

Substation Design Instruction

Switchyard surfaces

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Substation Design Instruction

Asset Standards & Design

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SDI 523 Switchyard surfaces

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1.0 PURPOSE

To outline the minimum requirements for switchyard surfaces in transmission/zone substations and switching stations.

2.0 SCOPE

This instruction outlines the minimum requirements for preparing switchyard surfaces, and it **must** be read in conjunction with Substation Design Instruction SDI 505 – Minimum requirements for design and construction of transmission and zone substations, Earthing Design Instruction EDI 516 – Major substation earthing design, construct and commissioning, and the approved earthing design.

3.0 REFERENCES

Internal

- Company Policy 9.2.5 – Network Asset Design
- Company Policy 9.7.1 – Network Asset Construction
- Company Procedure GSY 1066 – Worksite Hazard and Risk Assessment
- Endeavour Energy Network Management Plan
- Endeavour Energy Electrical Safety Rules
- Earthing Design Instruction EDI 516 – Major substation earthing design, construct and commissioning
- Environmental Management Standard EMS0001 – Environmental impact assessment and environmental management plans
- Substation Design Instruction SDI 505 – Minimum requirements for design and construction of transmission and zone substations and switching stations
- Substation Design Instruction SDI 510 – Buildings
- Substation Design Instruction SDI 514 – Access roads and driveways

External

- ENA National Electricity Network Safety Code (Doc 01-2008)
- Work Health and Safety Act 2011 (NSW)
- AS 1289.0:2014 - Method of testing soils for engineering purposes – **Definitions and general requirements**
- AS 1289.5.1.1:2017 - Method of testing soils for engineering purposes - Soil compaction and density tests – Determination of the dry density/moisture content relation of a soil using standard compactive effort
- AS 5577 – 2013 – Electricity network safety management systems

4.0 DEFINITIONS AND ABBREVIATIONS

EDI

Earthing Design Instruction

HV

high voltage

SDI

Substation Design Instruction

VENM

virgin excavated natural material

5.0 ACTIONS

5.1 General

The switchyard surface design **must** be in accordance with this instruction and the substation earthing design approved by the Substation Primary Design Manager.

If the requirements of this standard and/or the switchyard surface design conflicts with the approved earthing design then the switchyard surface preparation or construction **must** not proceed until satisfactory approval is given by both the Substation Primary Design Manager and the Substation Assets Manager. Refer also to clause 5.3 for backfilling requirements.

Refer also to SDI 514 for details relating to access roads and driveways within the substation.

5.2 Switchyard excavation

Before any soil is excavated, appropriate environmental controls such as sediment control **must** be in place to prevent the entry of soil into waterways such as drains and streams in accordance with EMS 0001.

All work **must** comply with the local council requirements, as specified in the Development Application certificate.

Level switchyards are preferred; however their preparation can incur substantial civil costs on certain sites. Therefore, when the switchyard land is sloping, a cost benefit analysis **can** be performed to decide whether the switchyard should be levelled or terraced, or be a combination of these options.

As a minimum, the following **must** be considered in the cost benefit analysis:

- excavation costs;
- safety issues – clearances, retaining walls and handrails;
- maintenance issues and additional costs incurred during maintenance; and
- future expansion of the switchyard.

The surface of the proposed switchyard **must** be stripped of all vegetation, top soil and debris. Tree stumps **must** be removed.

Areas of land that are unstable, or unsuitable to remain under or to bear the new construction, **must** be removed.

Soil that is excavated for laying the earth grid **will** be kept for backfilling purposes.

Prior to laying the earth grid, the site **must** be fenced and secured.

The earth grid **must** be laid in accordance with EDI 516 – Major substation earthing design, construct and commissioning, and the approved earthing design.

5.3 Switchyard backfill

The earthing system design is based on the soil electrical resistivity test results carried out for the site and therefore it is necessary to use the original soil when backfilling.

Where the original soil quantity is insufficient to fully backfill the openings, possibly due to compaction, then additional soil of similar electrical resistivity to the original soil **must** be used.

All soil used to backfill **must** comply with the geotechnical report and the following minimum requirements:

- be free from organic, combustible, contaminating and perishable matter;

- be certified clean fill (for example, VENM);
- have a maximum particle size of 25mm; and
- have a plasticity index between 2% and 15%.

For backfill soil with heightened concern for corrosion, suitable bedding must be used as outlined in EDI 516.

All backfill material must be placed in horizontal layers of a maximum 200mm thickness, and compacted at optimum moisture content to achieve a field dry density of not less than 98% of standard dry density, tested in accordance with AS 1289.5.1.1.

When work is carried out in an existing switchyard, areas where cables and ducts are buried underneath must not be compacted.

5.4 Stormwater drainage

The switchyard must be contoured, typically between 1.5% and 2%, to prevent water from ponding, and subsurface drainage must be installed to remove water rapidly from the area after rainfall has ceased.

5.5 Final switchyard covering

To reduce step and touch voltages, a high resistivity material must be laid as a final covering in the switchyard. Unless the approved earthing design requires otherwise, the high resistivity material must be crushed igneous rock (blue metal) with an electrical resistivity and minimum depth in accordance with EDI 516.

The crushed rock must consist of 20mm diameter single size aggregate, washed and cleaned.

Before installing the crushed rock, the earth grid and all conduits and drainage must be installed, and the top soil must be removed and be replaced with road base to make the switchyard trafficable and to limit the growth of weeds.

The crushed rock must be levelled flush to the surface of items such as cable trenches.

Blue metal must extend past the backfilled area by a minimum of 200mm on all sides. See Figure 1 below.

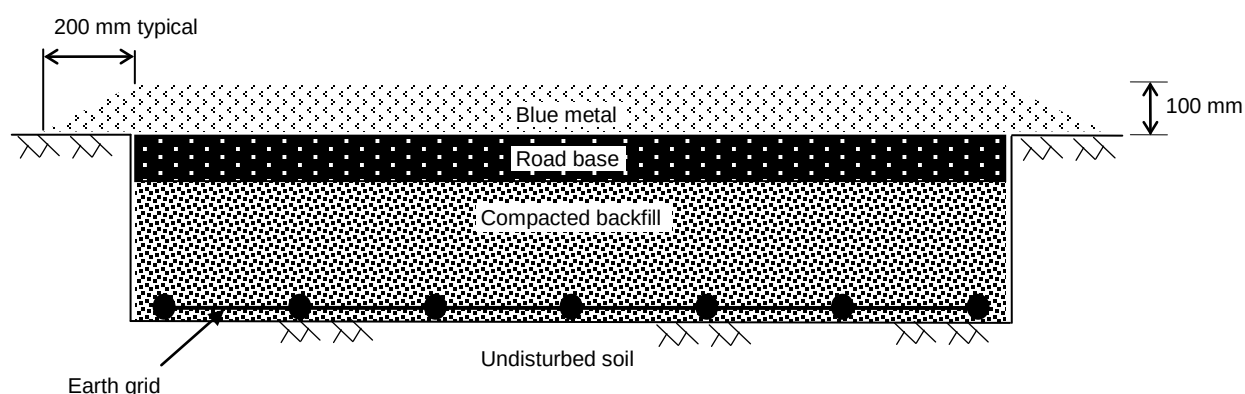


Figure 1: Typical switchyard excavation

The maximum grade on switchyard surfaces must be 10% fall.

5.6 Asphalt as an alternative to blue metal

Where high voltage equipment such as 33kV voltage transformers and HV capacitors are enclosed in cages and an outage is required to enter the cage, blue metal **must** not be laid inside the cage. Instead, the ground **must** be sealed with asphalt to prevent the growth of weeds and to reduce maintenance outages.

The asphalt **must** be laid evenly up to the cage perimeter fence and it **must** be compacted to a final layer of 50mm minimum thickness in accordance with figure 2.

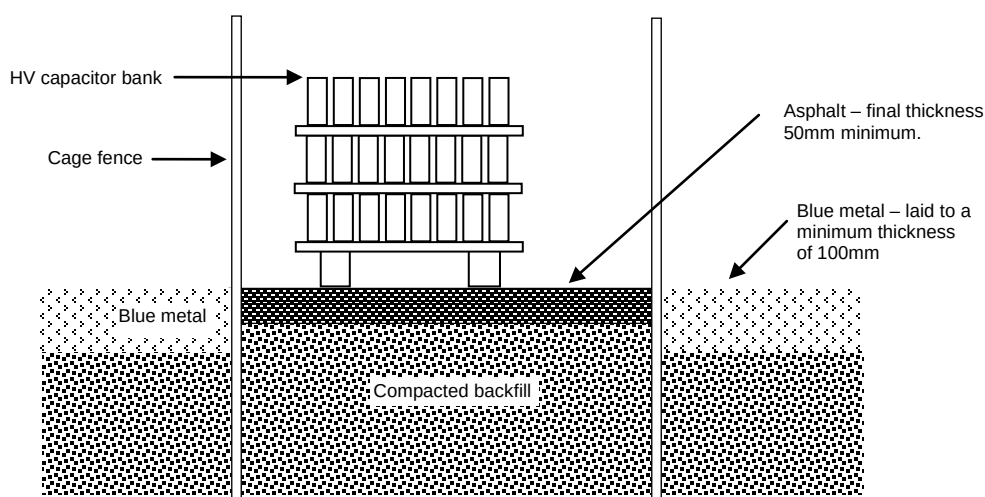


Figure 2: Laying of asphalt inside HV cages

In other areas of the substation, where weeds are seen as a problem, asphalt **can** be considered as an alternative to blue metal.

6.0 AUTHORITIES AND RESPONSIBILITIES

Manager Asset Standards & Design has the authority and responsibility for making recommendations to the **General Manager Asset Management** in respect to this instruction.

Substation Assets Manager has the authority and responsibility for keeping the content of this instruction up to date.

All **Endeavour Energy employees and/or contractors** have the authority and responsibility for:

- meeting the requirements of this instruction and SDI 505;
- working in accordance with local and statutory requirements; and
- working in accordance with Endeavour Energy's Electrical Safety Rules and systems when conducting works associated with this instruction.

All **Project Managers and Design Engineers** have the authority and responsibility for:

- meeting the requirements of this instruction within their area of responsibility; and
- overseeing that Endeavour Energy employees and/or contractors engaged to perform the work have appropriate qualifications and experience.

7.0 DOCUMENT CONTROL

Documentation content coordinator: **Substation Assets Manager**

Documentation process coordinator: Standards Process Coordinator