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| Snowy Technical Standards |
| ***SHL-GEN-133*** | ***Substation and Switchyard Fencing Standard*** |
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# Executive Summary

This document defines the requirements for security fences and gates for transmission switching stations, substations and transformer cells or vaults under the responsibility of Snowy Hydro Limited.

Switching, transmission or distribution substations along with transformer cells or vaults at power stations are referred to as ‘substations’ for the remainder of this document.

Excluded from the document are underground main or generator transformer vaults which have a full block or blast wall.

# Scope

This document is intended to be a Snowy Hydro standard for fencing and enclosures for HV apparatus, e.g., predominantly outdoor HV Transformers and Switchgear. It provides guidelines and standards that Snowy Hydro should follow for fencing of critical assets and outlines who is responsible for governing the fencing standards.

Critical assets include switchyards, substations, remote assets, and power stations. Temporary installations should also comply with this standard as far as possible.

For electrical installations inside power stations which are contained within access restricted areas (such as unit auxiliary transformers inside a locked room), fencing may not be required.

For any electrical installations installed on top of a pole or powerline such that they are not accessible by people, fences may not be required. (Eg pole mount transformer or isolator).

This standard applies to all security fences and gates under the responsibility of Snowy Hydro.

This standard contains requirements for design, supply, transportation, delivery to site, construction, and installation with complete documentation of security fences and gates and is to be applied to new installations as well as redevelopment of part or all of an existing installation.

The requirements set out in Snowy Hydro’s documents are minimum requirements that must be complied with by all Snowy Hydro team members, contractors, and other consultants.

The end user is expected to implement any practices which may not be stated but which can be reasonably regarded as good practices relevant to the objective of this document.

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# General

## Purpose

The purpose of this document is to provide a Snowy Hydro Technical Standard for fencing and enclosures for HV apparatus, e.g., predominantly outdoor HV Transformers and Switchgear. It provides guidelines and standards that Snowy Hydro should follow for fencing of critical assets and outlines who is responsible for governing the fencing standards.

This Standard is intended for new work being undertaken as a brownfield or greenfield project. This standard should not be applied retrospectively to any existing Snowy Hydro sites where there is no intention to replace the existing fence, however, for existing sites a risk based approach should be applied to the compliance with respect to this Standard in support of any intended replacement program.

## Objective

Snowy Hydro requires that the design, construction and installation of security fences and gates as covered in this standard are, where applicable, compliant with and cognisant of:

1. The need to be compliant with relevant Australian legal requirements.
2. The requirements of the New South Wales Electricity Regulations, Acts and the National Electricity Rules are met.
3. A need to ensure all personnel and public safety and environmental hazards are identified, analysed, and eliminated or control measures adopted.
4. The need to minimise risk to Snowy Hydro’s assets.
5. Ensuring the ease of operation and maintenance, including access and egress.

## Precedence

Any apparent conflict between the requirements of this standard and the law, mandatory requirements, industry standards, project specifications, non-statutory standards or guidelines, and any other associated documents should be brought to the immediate attention of the asset engineer within the Snowy Hydro Asset Engineering and Integrity group for resolution and no action must be taken that might result in a breach of law or mandatory standard.

Where there may be a conflict between the requirements of this standard and any:

1. law, mandatory requirement, or industry standard, then that law or statutory requirements will prevail over this standard.
2. non-mandatory standard, or guideline, then this standard will prevail over that standard or guideline.
3. project specification, then the contract documentation will prevail over this standard.

Approval for a deviation to this standard may only be accorded if it does not reduce the quality of workmanship, pose a safety risk to person or equipment, and does not deviate from the intent of this standard. Deviations if any must be specifically requested and approved in writing by Snowy Hydro.

## References

As a component of the complete specification for a security fence and gate system, this standard is to be read in conjunction with other relevant standards as applicable. Unless otherwise specified in the project specification, the equipment shall be in accordance with the latest edition and amendments of the standards listed below.

### Applicable Standards

Snowy Hydro shall use and apply as needed the standards listed below as guidelines for the construction, earthing and isolating of fences around critical assets.

**Table 1 - Table of Reference Standards**

| Standard  | Title |
| --- | --- |
| AS/NZS 1163 | Structural steel hollow sections |
| AS/NZS 1170 | Structural Design |
| AS 1379 | Specification and supply of concrete |
| AS 1725 | Chain-link fabric security fencing and gates |
| AS 2067 | Switchgear assemblies & ancillary equipment for alternating voltages above 1 kV |
| AS/NZS 2312 | Guide to the Protection of Structural Steel against Atmospheric Corrosion by the Use of Protective Coatings |
| AS 2423 | Coated steel wire fencing products for terrestrial, aquatic, and general use |
| AS/NZS 3000 | Electrical installations |
| AS 3600 | Concrete Structures |
| AS 3996 | Access covers and grates |
| AS/NZS 4534 | Zinc and zinc/aluminium-alloy coatings on steel wire |
| AS/NZS 4680 | Hot-dip galvanized (zinc) coatings on fabricated ferrous articles |
| AS/NZS 4792 | Hot-dip galvanized (zinc) coatings on ferrous hollow sections, applied by a continuous or a specialized process |
| BS 1722-10 | Fences – Part 10: Specification for Anti-Intruder Fences inChain Link and Welded Mesh |
| BS 1722-14 | Fences – Part 14: Specification for Open Mesh Steel PanelFences |

The following additional Standards may be used as guidelines for the security, construction, earthing and isolating of fences around critical assets.

ENA DOC 015 – 2006 ENA – National Guidelines for Prevention of Unauthorised Access to Electricity Infrastructure

ENA DOC 001-2008 National Electricity Network Safety Code

EG-0 Power System Earthing Guide Part 1: Management Principles

### Acts and regulations

All works, designs and equipment shall comply with the government Acts and Regulations listed below as a minimum.

* Electricity Supply (General) Regulation (NSW)
* Electricity Supply (Safety and Network Management) Regulation
* Work Health and Safety Act
* Work Health and Safety Regulation

### Snowy Hydro Technical Standards

The following Snowy Hydro standards listed below as guidelines for the construction, earthing and isolating of fences around critical assets as applicable and shall support the content of this document.

* SHL-CIV-112 Minor Concrete Works
* SHL-GEN-123 Protective Coatings
* SHL-GEN-131 High Voltage Danger Signs
* SHL-ELE-128 Earthing
* SHL-ELE-156 General LV Electrical Requirements : Annexure K - LV Earthing
* SP09-18 Excavation and Penetration

## Definitions

In addition to terms and definitions detailed in AS 1725 the following specific definitions apply to this standard:

AC Alternating current.

Animal guard A ‘Colorbond’ sheeting which is attached to the top of weld mesh or chainmesh fence panels on the outside to prevent animals from climbing the fence fabric. The guards are secured using stainless steel fixing straps.

BCA Building Code of Australia.

Back stay A diagonal tubular galvanised steel member supporting a post laterally and set into the ground.

Barbed wire The twisted longitudinal wires to which are attached four-point barbs and normally installed at the top of the fence line.

Bracing cable The wire and turnbuckle used in braced panel or strainer assemblies as a tension member.

Braced panel Two (2) adjacent vertical posts in a chainmesh or welded mesh fence with one horizontal connecting bracing rail and two diagonal bracing cables.

Bracing rail The horizontal galvanised tubular steel compression member installed between posts in a bracing panel.

Bracing post A diagonal tubular galvanised steel member fixed to end posts, strainer posts, intermediate posts, corner posts or gate posts, installed in the line of the fence and set into the ground.

Chainmesh A wound and interwoven galvanised wire nominally 50 mm mesh comprising supplier standard 3.15 mm diameter wire, with a twisted and barbed top selvedge and knuckled bottom selvedge, used to infill fence panels.

Construction hold point A point in the construction of the substation security fence where the

inspection and approval of the site works completed is required by Snowy Hydro before further construction works proceed on site.

Corner fence post A fence post positioned at the corners and changes of direction in the alignment of a fence.

Crank The top section of the fence post that is angled from the vertical.

DC Direct current.

Earth break fence panel A non-conductive section of fencing used to isolate the earth grid and substation fence from an adjoining property fence line.

EGL The external ground level, normally outside the substation security fence, prior to installation works.

End fence post The fence post at the end of a line of fencing.

Extra high voltage (EHV) Voltages normally associated with the transmission of electricity nominally within the range of 66 kV to 330 kV. This includes transmission line voltages, substation switching voltages and voltages on the line side of supply transformers within Snowy Hydro power stations and substations.

Extra low voltages (ELV) Voltages normally associated with the control of electricity at other levels, normally not exceeding 50 V ac or 120 V dc (ripple free).

Fence panel A section of fence between two adjacent vertical posts.

Fence post An upright tubular galvanised steel or treated pine member for supporting fencing materials.

Gate fence post Two (2) fence posts forming a gateway in a fence line.

Helicoil wire Specially formed wire positioned at the top, middle and bottom of the fence, used to limit the movement of the chain wire.

High voltage (HV) Voltages normally associated with the distribution of electricity, normally within the range of 1 kV to below 66 kV. This includes voltages on the load side of supply transformers, distribution switching voltages and distribution line voltages.

Hinged vehicular gate A round tubular galvanised steel frame covered with weldmesh, or chainmesh, hinged on a gate post or posts and used to close a vehicular gateway and normally rectangular in shape.

Insulated fence panel A section of substation fence constructed from non-conductive materials, usually timber.

Intermediate fence posts Fence posts positioned at a regular spacing between corner and/or end posts to provide support for fencing materials.

Lacing and tie wires The wire that is used to lace and or tie chainwire or other fencing materials to supporting helicoils, fence posts and gate frames.

Low Voltage (LV) Voltages normally associated with the control or consumption of electricity, normally within the range of 50 V ac to 1 kV ac or 120 V dc to 1500 V dc.

Palisade Panel A welded roll formed steel security barrier with a straight steel pale profile and a curved pale top on the outer facing side. This type of fencing is used for higher security sites.

Pedestrian gate A tubular galvanised steel frame covered with chainmesh or weldmesh, hinged on a gatepost and used to close a pedestrian gateway, normally rectangular in shape.

Pipe strap A stainless steel strap requiring a proprietary hand operated tool to fix into position and secure the strap.

Plinth A concrete foundation section cast in-situ at the base of the fence.

Post extensions An extension of the fence post above the normal height of chainwire or weldmesh that may be angled or vertical in alignment and to which barbed wire may be attached.

PRS Project Requirements Statement document (refer comment in Section 5 (i)).

RHS Rectangular hollow section of steel tubing.

Selvedge Top and bottom edges of the chainmesh.

SGL The switchyard ground level, normally inside the substation security fence, prior to installation works. Synonymous with Sw/Yard Level.

SHS Square hollow section of steel tubing.

Sliding vehicular gate A rectangular RHS galvanised steel frame, in-filled with galvanised vertical SHS members, sliding on a track between gateposts and used to close a vehicular gateway.

Strainer assembly A strainer post with bracing helicoil and turnbuckle or bracing stays, or alternatively a braced panel with crossed diagonal bracing cables and turnbuckle.

Strainer fence posts Fence posts positioned for significant variations in ground levels and at intervals when specified with either bracing stays or bracing cables to enable required tension of support helicoils and chainwire to be obtained.

Weldmesh panel A sheet of mesh constructed from welded and galvanised vertical and horizontal lengths of wire, typically in sheet sizes of 2500 mm high by 2400 mm long, eg ‘ WG 312 general purpose’, or of equivalent quality.

# Installation requirements

This standard details three (3)types of fence fabric:

1. Weldmesh.
2. Chainmesh
3. Palisade

And two (2) types of gates:

1. Hinged.
2. Sliding.

The selection of the fence fabric and gate type is dependent on the vulnerability assessment for the site. Snowy Hydro will undertake the vulnerability assessment and detail the type of fence fabric and gates required within the project specifications to meet the level of security required for the site. Typically, weldmesh will be used for general security fencing on the external boundary of substations and chain mesh within a substation to provide separation protection, eg. around a capacitor bank installation. The Palisade fencing is ideally suited for the external boundaries of assets where a greater level of security is required. Alternative fence fabric, such as block masonry with a barbed wire cranked section or prefabricated concrete panels, may be utilised if deemed necessary and detailed in the project specifications.

All materials, fittings and/or work must be supplied and installed in accordance with the vendor’s instructions to provide an effective and functional security fence and gate.

## General Requirements for Perimeter Fencing and Access Gates

The perimeter of live substation switchyards and the substation building shall be secured to minimise the risk of unauthorised entry.

The live switchyard security fence enclosing live outdoor electrical equipment, and the substation building, shall be designed to be secure against opportunistic intruders without the aid of tools or keys. The live switchyard security fence and the substation building shall be designed to be an intruder resistant and tamper-evident barrier. The barrier shall be resistant to covert attack.

Special attention shall be paid to personnel and vehicular entry gates within the security fencing, and these shall be fitted with Snowy Hydro padlocks, keypads, swipe card or other access locking devices.

The switchyard security fence and gates shall be designed in accordance with the requirements of this Technical Standard, and ENA Doc-15 National Guideline for Prevention of Unauthorised Access to Electricity Infrastructure.

Any concealed spaces outside the live switchyard security fence should be minimised where reasonably practicable.

Boundary fencing is to be provided as an initial level of security and to define the site boundary. The height and type of boundary fence will depend on the initial level of security required, the degree of screening necessary (both determined by Snowy Hydro) and the fencing type permitted by the Local Planning Authority or National Parks and Wildlife, as applicable. Where possible the boundary fence shall be of open style design such as chainmesh or palisade fence to allow for the principles and guidelines as set out in the Crime Prevention Through Environmental Design (CPTED). The CPTED information can be accessed via the following webpage link: (<https://www.police.nsw.gov.au/safety_and_prevention/policing_in_the_community/safer_by_design>)

 In community sensitive areas, where the need for an upgraded boundary fence has been agreed in writing by Snowy Hydro, the fence may be of timber, brickwork, blockwork or decorative mesh or a combination of each. Where metallic or conductive fencing material is used for the boundary fence it shall have sufficient separation from the switchyard fence to ensure that it cannot come in contact with the switchyard fence if it were to fall over.

# Design requirements

1. A site survey is to be undertaken and should include the property boundary, existing perimeter fence and the location of the new fence and gate.
2. A new fence plan drawing must be prepared in accordance with this standard and the project specifications and submitted to Snowy Hydro for approval. The fence plan drawing must include notes addressing construction detail, sequence of work, risk management and the location of all adjoining buildings and property fences.
3. A security fence and gate is normally located with a minimum ‘external’ horizontal clearance zone from the property boundary, together with a minimum ‘internal’ horizontal clearance zone from EHV or HV equipment and an ‘internal’ clearance from other infrastructure in accordance with the Snowy Hydro SAD’s (Safe Access Distances). All operational buildings shall be internal to the security fence where possible. For all LV equipment reference should be made to compliance with AS3000 Sections 5 and 6 for these enclosures.
4. Minimum electrical safety clearance from overhead EHV or HV conductors and live equipment must be maintained as per AS 2067 and Snowy Hydro Quality Management System document AP-26 - *Work in the Vicinity of Live Exposed Conductors* .
5. The location of any adjacent underground and overhead electrical infrastructure must be marked on the fence plan drawing.
6. All new substation security fences and gates must be designed for a minimum service life of 50 years.
7. All ferrous materials must be hot dipped galvanised to comply with the relevant standards as per Section 3.4 - References.
8. The new substation fence must be a minimum of 3250 mm high from the outside EGL (external Ground Level) to the top run of the barbed wire or other material constituting the fence. Where the fence is considered to be in a low risk area and only chainmesh will be used, the height may be reduced to 3000m. m to the top of the barbed wire and the chain mess at a minimum height of 2500mm.
9. The fence must be constructed of palisade, weldmesh or chainmesh panels or other approved material as specified in the project requirements statement or specification.
10. Where the type of fence fabric is not specified, then galvanised weldmesh or chainmesh shall be installed for the entire section of the new fence according to the applications outlined in this standard.
11. A concrete plinth must be provided at the base of the substation security fence and any internal security fence. All concrete plinths must follow the existing substation or power station yard level, removing excessive rise and fall in the ground levels outside the station.
12. Each vehicle gate must be constructed of:
	1. a single sliding gate, with a sliding gate runway on a concrete foundation; automated, or arranged for future automation; or
	2. two hinged gates, with a concrete foundation between supporting gate posts.
13. Where the type of vehicle gate is not specified, then a sliding gate must be provided.
14. New substation, power station or switchyard perimeter fence sections must be constructed outside the existing perimeter fence, with the new fence centre line within 200 mm of the existing fence centre line, unless otherwise detailed in the project specifications. Note: the construction of a new fence outside the boundary of any existing fence ensures reasonable security of the existing site is maintained during construction.
15. Concrete that is laid over new and existing buried services must be marked to indicate the location of the service..
16. Mitigation of transfer and touch potential should be considered when erecting metal fences.
17. When a metal fence is located parallel to a transmission line the effect of induced voltages is to be managed. (eg earthing and isolation panels installed).

# Adjoining property fences

Should an adjoining metallic property fence be connected to the substation perimeter fence, and the initial section of the adjoining property fence is not insulated then the first 4800 mm of the adjoining property fence must be replaced with earth break fence panels, including barbed wire topping (refer Section 7.13 -Insulated panel materials and installation ). Snowy Hydro or an appointed Contractor (as applicable) must obtain consent from the property owner/s of the adjoining fence/s prior to work commencing. In this case the earth break panel must have palings and animal guards on both sides of the fence. A perimeter concrete plinth is not required for this type of earth break panel.

# Construction requirements

## Pre-construction set-out

1. After being granted possession of each substation site by Snowy Hydro, and prior to commencing site works, the site must be surveyed and the location of the proposed fencing construction must be marked in accordance with the fence plan drawing.
2. The location of all underground infrastructure near the old and new fence lines must be marked out before work commences. This includes all underground EHV or HV cables, or LV control cables, earth grid grading ring, water supply and drainage systems.
3. The mark out must also include the location of all:
	1. new fence and gate posts,
	2. bracing sections,
	3. plinths including raised plinth sections,
	4. fence and sliding gate foundations,
	5. warning sign locations; and
	6. other site specific construction details.
4. The fence plan drawing must be updated to include any modified construction detail resulting from the pre-construction set-out.

## Excavations

1. All excavations are to be performed in conjunction with Snowy Hydro procedure SP09-18 Excavation and Penetration.
2. Waste spoil from excavations must be removed from site unless permission to retain on site is granted by Snowy Hydro; permission is to be requested in writing prior to starting excavation.
3. Post holes, plinths and foundations must be excavated with vertical sides and a firm base, as specified in the approved project drawings.
4. All excavated, filled or disturbed ground surfaces must be remediated to match the surrounding surfaces.

## Post footings

### Footing materials and Installation

The concrete used for footings and gate foundations must comply with AS 1379, Grade N25 and Snowy Hydro Technical Standard SHL-CIV-112 Minor Concrete Works.

All concrete finishes must comply with the following:

1. Footing – mass concrete placed around post; where a plinth is not installed, finish with a weathered top falling 25 mm from the post to the Switchyard Ground Level (SGL).
2. Plinth – finish with a weathered top falling 25 mm to the outside of the substation.
3. Sliding vehicle gate foundation – finish level with the existing roadway level along the length of the sliding gate foundation.
4. Pedestrian gate foundation – finish level with the SGL along the length of the pedestrian gate plinth.
5. All concrete must be vibrated to remove voids.

## Fence plinth

1. Two (2) Y12 reinforcing bars must be installed in each 7200 mm section of plinth.
2. Each bar must be continuous.
3. Install the reinforcing bars centrally within the plinth ensuring a minimum concrete cover in accordance with SHL-CIV-112.
4. Weld the reinforcing bars to each fence post, with one (1) bar on the inside of the fence posts and one (1) bar on the outside of the fence posts, for each section of plinth.
5. Where a pedestrian gate is installed in the fence line, the reinforcing bars must run through the gateway plinth.

### Plinth materials and installation

The concrete used for fence plinths must comply with AS 1379, Grade N25 and Snowy Hydro Technical Standard SHL-CIV-112 Minor Concrete Works.

1. A concrete plinth must be supplied and installed in situ under all:
	1. Palisade, chainmesh, or weldmesh perimeter fence sections;
	2. back stays and bracing posts; and
	3. insulated panels fence sections.
2. Concrete plinths must be supplied and installed from the fence plinth to each existing and proposed fence bracing post. Plinth width and height above SGL to be equal to fence plinth.
3. Plinth expansion and control joints must be installed centrally between posts at centres not exceeding 7200 mm. This allows for the installation of three fence posts to each section of plinth bordered by expansion and control joints.
4. Where a plinth is stepped, the concrete plinth should be stepped on the uphill side of the post as specified in project drawings.
5. To provide for future installation of electric security fence posts, the following must be applied for each change in plinth direction:
	1. 600 mm each side of a change in direction of the inside face of the plinth must be plumb and smooth.
	2. Cable pits must not be located within 600 mm of each change in direction.
6. Conduits must be installed in plinths.
7. Where the plinth finishes above EGL, install nominal 20 mm PVC pipe as ground water weep holes, at 1000 mm centres along the length of the raised section to vent level with the EGL. The inside of the weep holes to be covered with nominal 25 mm blue metal aggregate.

## Post materials and installation

1. Post materials are to be specified in the project fence drawing.
2. Holes must be pre-drilled in the cranked section of the fence post prior to galvanising for the installation of the barbed wire (if required).
3. With the exception of the welded gate frame, all joints between posts and rails must be galvanised fence and gate fittings.
4. Posts must be installed vertically at heights that follow the contour of the SGL.
5. All vehicle gateposts must be one piece, not cranked and extend to the same height as the gate barbed wire section.
6. The post crank forming part of the posts, for supporting the eight (8) strands of barbed wire, must extend outwards from the substation fence line.
7. The length of corner posts cranked section must be increased as appropriate to ensure the horizontal outreach matches the intermediate posts.

## Rail materials and installation

Rail materials are specified in the project fence drawing. Installation of the rails shall have:

1. All fence and gate fitting joints between fence posts or gateposts and rails galvanised.
2. Top, middle, and bottom rails installed for palisade and weldmesh fence panels.
3. Top and bottom rails installed for a chainmesh fence panel. The centre of the bottom rail for chainmesh fences must be installed one (1) full diamond from the bottom-knuckled selvedge.
4. Bolts used to fasten joints between posts and rails installed with the tamper proof mushroom head bolt on the outside of the substation fence.

## Wire materials and installation

Wire materials are to be specified on the project fence drawings. Installation of the wire shall be as follows:

1. Helicoil Wire for Chainmesh Fencing
	1. Helicoil wire must be installed on the outside face of the fence posts. Position the top run of helicoil wire one (1) half diamond from the top barbed selvedge. Position the bottom and middle run of helicoil wire equally spaced from the top of the chainmesh to the top helicoil wire.
	2. Each strand of helicoil wire must be wrapped twice around corner, gate, or end posts, finally secured back upon itself with at least four (4) turns and laced with tie wire.
	3. All helicoil wire runs must be tensioned to have maximum sag of 10 mm between all fence posts.
2. Lacing and Tie Wire
	1. With the exception of the tie wire for the barbed wire, all twisted ends of the tie wire must be on the inside of the substation fence.
	2. Two (2) strands of tie wire must be doubled around the member being tied, with the ends twisted and neatly cut off. This applies to all tie and lacing wire requirements except for the fixing of the chainmesh to the helicoil wire where only one (1) turn is required.
	3. When tying or lacing chainmesh to corner, gate, or end posts, use lengths of tie wire no longer than 1000 mm.
3. Barbed Wire
	1. Barbed wire must be secured to the outside face of the cranked section of the fence post using two (2) strands of tie wire threaded through a hole in the crank and around the post, twisted and neatly cut off.
	2. Barbed wire must be tensioned to have a maximum sag of 10 mm between all fence posts with all joins in the barbed wire being made at fence posts.
	3. Barbed wire must be secured in a manner that prohibits axial movement of the wire on the fence post or gate frame member.
	4. Where the barbed wire section of a cranked post is adjacent to another structure, a barbed wire in-fill must be provided to secure the gap.
	5. Barbed wire must be spaced as specified in the project fence drawings.

## Chainmesh fence panel materials and installation

Chainmesh fencing shall be used in areas assessed as low to very low risk of security breaches. In this case the minimum height of the chainmesh must be 2500 mm and installation must be as follows:

1. The chainmesh must be installed on the outside of the fence posts against the supporting helicoil wires and tensioned to have maximum sag of 10 mm between all fence posts.
2. The chainmesh must be tied off to the bottom fence rail and supporting helicoil wires on the inside of the substation using tie wire.
3. The chainmesh must be tied off to all fence posts in equally spaced positions.
4. The chainmesh must be laced to all corner, end, and gate posts from top to bottom of each fence panel.
5. The gap between any part of the chainmesh fence and the concrete plinth must not exceed 25 mm.

## Weldmesh fence panel materials and installation

All weldmesh fence panel ferrous materials must be hot dipped galvanised to comply with the relevant standard. Installation must be as follows:

1. Weldmesh must be installed on the outside of the fence posts and supporting fence rails.
2. The vertical wire of the weldmesh must be on the outside of the fence to reduce the ability to obtain a foothold on the external side of the fence.
3. The fence height shall be in accordance with Clause 5(h) above.

## Palisade fence panel materials and installation

All palisade fence panel ferrous materials must be hot dipped galvanised to comply with the relevant standard. Installation must be as follows:

1. Palisade must be installed on the outside of the fence posts and supporting fence rails.
2. The curved pale top of the palisade must be on the outer facing side of the fence to reduce the ability to obtain a foothold on the external side of the fence. Each palisade pale must have a tripoint top.
3. The pale centres must be a maximum of 80mm between pales and the height to be 3000 mm from SGL or e in accordance with Clause 5(h) whichever is the greater.

## Pedestrian gate materials and installation

1. All pedestrian gate frames must be supplied complete with two hinges that resist lifting when the gate is in the closed position. It should be noted that standard pedestrian gates are shorter in height than the fences required in this Standard and therefore a panel section above the pedestrian gate is required to maintain symmetry of the top of the fence line.
2. Self -closing hinges may be used if sufficient for closing the gate behind pedestrians.
3. Gates must be supplied complete with Snowy Hydro keyed single cylinder deadlatch, swipe card, or pin code pads to mitigate unauthorised access.
4. The small fence panel above the gate must be filled with palisade chainmesh or weldmesh that matches the adjacent fence panels.
5. Pedestrian gates must only open ‘inwards’ into the substation and be self-closing.
6. The padlocking mechanism must be mounted on a galvanised mild steel plate that extends across the gate post so as to provide a mechanical means of preventing movement of the gate outwards and removes the ability to force the lock open from the outside.
7. Locking mechanisms other than padlocking such as swipe cards, keypads or other electronic access shall have either galvanised or stainless steel fittings that lock securely and are generally maintenance free.
8. The concrete plinth must continue under all pedestrian gates and on either side to ensure standing areas on either side of the gate are suitable for pedestrian traffic.

## Vehicle gate materials and installation

### Vehicle gate materials

1. Hinged vehicle gates must:
	1. match the height of the adjacent fence line.
	2. be fitted with barbed extensions that match the height of the adjacent fence line if applicable.
	3. comprise two leaf gates and be fitted with hinges that resist lifting or jacking when in the closed position.
	4. have the gate foundation fitted with a ground mounted 25 mm diameter x 150 mm long galvanised steel tube gatekeeper for both leaf gates for both open and closed positions.
	5. have the gatekeeper positioned 10 mm in height clear of the surrounding concrete.
	6. be supplied complete with a deadlock for locking.
	7. be supplied with a 16 mm diameter galvanised steel drop-bolt, suitable for padlocking, fitted on the inside of both leaf gates to hold the gates in both open and closed positions.
	8. have a designated earthing palm welded to the lower portion of each gate adjacent to the gate frame earthing palm; and
	9. be in-filled with palisade or weldmesh that complies with the fencing profile. The palisade or weldmesh must be secured to a top, middle, and bottom horizontal gate rail.
2. Sliding vehicle gates must:
	1. include a track of Omega profile suitable for sliding gate wheels.
	2. have no horizontal members fabricated into the sliding gate that create potential climbing points, other than the top and bottom rails.
	3. be provided with a procedure to follow in the event of a gate malfunction, such as a jam. The procedure to be displayed on the outside of the gate motor enclosure, facing inside of the substation.
	4. be fitted with opening and closing back block cushions.
	5. be welded using a GMAW welding process, i.e. MIG welding machine; and
	6. be hot dip galvanised and painted in AS 2700 Y14 Golden Yellow in accordance with Snowy Hydro Technical Standard SHL-GEN-123 Protective Coatings.
3. Electric sliding vehicle gates must include:
	1. high speed gate slider,
	2. magnetic gate lock,
	3. key switches for exit and entry with a momentary contact spring return (low voltage), and must be capable of preventing inadvertent closing by means of electronic eye.

The types and models of all the above are to be approved for use by Snowy Hydro.

1. Concrete vehicle gate foundations must have a vehicle loading capacity of at least 80 tonnes and be installed under all vehicle access gates, including the gateposts.
2. The foundation must run the full length of the hinged gate opening or sliding gate runway.
3. Where the finished height of the foundation or sill is above the existing roadway level, taper the concrete to form ramps on both sides.

### Vehicle gate installation

1. Hinged vehicle gates must only open ‘inwards’ into the substation unless otherwise approved by Snowy Hydro. Mechanical interlocks must be installed on the gate hinge or across the gate opening to restrict movement of the gates outwards.
2. The opening width between supporting gateposts of vehicle gates must be as specified in the project fence drawings unless detailed otherwise in the project specification.
3. When in the closed position, the gap between the top of the concrete gate foundation and the bottom of the hinged gate frames must not exceed 25 mm. When in the closed position, the gap between the two gates must not exceed 25 mm.
4. The gap between the top of the sliding gate runway and the bottom of the sliding gate frame when in the closed position must not exceed 25 mm. This may require the track wheels being set into the gate frame to comply with the maximum clearances. The gap between the sliding gate posts and the gate frame when in the closed position must not exceed 25 mm.
5. Loose gravel is to be reduced on the approach to a sliding gate by forming hardstand hot-mix bitumen or concrete apron areas at least 5000 mm either side of the gate across the width of the existing roadway. All water run-offs should be sloped away from the sliding gate runway to further prevent gravel build up.
6. Sliding gates are to be automated, or arranged for future automation, complete with conduits and a cable pit. Automated sliding gates must have external and internal key switches mounted as required by the project specifications. Motor drives must be installed in weatherproof enclosures and is to incorporate a 240VAC weatherproof GPO inside each automatic gate motor enclosure to be supplied from a 415 VAC substation distribution board.

## Insulated panel materials and installation

Insulated fence panels are used where required to isolate the adjacent fence from the substation fence metallic items, located either inside or outside the substation or power station.

1. Insulated fence panels must be composed entirely of non-conductive materials, except for minor fastenings such as screws or bolts that do not provide an earth fault potential or current path.
2. Insulated fence panel sections must be constructed in accordance with the project fence drawings.
3. Fence palings must be installed on the outside of the fence rails, minimising the gap between palings.
4. ‘Screw-in’ type fasteners for affixing the palings must be of a type not easily removed and must be inserted at least two-thirds depth into the railing.
5. Nails may be used in conjunction with screw fasteners, but each fence paling must be secured with at least one screw fastener to each rail.
6. All fastenings must be corrosion resistant and not stand proud of the paling surface.
7. If a barbed wire extension is mounted on treated pine posts it must be cranked outwards.
8. The perimeter concrete plinth must extend beneath the insulated panel section.
9. All Y12 reinforcing bars installed within the plinth must not be physically bonded or have contact with any steel support post within the plinth. A clear gap must be inspected prior to pouring of concrete.

## Earth break fence panels

Earth break panels are used where it is necessary to isolate an earthed security fence from unearthed metallic fences. Earth break panels provide an isolating section between the metallic substation fence and any external fence. For the latter case, palings and animal guards should be fitted to both sides of the panel to ensure it does not create an entry point into the substation.

1. The minimum length of the panels must be 4800 mm.
2. Climbing points are to be removed from where the earth break fence panel abuts an adjoining property fence, eg wooden stock fence posts not to be located within 2000 mm of the earth break fence panels.

## Bracing materials and installation

1. Corner posts, end posts, mid-fence line braces and gate posts must be braced in the line of the fence with either horizontal galvanised tubes or diagonal bracing wires, or diagonal stays clamped to the posts and buried into concrete footings.
2. Bracing stays, at 60 degrees, must be a minimum of 3500 mm long.
3. Additional fence bracing posts must be provided at least at every third post, with the placement determined by counting from each corner post of every fence line section. No more than three (3) consecutive fence panels are to be without a bracing post.
4. A brace must be provided for every post that is flange mounted.
5. The location of fence post braces are not to interfere with the safe operation of sliding gates.
6. Where there is insufficient room or clearance for a bracing stay a NB65 post can be installed.
7. A concrete plinth must be installed around all bracing stays to 100 mm above SGL.
8. Where the concrete plinth is continuous and is of sufficient size and strength, the use of bracing may not be required. This is most typical of palisade fencing as it is often self-supporting.

## Animal guard materials and installation

All substation fences, earth break fence panels, vehicle gates and pedestrian gates must have an animal guard fitted. The animal guard is to prevent animals such as possums and other large climbing animals from traversing the fence.

Animal guard sheeting for chainmesh and weldmesh sections of fencing must be installed as specified in the project fence drawings.

1. Animal guard sheeting for insulated and earth break timber fence panels must be:
	1. Polycarbonate, corrugated, ultraviolet (UV) compatible material.
	2. 400 mm high with a gauge of nominal 3.5 mm; and
	3. Colorbond ‘Rivergum Green’ in colour for the external face and face outwards from the substation.
2. The animal guard must be installed on the outside of the fence with the top of the sheeting either level with the top run of chain wire on chainmesh fence panels, or level with the top of the weldmesh on weldmesh fence panels.
3. Where the fence panels are stepped then the top edge of the animal guard must be positioned such that it nominally follows the contour of the ground and aligns with only the high points of the fence panels.
4. No part of the panel should be exposed above the animal guard.
5. Fixing points for the animal guard to fence panels must be at least every 600 mm using M6 x 25 mm galvanised gutter bolts complete with M6 galvanised mudguard washer, M6 nyloc nut and two (2) 100 mm long x 40 mm wide x 3 mm gauge back plates. One (1) fixing point for animal guard must be at least 400 mm either side of each fence post.
6. The back plate is to be fitted top and bottom of the animal guard and on the inside of the fence.
7. The animal guard must be positioned to fully cover the stainless steel fixing straps to the top or bottom rail.
8. Where the animal guard is not continuous or where the animal guard stops at corner posts, gate posts and gate edges, the end of the animal guard must be laced with galvanised tie wire.
9. Animal guards must not be fixed to fence posts and all section joins must overlap by at least 50 mm.

### Insulated panel section installation

Material used for an animal guard on insulated panel sections can be made from polycarbonate sheets. This can be installed on an insulated fence panel or earth break fence panel level with the top of the fence palings by using flat head non-corrosive screws to secure the sheeting to the treated pine palings at least every 600 mm.

## Warning signs

Warning signs, including selection of materials and installation requirements, must be in accordance with Snowy Hydro Technical Standard SHL-GEN-131 – High Voltage Danger Sign. The warning signs must be used for new security fence installations, unless detailed otherwise in the project specifications. The installation of the warning signs must occur concurrently with the fence installation.

## Galvanised finish and repairs

1. Galvanised finishes and any repairs to galvanised finishes must be in accordance with Snowy Hydro Technical Standard SHL-GEN-123 Protective Coatings

## Perimeter conduits and pits materials and installation

For future security cabling, conduits must be installed in the plinth along the perimeter fence line and associated cable pits must be installed within the substation. The pit locations shall be specified on the project drawings. In addition to this:

1. All electrical conduits must satisfy AS/NZS 2053.2.
2. Install three (3) electrical conduits , nominal 32 mm, heavy duty type, complete with draw wires. The draw wire may comprise suitable 5 mm diameter poly cord conduit draw wire.
3. Electrical conduits must be of heavy duty type where the conduits enter the switchyard.
4. Sweep bends must be used for any change of direction.
5. Cable pits must comply with AS 3996 Type A, complete with a polycrete type material lid marked ‘Electrical Services’ or similar.
6. Install three (3) conduits at the bottom portion of the plinth concrete.
7. Where the fence line length exceeds 40 metres or ten (10) lengths of conduit, bring the conduits out into the switchyard and terminate into cable pits.
8. The cable pits must be installed at a minimum distance of 200 mm from the plinth to a finish level with SGL, with a minimum 50 mm concrete cover.
9. The cable pits are to be installed adjacent to all vehicle sliding gates to align with conduits.
10. Cable pits are not to be installed between a sliding gate or pedestrian gate in the open position and the adjacent fence.

## Earthing

For relevant LV earthing requirements, refer to the Snowy Hydro Technical Standard SHL-ELE-156 (K).

### Earthing of fence posts

1. Refer to Snowy Hydro Technical Standard SHL-ELE-128 Earthing Appendix C for switch yard fence earthing.
2. Metal gates must be earthed by bonding across the hinges to the fence.
3. Looping of earthing conductors is not permitted.
4. Supply and install a galvanised steel earth palm welded to corner posts, gateposts and every sixth intermediate fence post along a run of perimeter fencing. It is preferable to supply the fence posts to site with the earth palm already mounted in position
5. All nuts, bolts and washers must be galvanised.
6. Apply two brushed coats of cold galvanising paint in accordance with Snowy Technical Standard SHL-GEN-123 Protective Coatings to the fence post termination point after connection ensuring a complete painted cover of the earth palm, the cable crimp lug and connection bolt.

### Earthing of palisade, weldmesh, or chainmesh

Earthing of palisade and weldmesh fence panels must be in accordance with Snowy Hydro Technical Standard SHL-ELE-128 & SHL-ELE-156(K). However, for chainmesh fences the following shall apply:

1. Reconnect all existing fence line earth grid tails to the chainmesh using 70 mm2 insulated copper cable fitted with one high compression crimp lug for connections to the chainmesh plates. Where required, use one high compression crimp link for connections to the existing earth grid grading ring tail.
2. Existing and new connection points to the chainmesh fence must comply with the following:
	1. All nuts, bolts and washers must be stainless steel G316. Install the bolts with the head facing the outside of the fence line.
	2. Terminate the earth grid grading ring tail via the compression lug onto one of the stainless steel bolts. Nuts and bolts should be of different grades to prevent binding. (Bolts ‘304/A2 70’ and nuts ‘316/A4 70’). The earth grid conductor must be brought up on the inside of the fence line; the termination point must be inside the substation fence line.
	3. Electrolytic corrosion must be prevented from occurring between bare copper conductors and metal structures. Use only tinned copper where contact between copper earthing cables or busbar and steel structures may occur.
	4. The earth connection point must be free of corrosion, oxidisation or paint before and after the earth connection is made.
3. Where the new fence line intersects the existing earth grid, connect the earth grid to the fence line in the manner stated above. Where no existing earth grid connection is apparent, termination points must be installed as specified in the project requirements statement . This can be referenced from the Earth grid drawing in the appropriate site-specific schedules.
4. Gates must be connected to the substation earth grid grading ring using insulated flexible copper cables. Use 70 mm2 insulated flexible copper cable fitted with a high compression crimp lug to both ends. Terminate the cable lug to both the adjacent gate post-earth palm and the designated earthing palm welded to the lower portion of the gate adjacent to the gate frame.
5. A cable with a minimum length of 300 mm is an approved method for earthing pedestrian gates.
6. A cable with a minimum length of 500 mm is an approved method for earthing hinged vehicular gates.
7. A 95 mm2 insulated cable with a minimum length of 12 m attached at multiple points to a catenary wire runner is an approved method for earthing sliding vehicular gates.
8. Care must be exercised when excavating the concrete plinth and the post footings to ensure no earth grid or earth grid grading ring conductors are severed.
9. Any damage inflicted on the earth grid must have immediate temporary repairs, such as bridging, undertaken. This includes repairing broken individual strands of earth conductor, physical damage to the earth conductor from excavator damage and physically severing the earth conductor. Any earth grid damage and repair must also be documented, photographed, and recorded.
10. All electrical and earthing termination works on site must be in accordance with AS 3000 and AS 2067 and undertaken and completed by a licenced electrical Contractor. On completion of the earth grid and fence earthing works and prior to ground reinstatement, an electrical continuity test shall be performed for the new earth grid and fence line.

## Internal fenced enclosures

All substation equipment enclosures or substation internal fences, unless detailed otherwise within project specifications, are to be constructed as per perimeter security fences and gates, subject to the following exceptions.

1. Animal guard or skirting is not required unless stated in the site-specific schedule.
2. The fences should be chainmesh and the height can be lower than the perimeter fence but not less than 1200mm.
3. Internal fences do not require barbed wire around the top of the chainmesh
4. Warning signs are required for substation EHV or HV ground-mounted equipment enclosures as specified in Snowy Hydro Technical Standard SHL-GEN-131 High Voltage Danger Sign Requirements . However, warning signs are not required for other substation internal fences unless specified in the project specification.
5. Internal fences shall be located such that:
	1. a minimum internal horizontal clearance of 1000 mm exists for all equipment; and
	2. at least the minimum electrical safety clearance is maintained from live equipment according to Snowy Hydro Safe Access Distances (SADs) and AS 2067.