Technical Specification - HV Overhead Line Equipment

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Revision details

Version No.	Clause	Description of revision
1.0	All	General revision
2	All	Format update, changing ‘shall’, ‘should’ and ‘may’ to must where relevant to Sydney Water, ‘approved’ replaced with ‘accepted’, minor editorial changes elsewhere. New section – Section 9 Overhead Isolator

Introduction

This Specification is for the design, supply and installation of HV Overhead Line Equipment for Sydney Water assets.

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Acronyms

Term	Definition
AC (ac)	Alternating Current
AIS	Air Insulated Switchgear
ANSI	American National Standards Institute
AS	Australian Standard
AUD	Australian Dollars
CB	Circuit Breaker
CT	Current Transformer
c/w	complete with

Term	Definition
DC (dc)	Direct Current
ELV	Extra Low Voltage (i.e. ≤ 50 V AC or ≤ 120 V DC)
EN	European Normalised Standard
ESW	Earth Switch
GA	General Arrangement (drawing)
HMI	Human Machine Interface
HV	High Voltage (i.e. > 1000 V AC or > 1500 V DC)
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical & Electronic Engineers
ISO	International Standards Organisation
ITP	Inspection and Test Plan
LV	Low Voltage (i.e. greater than ELV but ≤ 1000 V AC or ≤ 1500 V DC)
MSDS	Material Safety Data Sheet
MV	Medium Voltage (note this term is not used in this specification)
pu	per unit
SAA	Standards Association of Australia
SF_6	Sulphur Hexafluoride
Sec.	second
SLD	Single Line Diagram
TBA	To Be Advised
TBC	To Be Confirmed

1. General

1.1 Introduction

This specification defines the minimum technical requirements for the design, manufacture, supply and delivery of High Voltage (HV) Overhead Line equipment.

1.2 Scope

This specification does not apply to the installation / erection, commissioning or performance testing of the equipment.

1.3 Proprietary items

Nomination of a proprietary item by Sydney Water does not imply preference or exclusivity for the item identified.

Alternatives that are equivalent to the nominated items can be submitted to Sydney Water for acceptance. The submission must include appropriate technical information, samples, calculations and the reasons for the proposed substitution, as appropriate.

2. Technical requirements - general

2.1 Environmental requirements

All overhead line equipment must be designed to suit the following minimum environmental conditions.

Environmental conditions		
Maximum ambient temperature		+45 ºC
Maximum 24hr average temperature		+35 ºC
Minimum ambient temperature (corresponds to “minus 5ºC indoor class”)		-5 ºC
Maximum relative humidity	For one month For 24 hours	90% 95%
Pollution		Areas of coastal salt spray and/or industrial pollution range with equivalent salt deposit densities of range 2 to 3 gm^{-2}

All overhead line equipment must be suitable for installation and service up to an elevation of 1000 m above sea level.

2.2 Standardisation

Equipment must be designed with standard parts and components readily available within Australia. Parts and components must be standardised as much as possible. All replaceable and consumable equipment must be standard supply equipment. The use of “one off” special designs is not permitted.

3. Technical requirements - reclosers

3.1 General

Reclosers must be designed in accordance with IEC 62271-111 and suitable for operation on non-effectively earthed and effectively earthed networks and under the service and environmental conditions outlined in section **Error! Reference source not found.** of this specification.

3.2 Interrupting medium

The recloser interrupting medium must be vacuum. Each phase must have a separate interrupter.

3.3 Insulation medium

The recloser insulation medium between phases and phase to earth must be either SF_6 or epoxy. Where SF_6 is used the recloser must be fitted with a pressure indication and alarming device which must:

a) Indicate the actual pressure of SF_6 in the tank, or indicate when an alarm condition is reached

b) Automatically trip and lock out the recloser if the AF6 pressure falls to a value where and further loss of pressure results in a reduction of insulation level required, below the system maximum voltage.

3.4 Construction

All ferrous surfaces of the recloser and associated control cabinet must be manufactured from marine grade 316 stainless steel.

All support structures and associated bolts and nuts with these parts must be hot-dipped galvanised steel or 316 stainless steel. Suitable precautions must be implemented to prevent corrosion due to the use of dissimilar materials and gases.

The recloser tank must incorporate a pressure relief/rupture mechanism that is of non-fragmenting design and design to vent the pressure away from the operator.

Pre drilled brackets must be attached to the recloser tank (not the lid), one adjacent to each HV bushing to enable the mounting of surge arresters and must be in the same plain as the associated phase bushing., The surge arrester brackets must be used as the connection point for the arrester earth. The brackets must have an unpainted corrosion resistance metal connecting zone that has the capability to conduct surge arrester current. Clearance between the recloser metalwork and surge arresters must be such that phase-ground clearances are achieved.

Adequately rated lifting facilities must be provided and they must be designed to allow the complete assembled recloser.

The recloser must be fitted with feet if necessary, to prevent overturning when placed on a level surface.

The recloser control cabinet must be mounted independently of the recloser.

3.5 Mounting

The recloser must be suitable for single pole mounting, on concrete or timber poles. All reclosers are to be supplied with standard pole mounting brackets fixed to the rear of the recloser. The bracket must be designed to ensure that the recloser live parts have statutory clearances from the pole and the earthed metal equipment.

The brackets and tank wall are to be of adequate strength to limit distortion, when mounted. The bracket must be suitable to carry the total weight of the recloser.

3.6 Bushings

Bushings must be of outdoor type, manufactured and tested in accordance with AS 60137 and the rated voltage, current and environmental conditions as specified in section **Error! Reference source not found.** of this Specification. The HV bushings must be of high quality glazed porcelain, or cyclo aliphatic epoxy resin. The bushing terminals must allow for the connection of copper of aluminium conductors 10 to 120 mm^2.

The source side must incorporate a measurement voltage transformer.

The contractor must provide a dimensional scaled drawing of the bushing (and boot if applicable).

3.7 Earthing

All metal parts of the recloser must be bonded together using earthing straps to provide electrical continuity. Earthing terminals must be fitted to all metal parts.

The control (umbilical) cable must be adequately earthed to shield the control equipment against electrical interference.

3.8 Markings and rating plates

Phase indication markings must be provided on each bushing and must remain viewable for the products working life.

Each recloser must be fitted with a stainless steel rating plate with the following information engraved/etched onto it. Printed rating plates will not be acceptable.

a) Manufacturers Name

b) Manufacturers type or identification no.

c) Serial no.

d) Rated maximum voltage

e) Rated Continuous current.

3.9 Rated impulse withstand voltage

The rating plate must be mounted clear of live parts in a position to be readable while the recloser is in service without compromising operator safety.

3.10 Operating mechanism

The recloser may use a low voltage system supplied from a battery or voltage transformer (VT) to operate a closing mechanism. Tripping energy must be supplied from a spring mechanism automatically tensioned when the recloser is closed.

Internal batteries used for the above purpose must not have any dependence on recloser load current to maintain their state of charge.

The recloser must incorporate provision for an operator to manually open the recloser using a standard operating stick in the event a failure of the electrical control system.

Clear indication must be provided to an operator standing on the ground as to the status of the recloser. This indicator must be mechanically linked to the recloser switching mechanism. Symbols and colours for the indicators must be a RED “I” or “ON” for ON/closed and GREEN “0” or “OFF” for OFF/open. Painted symbols are not acceptable.

3.11 Current transformers (CTs)

CT’s must comply with AS 600044.1 and be designed with insulation and fault level ratings compatible with the recloser.

The CTs must be incorporated in the recloser to provide metering and protection functions.

3.12 Voltage transformers (VTs)

Voltage transformers must be designed in accordance with AS 60044.2 and be sufficiently rated to supply the controls metering functions of the recloser.

3.13 Control cabinet

The recloser control cabinet must be of stainless steel construction designed for the service conditions as detailed in section **Error! Reference source not found.** of this specification, be adequately ventilated and fitted with a padlockable door suitable for Sydney Water 10 mm padlocks.

The control cabinet must be mounted below the switchgear tank and they must be connected by an ultra-violet stabilised screened multi-core-control cable. The screening of the cable must be adequate to protect it against electrostatic and electromagnetic interference.

The control cable must have robust multi-pin weatherproof connectors at each end and connect to the recloser tank and control cabinet via a plug and socket arrangement.

It must be possible to disconnect the control cable at the tank while the recloser is connected to the power system, without causing damage or mal-operation. Disconnection of the control cable must not result in the CTs becoming open-circuited.

The control cabinet must have bottom entry cables only.

3.14 Surge arresters

Surge arresters must be polymeric or silicon housed metal oxide type, manufactured and tested in accordance with AS 1307.

3.15 Performance and testing

For Reclosers the schedule of tests and requirements for the testing must be in accordance with IEC 62271-111.

4. Technical requirements - air break switches (ABS)

Air break switches must be designed in accordance with AS/NZS 60265.1 and suitable for operation on non-effectively earthed and effectively earthed networks and under the service and environmental conditions outlined in section **Error! Reference source not found.** of this specification.

Air-break switches must be for three phase, pole mounted unitised, ganged suitable for both pole top and mid pole mounting on overhead power systems in a totally exposed environment. They must be used for isolation as well as full-load switching of overhead networks.

4.1 Construction

Air break switches must be of “unitised” construction i.e. supplied completely assembled except for the pole bracket, down-rod and operating handle assemblies.

The switch must be designated as class M1 mechanical endurance requiring mechanical operation tests of 1000 cycles as per AS 60265.1

All support brackets and ferrous parts of the air break switch other than stainless steel must be hot dipped galvanised.

Lifting lugs must be provided. The position of the lifting facilities must ensure that during lifting the switch remains in its finial orientation with respect to the mounting bracket.

The switch must be load-make and load break type and be fitted with expulsion interrupters.

The switch must be designed in such a manner to minimise the risk of flashover due to birds and other animal life without the use of plastic or rubber coverings.

All electrical contact surfaces must be silver plated. The Contacts must be of the self-aligning type.

4.2 Mounting

Each switch must be suitable for both pole top and mid pole mounting without any adjustments in the field (i.e. adjustment of centre phase).

4.3 Insulators

Insulators must be a single piece, fully vitrified non-puncturable porcelain with cap type end fittings in accordance with AS 4398. Sulphur cement must not be accepted as a bonding agent between the cap end fittings and porcelain.

The insulator must be of adequate mechanical strength to withstand the loads applied during the opening and closing cycles.

Each insulator must be indelibly marked with the supplier name, date of manufacture and mechanical strengths.

4.4 Support arm and interphase coupling rod

The support arm and interphase coupling rod must use durable, corrosion resistant, low maintenance material with no shrinkage characteristics. Timber is not acceptable. The interphase coupling rod must be adequately rated to withstand the mechanical forces during operation.

4.5 Operating equipment

Means must be provided on individual phases to prevent over travel of the switch blade contacts.

Down-rods must be of a durable material. Connection of the down-rod to the switch must incorporate universal coupling. Down-rods must be supplied complete with down rod guides that allows attachment to pole using M16 coachscrews or “Band-it” straps. The design of the guide must allow attachment to the pole with the down-rod in final position.

The operating handle and bracket must be capable of being mounted to the pole using M16 coachscrews or “Band-it” straps. The operating handle for the ganged switch must provide for padlocking in the open or closed position. The operating handle mounting bracket must suitable provided for the connection of earth cable.

4.6 Hardware

All nuts, bolts and washers associated with each phase assembly and interphase coupling rod must be 316 stainless steel. Suitable lubricant must be applied to the threads of all stainless steel bolts before tightening. Lubricants containing graphite are not acceptable.

4.7 Performance and testing

For Air break switches the schedule of tests and requirements for the testing must be in accordance with AS/NZS 60265.1.

5. Technical requirements - disconnect fuse units / expulsion drop out fuses (EDOs)

The disconnect fuse units must be Class AK1 complying with AS 1033.1.

5.1 Construction

The disconnect fuse unit must be designed and constructed such that on closing the fuse carrier-fuse link no additional stress must be applied to the fuse link which could cause it to fail. It must not be possible to close the fuse carrier without the top cap fitted.

All support brackets and ferrous parts of the air break switch other than stainless steel must be hot dipped galvanised.

The distance between the contacts of the fuse carrier must be such that it allows interchange ability between different fuse manufacturers.

The insulator/mounting bracket combination must be designed in such a manner to minimise the risk of flashover due to birds and other animal life without the use of plastic or rubber coverings.

Lifting rings must be provided on the bottom end and the top of the fuse tube to enable the removal and replacement of the fuse tube using a standard operating rod fitted with a hook-link stick.

When an expulsion drop-out disconnect fuse unit is mounted on a pole the fuse carrier must not hit the pole during opening operation.

All electrical contact surfaces must be silver plated. The contacts must be of the self-aligning type and must have wiping action to remove oxide or other contamination on the contact surfaces and constructed to eliminate arcing damage to the main contacts.

5.2 Terminal connections

Terminal connections must be provided on both the supply and load side of the disconnect fuse unit and must be suitable for bolted connection. The connections must be designed for use with aluminium, copper, or steel conductors and to minimize the effects of electrolytic corrosion of dissimilar metals.

5.3 Mounting

The disconnect fuse unit must be capable of being mounted on either poles or crossarms.

5.4 Insulators

The Insulator must be a single piece, fully vitrified non-puncturable porcelain in accordance with AS 2947.

The insulator must be of adequate mechanical strength to withstand the loads applied during the opening and closing cycles.

5.5 Fuse links and installation

A flipper spring mechanism must be incorporated into the design of the fuse carrier to assist with the fuse link ejection. The fuse link must be held captive such that it does not make contact with the inner wall of the fuse carrier. I.e. the flipper spring mechanism must be centrally locate the fuse link

The fuse link and strain element must be of suitable material to achieve the required electrical rating and performance of the link.

The electrical characteristics of the fuse links must conform to the relevant Time-current characteristic detailed in AS 1033.1

5.6 Performance and testing

To disconnect fuse units the schedule of tests and requirements for the testing must be in accordance with AS 1033.1.

6. Insulators

6.1 General

Overhead line insulators must be designed and constructed in accordance with the applicable standard as detailed in Section **Error! Reference source not found.**

Overhead line insulators must be either porcelain of composite type only.

6.2 Porcelain insulators

The surface of the insulator must be smooth, uniform and moisture proof. It must be unaffected by weather, ozone, acidic and/or alkali deposits.

All porcelain insulators must be non-porous and pass the porosity test requirements detailed in Clause 25 of AS 2947.1.

Tongue and clevis disc insulators must comply with minimum designation U70C as defined in AS 60305 and supplied complete with coupling pin and split pin.

Ball and socket disc insulators must comply with minimum designation U70BL as defined in AS 60305 and have standard couplings complying with AS 60372.

Line post insulators are to be supplied with a minimum M20 galvanised steel stud complete with spring lock washer, round washer and nut.

The cement used to join the insulator and its associated metalwork must be non-hydroscopic and must not affect the corrosion performance of the metal fittings.

6.3 Composite Longrod insulators

Composite insulators must be constructed using a central member of solid high-density axially aligned glass-fibre-reinforced pultruded EPOXY resin rod. Hollow cores are not acceptable. The core must be a uniform cross-section and free of cracks and voids.

The sheds must be moulded from a suitable elastomer which is stabilised against the effects of ultraviolet and other solar radiation and against the effects of airborne contaminants as detailed in section **Error! Reference source not found.**.

Tongue and clevis type end fittings must comply with minimum designation 16L as defined in AS 60471 and supplied complete with coupling pin and split pin. The tongue must be fitted on the lower end of the insulator and clevis on the upper end.

Ball and socket couplings must comply with minimum designation 16B as defined in AS 60120. The socket must be provided on the upper end of the insulator and ball on the lower end.

The metal fittings at both ends of all insulators must be compressed on the core material.

6.4 End fittings

All end fittings must be hot dip galvanised ferrous type with minimum thickness complying with acceptance criteria set out in clause 26 of AS 2947.1.

6.5 Performance and testing

For porcelain insulators the schedule of tests and requirements for the testing must be in accordance with AS 2947.1, AS 3609.

For composite Longrod insulators the schedule of tests and requirements for testing must be in accordance with AS 4435.1.

7. Technical requirements - bare conductor, stay wire

7.1 General

The conductors and stay wires must be designed and constructed in accordance with the applicable standard as detailed in section **Error! Reference source not found.**

7.2 Welding

Butt welding of steel wires before aluminium cladding or galvanising may be performed in accordance with the provision of the appropriated Australian Standard. The aluminium cladding or galvanising must be continuous across the weld point.

No butt welds of the aluminium clad steel wire, after cladding, must be contained in any drum of conductor.

No more than four butt welds of the galvanised steel wires, after galvanising, must be contained in any 3000 m length of conductor.

Butt welding of aluminium wires may be performed in accordance with the provisions of the appropriate Australian Standard. No more than four butt welds of the aluminium must be contained in any 3000 m length of conductor.

Welding certificates must be supplied for all drums of conductors regardless of whether they contain welds. They must indicate the type of weld, strand layer and appropriate location of the weld.

7.3 Grease

All ACSR conductors and stay wires must be fully greased as defined in the relevant Australian Standard. No grease is permitted on the outermost layer of the conductor or stay wire.

Greasing of AAC and AAAC conductors is not required unless specified by Sydney Water.

Grease must not contain graphite. A Material Safety Data Sheet (MSDS) for the grease must be submitted to Sydney Water with the offer.

7.4 Identification of alloy

1120 alloy conductor must be marked as detailed in AS 3607 and AS 1531.

7.5 Tie wire

Aluminium, copper and stainless steel tie wire must be annealed.

7.6 Performance and testing

Conductors and stay wires must be tested in accordance with the requirements of the relevant Australian Standard.

7.7 Packaging

Conductors and Stay wires may be supplied on either hardwood timber drums of steel drums complying with the requirements of AS 3983.

The conductor or stay wire on the drum must be protected by external lagging to ensure that it is delivered undamaged.

The drums must be sufficiently robust to ensure that the cable is delivered undamaged.

Each drum must be marked in accordance with the requirements of the relevant Australian Standard.

8. Technical requirements - power poles and cross-arms

8.1 General

The power poles and cross-arms must be supplied in accordance with the applicable standard as detailed in section **Error! Reference source not found.**

Generally Timber utility poles and cross-arms must be used for all sites unless sites have been identified as having termite activity. For termite active sites concrete or steel pole poles and non-timber cross-arms must be used.

Limit State Design principles in accordance with AS 7000 must apply for all overhead line design and construction. The contractor must provide technical details / design calculations in determining the strength ratings of the poles required.

8.2 Markings

All poles must be clearly marked.

Wood Poles must typically be identified with an aluminium disk fixed to pole giving length, design load (kN rating), timber species, treatment type, treatment date.

Concrete poles must be identifier with a metal plate affixed to the pole with the following information impressed on it: name of manufacturer, year of manufacture, length/mass of pole, ultimate/working strength and serial number.

Steel poles must be identified with a metal plate affixed to pole with the following information impressed on it: name of manufacturer, year of manufacture, length/mass of pole, load capacity, impact classification and serial number.

8.3 Performance and testing

Poles must be tested in accordance with the requirements of the relevant Australian Standard.

9. Technical requirements - Overhead Isolator

9.1 General

Overhead (OH) Isolator must be designed in accordance with AS/NZS 62271 series, IEC 62271.111, IEC 60129, ANSI/IEEE C 37 and suitable for operation on non-effectively earthed and effectively earthed networks and under the service and environmental conditions outlined in section **Error! Reference source not found.** of this specification.

The overhead (OH) isolator must be fault make and load breaker type. The OH isolator must be able to provide earthing functionality on either side of supply, and the earthing operating mechanism must be independent from the isolator OPEN/CLOSE mechanism. The minimum short-time withstand current rating must be a minimum of 20kA/3s. The OH isolator and the earthing switch, must have M2 as the minimum mechanical endurance rating.

9.2 Insulation medium

The OH isolator insulation medium between phases and phase to earth must be either SF_6 or epoxy. Where SF_6 is used the SF6 tank must be fitted with a pressure indication and alarming device which must:

c) Indicate the actual pressure of SF_6 in the tank, or indicate when an alarm condition is reached

d) Automatically trip and lock out the OH isolator if the SF6 pressure falls to a value where and further loss of pressure results in a reduction of insulation level required, below the system maximum voltage.

9.3 Construction

All ferrous surfaces of the OH isolator and associated control cabinet must be manufactured from marine grade 316 stainless steel. All support structures and associated bolts and nuts with these parts must be hot-dipped galvanised steel or 316 stainless steel. Suitable precautions must be implemented to prevent corrosion due to the use of dissimilar materials and gases.

The OH isolator tank must incorporate a pressure relief/rupture mechanism that is of non-fragmenting design and design to vent the pressure away from the operator. The OH Isolator must be welded construction to minimise the potential corrosion and be maintenance free.

Pre-drilled brackets must be attached to the tank ,one adjacent to each HV bushing to enable the mounting of surge arresters and must be in the same plain as the associated phase bushing. The surge arrester brackets must be used as the connection point for the arrester earth. The brackets must have an unpainted corrosion resistance metal connecting zone that has the capability to conduct surge arrester current. Clearance between the OH isolator metalwork and surge arresters must be such that phase-ground clearances are achieved.

Adequately rated lifting facilities must be provided and they must be designed to allow the complete assembled OH Isolator.

The OH isolator must be fitted with feet if necessary, to prevent overturning when placed on a level surface.

The OH Isolator control cabinet must be mounted independently of the OH Isolator.

9.4 Mounting

The OH isolator must be suitable for single pole mounting, on concrete or timber poles. All OH Isolators are to be supplied with standard pole mounting brackets fixed to the rear of the OH Isolator. The bracket must be designed to ensure that the OH Isolator live parts have statutory clearances from the pole and the earthed metal equipment.

The brackets and tank wall are to be of adequate strength to limit distortion, when mounted. The bracket must be suitable to carry the total weight of the OH Isolator.

9.5 Bushings

Bushings must be of outdoor type, manufactured and tested in accordance with AS 60137 and the rated voltage, current and environmental conditions as specified in section **Error! Reference source not found.** of this specification. The HV bushings must be of high quality glazed porcelain, or cyclo aliphatic epoxy resin. The bushing terminals must allow for the connection of copper of aluminium conductors 10 to 120 mm^2.

The source side must incorporate a measurement voltage transformer.

The contractor must provide a dimensional scaled drawing of the bushing (and boot if applicable).

9.6 Earthing

All metal parts of the OH Isolator must be bonded together using earthing straps to provide electrical continuity. Earthing terminals must be fitted to all metal parts.

The control (umbilical) cable must be adequately earthed to shield the control equipment against electrical interference.

9.7 Markings and rating plates

Phase indication markings must be provided on each bushing and must remain viewable for the products working life.

Each OH Isolator must be fitted with a stainless steel rating plate with the following information engraved/etched onto it. Printed rating plates will not be acceptable.

f) Manufacturers name

g) Manufacturers type or identification no.

h) Serial no.

i) Rated maximum voltage

j) Rated continuous current.

9.8 Rated impulse withstand voltage

The rating plate must be mounted clear of live parts in a position to be readable while the OH Isolator is in service without compromising operator safety.

9.9 Operating mechanism

The OH Isolator may use a low voltage system supplied from a battery or voltage transformer (VT) to operate a closing mechanism. Tripping energy must be supplied from a spring mechanism automatically tensioned when the OH Isolator is closed.

Internal batteries used for the above purpose must not have any dependence on OH Isolator load current to maintain their state of charge.

The OH Isolator must incorporate provision for an operator to manually open the OH Isolator using a standard operating stick in the event a failure of the electrical control system.

Clear indication must be provided to an operator standing on the ground as to the status of the OH Isolator. This indicator must be mechanically linked to the OH Isolator switching mechanism. Symbols and colours for the indicators must be a RED “I” or “ON” for ON/closed and GREEN “0” or “OFF” for OFF/open. Painted symbols are not acceptable.

The OH Isolator must be able to apply Sydney Water HV padlock for all operating positions.

9.10 Current transformers (CTs)

When specified, the CTs must be able to incorporate in the OH Isolator to provide metering, monitoring and protection functions.

CT's must comply with AS 600044.1 and be designed with insulation and fault level ratings compatible with the OH Isolator.

9.11 Voltage transformers (VTs)

When specified, the VTs must be able to incorporate in the OH Isolator to provide metering, monitoring and protection functions.

Voltage transformers must be designed in accordance with AS 60044.2 and be sufficiently rated to supply the controls metering functions of the OH Isolator.

9.12 Control cabinet

The OH Isolator control cabinet must be of stainless steel construction designed for the service conditions as detailed in section **Error! Reference source not found.** of this specification, be adequately ventilated and fitted with a padlockable door suitable for Sydney Water 10 mm padlocks.

The control cabinet must be mounted below the switchgear tank and they must be connected by an ultra-violet stabilised screened multi-core-control cable. The screening of the cable must be adequate to protect it against electrostatic and electromagnetic interference.

The control cable must have robust multi-pin weatherproof connectors at each end and connect to the OH Isolator tank and control cabinet via a plug and socket arrangement.

It must be possible to disconnect the control cable at the tank while the OH Isolator is connected to the power system, without causing damage or mal-operation. Disconnection of the control cable must not result in the CTs becoming open-circuited.

The control cabinet must have bottom entry cables only.

9.13 Surge arresters

Surge arresters must be polymeric or silicon housed metal oxide type, manufactured and tested in accordance with AS 1307.

9.14 Performance and testing

For Reclosers the schedule of tests and requirements for the testing must be in accordance with AS/NZS 62271 series and IEC 62271.111.

10. Reference documents

The HV overhead line equipment and materials must be designed, manufactured and tested in accordance with the latest revisions of the Federal and State statutory requirements, applicable Australian and IEC Standards, as well as the Sydney Water standard specifications.

Document type	Title
Legislation	- Work Health and Safety Act 2011 - Service and Installation Rules of New South Wales 2006
Policies and procedures	- WSA201 - Manual for Selection and application of protective coatings - Supplement to WSA201 - Manual for Selection and application of protective coatings - PCS100 - Protective Coatings - Sydney Water Emergency Stop Policy
Other documents	- Sydney Water Technical Specification - Electrical
Standards	- AS ISO 1000: The International System of Units (SI) and its application (ISO 1000) - AS 1033 (IEC 60282.2): High voltage fuses (for rated voltages exceeding 1000V) (Parts 1 and 2) - AS 1154: Insulator and Conductor fittings for overhead power lines - AS 1170: Minimum design loads on structures (known as the SAA Loading Code). (Parts 2 and 4) - AS 1222: Steel conductors and stays - Bare overhead - AS 1307 (IEC 60099): Surge arresters (diverters) - AS 1531: Conductors - Bare overhead - Aluminium and aluminium alloy - AS 1574: Copper and copper alloys – Wire for electrical purposes - AS 1627: Metal finishing - Preparation and pre-treatment of surfaces - AS 1720: Timber Structures (Parts 1 and 2) - AS 1746: Conductors - Bare overhead - Hard drawn copper - AS 1824 (IEC 60071): Insulation coordination (phase-to-earth and phase-to-phase, above 1 kV) (Parts 1 and 2) - AS 1852.441: International electrotechnical vocabulary - Switchgear, controlgear and fuses - AS 1931 (IEC 60060): High voltage testing techniques (Parts 1 and 2) - AS 2024 (IEC 62271-105): High voltage AC switchgear and control gear - Switch-fuse combinations - AS 2067: Switchgear assemblies and ancillary equipment for alternating voltages above 1 kV - AS 2209: Timber - Poles for overhead lines - AS 2467: Maintenance of electrical switchgear

Document type	Title
	- AS 2700: Colour standards for general purposes - AS 2857: Timber Drums for insulated electric cables and bare conductors - AS 2947: Insulators - Porcelain and glass for overhead power lines - Voltages greater than 1000V AC - AS/NZS 3000: Electrical installations (known as the Australian/New Zealand Wiring Rules) - AS 3607: Conductors - Bare overhead, aluminium and aluminium alloy - Steel reinforced - AS 3609: Insulators - Porcelain stay type - Voltages greater than 1000 V AC - AS 3818.4: Timber - Heavy structural products - Visually graded, Part 4: Cross-arms for overhead lines - AS 3822: Test methods for bare overhead conductors - AS 3983: Metal drums for insulated electric cables and bare conductors - AS 4065: Concrete utility service poles - AS 4243: Additional requirements for enclosed switchgear and control gear from 1 kV to 72.5 kV to be used in severe climatic conditions - AS 4398: Insulators - Ceramic or glass - Station post for indoor and outdoor use - Voltages greater than 1000V AC (Parts 1 and 2) - AS 4435: Insulator - composite for overhead power lines - Voltages greater than 1000V AC - AS 4676: Structural design requirements for utility service poles - AS 4677: Steel utility service poles - AS 4899: Pin insulators - porcelain and glass for overhead power lines - voltages greater than 1000V AC - AS 60038: Standard voltages - AS 60044.1 (IEC 60044-1): Instrument transformer - Current transformers - AS 60044.2: Instrument transformers - Inductive voltage transformers - AS 60137 (IEC 60137): Bushings for alternating voltages above 1000 V - AS/NZS 60265.1:2001 (IEC 60265-1): High-voltage switches - Switches for rated voltages above 1 kV and less than 52 kV - AS 60305: Insulators for overhead lines with a nominal voltage above 1000 V - Ceramic or glass insulator units for AC systems - Characteristics of insulator units of the cap and pin type - AS 60437 (IEC 60437): Insulators for overhead lines with a nominal voltage above 1000V - Ceramic insulators for AC systems - Characteristics of insulator units of the long rod type - AS 60529 (IEC 60529): Degrees of protection provided by enclosures (IP Code)

Document type	Title
	- AS 62271-303 (IEC 62271-303): High-voltage switchgear and controlgear - Use and handling of sulphur hexafluoride (SF_6) in high-voltage switchgear and controlgear - AS/NZS 7000: Overhead line design - Detailed procedures - ENA 011: Pole supply and performance specification - ESAA C(b)1: ESAA Guidelines for design and maintenance of overhead distribution and transmission lines - IEC 376: Sulfur Hexafluoride - IEC 60255 series: Measuring relays and protective equipment - IEC 62271-111: High-voltage switchgear and controlgear - Automatic circuit reclosers and fault interrupters for alternating current systems up to 38 kV - ANSI C37.60: Requirements for overhead, pad mounted, dry vault, and submersible automatic circuit reclosers and fault interrupters for AC systems up to 38 kV

10.1 Conflicts between specification, standards and/or codes

Review the above standards and make use of them where they are applicable. Identify any conflicts between the above standards and recommend which criteria to use. The Contractor must refer and conflicts in the information to Sydney Water for clarification.

Ownership

Ownership

Role	Title
Group	Integrated Systems Planning - Liveable City Solutions
Owner	Manager of Urban Design and Engineering
Author	Lead Engineer Electrical

Change history

Version No.	Prepared by	Date	Approved by	Issue date
1	Robert Lau / Andrew Manganas / Paul Zhou	05/12/2014	Norbert Schaeper	05/12/2014
2	Paul Zhou	20/02/2020	Steve-Keevil Jones	20/02/2020