# Section 9

# High Voltage Electrical Installations

# Section 9 – Contents

# Section 9 – Contents (continued)



# Appendix A – Contents

## 9.1 Scope

This Section details a Distributor's requirements for Customers taking supply at high voltage, up to and including 22 kV and provides guidance for 66 kV installations. The purpose of this Section is to ensure the Customer's high voltage installation consists of suitable equipment, provides a safe environment to operating personnel and the general public and does not adversely affect the Distributor's supply system.

These requirements are additional to the requirements of Electricity Safety Act and Regulations and apply to both new installations, and alterations or extensions to existing Customer installations.

For loads above 10 MW which are either likely to grow or cause significant voltage fluctuations to the Distributor's supply system, supply at 66 kV should be considered.

This section also applies to embedded generators connecting to the network at high voltage.

## 9.2 Contractual Arrangements

A Customer requiring a supply of electricity at high voltage shall be required to enter into:

- an Electricity Supply Contract with a Retailer; and
- a specific electricity distribution connection agreement or contract or a deemed electricity distribution contract.

And where applicable:

- an Extension Agreement with the Distributor; and/or
- an electricity distribution demand tariff agreement or contract

Refer to the Essential Services Commission for additional information for electricity market operation.

## 9.3 Systems of Supply

The Distributor will negotiate the system of supply and the voltage of supply with regard to the proximity of its relevant high voltage systems to the Customer's point of supply and the nature of the Customer's load.

One of the following nominal supply voltages may be made available :–

- 6.6 kV;
- 11 kV;
- 22 kV; or
- 66 kV.

As most of the existing 6.6 kV areas of supply are scheduled for conversion to either 11 kV or 22 kV, any Customer currently taking supply at 6.6 kV should take this into account.

The supply shall be made available at a nominal frequency of 50 hertz (cycles per second).

## 9.4 Preliminary Information

The Customer should provide the earliest possible notice (preferably 12 months) to their selected Retailer and the Distributor of the intention to plan for a high voltage supply.

The following preliminary information shall be provided to the Distributor:

- A single line diagram of the proposed installation. (Refer Figure 9.1)

- An overall site plan showing the location of the HV equipment;
- The preferred Point Of Supply (new installation);
- The anticipated maximum demand (MVA) required for the installation;
- Any proposed on-site generation;
- Any disturbing loads (eg. large motors, arc furnaces, etc).

Negotiations should precede detailed design work, placement of orders for equipment and letting of contracts to avoid loss to the Customer arising from designs or equipment being found by the Distributor to be unsuitable for connection to the supply system.

## 9.5 Installation Design

The installations supply, protection, earthing and metering arrangements shall be:

- Installed to the satisfaction of the relevant Distributor; and
- Arranged to comply to the requirements of clause 6.5 (Supply Loading) and the Electricity Distribution Code in respect to interference to the Distributor's supply system: and
- Comply with all applicable Regulations , Codes of Practice and these Rules.

Standards which should be referenced and installation components which should be considered include the items listed in the Appendices attached to this Section.

## 9.6 Conversion from Low Voltage to High Voltage Supply

Taking supply at high voltage may involve the transfer of ownership of high voltage assets. It may also be necessary to modify existing assets to comply with the Electricity Safety Act. These contract conditions are to be negotiated with the Distributor.

## 9.7 General Design

### 9.7.1 Circuit Connections

The normal supply arrangement is via a single Distributor high voltage feeder.

Arrangements can usually be made for a second high voltage feeder where required. Paralleling of high voltage feeders may be permitted subject to the conditions as detailed in Clause 9.7.2

### 9.7.2 Control of Incoming High Voltage Supply

The main switch or switches shall consist of an automatic circuit breaker capable of making and breaking the maximum prospective fault currents on all three phases.

The main switch or switches shall be:

- located as near as possible to the Customer's Point of Supply; and
- readily accessible to authorised persons; and
- provided with adequate means of isolation for maintenance purposes.

Normally, where more than one high voltage supply is provided to a Customer, the main switches shall be interlocked in such a manner that paralleling of the high voltage supplies shall not be possible.

Where technically feasible, consideration will be given to allowing momentary paralleling of the Distributor's high voltage feeders, to permit transfer from one feeder to the other without interruption to supply.

Permanent paralleling of high voltage feeders to provide a no break supply may also be considered, subject to the installation of additional protection at the zone substation and the Customer's installation at the Customer's expense.

## 9.8 Protection

The main switch or switches shall be fitted with a protection system which is compatible with the Distributor's high voltage protection system. The Customer shall test the main protection system at the time of commissioning the installation to demonstrate that the performance meets the design parameters.

Prior to placing orders for equipment the customer shall discuss the installations protection requirements with the Distributor.

All circuit breakers shall be fitted with at least three phase overcurrent and earth fault protection that incorporates three phase tripping (lockout) as a minimum. More complex protection arrangements may be required, in particular cases to meet acceptable protection performance criteria depending on the Customer's installation arrangement, the Distributor's system arrangement and the required protection performance levels.

It is preferred that current transformers for overcurrent protection be located on the supply side of the main circuit breaker.

Protection settings and equipment shall be subject to the acceptance of the Distributor prior to commissioning. Any modification of the settings shall be subject to the acceptance of the Distributor.

In general the Customer's primary phase fault protective devices for faults at the voltage level of the supply shall detect and clear the bolted short circuit faults not greater than 150 milliseconds at the fault level nominated at the point of supply. Any proposed operating time greater than 150 milliseconds shall be discussed with the Distributor at an early stage.

## 9.9 Insulation Co-ordination

The safety clearances, separation of live parts, and insulation levels (impulse strength) shall be in accordance with AS 2067 and AS 1824.1.

## 9.10 Short Time Withstand Current

High voltage switchgear, conductors, associated equipment and earthing systems shall be capable of withstanding the maximum fault current which may be imposed on it for a duration of at least one second and in some instances for three seconds.

The maximum design fault current for the various supply voltages are as follows:

- 66 kV - 21.9 kA (2500 MVA)
- 22 kV - 13.1 kA (500 MVA)
- 11 kV - 18.4 kA (350 MVA)
- 6.6 kV - 21.9 kA (250 MVA)

Actual fault currents and their maximum duration at any particular location on the Distributor's high voltage system will be made available upon request.

# 9.11 Earthing

## 9.11.1 General

The earthing system of the Customer's high voltage installation shall comply with AS/NZS 3000 and these Rules.

Special attention should be paid to the management of "step and touch" potentials that may occur under earth fault conditions associated with any earthing system installed within a customer's installation. Particular attention should be paid to the separation of independent earthing systems and the proximity of earthed infrastructure such as metallic fences and buildings to earthing systems so as to avoid the possibility of hazardous step and touch potentials.

Earthed primary neutral windings are not permitted on any transformer of the nominal supply voltage. It is recommended that the Customer use Delta–Star transformers to comply with this requirement.

## 9.11.2 Size of Earthing Conductors

Earthing systems shall be designed to withstand the maximum system design fault current levels as specified in clause 9.10 (Short Time Withstand Currents).

All conductors used within the customers installation for combined or separate earthing systems shall have a minimum equivalent copper cross–sectional area as follows :–

- Subtransmission voltage earthing conductors: 66kV – 120 $mm^2$;
- High voltage earthing conductors:
  - 22 kV – 70 $mm^2$,
  - 11 kV – 95 $mm^2$;
  - 6.6kV – 95$mm^2$
- Low voltage earthing conductors : 120 $mm^2$;

## 9.11.3 Earthing of Metering Equipment

The enclosure of the meter, metering transformers and any metal supporting structure/s shall be connected to the same earth grid as the Current Transformer and Voltage Transformer secondaries (see Figures 9.5 and 9.6). The size of earthing conductors used for this purpose shall be in accordance with clause 9.11.2 (Size of Earthing Conductors).

A suitable earth grid is required for all metering installations. The specifications contained in Figure 9.6, concerning the earthing grid, are minimum requirements

# 9.12 Distributor's Acceptance Requirements

The Customer shall submit the following details for written acceptance prior to supply at high voltage being made available:

- Final single line diagram;
- Agreed maximum demand;
- Main circuit breaker specification;
- Protection settings for main circuit breaker;
- Compliance to Distribution Code, eg. Systems study, etc;
- Copy of HV Metering VT and CT test certificates – refer to clause 9.13.3 (Metering Transformers)

Before final connection is made the customer must provide :

- The Electricity Suppliers Copy of the prescribed Certificate of Electrical Safety;
- A copy of:
  - the installations HV operating procedures; Refer to Clause 9.15.1 (Operating Procedures)
  - commissioning and test certificates as determined by the Customer and as prescribed by AS/NZS 3000 which must include trip tests on the incoming circuit breaker; Refer also to clause 9.14 (Testing and Commissioning)
  - HV plant and equipment maintenance plan. Refer to Clause 9.15.3 (Maintenance)
- Contact details for Customer authorised HV operators; Refer to Clause 9.15.2 (Trained Operators)
- HV clearance to energise the installation;

## 9.13 Metering

The following high voltage metering requirements are applicable to single feeder high voltage installations (up to 66 kV) and are consistent with the National Electricity Code, the Victorian Electricity Supply Industry Metrology Procedures and the Electricity Customer Metering Code.

Other high voltage installations such as dual high voltage feeders and cogeneration installations will require additional provisions.

### 9.13.1 General Requirements

Metering equipment shall be installed by the Meter Provider in accordance with the applicable requirements of Section 8 LV Metering and the following specifications. These include:

- A clear, illuminated (during normal business hours), paved and level space as specified in Clause 8.9 (Access), shall be provided in front of the metering position to allow access for meter reading and to accommodate test personnel and their equipment. A clear space 1.0 m deep is required in front of the meter position for safe access by Meter Provider and Distributor personnel.
- Access must be direct (ground floor), or by stairs or lift. Ladder access is not acceptable.
- Metering equipment shall not be installed in unsuitable locations as described in Clause 8.8.5 (Unsuitable Metering Locations) and in locations where an entry permit is required.
- Metering equipment must not be subjected to industrial contamination, extremes in temperature, or vandalism.
- Enclosures must comply to the same requirements contained in Clause 8.4 (Metering Panels, Surrounds and Enclosures).

### 9.13.2 Single Feeder Metering Requirements

#### 9.13.2.1 Meters Panels

The customer shall provide the meter panel/s and a suitable enclosure or surround for mounting a lift–off hinged panel on which to mount the metering equipment. For details see Figures 8.4 and 8.5.

A clear space of 2.1 m high by 1.2 m wide is required to provide access for mounting of metering equipment. See Clause 8.8 (Location).

The minimum size meter panel for HV metering shall be 600mm X 600mm, however in some cases a 900mm high and 600mm meter panel may be required.

Meter enclosures shall comply with Clause 8.4. The door on meter enclosures shall be labelled "**Electricity Meters"**.

The Meter Provider will normally provide and install the wiring for the meter panel.

#### 9.13.2.2 Freestanding Meter Enclosures

The Customer shall install and maintain:

A metering enclosure (cubicle) complying with the requirements of Clauses 8.4 (Meter Panels, Surrounds and Enclosures)

The metering enclosure (cubicle) foundations and supporting structure to the specifications shown in Figures 9.2 & 9.4.

A formed all–weather roadway for vehicles to the meter position.

### 9.13.3 Metering Transformers

#### 9.13.3.1 Compliance

Voltage transformers shall comply with AS 1243, "Voltage Transformers for Measurement and Protection", and the current transformers shall comply with AS 1675, "Current Transformers for Measurement and Protection". The transformers shall meet the performance requirements detailed in Table 9.1.

The metering transformers shall be solely for metering purposes and are not to be used for other purposes such as protection or load monitoring.

Metering transformers mounted within the Customer's high voltage switchgear shall only be acceptable if approved by a Meter Provider.

Test certificates from a NATA registered laboratory shall be provided to the relevant Distributor and the Meter Provider prior to installation. The test certificate shall show conclusive evidence that the transformers comply with the relevant Australian Standard specification.

The following minimum information shall be written in English and be included on the test certificate:–

- Serial No.
- Make
- Rating
- Burden
- Class
- Specification
- Date of Test
- Proof of compliance with high voltage insulation requirements.
- Test ratio(s), Burden(s), Currents, Voltages. Absolute values of Magnitude and Phase
- Errors at each test point.
- Statement of uncertainty in determination of errors.

#### 9.13.3.2 Test Facilities

A current transformer test marshalling point shall be provided within the meter cubicle for Burden testing in a readily accessible location. The test marshalling point shall be fitted with sealing facilities for the Meter Provider.

These facilities must not be located within the high voltage chamber. Refer to Figure 9.7 for a typical wiring diagram test marshalling point.

### 9.13.3.3 Mounted in Switchgear

The following requirements must be met when metering transformers are mounted in high voltage switchgear:–

- The metering transformers must be mounted within a HV chamber which is able to be placed under the Meter Providers seals. The HV chamber design must be approved by the Meter Provider prior to purchase and construction.
- The layout of the transformer will be such that identification of transformer polarities can be readily established, and such that there is ready access to the secondary terminals of all transformers.
- No other devices apart from metering equipment (with the exception of anti-condensate heaters) shall be located within the HV chamber.
- The voltage transformers will be permanently mounted within the metering HV chamber.
- The secondary terminals of the metering transformers must be easily accessible.
- The secondary windings of the voltage transformers shall be protected with 32 Ampere HRC off set tag fuse cartridge and fittings equipped with 10 Ampere fuse links located with the test marshalling point.
- The white phase secondary winding of the voltage transformer, which is earthed, must not be fused. Refer Figure 9.7.
    - The metering transformers shall be installed on the supply side of the Main Incoming Circuit Breaker. Provision for Customer switching or isolation prior to the metering transformers is not permitted.
    - Secondary wiring from the current transformers test marshalling point to the meter position shall be hard wired.
    - Provision shall be made within the HV chamber for the bonding of all high voltage conductors to earth, to facilitate disconnection of supply and work to be carried out on the metering transformers.
    - The current and voltage transformers shall be completely encapsulated with the secondary terminal box part of the resin body of the transformer.

### 9.13.3.4 Supplied From an Underground Cable

#### (a) Located Outdoors

Metering transformers shall be installed within an enclosure mounted on a concrete pad supplied and installed by the Customer in accordance with Figure 9.5 and 9.4.

#### (b) Located Indoors

Where metering transformers are located indoors and enclosed in a cage or cubicle, the requirements of Clause 9.13.3.1 (Compliance) shall apply in addition to the following.

The transformer enclosure shall be designed and installed in accordance with the requirements of AS 2067. A cubicle shall comply with, and meet at least the minimum space requirements as shown in Figure 9.5.

The Customer shall provide and install a minimum of a 32mm conduit for the secondary wiring from the transformer enclosure to the metering position. Secondary wiring will be supplied by the Meter Provider, but shall be installed by the Customer in those conduits.

The enclosure shall also contain a suitable earthing bar between the CT's and VT's to allow for the earthing of secondary wiring circuits.

Locking facilities suitable for padlocks (10 mm hasp) must be provided for securing of the metering transformer enclosure.

#### 9.13.3.5 Pole Mounted Metering Transformers – Overhead Supply

The customer shall supply and maintain the pole and attached hardware to support the Distributor's metering transformers.

Pole mounted metering transformers shall be mounted on a pole structure in the manner shown by Figure 9.3.

**Table 9.1 Metering Transformers Performance Requirements**

| DESCRIPTION | REQUIREMENT |
|---|---|
| **Voltage Transformers** | |
| ratio – 11 kV | 11 000 / 110 V |
| ratio – 22 kV | 22 000 / 110 V |
| class | 0.5 M |
| rated burden | 4 mS for three phase units or 12 mS for single phase units |
| rated output | 50 VA (min) |
| voltage factor | 1.9 / 30 s |
| insulation level – 11 kV | 28 kV (PFWV), 95 kV (LIWV) |
| insulation level – 22 kV | 50 kV (PFWV), 125 kV (LIWV) |
| **Current Transformers** | |
| ratio | 100 – 200 / 5 A or 200 – 400 / 5 A |
| class | 0.5 M |
| rated burden | 0.6 ohm |
| rated output | 15 VA |
| thermal limit current | |
| 100 – 200 / 5 Amps | 300 A |
| 200 – 400 / 5 Amps | 600 A |
| rated short time current – 11 kV | 18.4 kA / 2 s |
| rated short time current – 22 kV | 13.1 kA / 2 s |
| insulation level – 11 kV | 28 kV (PFWV), 95 kV (LIWV) |
| insulation level – 22 kV | 50 kV (PFWV), 125 kV (LIWV) |

## 9.14 Testing and Commissioning

The Electricity Safety Act requires that an inspection of new or altered high voltage equipment constituting prescribed work must be performed in accordance with the regulations prior to connection of supply.

The high voltage equipment shall be tested on site in accordance with the requirements of the Wiring Rules and other relevant Australian Standards as deemed necessary by the Distributor. These tests shall be performed by a competent testing organisation.

Routine test reports on all high voltage electrical equipment up to and including the main switch shall be submitted to the Distributor for approval prior to supply being made available.

The Distributor will not connect the whole or any part of the installation which in the opinion of the Distributor is unsatisfactory for connection to the supply system.

## 9.15 Customer's HV Installation Operation and Maintenance

### 9.15.1 Operating Procedures

The Electricity Safety Act requires HV customer's to have, maintain and use up to date HV Operation Procedures and a trained operator.

The minimum operating procedures for customer's high voltage installations are set out in the ''Code of Practice on Electrical Safety in the Victorian Electricity Supply Industry (Blue Book)''.

The Customer shall provide to the Distributor a copy of the Customer's high voltage operating procedures, prepared in accordance with the "Blue Book".

### 9.15.2 Trained Operators

The Customer shall ensure that high voltage switches, other than control switches designated for the use of plant operators, shall be operated only by persons selected and authorised by the Customer for that purpose.

The customer shall ensure 24–hour availability of a suitably trained High Voltage Operator to undertake switching operations on the high voltage assets as required by the Distributor for the purpose of inspection of HV metering transformers, load shedding, routine maintenance and emergency repair of the incoming high voltage supply cable.

The customer must provide the Distributor with a current list of their authorised high voltage operators. This list must be made available to the Distributor's operational control centre.

### 9.15.3 Maintenance

A Customer who takes supply at high voltage shall ensure that the high voltage installation is maintained in good order to ensure that any malfunction will not create a hazard or cause interference to the Distributor's supply system.

The Customer shall provide a written maintenance proposal for the Main Incoming Circuit Breaker before supply is made available.

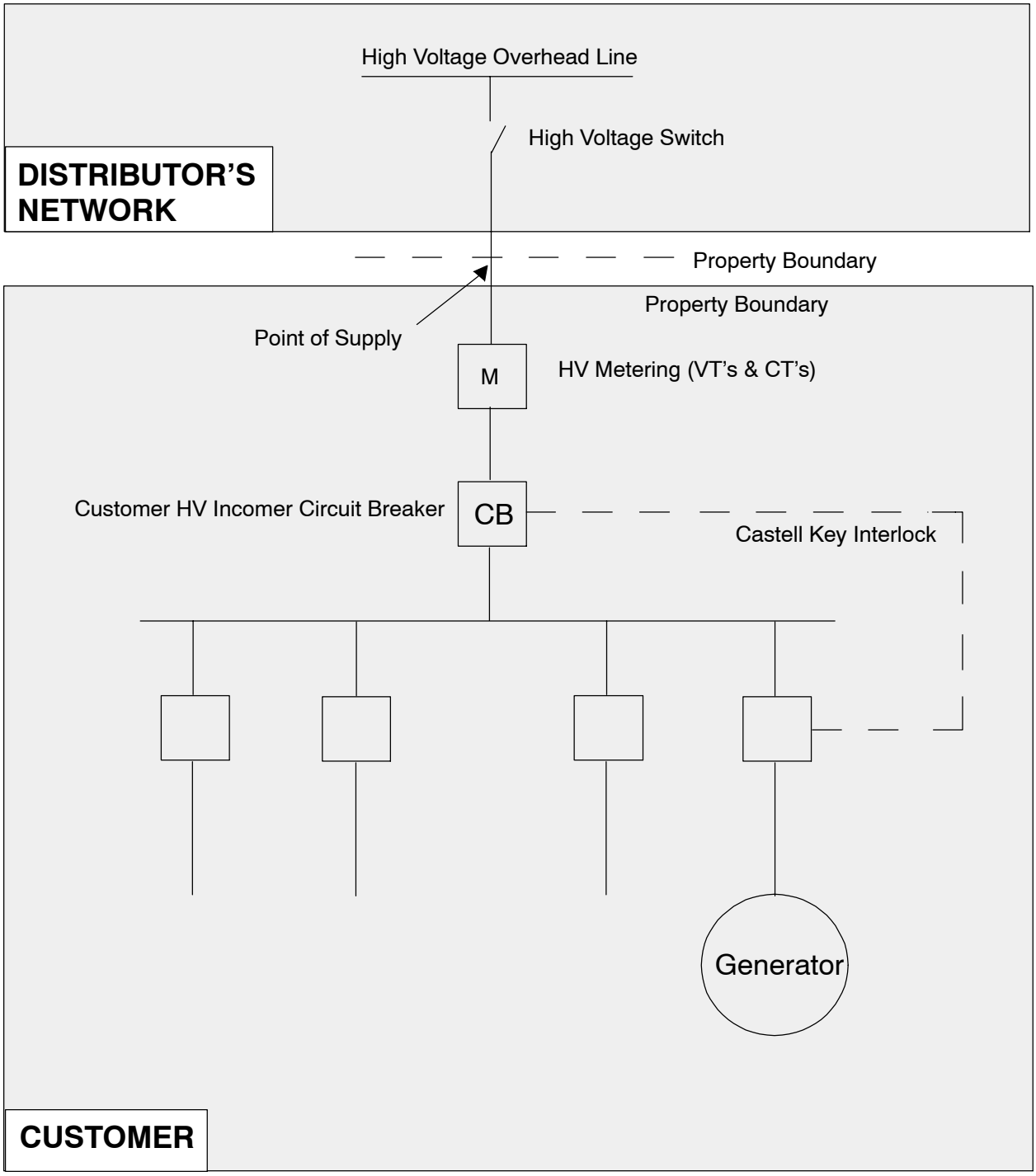



**Figure 9.1 HV Customer Example**

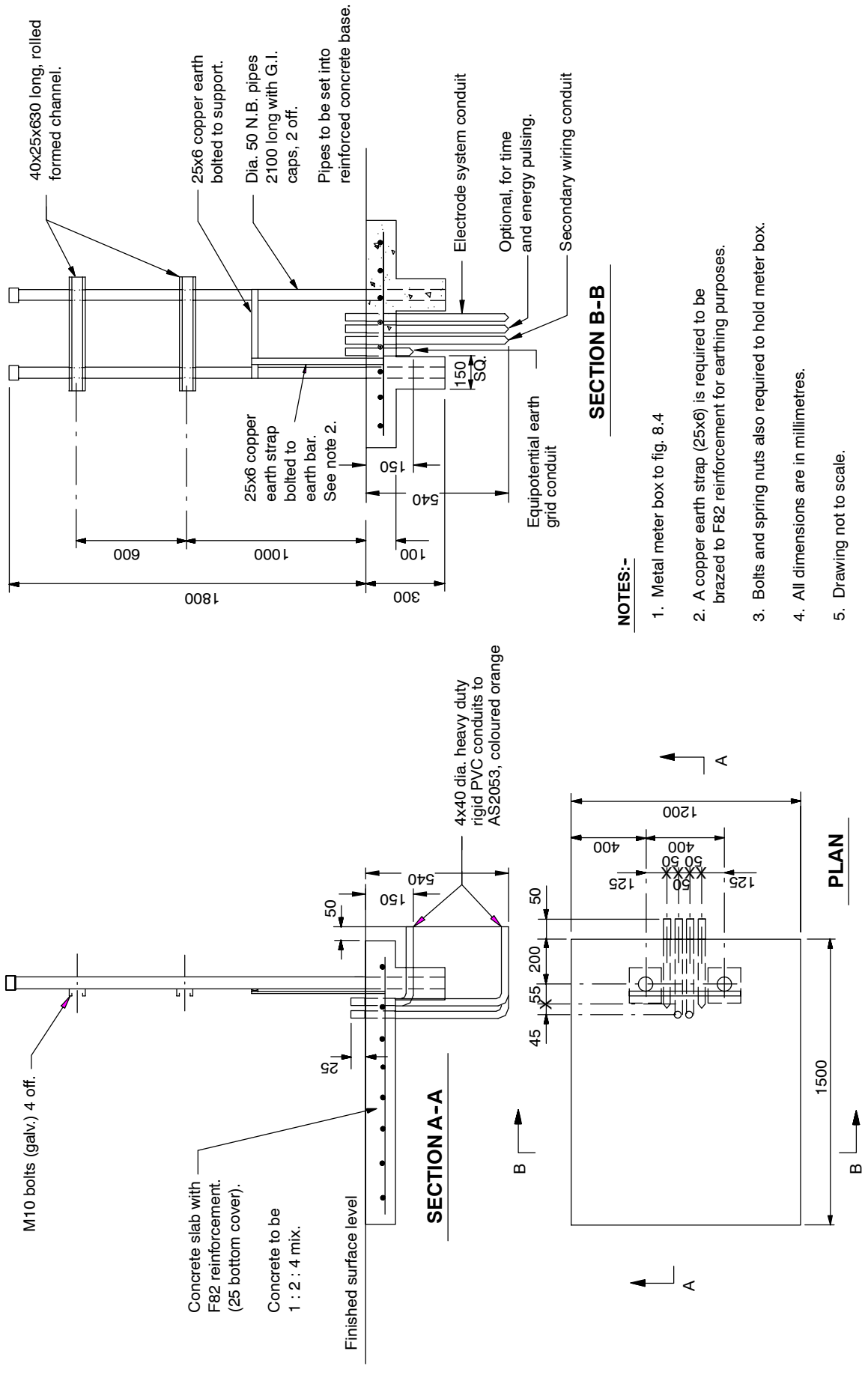



**Figure 9.2 H.V. Metering Structure - Foundation and Support Details for Meter Box**

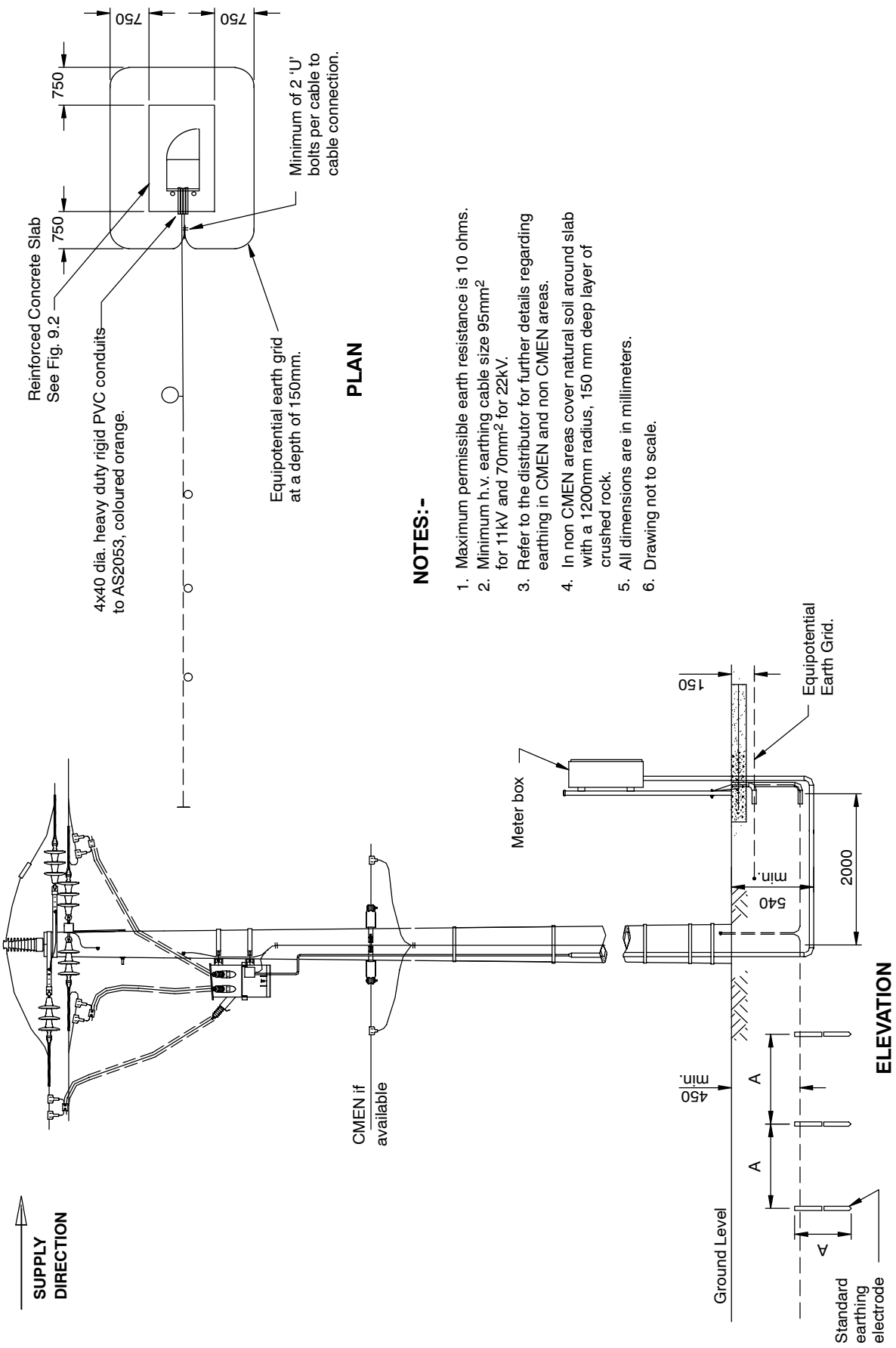
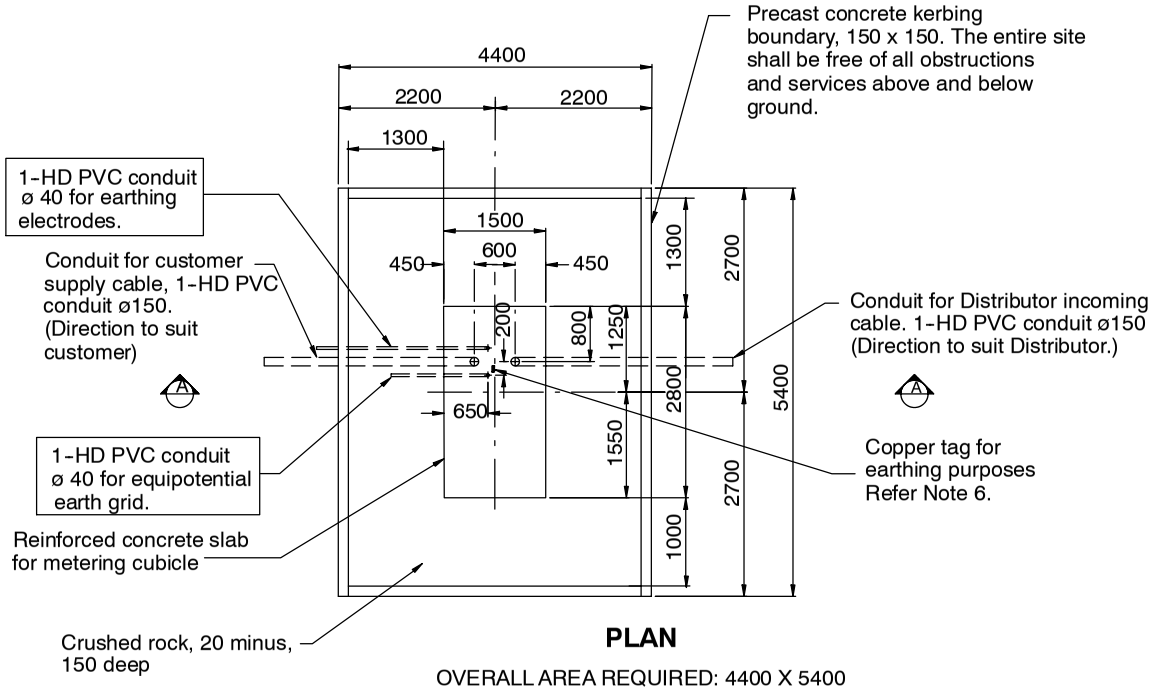
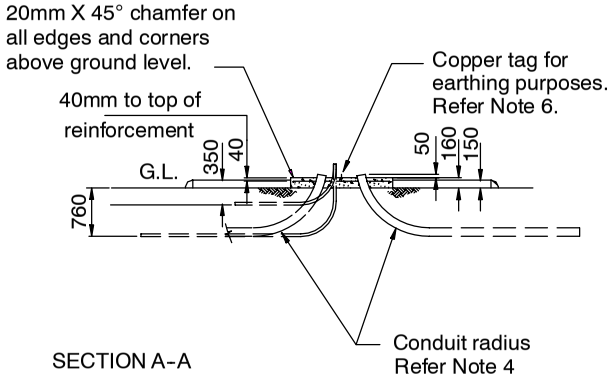



**Figure 9.3 11kV & 22kV Metering Installations - Earthing Diagram**




**NOTES :-**

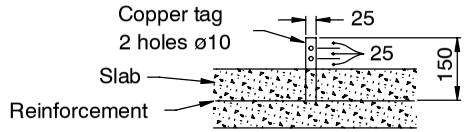
1. Concrete shall be graded 25MPa, and nominal slump shall not exceed 75mm. Concrete to have a hard surface, levelled and trowelled smooth. A suitable slope is required to ensure water run off.
2. Steel reinforcement shall comply with S.A.A. codes as follows: F81 wire fabric - to AS/NZS 4671 S12 plain bars - grade 230S to AS/NZS 4671 Reinforcement to have 50mm cover to all formwork & 40mm cover to top of footing.
3. Crushed rock under footings shall be compacted by three passes (minimum) of a wacker or other approved mechanical means.

4(a). Conduits for cables :- Heavy duty rigid PVC ø150mm to AS2053, coloured orange. Conduits to have 1020mm minimum radius bend where required, and terminate 50mm above slab level. Depth to invert level of conduits - 760mm min.

4(b). Conduits for earthing :- Heavy duty rigid PVC ø40mm to AS2053, coloured orange. Conduits to have 300mm minimum radius bend where required, and terminate 50mm above slab level.

4(c). All conduits fitted with removable plug in each end and all joints must be free of internal projections.

5. Site to be suitably drained.
6. A copper tag (25x6x150) shall be brazed to the reinforcement for earthing requirements. Tag as per the following detail:




7. All dimensions are in millimetres.
8. Drawing not to scale.

**Figure 9.4 Typical HV Metering Cubicle - Foundation Details**

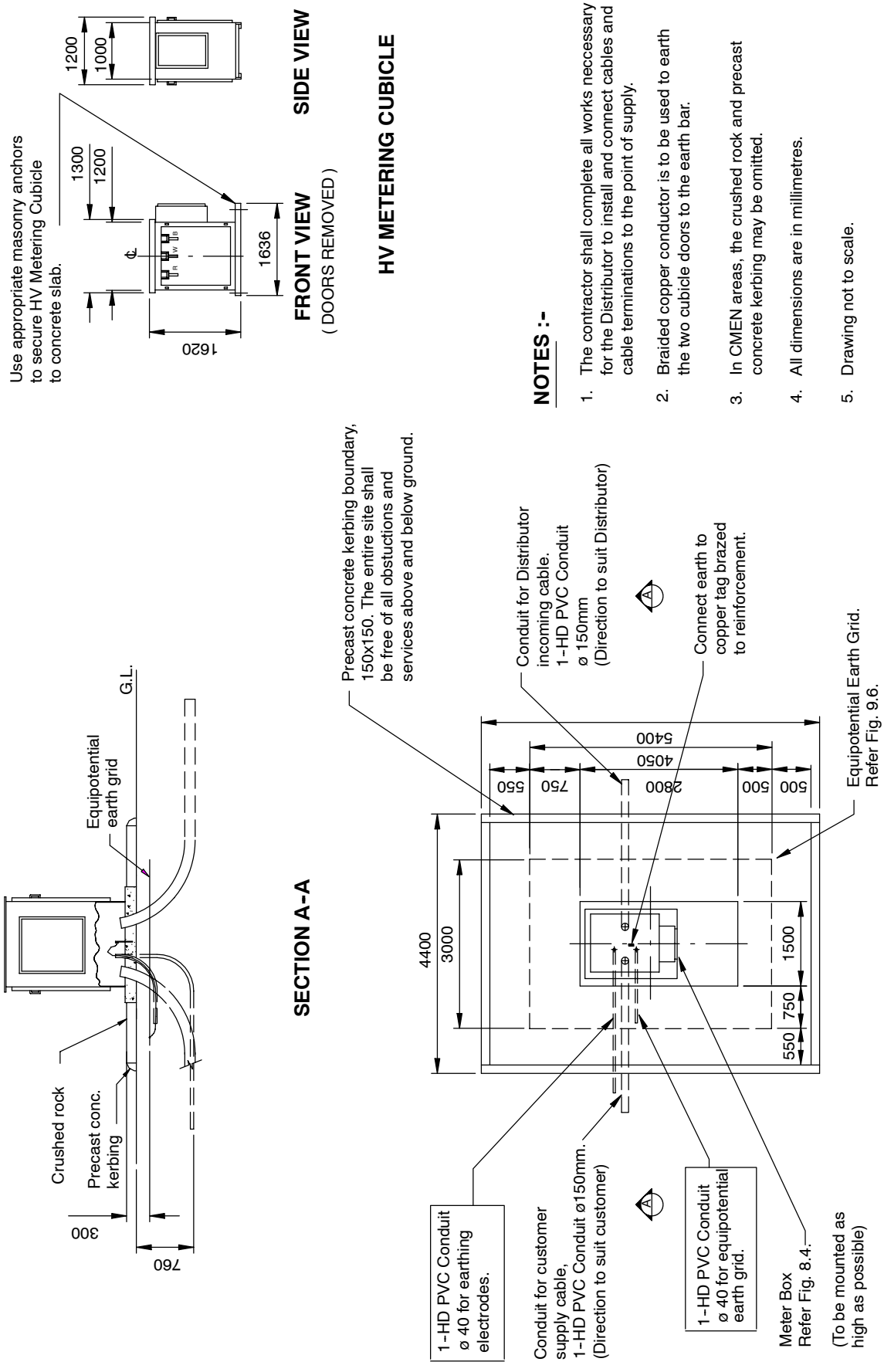



**Figure 9.5 Typical HV Metering Cubicle - General Arrangement**

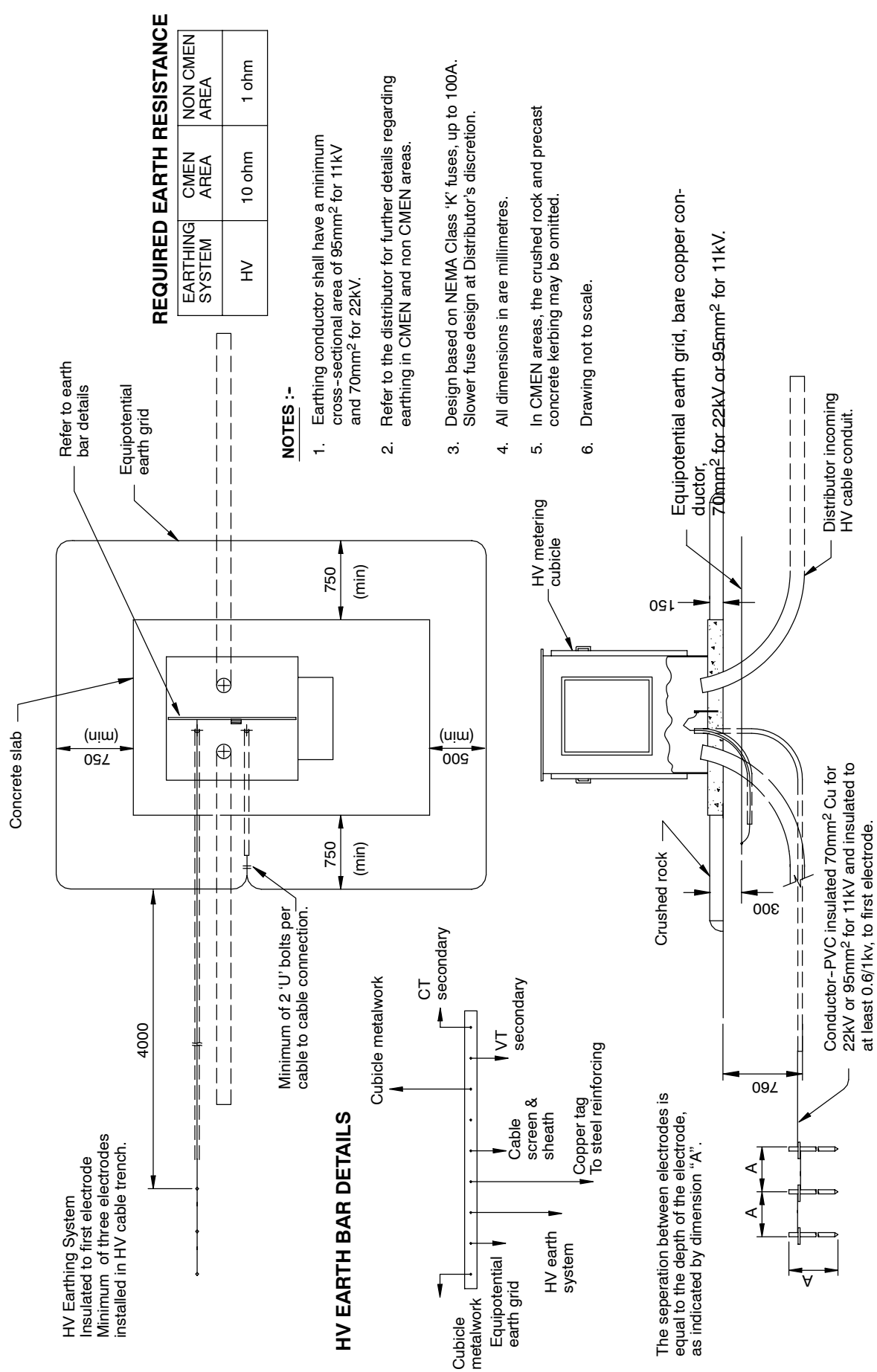
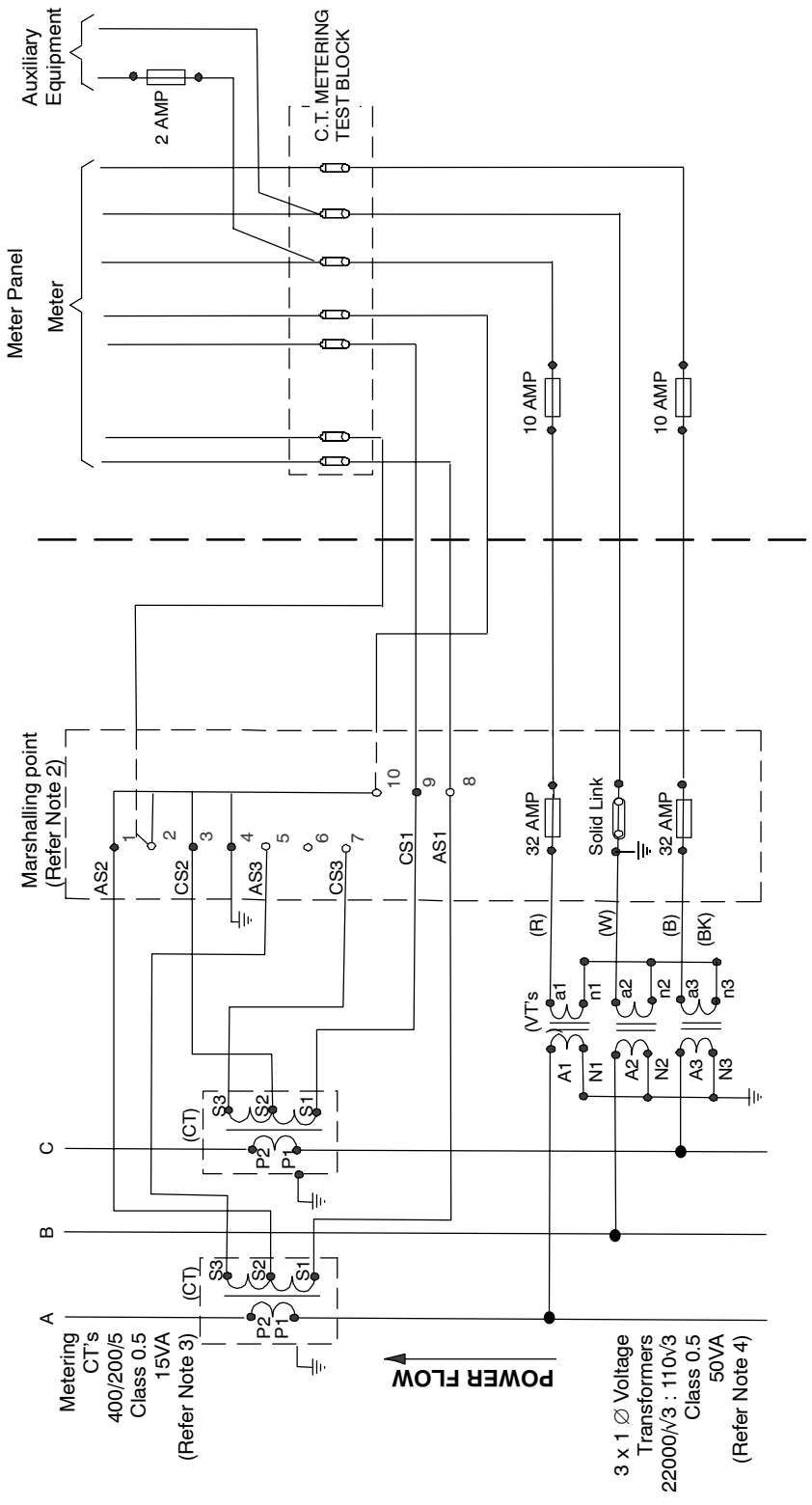



**Figure 9.6 Earthing Diagram - Typical HV Metering Cubicle**




**Note:**

1. CT wiring to be 4mm$^2$ copper, VT wiring to be 2.5mm$^2$ copper. CT and VT wiring to be 0.6/1.0kV, V90 PVC.
2. CT's and VT's are to be wired to the marshalling point, which is to be accessibly located to facilitate testing and tap changing purposes. CT and VT wiring to be brought out to the meter enclosure by the customer.
3. P1 of the CT's on the supply side.
4. VT star point to be connected across N1, N2 and N3.
5. Meter enclosures are to be located in accordance with Section 8 (LV Metering) and outside areas requiring persons to be authorised to enter.
6. Meter enclosures and surrounds are to be earthed in accordance with the requirements for earthing in Clause 9.11.3.

**Figure 9.7 Typical HV Metering Secondary Wiring Diagram**

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# Considerations for High Voltage Installations

This appendix is to provide advice to customers of some of the issues to be considered when planning for and designing a high voltage installation.

Consideration of the following is considered good industry practice.

## A1 Equipment and Standards

Relevant Australian Standards for plant and equipment, including, but not limited to :–

- Circuit Breakers AS 2006, AS 2067, AS 2086, AS 1824
- Transformers AS 2374
- Underground Cables AS 1026, AS 1429.1
- Motors AS 1329
- Motors and Generators AS 1359
- Current Transformers AS 1675
- Voltage Transformers AS 1243
- Protection Relays IEC 60255
- High Voltage Fuses AS 1033 or IEC 282

### A1.1 Circuit Breakers

- manufacturer;
- type number;
- class – indoor or outdoor;
- rated voltage;
- rated insulation level (lightning impulse withstand level);
- rated load current;
- rated short circuit breaking current;
- rated short circuit making current;
- minimum clearances in air – between phases and to earth;
- type of closing mechanism;
- whether trip free or fixed trip and with lock–out preventing closing;
- rated supply and /or pressure of closing mechanism; and
- details of any interlocking systems.

### A1.2 Transformers

- manufacturer;
- rated voltages and tapping range;
- rating (kVA);
- lightning impulse withstand level;
- vector group symbol;
- insulating medium; and
- type of connections.

## A1.3 Underground Cables

- manufacturer;
- voltage designation;
- number of cores;
- conductor material, size and where applicable, size of reduced neutral conductor;
- type of insulation;
- construction details;
- type of terminations proposed;
- fault withstand rating of core and screen;
- proposed method of installation including mechanical protection; and
- screen earthing details for each end of any incoming supply cable.

## A1.4 High Voltage Motors

- manufacturer;
- type of motor and if an induction motor – cage or wound rotor;
- rated power (kW or hp);
- rated voltage;
- rated current;
- method of starting to be employed;
- starting torque in terms of the rated load torque and the maximum starting current
- which may be taken from the supply with the starting apparatus in the circuit;
- if thyristor control equipment is proposed, details relating to the harmonic current
- generation is required; and
- frequency of starting.

## A1.5 Generators

- manufacturer;
- type of generator;
- rated output;
- rated voltage;
- rated current;
- synchronous, transient and sub transient reactance. (if generator is connected to the supply system through a solid state inverter indicate three phase short circuit current at output side of inverter);
- details of generator neutral earthing;
- type of excitation;
- voltage regulation; and
- speed regulation.

### A1.6 Protection and Control Equipment

- Current Transformers :
  – rated transformation ratios;
  – primary current rating;
  – secondary current rating;
  – type classification;
  – accuracy classification;
  – accuracy limit factor;
  – rated burden;
  – rated secondary reference voltage;
  – manufacturer serial number(s);
  – secondary winding configuration; and
  – applicable standard if not to AS 1675.
- Voltage Transformers :
  – rated transformation ratios;
  – rated secondary voltage;
  – type classification;
  – accuracy classification;
  – rated burden;
  – rated output;
  – rated voltage factor and duration;
  – manufacturer serial number(s);
  – secondary winding configuration;
  – primary connections; and
  – applicable standard if not to AS 1243.
- Protection Relays
  – manufacturer;
  – type; and
  – settings.
- High voltage fuses :
  – type;
  – rated current or reference current; and
- Battery and battery charger details.

## A2 Installation

### A2.1 Underground Cables

The high voltage underground cables should be installed in accordance with the Electricity Safety (Installations) Regulations and be consistent with the Electricity Safety (Network Assets) Regulations.

After installation and before activation, the cables should be tested in accordance with the relevant industry standards and cleared for service.

In accordance with the Electricity Safety (Installations) Regulations a detailed drawing recording the route, depth of laying and other relevant information should be produced by the customer. This drawing should be available for the use of all persons concerned with future ground openings on the property.

### A2.2 Overhead Lines

Overhead lines should be designed and constructed consistent with the Electricity Safety (Network Assets) Regulations.

Unless otherwise set out in the Wiring Rules, current ratings of aerial conductors should be determined in accordance with Energy Supply Association of Australia Limited (ESAA) Document D(b)5 – 1988

### A2.3 Substations

All apparatus should be clearly and uniquely labelled to ensure correct identification by operating and maintenance personnel.

The design of the substation should provide suitable safety clearances and earthing points to allow safe access for maintenance and inspection without the need to de–energise the entire installation. This should be in accordance with the Code of Practice on Electrical Safety for Work on or Near High Voltage Electrical Apparatus (The Blue Book).

### A2.4 Energy and Time Impulses

If a Customer wishes to monitor and control energy management equipment, energy and time impulses are available on request from the Meter Provider. The cost of this will be in addition to other costs incurred. The form of pulses provided will be at the discretion of the Meter Provider.

The Distributor will bear no liability under any circumstances for possible malfunctions of the pulsing equipment.

### A2.5 Operating Equipment

High Voltage apparatus such as operating sticks, safety earths, gloves and insulating mats shall be made available by the Customer for use by their HV operators in accordance with the Customer's high voltage operating procedure.

## A3 High Voltage Earthing

### A3.1 Combined Earthing System

The preferred earthing system is the ''combined earthing system''. A combined earthing system is one where the high voltage and low voltage equipment is earthed to a common terminal bar.

Each substation on the Customer's property should have its own independent earthing system. Where there are multiple substations on the Customer's property it shall be necessary that the earthing systems be connected together by a conductor of the same size as the high voltage earthing conductors.

### A3.2 Separate Earthing System

If the requirements of the combined earthing system cannot be met, then a separate earthing system should be installed in accordance with the relevant clauses of the Wiring Rules. If a separate earthing system is installed then the customer should advise the Distributor and provide details of the installation.

### A3.3 Other Earthing Requirements

All metallic substation fences, doors or enclosures should be connected to the earthing system and a grading ring should be installed around the substation enclosure in accordance with AS 2067.

Reinforcing in the substation floor or walls should be connected to the common earth terminal bar.