

# **Section 7**

# **High Voltage Installations**

**Service and Installation Rules of New South Wales**

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# 7 High Voltage Installations

## 7.1 INTRODUCTION

This Section outlines the procedures and requirements for the supply of electricity at voltages higher than 1000 V AC.

This section is to be considered in conjunction with Section 1 of these Rules, the High Voltage Electrical Installations Section of the AS/NZS

3000, the electricity distributor's high voltage requirements and Safety Plans and applicable Australian or other approved Standards.

Inquiries on high voltage supply and installations should be directed to the electricity distributor's offices.

## 7.2 GENERAL INFORMATION

Supply of electricity will depend on:

- Availability.
- System constraints.

Customers who take supply at high voltage must bear the costs associated with:

- (a) Transformer energy losses.
- (b) The purchase, installation, operation, testing and maintenance of high voltage equipment.

(c) Spare equipment.

(d) Insurance, interest and depreciation.

(e) Compliance with the electricity distributor's Bush Fire Management Plan.

Customers must also bear the cost of fees, deposits, charges or capital contributions which may be required by the electricity distributor, subject to the determinations of the Independent Pricing and Regulatory Tribunal (IPART).

## 7.3 SUBMISSION OF PROPOSAL

Where the electricity distributor has agreed in principle to supply a new high voltage installation, alter or add to an existing high voltage installation, the proponent must lodge a detailed proposal and include the following key points:

- (a) The date at which supply is required.
- (b) Whether temporary or permanent supply is required. If temporary how long is supply required for.
- (c) A locality plan of the property.
- (d) Your proposed system voltage.
- (e) A schematic diagram of the proposed electrical installation.

(f) Loading details including, load characteristics and duty cycles of equipment.

(g) Protection and control details.

(h) The fault level gradients throughout the installation.

Considerable planning time may be necessary for the electricity distributor to consider augmentation and/or an extension to the existing distribution system to accommodate the proposed high voltage installation. This is particularly so where the proposed load is relatively large or is located in a remote and un-reticulated area.

Potential high voltage customers are advised not to purchase or install any high voltage equipment before the design and construction programs have been accepted by both parties.

## 7.4 PROVISION OF FACILITIES FOR METERING EQUIPMENT

All metering equipment will be provided, installed and maintained by the customer subject to the agreed Standard Form Customer Connection Contract and Operating Agreement offered by the electricity distributor in an agreed location which is accessible to the electricity distributor's staff.

The customer must arrange for the supply and installation of the metering equipment, including CTs, VTs and meters, in a suitable location, in accordance with the electricity

distributor's requirements and Chapter 7 of the National Electricity Rules.

This equipment must be located within the customer's installation. This equipment must also be accessible to the electricity distributor, via its electricity metering locking system. The customer must provide suitable accommodation for the metering equipment, including adequate lighting and availability of socket outlets and any other facilities stipulated by the electricity distributor.

## 7.5 CUSTOMER'S HIGH VOLTAGE INSTALLATION

### 7.5.1 Point of Supply

The high voltage installation commences at the point of supply, which is the point agreed between the customer and the electricity distributor.

### 7.5.2 Compliance

The high voltage installation and equipment must comply with the requirements of:

- (a) The High Voltage Electrical Installations Section of the AS/NZS 3000.
- (b) These Service and Installation Rules.
- (c) The electricity distributor's high voltage requirements.
- (d) The electricity distributor's.
  - i) Customer Installation Safety Plan.
  - ii) Bush Fire Risk Management Plan.
  - iii) Network Management Plan.
- (e) Applicable Australian or other approved Standards.

#### 7.5.2.1 High Voltage Installation Safety Management Plan

Each high voltage installation shall have a High Voltage Installation Safety Management Plan. This plan considers the compliance requirements of the Service and Installation Rules and other relevant codes, guides and plans.

### 7.5.3 Supply Voltage

The electricity distributor will nominate the supply voltage during negotiations. Consult with the electricity distributor for its likely range of voltage conditions and install suitable equipment accordingly.

Transformers should have tapplings similar to those specified for the electricity distributor's transformers. These tapplings enable your electrical installation's voltage level to mirror those available on the supply system.

Momentary voltage dips and spikes may occur and you should:

- (a) Install "line conditioning equipment" for supply to voltage-sensitive equipment.
- (b) Make sure that, when they are used, the over/under voltage relays are designed to avoid unnecessary operation.

### 7.5.4 Fault Levels

AS/NZS 3000 states that the electricity installation must be designed so that it "is capable of performing satisfactorily under fault conditions". The short-circuit current which may occur in your installation is dependent upon:

- (a) The prospective fault level at the point of supply.
- (b) Any contribution which may be made by large rotating electrical plant connected within the installation.
- (c) Impedances within the installation.

The effect of the short-circuit current must be taken into account in the installation design. The electricity distributor will advise in writing of the maximum prospective fault level on the distribution system at the point of supply, under normal operating conditions.

The fault level will be used to determine minimum equipment fault ratings. The fault level given is generally higher than will exist initially to provide for system development.

Unless otherwise advised, you must install equipment that meets the following minimum fault levels:

- (d) 11kV nominal supply voltage: 250 MVA.
- (e) Other voltages: refer to the electricity distributor.

The electricity distributor will also advise you of the initial fault level at the connection point so that you can calculate the protection relay settings and anticipated voltage fluctuations.

Your design submission must include details of fault levels assigned throughout the installation.

### 7.5.5 Consumers Mains

Select the size and type of cable (and the terminations) in consultation with the electricity distributor.

Cable selection should take into account the possibility of future load growth and be adequate for the maximum prospective fault level.

### 7.5.6 Bush Fire Precautions

High Voltage installations may represent particular hazards in relation to bush fire risk such as bare overhead lines, earthing systems, expulsion fuses and other protective devices, etc. For further pertinent information refer to clauses 1.9.5, 3.3.4 of these Rules and the relevant clauses of AS/NZS 3000.

### 7.5.7 Protection and Control of Incoming Supplies

The customer must include protection devices in each incoming supply, as well as the control device required by the AS/NZS 3000.

Protection devices must ensure discrimination with the electricity distributor's protection devices, in the event of a fault on any part of your installation. Include the relevant details of your proposed main protection devices in the design submission.

Where batteries are used to operate the incoming supply circuit breaker's trip mechanism, the battery must be provided with:

- (a) Automatic charging equipment.
- (b) A battery-condition indicator.
- (c) An under voltage alarm.

Refer to Attachment B which sets out the typical details the electricity distributor requires.

### 7.5.8 Testing and Inspection

The customer must arrange and pay for the testing (to the electricity distributor's satisfaction) of all high voltage equipment:

- (a) Within a new installation.
- (b) Involved in the repair, alteration or addition to an existing installation.

The testing must be completed before the electricity distributor may permit the connection of the installation, or any part of it, to their supply.

The customer must provide the electricity distributor with copies of all test reports indicating that the equipment has passed the required tests.

The electricity distributor will inspect your installation for compliance with the requirements of AS/NZS 3000 and relevant standards.

The person responsible for carrying out the work is required to submit the installation particulars on the relevant notification of electrical work form.

### 7.5.9 Operation of the Customer's High Voltage Installation

The customer is responsible for the operation of the high voltage installation, including any switching of the customer's equipment.

The prospective high voltage customer shall establish and document effective operational procedures as part of their Network Management Plan, Customer Installation Safety Plan and/or Bushfire Management Plan.

The electricity distributor will agree to supply you at high voltage, only if you have either:

- (a) Trained staff; or
- (b) A trained electrical contractor

available and qualified to safely operate the high voltage switchgear.

The customer must provide the required safety and operating equipment for people working on the electrical installation. Refer to these Rules outlined in AS 2467 'Maintenance of Electrical Switchgear'. Attachment A of this publication must be read in conjunction with this standard.

### 7.5.10 Maintenance

The customer must maintain the high voltage installation to ensure the electrical equipment is always in sound operating condition. It must be maintained to safely perform the functions for which it is designed.

The following publications are relevant in this regard:

- (a) AS 1940 'The storage and handling of flammable and combustible liquids'.
- (b) AS 2467 'Maintenance of Electrical Switchgear'
- (c) AS 1883 'Guide to maintenance and supervision of insulating oils in service'.
- (d) AS 1767 'Insulating oil for transformers and switchgear'.
- (e) Electricity Supply (Safety and Network Management) Regulation 2008.
- (f) IEC 61230 Ed1.0 (Bilingual 1993) Live Working – Portable equipment for earthing or earthing and short-circuiting

Before working on the installation it must be earthed. The customer must provide suitable direct earthing equipment, or use equipment with built-in earthing facilities.

### 7.5.11 Power Factor Correction

The customer must maintain the power factor at all metering points at a value not less than 0.9 lagging (Customers supplied at a voltage in excess of 50 kV refer to the National Electricity Rules). You should allow for power factor correction equipment in the initial design, refer to clause 1.10.11.

## ATTACHMENT A - SCHEDULE OF MINIMUM OPERATING PROCEDURES AND SAFETY EQUIPMENT - HV INSTALLATIONS

Customers taking supply at high voltage must employ adequately trained staff or contractors. You must establish operating procedures and provide safety equipment to ensure the safe performance of all work on your installation.

All operating procedures must meet the overall conditions of AS 2467 'Maintenance of Electrical Switchgear' namely:

1. The High Voltage Installation (HVI) responsible person must have a documented set of electrical safety rules covering all aspects of operating the high voltage installation. The Safety Rules documented in Appendix A of AS 2467 'Maintenance of Electrical Switchgear' is the minimum requirement.
2. The HVI responsible person must provide all persons engaged in work on your high voltage electrical substations and/or installation with a copy of the electrical safety rules.
3. The HVI responsible person must prominently and permanently display the installation's high voltage system operating diagram in each high voltage electrical substation.
4. The HVI responsible person must provide and cause the operators to be trained in the use of:
  - (a) high voltage earthing equipment designed to facilitate the earthing of all types of high voltage equipment within the installation
  - (b) insulating mats, screens and other similar equipment necessary for the safe operation of the high voltage installation.
5. The HVI responsible person must provide testing equipment to prove that high voltage mains and apparatus are dead.
6. The HVI responsible person must provide appropriately coloured tape barriers and stands to display access permits clearly identifying isolated, proven de-energised and earthed sections of the high voltage installation on which work can safely be performed.

White tape is impractical for snow prone areas.

7. The HVI responsible person must provide labelled storage facilities as close as practicable to the point of use for the equipment described in items 4 to 6 inclusive.
8. The HVI responsible person must display a safety poster prominently and permanently in each high voltage station within the installation. The poster must outline resuscitation methods and provide instruction in the release of persons from contact with live conductors.
9. The HVI responsible person must provide "access permit forms" to facilitate the monitoring of all persons accessing isolated sections of your electrical installation, to perform work and to ensure all such persons are clear prior to re-energising of the isolated section of the installation.
10. The HVI responsible person must ensure that only persons trained in the operation of the installation perform switching within the high voltage installation, and issue access permits authorising persons to work on isolated and earthed sections of the installation.
11. If the HVI responsible person requires isolation of the electricity distributor's high voltage supply(s), the electricity distributor will ask you to complete an "Operating Agreement". This agreement must be between your authorised operator and the electricity distributor's system controller.

The customer must submit documentation to the electricity distributor outlining the practices, procedures and equipment proposed to be operated, to ensure the high voltage installation is managed in a safe and responsible manner.

For assistance with the written submission and formulation of the required HV switching and safety procedures consult the local electricity distributor's Network Management Plan.

## ATTACHMENT B - PROTECTION DETAILS REQUIRED FOR NEW OR ALTERED HV INSTALLATIONS

The electricity distributor will assess the proposed protection scheme(s). The customer must provide the following detailed information:

1. Single line diagram of the high voltage installation, including main transformers winding configurations, eg 33kV Delta-11kV Star.
2. Loading details, eg maximum expected load, load characteristics, duty cycles, large motor starting details, etc.
3. Where the incoming protection device is a fuse:
  - (a) Rated current of fuse.
  - (b) Rated breaking current of fuse.
  - (c) Make and type of fuse.
  - (d) Current-time characteristic curves.
4. Where the incoming protection device is a circuit breaker:
  - (a) A control and protection schematic diagram of the incoming circuit breaker(s).
  - (b) Make, type, rated load current and rated fault MVA or rated breaking current of incoming circuit breaker(s).
  - (c) Details of protection relays used, including:
    - i) Make and type.
    - ii) Setting range.
    - iii) Characteristic curves.
    - iv) Thermal ratings of input circuit.
    - v) Tripping and control supply details.
- (d) Protection current transformer details including:
  - i) Make and type.
  - ii) Primary current rating.
  - iii) Secondary current rating.
  - iv) CT class.
  - v) Short time rating.
  - vi) Length and size of secondary circuit wiring.
  - vii) Proposed location.

Note: CTs which utilise primary tapplings for ratio changes are not acceptable. CTs located within a transformer tank or bushings are not acceptable.
5. Protection details of the next line of protection within the installation, so that a realistic grading can be achieved.
6. Voltage transformer details including:
  - (a) Make and type.
  - (b) Primary voltage rating.
  - (c) Secondary voltage rating(s).
  - (d) Category of performance.
  - (e) Rated burden.
  - (f) Accuracy class.
  - (g) Rated voltage factor and rated duration.
7. Estimated date when protection is to be commissioned.

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