Technical Specification - Prefabricated (Kiosk) Substations

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Revision details

Version No.	Clause	Description of revision
1.0		General revision
2.0		General revision
3.0		General revision
4	All	Format update, changing ‘shall’, ‘should’ and ‘may’ to must where relevant to Sydney Water, ‘approved’ replaced with ‘accepted’, minor editorial changes elsewhere.

Introduction

This Specification is for the design, supply and installation of Prefabricated (Kiosk) Substations for Sydney Water assets.

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Acronyms

Term	Definition
AC (ac)	Alternating Current
AI	Analogue Input
ANAF	Air (Natural convection) and Air (Forced convection)
ANSI	American National Standards Institute
AO	Analogue Output
AS	Australian Standard
AUD	Australian Dollars

Term	Definition
CB	Circuit Breaker
CT	Current Transformer
c/w	complete with
DC (dc)	Direct Current
DI	Digital Input
DO	Digital Output
ELV	Extra Low Voltage (i.e. ≤ 50 V AC or ≤ 120 V DC)
EN	European Normalised Standard
ESW	Earth Switch
FLC	Full Load Current
GA	General Arrangement (drawing)
HV	High Voltage (i.e. > 1000 V AC or > 1500 V DC)
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical & Electronic Engineers
I/O	Inputs/Outputs
ISO	International Standards Organisation
ITP	Inspection and Test Plan
KNAN	Cooling fluid with flash point > 300 (Natural convection) and Air (Natural convection)
LV	Low Voltage (i.e. greater than ELV but ≤ 1000 V AC or ≤ 1500 V DC)
MCR	Maximum Continuous Rating
MEPS	Minimum Energy Performance Standard (as defined in AS 2374.1.2 - 2003)
MSDS	Material Safety Data Sheet
MV	Medium Voltage (note this term is not used in this specification)
NEMA	National Electrical Manufacturers Association
ONAF	Oil (Natural convection) and Air (Forced convection)
ONAN	Oil (Natural convection) and Air (Natural convection)

Term	Definition
OTI	Oil temperature Indicator
PCB	Polychlorinated Biphenyl - chemical substance in which the biphenyl structure has chlorine substitutions (for hydrogen atoms) to varying degrees. They have the chemical formula C_{12} H_{10} - n Cl n where n ranges from 1 to 10.
PF	Power Factor
PLC	Programmable Logic Controller
pu	per unit
SAA	Standards Association of Australia
Sec.	second
SLD	Single Line Diagram
TBA	To Be Advised
TBC	To Be Confirmed
TCS	Trip Circuit Supervision
TCM	Transformer Conservator Membrane
TX	Transformer
WTI	Winding Temperature Indicator

1. General

1.1 Introduction

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

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 General

This Specification applies to prefabricated substations that must be designed and constructed in accordance with the current issue of AS 62271.202 and any additional requirement indicated in the following sections.

2.2 Environmental requirements

The Prefabricated substation enclosure class must be Class 10 in accordance with AS 62271.202.

Depending on the LV switchboard configuration, its cooling must be in compliance with AS 60947.1.

Environmental conditions	
Maximum ambient temperature	+60 ºC
Monthly average temperature	+30 ºC
Yearly average temperature	+20 ºC
Minimum ambient temperature (corresponds to “minus 5ºC indoor class”)	-5 ºC
Minimum ambient temperature (corresponds to “minus 25ºC outdoor class”)	-25 ºC
Maximum relative humidity	95%

The Prefabricated substation must be suitable for installation and service up to an elevation of 1000 m above sea level.

2.3 Key ratings and features

The key ratings and features of the prefabricated substation enclosure must be as follows:

Ref	Rating or feature	Requirement
1	Construction	Fully type tested
2	Material of enclosure	Zinc annealed sheet steel /Stainless Steel/ Aluminium (Marine Graded)
3	Mounting arrangement	Free standing floor mounted on a hot dipped galvanised base
4	Minimum Internal Fault Protection Classification	IAC AB 20 kA 1 s (lower fault level may be considered upon request to principal, and the IAC-AB requirement maybe omitted for transformer ONLY kiosk)
5	Accessibility of compartments (where fitted)	HV Compartment - padlockable doors Transformer - Padlockable doors LV Compartment - Padlockable doors
6	HV Cable entry	Bottom

Ref	Rating or feature	Requirement
7	LV cable entry	Bottom
8	Minimum Degree of protection	HV compartment - IP43D Transformer compartment - IP23D LV compartment - IP43D
9	Internal Lighting	Required - Door limit switch activated
10	LED Lighting voltage	48 V DC

2.4 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 - construction

3.1 General

The prefabricated substation must be designed for operation where continuity of supply is the first consideration. Facilities must be provided to assist inspection, maintenance, testing, cleaning, and repairs.

Prefabricated substations must typically be completely self-contained, factory assembled in a totally enclosed metal cladding. The housing must be vermin proof, dust proof and, weatherproof housing ready for placing into position upon a concrete base.

Prefabricated substations can be used to house HV switchgear, transformer and LV switchgear; HV switchgear and Transformer, or Transformer and LV switchgear, or Transformer Only. The amount of prefabricated substation compartments must be supplied based on the application.

HV switchgear, Transformer and LV switchgear must be housed in separate compartments. The compartments must be completely separated by metal barriers transfer of arc fault between compartments must be minimised. All compartments must be individually accessible by their own padlockable door(s) from the outside of the kiosk substation.

Cooling of the prefabricated substation must be by natural ventilation.

Only cables associated with equipment may enter the compartment for that equipment.

The roof of the prefabricated substation must be peaked to shed rainwater.

The prefabricated substation must have sufficient mechanical strength to withstand loading as stated in AS 62271.202.

Type test certificates for the prefabricated substation must be supplied by the Contractor during equipment selection phase.

All apparatus must be of the continuous maximum rating designed to ensure satisfactory operation under all climatic and atmospheric conditions prevailing at site. The apparatus must operate satisfactorily under such variations of load, voltage and short circuits, within its assigned rating, as may be met with under working conditions of the system.

All conductors, connections and contacts must be of ample section and surface area for carrying continuously the specified full load, currents and for carrying the specified short circuit current for sufficient time to enable the supplied fuse or circuit breaker to clear the fault.

In no part of the equipment, including busbars, connections, isolators, fuses, contacts, cable boxes and trunkings and connections must the temperature rise exceed the values specified in the relevant IEC publications or equivalent standards.

3.2 Sheet metal work

The prefabricated substation enclosure must be fabricated such that the framework is sufficiently rigid and stable to withstand all normal operating, handling and shipping forces without deformation, misalignment or damage. Removable sections of the enclosure must not be used to obtain such rigidity. Written approval from Sydney Water must be obtained if rivets are to be used in the assembly of steel sections.

All steel panelling must be of folded construction, utilising 2 mm (minimum) zinc annealed sheet steel, marine graded aluminium or 316 stainless steel.

The substation must be easily lifted by means of suitable slings through lifting eyes. If lifting eyes are located on the floor frame of the substation, then a suitable lifting beam, to which the slings must be attached, must be supplied in order to keep the slings away from the substation side to prevent scratching.

3.3 Compartment doors

Compartment doors must be provided at each end and sides of the prefabricated substation, providing access to HV switchgear, LV switchgear and transformer off load tap changer selector switch, all protection and indication devices, all valves, CTs etc.

Compartment doors must be suitably designed and braced to prevent sagging or drumming taking into account their weight. All panel seams and joins must be continuously welded.

Compartment doors must be provided with hinges that swing open outwards through 180 degrees and be fitted with a latching mechanism at angles 90 degrees, 120 degrees and 10 degrees preventing the door from self-closing. The latches must be installed such that they are easily operated without requiring special tools.

Compartment doors must have earth studs welded on the back of the doors and be equipotentially bonded to the kiosk substation frame with minimum 4 mm^2 earth conductors.

Compartment doors must have a continuous neoprene seal around the perimeter in order to achieve the required IP classification (the seal must be glued or fixed to the door).

Full height compartment doors must be provided with a three point latching system.

Compartment doors must be removable.

Compartment doors must be fitted with door handles that have padlocking facilities to suit Sydney Water 10 mm padlocks.

Access to the transformer can be through removable bolted panels fitted with two handles positioned on the panel to assist with its removal. Each removable panel must not exceed 15 kg in weight.

Compartment doors must have interlock system to ensure transformer compartment and LV compartment doors can only been accessed when the respective transformer is de-energised and earthed. (this is not a mandatory requirement for transformer ONLY kiosk).

3.4 HV compartment

This compartment is designed to be equipped with HV secondary switchgear or Ring main Units and associated control circuit and protection relays. Where there is insufficient room to house the protection relays in the HV compartment then it must be housed in a separate control panel in the LV compartment.

3.5 Transformer compartment

The transformer compartment must be designed to provide the transformer with sufficient airflow volume for cooling through adequately sized ventilation openings.

Integral oil containment must be provided with a capacity of at least 110% of the oil volume of the transformer. The oil bund must have a drain valve.

3.6 The oil containment must not de-rate the transformer rating LV compartment

This compartment is designed to be equipped with LV switchgear. All LV terminations must have IP2X minimum degree of protection.

All protection and indication/ auxiliary devices on the transformer must be wired to a marshalling box located inside the secondary end of the prefabricated substation. In addition to the requirements in this document, the LV compartment design must also comply with the latest revision of Sydney Water Technical Specification - Electrical.

3.7 Surface preparation and painting

The complete enclosure surface must be prepared and painted to provide adequate protection against the adverse effects of the site conditions specified in Section 2.2.

Surface preparation and paint systems must be selected to give a life of not less than 15 years to first maintenance.

All Metal finishing, the preparation, pre-treatment of surfaces and painting must be carried out strictly in accordance with Sydney Water Standard specification WSA 201 - Manual for selection and Application of Protective Coatings and WSA 201 - Sydney Water Supplement and PCS 100 - Protective coating standard.

Preferred paint colours	
Electrical Kiosk	N35 (light Grey)

3.8 Fixings

All metal handles, hinges, screws and nuts must be of manufacturer's standard finish and suitably protected against corrosion.

Externally fitted fixings must be hot dipped galvanised.

Cadmium plated fixings must not be used.

All current carrying connections must be with conical washers. Bolt length is to be selected so that approximately two threads protrude on final installation.

All equipment located on equipment mounting plates must be fixed via drilled and tapped holes in the mounting plates.

3.9 Earthing & earth bars

a) All doors and access panels must be connected to the prefabricated substation enclosure with a minimum 70 mm^2 bare copper braid. A separate braid must be provided for each door and panel. The enclosure must be connected to the prefabricated frame with 70 mm^2 bare copper braids at a minimum of two separate locations at either end of the substation.

b) A tinned copper main earth bar suitably rated for the maximum earth fault current and duration (40 mm x 6.3 mm minimum size) must be installed along length of the prefabricated substation from LV compartment to HV compartment, typically bolted directly to the substation base frame. A minimum of four spare holes 14 mm diameter to suite M12 bolts must be provided at each end (HV and LV compartment) of the main earth bar to allow for connection to earth grid.

c) The main earth bar must be readily accessible from the HV and LV compartment and must not impede the operation of the LV or LV switchgear of termination of cables

d) The transformer tank must be connected to the prefabricated earth busbar using a tinned copper busbar minimum 40 mm x 6.3 mm

e) The HV switchgear busbar must be connected to the prefabricated substation main earth bar using two 70 mm^2 cable connected either end of the HV switchgear

f) The LV switchgear neutral busbar must be connected to the prefabricated substation main earth bar using either two 70 mm^2 cables or 40 mm x 6.3 mm tinned copper busbar.

3.10 Equipotential bonding

All electrical equipment and conductive part must be equipotentially bonded in accordance with the requirements in Sydney Water Technical Specification - Electrical.

4. Technical requirements - equipment

4.1 HV switchgear

HV switchgear installed into the prefabricated substation must be secondary or ring main unit type complying with Sydney Water equipment specification DOC0012 - HV switchgear.

4.2 Transformers

Transformers installed into the kiosk substation must be typically oil immersed type complying with Sydney Water equipment specification DOC0019 - Power Transformers.

4.3 LV switchgear

LV Switchgear installed into the kiosk substation must comply with Sydney Water Technical Specification - Electrical.

4.4 Interconnections

The prefabricated substation must be fitted with interconnections (power and control) between HV switchgear and transformers, Transformer and LV switchgear.

The power interconnections must be either cabling or busbar and must be sufficiently rated to the connected equipment's maximum current and fault rating.

All interconnections must be fully supported. Equipment terminals must not be used to support the interconnecting cables or busbar.

5. Technical requirements - fittings and accessories

5.1 General

The prefabricated substation must be provided with:

a) Lifting lugs

b) Hot dipped galvanised base frame.

5.2 Rating plates

Each prefabricated substation must be fitted with a stainless steel rating plate with all information of the HV switchgear, transformer and LV switchgear as detailed in their respective specifications engraved/etched onto the rating plate. Printed rating plates will not be acceptable.

The rating plate must be placed in a position that it is clearly visible from the front of the prefabricated substation.

5.3 Name plates

Each prefabricated substation must be fitted with a stainless steel name plates with all the information as specified in AS 62271.202 engraved/etched onto the name plate. Printed name plates will not be acceptable:

5.4 Accessories

The substation must be fitted with the following:

a) 240 V AC 10 A 3-pin double switched socket outlet located in the LV compartment of the substation

b) Door limit switch operated lighting (LED type) mounted above and in front of the equipment located in the HV and LV compartment

c) LED lighting in HV and LV compartments

d) Sufficiently rated 48 V DC Battery Charger supplied from an MCB protected circuit supplied from LV switchboard in the kiosk. The battery charger must supply the all the equipment installed in the kiosk requiring DC supply, including but not limited to: switchgear protection and control functions.

5.5 Wiring

All LV and ELV wiring is to be installed in a neat and logical manner following standard industry practices.

All LV and ELV wiring must fully comply with the requirements of AS 3000 Wiring Rules.

All conductors must be FLEXIBLE stranded tinned copper wire.

Minimum conductor sizes must be:

Item	Wire type	Wiring and/or conductors	Colours
Extra Low Voltage (AC or DC)	1.5 mm^2 Cu, 0.6 / 1 kV PVC insulated type V75 to AS 3147	Active/Positive Neutral/Negative	Light Grey (LtG)
240 V AC control when supplied from same compartment or SCA	2.5 mm^2 Cu, 0.6 / 1 kV PVC insulated type V75 to AS 3147	Active Neutral	Brown (BN) Black (BK)

Item	Wire type	Wiring and/or conductors	Colours
In all other cases		Active Neutral	Orange (O) Black (BK)
CT and VT secondaries	4 mm^2 Cu, 0.6 / 1 kV PVC insulated type V105 to AS 3147	Red Phase White Phase Blue Phase Neutral	Red (R) White (W) Blue (B) Black (BK)
Core Balance toroids	4 mm^2 Cu, 0.6 / 1 kV PVC insulated type V105 to AS 3147	S1 S2	Black (BK) Black (BK)
Earth conductors	Minimum 4 mm^2 Cu, 0.6 / 1 kV PVC insulated type V75 to AS 3147		Green-Yellow (G-Y)
Instrumentation twisted pair conductors		Positive Negative	White (w) Black (BK)
Ethernet	CAT 6		Blue
Conductors connecting voltage free relay contacts where the voltage is undefined	1.5 mm^2 Cu, 0.6 / 1 kV PVC insulated type V75 to AS 3147	Active/Positive Neutral/Negative	Violet (V)

All LV and ELV wiring is to be installed in plastic cable duct with clip-on covers, strapped looms or flexible conduit is to be provided from panel to door. Cable ducts are to have 30% spare capacity. Panel to door wiring must include a loop to relieve stress and must be anchored at the panel and the door.

No joints in runs of wiring (i.e. at locations other than at terminals) must be permitted.

All LV and ELV wiring is to be arranged so that the line side is connected to the top of the respective device.

Adhesive wiring supports are unacceptable.

Where wiring is to pass through cut-outs in panelling, the hole must be bushed.

All terminal strips and individual terminal blocks must be labelled using proprietary labelling/numbering systems.

All conductors must be terminated at both ends with pre-insulated crimp terminations. They must be of the correct size for the conductor and must be applied with the terminations manufacturer's tool.

- Ring type termination lugs must be used for terminating to stud-type terminals
- Lip blade termination lugs must be used for terminating to rail-type terminals
- U shaped termination lugs must be used on selector switches and similar small equipment.

Solder connections are not acceptable

All conductors must be uniquely numbered at both ends in accordance with the respective schematic diagrams.

All field wiring must be marshalled at terminal strips.

Terminals must comply with the following requirements:

a) Tunnel type connectors

b) Only one conductor must be terminated on each side of each terminal

c) All terminal strips must maintain a degree of protection of IP2X

d) All field cabling must be terminated on one side of each terminal strip and all panel wiring must be terminated on the other side of the terminal strip

e) For clarity, provide barriers between groups of terminals having different functions (e.g. between terminals for 240 V AC supply, DC output and signal terminals)

f) Provide a separate earth terminal for each field cable

g) All terminal blocks must be uniquely numbered in accordance with the respective schematic diagrams

h) All terminals must be uniquely numbered in accordance with the respective schematic diagrams.

MCBs must be provided for isolating all auxiliary power supplies.

5.6 HV and LV cable terminations

The base frame or support structure of the prefabricated substation must not interfere or impede the installation of the HV and LV cables.

The prefabricated substation must be installed with suitable cable clamps and adjustable cable support frames to suit the HV and LV cables to be connected to the HV and LV switchgear.

6. Identification and labelling

All electrical equipment forming part of the prefabricated substation must be readily identified in the English language by a label in accordance with the relevant standard and this Specification.

All labelling and nameplates must be in accordance with nomenclature used on the relevant electrical Drawings and Schedules provided by Sydney Water.

All labels must be engraved/etched stainless steel secured with stainless steel screws into tapped holes. Departures from these requirements must require the written pre-approval of Sydney Water.

All external and internal labels must be attached to the mounting surface with a minimum of two screws with holes drilled and tapped. Double sided adhesive tape is not acceptable.

All equipment labels must be mounted on a fixed portion of the enclosure directly adjacent to the device.

Terminal block group labels must be manufactured of the material and mounted in accordance with the standard procedures adopted by the terminal strip manufacturer. Terminals must not be made of brittle material.

Generally, labels must be manufactured to the following specification.

Label function and location	Typical label size (mm)	Text colour / background colour	Label description	Text height (mm)
Rating Plate - Mounted on outside of enclosure		Black / Stainless Steel	Refer to section 5.2	
Name Plate - Mounted on outside of enclosure		Black / Stainless Steel	Refer to section 5.3	
Substation Main Label (Sydney Water Number plate style) - Mounted on outside of enclosure at either end	200 L x 100 H	Black / Yellow	Substation Number	80
Substation Main Label - Mounted on outside of enclosure at either side	400 L x 200 H	Black / Stainless steel	Voltage rating primary / secondary winding Transformer MVA Rating Fed From XXX	50 50 50
HV Compartment Voltage Label - Mounted on doors of compartment	200 L x 50 H	Black / Stainless Steel	Voltage rating	40
LV Compartment Voltage Label	200 L x 50 H	Black / Stainless Steel	Voltage rating	40

Label function and location	Typical label size (mm)	Text colour / background colour	Label description	Text height (mm)
- Mounted on doors of compartment				
Transformer Marshalling box label - Mounted on front door of marshalling box	100 L x 50 H	Black / Stainless Steel	Transformer Marshalling Box	15 15
All other removable cover labels that provide access to high voltage equipment - Mounted on all covers and doors that provide access to HV		White / Red / Black	DANGER HIGH VOLTAGE (to AS 1319)	
All marshalling box internally mounted equipment labels (e.g. control relays, control MCBs, Terminals etc) - Mounted below equipment.		Black / White		3
All compartment internally mounted equipment labels (e.g. control relays, control MCBs, Terminals etc) - Mounted below equipment		Black / White		3

Note: HV and LV switchgear labels must be in accordance to their respective specifications.

6.1 Label schedule

A label schedule showing details of each label must be submitted for approval prior to manufacture of the relevant labels.

7. Testing requirements

7.1 Type testing

The Contractor must provide test (type test) reports in accordance with AS 62271.202 for each type of prefabricated substation. The minimum must be submitted:

a) Dielectric tests
b) Temperature rise tests
c) Short time and peak withstand current of earthing circuits
d) Functional tests on assembly
e) IP tests (degree of protection)
f) IK tests (mechanical impact tests)
g) Internal arc fault tests class IAC-AB 20 kA / 1 s (this is not a mandatory requirement for transformer ONLY kiosk).

The type tests must be submitted in English from an approved laboratory for Sydney Water to review.

If a new type or special tests are performed, representatives from Sydney Water must be given the opportunity to witness the tests. 14 calendar days' notice must be given for tests in Australia and 21 calendar days' notice must be given for tests outside Australia.

Copies of all type test reports (whether previous or new) must be submitted to Sydney Water for approval.

Note: For the transformer ONLY kiosk application, the type testing requirements (c) and (g) maybe omitted with prior approval from Sydney Water.

7.2 Factory inspection

Representatives from Sydney Water must be given the opportunity to witness the factory tests. 14 calendar days' notice must be given for tests in Australia and 21 calendar days' notice must be given for tests outside Australia.

7.3 Routine (factory) testing

All routine tests listed by AS 62271.202 must be performed on each prefabricated substation at the manufacturers factory prior to shipment to site, including:

a) Dielectric test on the HV interconnection
b) test on auxiliary and control circuits
c) Function tests
d) Verification of correct wiring.

Factory tests must also include:

a) All tests for HV switchgear in accordance with Sydney Water equipment specification DOC0012 - HV Switchgear
b) All tests for transformer in accordance with Sydney Water equipment specification DOC0019 - Power Transformers
c) All tests for LV switchgear in accordance with Sydney Water Technical Specification - Electrical
d) Detailed mechanical inspection
e) Detailed electrical inspection
f) Review of routine test certificates for protection devices (from place of manufacture)

g) Review of manufacturing inspection and test documentation and records

h) Review of manufacturing defect lists / punch lists.

The results of all factory tests must be available for review during the tests.

A comprehensive Factory Test Report must be submitted for review within five working days of completion of the tests (or prior to shipment, whichever is the earlier). The Factory Test Report must include:

a) Results of all tests

b) Copies of any test oscillograms, graphs, printouts, etc

c) Copies of all routine test certificates (from place of manufacture) for protection devices, CTs, etc

d) Copies of magnetisation curves for all CTs

e) Copies of manufacturing inspection and test documentation and records, follower cards, etc

f) Copies of factory defect lists / punch lists

g) Copy of the completed Factory ITP

h) Statement confirming compliance with the specified requirements.

Unless agreed otherwise by the Superintendent, all defects arising prior to or during the factory tests must be rectified to the satisfaction of the Superintendent prior to the respective transformer being shipped to site.

7.4 Site testing

The Contractor must provide a detailed procedure (for review by Sydney Water) for site testing and commissioning of the prefabricated substation. The procedure must fully comply with the requirements of AS 62271.202.

The site test will be performed by the Contractor, in accordance with the procedure provided by the Contractor.

8. Quality assurance and inspection and test plans

The Contractor must implement a quality system that complies with the requirements of ISO 9001 for all work on the prefabricated substation.

The Contractor must submit to Sydney Water for review two project-specific Inspection and Test Plans (ITPs) for the prefabricated substation:

a) Factory ITP- covering all activities i.e. engineering, design, supply, manufacture, factory assembly, factory testing, type testing, resolution of factory defects/punch lists, release for delivery, preparation for transport, etc for the prefabricated substation and all associated equipment installed in the substation.

b) Site ITP - covering all on-site activities i.e. delivery to site, unloading, installation, assembly, site testing, resolution of site defects/punchlists, handover, etc.

The ITPs must identify the standards and/or procedures as well as the acceptance criteria that must apply for each stage in the ITPs.

Unless approved otherwise by Sydney Water, all standards, procedures and acceptance criteria included in the ITPs must comply with the requirements defined in this specification.

Perform all work on the prefabricated substation in accordance with the approved ITPs.

Sydney Water may apply witness points and/or hold points on various stages of the ITPs.

Sydney Water must be given the option of witnessing all inspections and tests including type tests, (routine) factory tests and site tests. Sufficient notice (seven calendar days for tests on site, 14 calendar days for test elsewhere in Australia, 21 calendar days for tests outside Australia) must be given to enable the necessary travel arrangements to be made.

Sydney Water may elect to appoint third party inspector(s) to witness inspections and tests.

All costs associated with attendance by representatives of Sydney Water at inspections and tests must be borne by Sydney Water.

9. Spare parts

9.1 Consumable spare parts

The Contractor must provide all consumable spare parts (including fluids) required for the transformers up to the end of the defects liability period.

All consumable spares must be provided in advance and held in storage at site.

9.2 Routine maintenance spare parts (for defects liability period)

The Contractor must provide all consumables and spare parts for routine and scheduled maintenance up to end of the defects liability period.

All routine maintenance spares must be provided in advance and held in storage at site.

9.3 Long-term maintenance / strategic spare parts and special tools

The Contractor must provide a priced list of optional recommended spare parts for long-term maintenance activities and strategic planning, as well as any special tools required to perform long-term maintenance activities. Sydney Water will confirm if it wishes to purchase some (or all) of these recommended spare parts and tools.

10. Manuals and drawings

Two paper copies of erection, maintenance and operating manuals in accordance with Clause 10 of AS 62271.202 must be supplied.

One electronic copy of all manuals, drawings and test results must be provided on suitable electronic media in PDF file format as a minimum.

Equipment manuals provided must contain details of all aspects of the operation and maintenance of the supplied equipment, a detailed parts list of all major components and copies of all factory test results.

Electrical circuit diagrams must be supplied either with the manuals or as separate A3 size drawings. All drawings must be supplied electronically in an AUTOCAD compatible format.

Equipment manuals and drawings must not contain descriptions or details of alternative equipment not specifically used in the supplied equipment.

Maintenance manuals and regimes must be specific for each site installation, with respect to the maintenance timeframes required for the environmental conditions of the specific site.

11. Related documents

The Prefabricated Substation and all associated 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	- Latest edition of the Work Health and Safety Act - Latest edition of the Service and Installation Rules of New South Wales
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
Other documents	- DOC0012 - Specification HV Switchgear - DOC0019 - Specification Power Transformers - Sydney Water Technical Specification - Electrical
Standards	- AS ISO 1000: The International System of Units (SI) and its application (ISO 1000) - AS 1170: Minimum design loads on structures (known as the SAA Loading Code). (Parts 2 and 4) - AS 1214 (ISO 1460/61): Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series) - AS 1627: Metal finishing - Preparation and pre-treatment of surfaces. - AS 1767 (IEC 60296): Insulation liquid - Specification for unused mineral insulating oils transformers and switchgear (IEC296) - AS 1824 (IEC 60071): Insulation coordination (phase-to-earth and phase-to-phase, above 1 kV) (Parts 1 and 2) - AS 1931 (IEC 60060): High voltage testing techniques (Parts 1 and 2) - AS1939: Classification of Degrees of Protection for Enclosures for Electrical Equipment - AS 1940: The storage and handling of flammable and combustible liquids. - AS 2067: Switchgear assemblies and ancillary equipment for alternating voltages above 1 kV - AS 2374 (IEC 60076): Power transformers (Parts 1, 2, 5, 7 and 8) - AS 2700: Colour standards for general purposes - AS 2768: Electrical Insulating Materials - AS/NZS 3000: Electrical installations (known as the Australian/New Zealand Wiring Rules) - AS/NZS 3439: Low Voltage switchgear and controlgear assemblies - AS/NZS 3947: Low Voltage switchgear and controlgear

Document type	Title
	- AS 60038: Standard voltages - AS 60076 (IEC 60076): Power transformers (parts 1, 3, 4, 10 and 11) - AS 60529 (IEC 60529): Degrees of protection provided by enclosures (IP Code) - AS60947-2 Low voltage switchgear and controlgear - AS/NZS 6100: Electromagnetic Compatibility (EMC) - AS 62271.1 (IEC 62271-1): High Voltage Switchgear and controlgear - Part 1: Common specifications - AS 62271.200 (IEC 62271-200): High Voltage Switchgear and controlgear - AS 62271.202 (IEC 62271-202): High Voltage/Low Voltage prefabricated substation

11.1 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 any 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	Robert Lau / Andrew Manganas / Paul Zhou	21/09/2016	Norbert Schaeper	21/09/2017
3	Robert Lau / Paul Zhou	14/09/2018	Ken Wiggins	14/09/2018
4	Paul Zhou	20/02/2020	Steve-Keevil Jones	20/02/2020