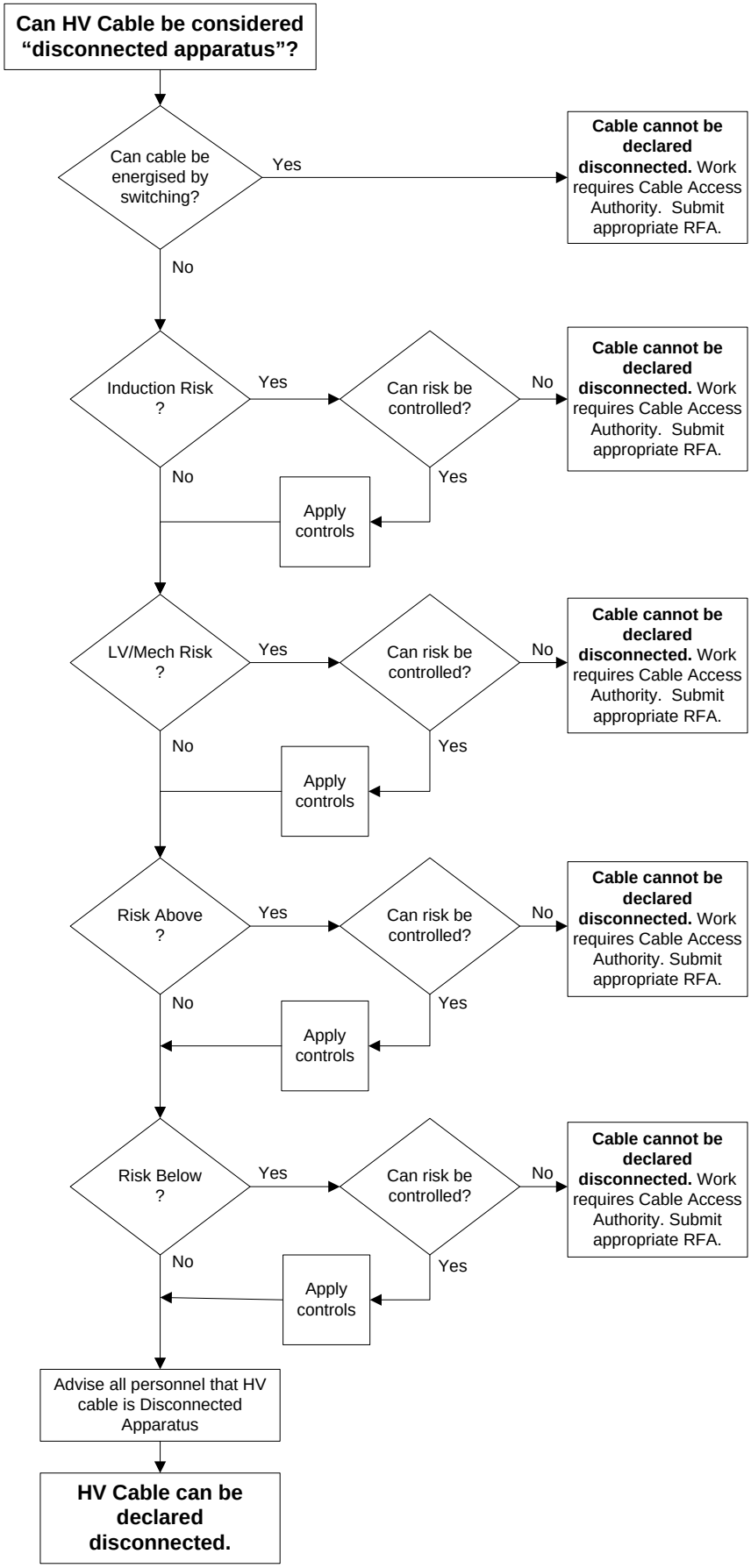
For work on underground HV cables, the requirements for being considered Disconnected Apparatus are given in section 7.5.5 of the Power System Safety Rules.

This flow diagram shows the process to be followed in order to determine whether a HV cable can be considered "disconnected apparatus". This means that the high voltage hazards can be appropriately controlled. **It does not mean that all hazards can be removed**, so it is still necessary to carry out appropriate pre-work risk assessments.

A checksheet for establishing HV cables as Disconnected Apparatus is included as Attachment 4, which is to be completed by a person authorised category 7.5. Any control measures which apply shall be included on this sheet and included as part of the briefing given to the work party.

Once a HV Cable line is established as Disconnected Apparatus, it can be worked on by Ordinary Persons outside a substation.

If it is required to make a section of HV cable disconnected apparatus within a substation, then it must comply with **both Disconnected Apparatus - HV Substation Equipment** (sect. 4) **and Disconnected Apparatus - HV Cables.**



7.5.5 (a) The *HV Cable* is disconnected from all sources of electrical energy by the removal or absence of *conductor*s and cannot be *energised* by *electrical operating work*;

7.5.5 (b) Any risks associated with induced *voltage*s or transferred potentials are appropriately controlled;

7.5.5 (d) Appropriate *Low Voltage* and *mechanical isolations* have been carried out

7.5.5 (c) There is no possibility of coming on or *near* the *High Voltage exposed conductors* of other *High Voltage electrical apparatus.*

Are there live conductors in the vicinity of the work? If so, this constitutes "risk above". If any of the work could possibly infringe safe clearances (e.g. by the use of vertically-extendable equipment) this means that the cable **cannot** be considered "disconnected". The associated live overhead conductors must be must be taken out of service using a Field Access Authority, which must be cross-referenced to the Cable Access Authority.

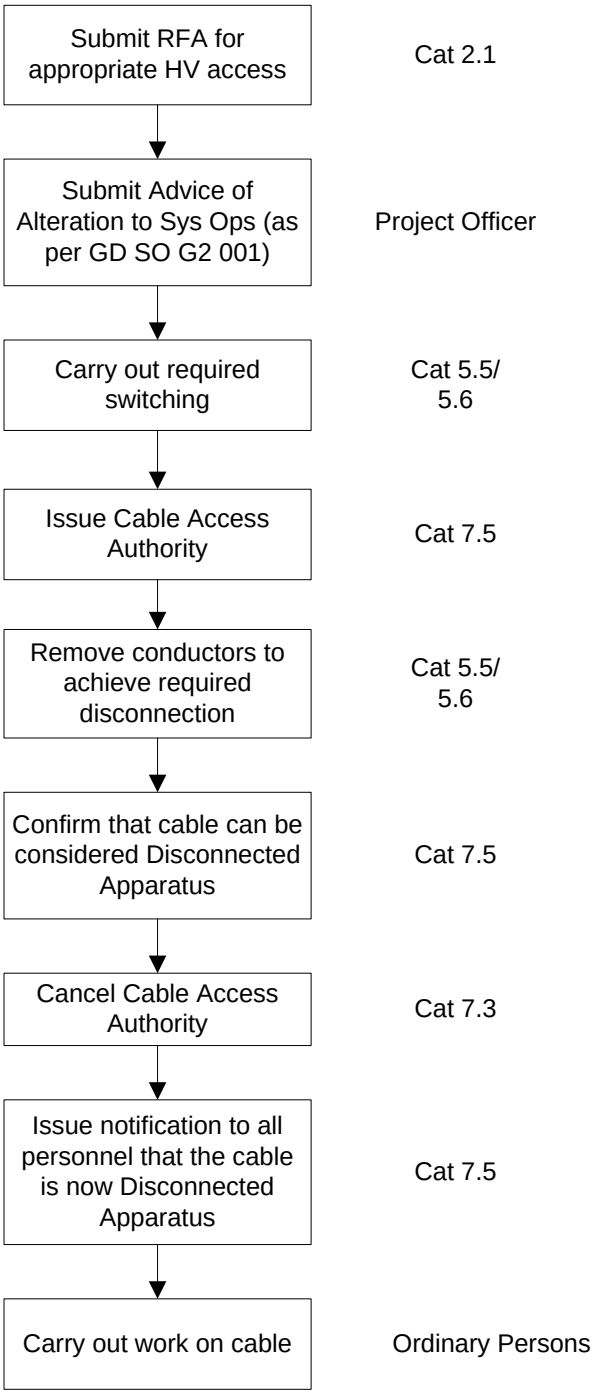
Are there any other sources of high or low voltage in the vicinity of the cable? Will the work involve mechanical excavations? These risks must be controlled in the usual manner (dial-before-you-dig etc.)

5.2 Making Existing HV Cables "Disconnected Apparatus"

Existing HV cables can be made Disconnected Apparatus for two reasons:-

> Carrying out a major maintenance activity (with the intent of returning the cable to service on completion); and
> Permanently decommissioning the cable.

This flow chart explains the process for establishing an existing cable as Disconnected Apparatus:-

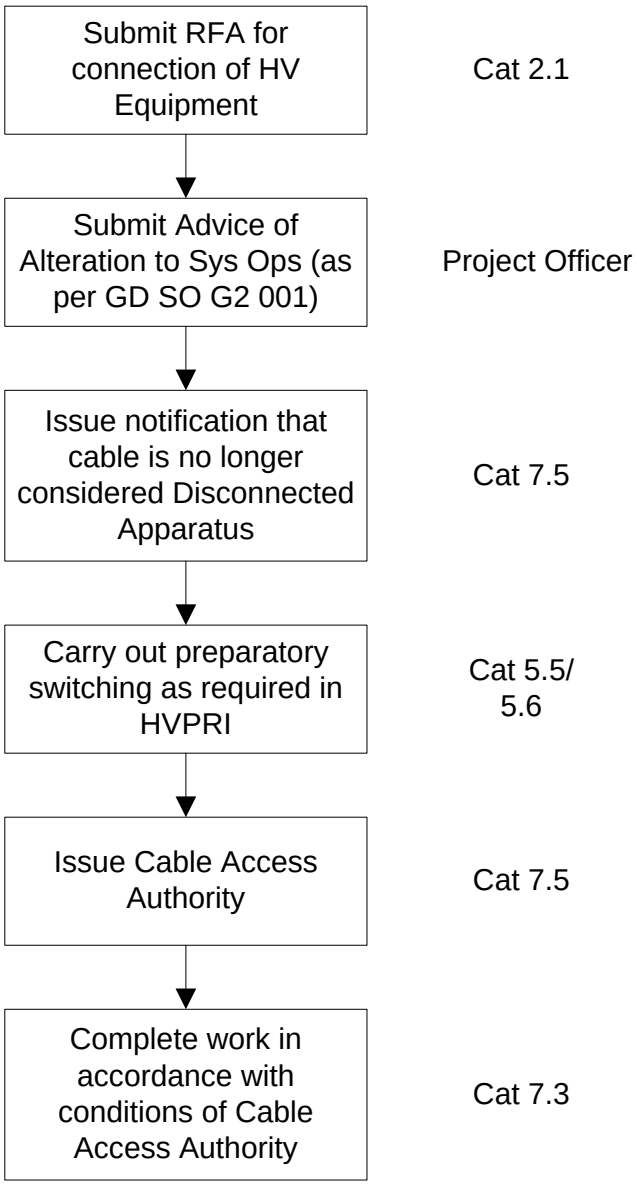


5.3 Making New HV Cables "Disconnected Apparatus"

It is envisaged that all new HV cables will be constructed using the principles of "disconnected apparatus", using appropriate risk management methodology. Due to the nature of the work, it is not required to formally make the cable under construction "disconnected apparatus", but the broader principles should be used to assess the work method proposed.

5.4 Connecting "Disconnected Apparatus" (HV Cables)

Once the work on the "Disconnected Apparatus" HV cable is completed, the following flow chart explains the process for reconnecting the equipment:-



6. Change history

Revision no	Approved by	Amendment
0	L Smyth	Revision 0 New Work Instruction
1	D Donehue, Acting Manager/HSE	Minor changes to procedure include updating position titles
2	Krista-Lee Fogarty, Head of HSE	Work instruction updated to a new template

7. Implementation

This procedure is part of a package of documents explaining how to implement the Power System Safety Rules. It will be included as part of the training for persons authorised to the level required to declare equipment Disconnected Apparatus.

8. 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;

(b) Where a process change has occurred; and

(c) Recommendations arising from incidents.

9. Attachments

Appendix A - Fencing Requirements for Disconnected Apparatus in a Substation

Appendix B - Establishing HV Equipment as Disconnected Apparatus

Appendix C - Establishing Overhead Line as Disconnected Apparatus

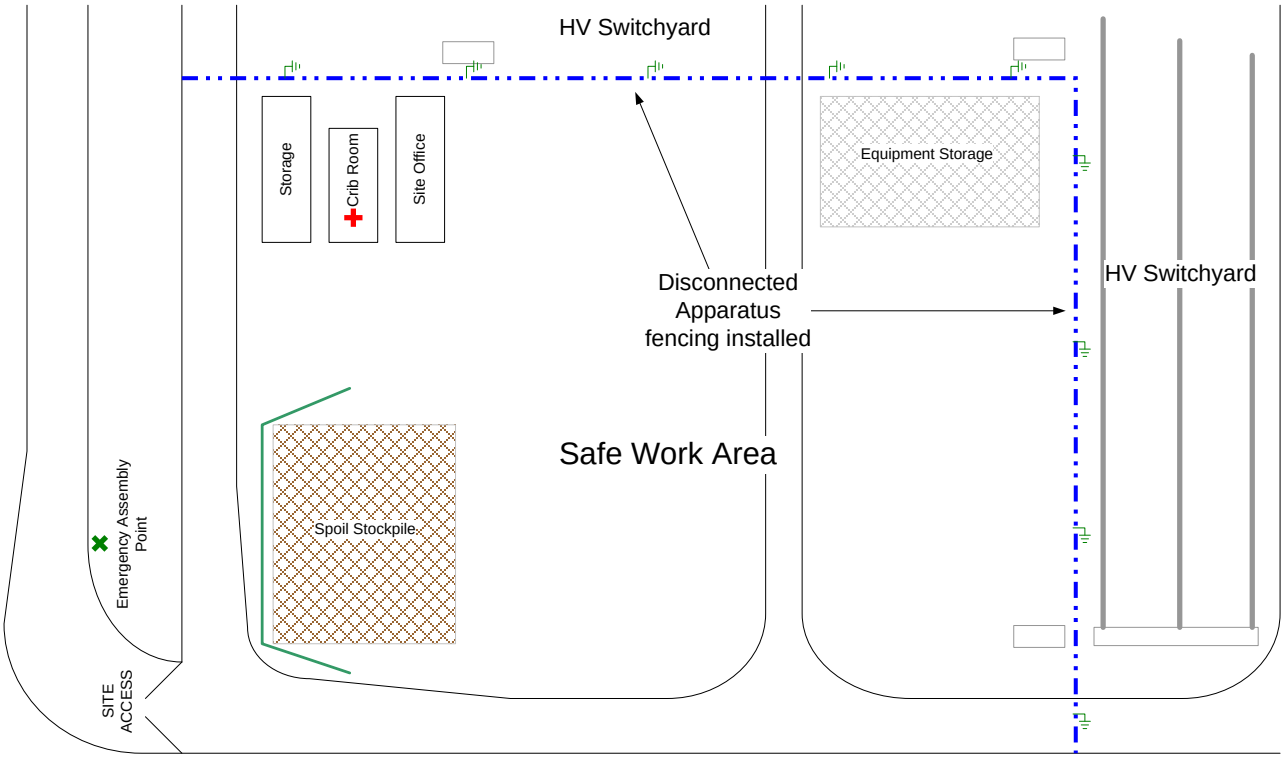
Appendix D - Establishing HV Cables as Disconnected Apparatus

Appendix A - Fencing Requirements for Disconnected Apparatus in a Substation

The fencing requirement for Disconnected Apparatus is as follows:-

- At least 1.8m high;
- The fence panels shall be joined with at least 2 bolted clamps to ensure earth continuity and to prevent inadvertent opening;
- The fence panels shall be earthed at least every 10 metres;
- All entrances shall be secured using an appropriate padlock, with no more than one entrance to be open at any time;
- Signs reading “Disconnected Apparatus” shall be affixed to every second fence panel, facing outwards.

The fence shall be arranged so that it does not obstruct access to live parts of the substation. A typical arrangement for the fence is given below:-



Appendix B - Establishing HV Equipment as Disconnected Apparatus

Disconnected Apparatus – HV Equipment

This form is a check sheet for determining whether HV equipment in a substation can be regarded as Disconnected HV Apparatus Safe for Work (as per PSSR para 5.5.3). It is concerned with the removal of hazards normally managed by the PSSR only. All other hazards are to be managed through the normal processes.
On completing the form below, tick the "Yes" box if the hazard is completely removed or not applicable. If it is not possible to remove the hazard, then tick the "No" box and include the control measure required.

High Voltage connections Removed / N/A?	**Yes**	**No**

This includes removing connections from any LV sources which could energise the high voltage equipment e.g. Voltage Transformers. Opening of links or removal of fuses is not sufficient.

Hazards from induced voltages and transferred potential controlled / N/A?	**Yes**	**No** →	Control Measure:-

Long objects appropriately bonded to a common earthing point

Appropriate LV/ Mechanical isolations carried out / N/A?	**Yes**	**No** →	Control Measure (include details of any live LV supplies)

A LVMPRI should be prepared and executed to provide the necessary LV/Mech isolations

High Voltage Hazards removed / N/A?	**Yes**	**No** →	Control Measure (inc.vertical restrictions due to live overhead conductors)

Confirm that the Disconnected Apparatus area does not infringe on safe clearances to adjacent live conductors. Confirm signage is in place warning of "Live HV Conductors" beyond the fence where required.
If there are live HV conductors overhead, establish the maximum safe height and specify no equipment capable of extending beyond this level is to be used.

Underground Hazards removed / N/A?	**Yes**	**No** →	Control Measure (attach excavation permit if reqd)

Does the work involve any form of mechanical excavation? If so, an excavation permit is required and all associated controls applied. If not required, include a note in the Control Measure "No Mechanical Excavation Required".

Man-proof fence erected / earthed / signed as "Disconnected Apparatus"	**Yes**	**No**

Subject to the Control Measures listed above, the equipment within this fenced area complies with the Power System Safety Rules requirement for "Disconnected HV Apparatus Safe for Work" (para. 5.5.3).

Signed…… Service No…….. Date…….

Remarks:

Completed sheet to be affixed to the fence in a waterproof cover adjacent to the entrance.

Use the "Remarks" section to add any further information regarding the status of the equipment that may be of use to the person supervising the work.
If any of the required Control Measures will not fit into the space above, then add an appropriate continuation sheet and refer to the sheet in the Control Measures box.

Appendix C - Establishing Overhead Line as Disconnected Apparatus

Disconnected Apparatus – Overhead Lines

This form is a check sheet for determining whether Overhead Lines can be regarded as Disconnected HV Apparatus Safe for Work (as per PSSR para 6.5.3). It is concerned with the removal of hazards normally managed by the PSSR only. All other hazards are to be managed through the normal processes.
On completing the form below, tick the "Yes" box if the hazard is completely removed or not applicable. If it is not possible to remove the hazard, then tick the "No" box and include the control measure required.

High Voltage connections Removed / N/A?	**Yes**	**No**

Hazards from induced voltages and transferred potential controlled / N/A?	**Yes**	**No** →	Control Measure:-

Adjacent in-service lines will cause induction which must be managed appropriately. A double-circuit line can only be regarded as Disconnected Apparatus if **both** lines are disconnected.

High Voltage Hazards removed / N/A?	**Yes**	**No** →	Control Measure (inc.vertical restrictions due to live overhead conductors)

Confirm that the Disconnected Apparatus does not infringe on safe clearances to adjacent live conductors.
If there are live HV conductors overhead, establish the maximum safe height and specify no equipment capable of extending beyond this level is to be used.

Undercrossing Hazards removed / N/A?	**Yes**	**No** →	Control Measure

Are there any live undercrossings? Does the nature of the work mean there is any possibility of a conductor coming into contact with an undercrossing?

Subject to the Control Measures listed above, the overhead line complies with the Power System Safety Rules requirement for "Disconnected Overhead Lines Safe for Work" (para. 6.5.3).

Signed…… Service No…….. Date…….

Remarks:

Completed sheet to be affixed to the fence in a waterproof cover adjacent to the transmission tower nearest to the worksite entrance .

Use the "Remarks" section to add any further information regarding the status of the equipment that may be of use to the person supervising the work.
If any of the required Control Measures will not fit into the space above, then add an appropriate continuation sheet and refer to the sheet in the Control Measures box.

Appendix D Establishing HV Cables as Disconnected Apparatus

Disconnected Apparatus – HV Cables

This form is a check sheet for determining whether High Voltage Cables can be regarded as Disconnected HV Apparatus Safe for Work (as per PSSR para 7.5.5). It is concerned with the removal of hazards normally managed by the PSSR only. All other hazards are to be managed through the normal processes.
On completing the form below, tick the "Yes" box if the hazard is completely removed or not applicable. If it is not possible to remove the hazard, then tick the "No" box and include the control measure required.

High Voltage connections Removed / N/A?	**Yes**	**No**

Hazards from induced voltages and transferred potential controlled / N/A?	**Yes**	**No** →	Control Measure:-

Adjacent in-service cables will cause induction which must be managed appropriately.

Hazards from LV/ Mechanical sources controlled / N/A?	**Yes**	**No** →	Control Measure (include details of any live LV supplies)

If required a LVMPRI should be prepared to isolate LV equipment.

High Voltage Hazards removed / N/A?	**Yes**	**No** →	Control Measure (inc.vertical restrictions due to live overhead conductors)

Confirm that the Disconnected Apparatus does not infringe on safe clearances to adjacent live conductors.
If there are live HV conductors overhead, establish the maximum safe height and specify no equipment capable of extending beyond this level is to be used.

Underground Hazards removed / N/A?	**Yes**	**No** →	Control Measure

Are there any live cables or other underground hazards in the vicinity of the work? Can they be appropriately identified and managed? Does the work require mechanical excavations?

Subject to the Control Measures listed above, the HV Cable complies with the Power System Safety Rules requirement for "Disconnected HV Cable Safe for Work" (para. 7.5.5).

Signed…… Service No…….. Date…….

Remarks:

Completed sheet to be affixed to the fence in a waterproof cover adjacent to the entrance to the disconnected apparatus area.

Use the "Remarks" section to add any further information regarding the status of the equipment that may be of use to the person supervising the work.
If any of the required Control Measures will not fit into the space above, then add an appropriate continuation sheet and refer to the sheet in the Control Measures box.