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| Assets Planning and Delivery GroupEngineering |

DESIGN STANDARD DS 26-08

Type Specifications – Electrical

Type Specification for High Voltage Switchboards

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| version 2revision 1 |
| May 2022 |

**FOREWORD**

The intent of Design Standards is to specify requirements that assure effective design and delivery of fit for purpose Water Corporation infrastructure assets for best whole-of-life value with least risk to Corporation service standards and safety. Design standards are also intended to promote uniformity of approach by asset designers, drafters and constructors to the design, construction, commissioning and delivery of water infrastructure and to the compatibility of new infrastructure with existing like infrastructure.

Design Standards draw on the asset design, management and field operational experience gained and documented by the Corporation and by the water industry generally over time. They are intended for application by Corporation staff, designers, constructors and land developers to the planning, design, construction and commissioning of Corporation infrastructure including water services provided by land developers for takeover by the Corporation.

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[Overview of Western Australia’s Work Health and Safety (General) Regulations 2022 (dmirs.wa.gov.au)](https://www.dmirs.wa.gov.au/sites/default/files/atoms/files/overview_general_regulations.pdf)

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**Head of Engineering**

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REVISION STATUS

The revision status of this standard is shown section by section below.

| **REVISION STATUS** |
| --- |
| **SECT.** | **VER./REV.** | **DATE** | **PAGES REVISED** | **REVISION DESCRIPTION****(Section, Clause, Sub-Clause)** | **RVWD.** | **APRV.** |
| **1** | **2/0** | **06/04/16** | **10–12** | **Revised** | **NHJ** | **MSP** |
|  |  |  |  |  |  |  |
| **2** | **2/0** | **06/04/16** | **12–13** | **Revised** | **NHJ** | **MSP** |
|  |  |  |  |  |  |  |
| **3** | **2/0** | **06/04/16** | **13** | **Formatted** | **NHJ** | **MSP** |
|  |  |  |  |  |  |  |
| **4** | **2/0** | **06/04/16** | **13-14** | **Revised** | **NHJ** | **MSP** |
|  |  |  |  |  |  |  |
| **5** | **1/4** | **30.08.11** | **17** | **5.3 revised** | **NHJ** | **AAK** |
|  | **2/0** | **06/04/16** | **14–18** | **Revised** | **NHJ** | **MSP** |
|  |  |  |  |  |  |  |
| **6** | **2/0** | **06/04/16** | **19-20** | **Revised** | **NHJ** | **MSP** |
|  |  |  |  |  |  |  |
| **8** | **2/0** | **06/04/16** | **21** | **Revised** | **NHJ** | **MSP** |
|  |  |  |  |  |  |  |
| **10** | **2/0** | **06/04/16** | **21** | **Revised** | **NHJ** | **MSP** |
|  |  |  |  |  |  |  |
| **11** | **2/1** | **29/04/22** | **11-24** | **Revised** | **TL** | **EDG** |

| **REVISION STATUS HISTORY** |
| --- |
| **VER./****REV.** | **DATE** | **PAGES REVISED** | **REVISION DESCRIPTION****(Section, Clause, Sub-Clause)** | **RVWD.** | **APRV.** |
| **0/0** | **01.0801** | **All** | **New Edition** | **NHJ** | **AAK** |
| **0/1** | **18.09.01** | **4** | **8.4.6,8.4.9 general revision** | **NHJ** | **AAK** |
| **0/1** | **18.09.01** | **6** | **8.5.10 general revision** | **NHJ** | **AAK** |
| **0/1** | **18.09.01** | **7** | **8.5.18 general revision** | **NHJ** | **AAK** |
| **0/1** | **18.09.01** | **8** | **8.5.22 general revision** | **NHJ** | **AAK** |
| **0/1** | **18.09.01** | **9** | **8.6.4 general revision** | **NHJ** | **AAK** |
| **0/1** | **18.09.01** | **10** | **Table revised** | **NHJ** | **AAK** |
| **0/1** | **18.09.01** | **11** | **8.7.1,8.7.3,8.7.4 general revision** | **NHJ** | **AAK** |
| **0/1** | **18.09.01** | **12** | **8.7.5 general revision** | **NHJ** | **AAK** |
| **0/1** | **18.09.01** | **13** | **A6 general revision** | **NHJ** | **AAK** |
| **0/1** | **18.09.01** | **14** | **Page split** | **NHJ** | **AAK** |
| **0/1** | **18.09.01** | **15** | **8.1.7-10 included** | **NHJ** | **AAK** |
| **0/2** | **12.03.02** | **8** | **8.5.23 included** | **NHJ** | **AAK** |
| **0/2** | **12.03.02** | **9** | **8.6.4 general revision** | **NHJ** | **AAK** |
| **0/2** | **12.03.02** | **10** | **5. included** | **NHJ** | **AAK** |
| **0/2** | **12.03.02** | **13** | **A7. and A9. revised** | **NHJ** | **AAK** |
| **0/2** | **12.03.02** | **14** | **A20 included** | **NHJ** | **AAK** |
| **0/2** | **19.04.02** | **17** | **8.5.23 included, minor corrections** | **NHJ** | **AAK** |
| **0/3** | **30.10.02** | **1** | **8.1.1,8.1.3 general revision** | **NHJ** | **AAK** |
| **0/3** | **30.10.02** | **2** | **8.1.9 general revision** | **NHJ** | **AAK** |
| **0/3** | **30.10.02** | **7** | **8.5.16 general revision** | **NHJ** | **AAK** |
| **0/3** | **30.10.02** | **9** | **8.6.1 general revision** | **NHJ** | **AAK** |
| **0/3** | **30.10.02** | **11** | **8.7.1 general revision** | **NHJ** | **AAK** |
| **0/3** | **30.10.02** | **12** | **8.8,8.9,8.10 new** | **NHJ** | **AAK** |
| **0/3** | **30.10.02** | **13-15** | **Annexures general revision** | **NHJ** | **AAK** |
| **0/3** | **30.10.02** | **16-19** | **Type Specifications general revision** | **NHJ** | **AAK** |
| **0/4** | **01.09.03** | **All** | **Reformatted** | **NHJ** | **AAK** |
| **0/4** | **01.09.03** | **3** | **8.1.9 general revision** | **NHJ** | **AAK** |
| **0/4** | **01.09.03** | **6** | **8.5.17 general revision** | **NHJ** | **AAK** |
| **0/4** | **01.09.03** | **7** | **8.5.21(a) general revision** | **NHJ** | **AAK** |
| **0/4** | **01.09.03** | **7** | **8.5.24 new clause** | **NHJ** | **AAK** |
| **0/4** | **01.09.03** | **18-20**  | **Tender response schedule** | **NHJ** | **AAK** |
| **1/0** | **27.02.04** | **All** | **Sections split. 1.6.1 general revision** | **NHJ** | **AAK** |
| **1/1** | **23.05.05** | **All** | **Paragraphs renumbered** | **NHJ** | **AAK** |
| **1/2**  | **30.04.07** | **7,8** | **1.3 included** | **NHJ** | **AAK** |
| **1/2**  | **30.04.07** | **8** | **1.8 amended** | **NHJ** | **AAK** |
| **1/2**  | **30.04.07** | **9** | **2 & 3 included** | **NHJ** | **AAK** |
| **1/2**  | **30.04.07** | **10** | **3 amended** | **NHJ** | **AAK** |
| **1/2**  | **30.04.07** | **10** | **4.1 amended** | **NHJ** | **AAK** |
| **1/2**  | **30.04.07** | **10** | **4.4 included** | **NHJ** | **AAK** |
| **1/2**  | **30.04.07** | **11** | **4.11 amended** | **NHJ** | **AAK** |
| **1/2**  | **30.04.07** | **11** | **4.12 included** | **NHJ** | **AAK** |
| **1/2**  | **30.04.07** | **11** | **5.2 amended** | **NHJ** | **AAK** |
| **1/2**  | **30.04.07** | **11** | **5.3, 5.5 included** | **NHJ** | **AAK** |
| **1/2**  | **30.04.07** | **12** | **5.6 amended** | **NHJ** | **AAK** |
| **1/2**  | **30.04.07** | **12** | **5.7 included** | **NHJ** | **AAK** |
| **1/2**  | **30.04.07** | **12** | **5.9,5.11,5.12 amended** | **NHJ** | **AAK** |
| **1/2**  | **30.04.07** | **12,13** | **5.13 amended** | **NHJ** | **AAK** |
| **1/2**  | **30.04.07** | **13** | **5.14,5.17, 5.18 amended** | **NHJ** | **AAK** |
| **1/2**  | **30.04.07** | **15** | **5.25,5.26,6.1 amended** | **NHJ** | **AAK** |
| **1/2**  | **30.04.07** | **17** | **7.2 amended** | **NHJ** | **AAK** |
| **1/2**  | **30.04.07** | **17** | **7.3,7.4 included** | **NHJ** | **AAK** |
| **1/2**  | **30.04.07** | **17** | **8 amended** | **NHJ** | **AAK** |
| **1/2**  | **30.04.07** | **17,18** | **9 amended** | **NHJ** | **AAK** |
| **1/2**  | **30.04.07** | **18** | **10 included** | **NHJ** | **AAK** |
| **1/2**  | **30.04.07** | **18** | **11 amended** | **NHJ** | **AAK** |
| **1/2**  | **30.04.07** | **18** | **12,13 included** | **NHJ** | **AAK** |
| **1/2**  | **30.04.07** | **18,19** | **14 included** | **NHJ** | **AAK** |
| **1/2**  | **30.04.07** | **20-22** | **Annexure amended** | **NHJ** | **AAK** |
| **1/2**  | **30.04.07** | **23-28** | **Type specification amended** | **NHJ** | **AAK** |
| **1/3** | **02.06.09** | **19** | **10 amended** | **NHJ** | **AAK** |

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# GENERAL

## Scope

1. This Specification covers the requirements for the design, construction and delivery, on site assembly, mechanical installation and testing of a High Voltage switchboard rated in the voltage range 1kV to 36 kV and as further detailed hereunder.
2. This Specification shall be read in conjunction with the accompanying Annexure and the Principal’s drawings listed therein.

## Site

The location of and access to the site for the installation of the High Voltage switchboard shall be as shown in the Annexure.

## Standards

1. Except where specified otherwise in this Specification, the workmanship, equipment and materials provided in accordance with this Specification shall comply in design, construction, rating and performance with the current relevant Australian or International Standards and Codes.
2. Such compliance shall also be in accordance with the requirements of competent Australian Authorities having jurisdiction over all or any part of the design, manufacture, installation and operation of the equipment.

In particular the High Voltage switchboard shall be in accordance with the requirements of AS 62271.200.

1. Specific reference is made within the Specification to the following Australian and International Standards:

IEC60071-1 Insulation co-ordination – Part 1: Definitions, principles and rules, which is current

AS 1319 Safety signs for the occupational environment

AS 2124 General conditions of contract

AS/NZ 5000.1 Electric cables - Polymeric insulated Part 1
for working voltages up to and including 0.6/1 kV

IEC 60050-441 International Electrotechnical Vocabulary. Switchgear, controlgear and fuses

AS 61869.1 Instrument transformers - Part 1: General requirements

AS 61869.2 Instrument transformers - Part 2: Additional requirements for current transformers

AS 61869.3 Instrument transformers - Part 3: Additional requirements for inductive voltage transformers

IEC 60099-4 Surge arresters Part 4 - Metal oxide type for A.C. systems
(AS 1307.2 is acceptable though not equivalent)

AS 60265.1 High-voltage switches - Switches for rated voltages above 1 kV and less than 52 kV IEC 60282-1 High Voltage fuses, Part 1 - Current limiting fuses
(AS 1033.2 is acceptable though not equivalent)

AS 60529 Degrees of Protection Provided by Enclosures of Electrical Equipment

AS 62271.1 High-voltage switchgear and controlgear - Common specifications for alternating current switchgear and controlgear

AS 62271.100 High-voltage switchgear and controlgear - Alternating-current circuit-breakers

AS 62271.102 High-voltage switchgear and controlgear - Alternating current disconnectors and earthing switches

IEC 62271-106 High-voltage switchgear and controlgear - Part 106: Alternating current contactors, contactor-based controllers and motor-starters

AS 62271.200 High-voltage switchgear and controlgear - AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV ISO 9001 Quality management systems - Requirements

ISO 9223 Corrosion of metals and alloys - Corrosivity of atmospheres - Classification, determination and estimation

## Supervising Engineer

1. For work being carried out under a formal contract utilizing General Conditions of Contract AS 2124, Supervising Engineer shall mean the Contract Superintendent.
2. In all other instances, Supervising Engineer shall mean the engineer who approved the relevant Principal’s drawings or an engineer authorised to act on his/her behalf.
3. In the event of a discrepancy between the Principal’s drawings and this Specification, the matter shall be referred to the Supervising Engineer for resolution.

## Principal’s Drawings

The switchboard shall be constructed strictly in accordance with the Principal’s drawings and with this Specification. The arrangement of the primary circuit and the type and rating of equipment shall be as shown on the Principal’s drawings and shall not be modified unless by written variation from the Supervising Engineer.

## Work by the Principal

The work to be performed by the Principal shall be as detailed in the Annexure.

## Information to be provided by the Contractor

The Contractor shall provide the following documentation in respect to the switchboard within the listed number of days after receipt of the Principal’s order.

1. General Arrangement Drawings 28 day
2. Electrical Wiring and Schematic Drawings 28 days
3. Manufacture and Delivery Schedule 14 days
4. Specification Data Sheets 35 days
5. Inspection and Test Plan 35 days
6. Test certificates On Delivery
7. Operating and Maintenance Manual On Delivery

## Contractor’s Drawings

1. All drawings provided by the Contractor shall be in accordance with the latest issue of the Water Corporation Design Standard DS24 – Electrical Drafting
2. All drawings shall be prepared in AutoCAD format, Release 2018 or later software
3. Drawings shall be prepared on the “Electrical” A1 metric drawing sheet and title block provided in the Water Corporation eXternal (WCX) package (available for download) in accordance with the Water Corporations Design Standard DS80
4. The drawings shall provide within the title block, the details to identify the drawing, including but not limited to its title, plan number, revision status, date of issue, Corporate project number, contractor’s name and reference number (if applicable)
5. Drawings’ detail shall include, but not limited to, the general arrangement, panel layout, power and control circuit diagrams and equipment specifications, as required
6. The contractor shall submit drawings in both AutoCAD and PDF formats in accordance with the Drawing Submission Process. Adequate contrast within the PDF image shall be maintained between drawing content and background to ensure the clarity and quality of the drawings

## Quality Assurance

The switchboard shall be manufactured under a quality system certified by an Accredited Authority in accordance with AS/NZS ISO 9001or an approved equivalent.

#  SERVICE CONDITIONS

## Electrical System

The switchboard shall be suitable for connection to a 3-phase electrical system having the characteristics detailed in the Annexure.

## Electrical System Earth Fault Factor

The switchboard shall be suitable for installation at a site where the earth fault factor as defined in IEC 60071-1 is as shown in the Annexure.

## Location and Accessibility

1. The switchboard shall be suitable for installation indoors in a switchroom with ceiling, lateral wall and rear wall clearances in accordance with AS 62271.200 Clause AA.1.1.
2. If the switchboard is specified in the Annexure to be suitable for location such that the rear side is non-accessible, it shall have an Internal Arc Classification (IAC) of not less than AFL.
3. If the switchboard is specified in the Annexure to be suitable for location such that the rear side is accessible, it shall have an Internal Arc Classification (IAC) of AFLR.
4. If the switchboard is specified for downwards internal arc fault gas exhaust, the floor void shall have a volume of not less than 2 cubic metres.

## Abnormal Service Conditions

1. Except where more arduous conditions are specified in the Annexure, the switchboard shall be rated for operation in locations where:
2. the maximum ambient air temperature may reach 45oC, and
3. other service conditions are normal service conditions as defined in AS 62271.1.
4. If more arduous conditions are specified in the Annexure, these shall apply.

# TYPE TEST REQUIREMENTS

1. The switchboard shall be of a design which has been type tested in accordance with IEC 62271-200 including internal arc fault testing in all compartments containing High Voltage conductors except in compartments where all such conductors are fully insulated with SF6 gas or with solid insulation.
2. Such tests shall be on the basis of the specified Internal Arc Classification rating.

# RATINGS

## Rated Voltage

The switchboard’s nominal rated voltage and highest rated voltage shall match the values of electrical system nominal voltage and highest voltage specified in the Annexure.

## Rated Insulation Level

The switchboard’s rated insulation level shall be in accordance with AS 62271.1 Table 1

## Rated Frequency

The switchboard’s rated frequency shall match the electrical system frequency specified in the Annexure.

## Number of Phases and Busbars

The switchboard shall control 3-phase main circuits as shown on the Principal’s drawings listed in the Annexure.

## Rated Normal Current

The rated normal current of the busbars and the various incoming and outgoing circuits shall be as shown in the Annexure.

## Rated Short-time Withstand Current

The switchboard’s rated short-time withstand current shall be as shown in the Annexure. This rating shall apply to all switches and circuit breakers except earth switches on the load side of current limiting fuses which shall have a short-time withstand current rating of not less than 5 kA.

## Rated Peak Withstand Current

The switchboard’s rated peak withstand current shall be 2.5 times the switchboard’s rated short-time withstand current.

## Rated Duration of Short Circuit

The switchboard’s rated duration of short circuit shall be 1 second.

## Rated Internal Arc Fault Current

The switchboard shall be rated to withstand an internal arc fault having a current equivalent to the rated short-time current unless a lower value is shown in the Annexure, in which case the latter value shall apply.

## Rated Supply Voltage of Auxiliary Circuits

The switchboard’s rated supply voltage of closing and opening devices and auxiliary circuits shall be as shown in the Annexure.

## Rated Supply Frequency of Auxiliary Circuits

If the switchboard’s closing and opening devices and auxiliary circuits are to be A.C. powered, the rated supply frequency of such devices shall be the frequency of the electrical system as specified in the Annexure.

## Rated Values of Components

The rated values and settings of all components shall be as shown on the Principal’s drawings.

# CONSTRUCTION

## General

The switchboard shall be designed and constructed in accordance with AS 2067 and AS 62271.200.

## Type of Enclosure

The switchboard shall be a metal clad type in accordance with AS 62271.200 with either partition class PM or partition class PI.

## Degree of Protection

The switchboard shall provide a degree of protection of persons against access to hazardous parts and of ingress of solid foreign objects in accordance with AS 60529 of not less than IP 2XC in all compartments except the bus bar chamber which shall provide a degree of protection of not less than IP 3X.

## Use Floor Surfaces to Provide Required Degree of Protection

The switchboard will be mounted on smooth concrete floor over cable ducts. If the design of the switchboard is such that it relies on the floor surfaces to be part of the enclosure providing the required degree of protection, the Contractor shall provide all necessary materials and instructions to enable the Principal to take the measures necessary to achieve the required degree of protection.

## Loss of Service Continuity

Unless specified otherwise in the Annexure, the design and construction of the switchboard shall provide a loss of service continuity of category LSC2A in accordance with AS62271.200.

## Protection Against Internal Faults

The design and construction of the switchboard shall incorporate features to minimise the likelihood of internal faults particularly in the following locations:

1. Cable termination compartments,
2. disconnectors, switches and earthing switches,
3. bolted connections and contacts,
4. instrument transformers, and
5. circuit breakers.

## Arc Gas Vents

1. Internal arcing fault gas vents shall be arranged in one of the following modes as specified in the Annexure:
2. downwards into a floor void in accordance with clause 2.3(d).
3. via exhaust ducts through the rear wall of the switchroom, or
4. through the rear side of the switchboard provided the rear side of the switchboard is non-accessible in accordance with AS 62271.200 AA.1.1
5. If arc fault gas venting is through the rear side of the switchboard, gas vents shall be arranged to direct the gases downwards.

## Dehumidifying Equipment

Dehumidifying equipment such as anti-condensation heaters shall be provided if necessary in order to meet the requirements of the Specification under the specified service conditions.

## Switching Interlocks

The switchboard shall incorporate the switching interlocks shown on the Principal’s drawings in addition to the interlocks required by AS 62271.200.

## High Voltage Busbar Insulation

The main High Voltage busbar system shall be SF6 or air insulated.

## High Voltage Disconnecting and Earthing Switches

1. High Voltage disconnecting and earthing switches shall be in accordance with AS 62271.102.
2. High Voltage disconnecting switches in switchboards with a rated voltage greater than 6.6 kV shall be SF6 insulated.

## High Voltage Circuit Breakers

1. High Voltage circuit breakers shall be either of the vacuum or SF6 type in accordance with AS 62271-100.
2. High Voltage circuit breakers shall incorporate spring charged stored energy closing and tripping mechanisms.
3. High Voltage circuit breakers shall have mechanical and electrical endurance ratings of not less than 500 on-off operations at rated current and 0.7 power factor without the need for maintenance.
4. Circuit breakers shall not be used for operational control of High Voltage motor loads.
5. Unless shown otherwise on the Principal's drawings, High Voltage circuit breakers controlling transformers rated not greater than 630 kVA shall incorporate protection relays and shunt trip mechanisms powered from the protection current transformers and requiring no external energy.

## High Voltage Contactors

1. High Voltage contactors shall be either of the SF6 or vacuum type in accordance with IEC 62271-106.
2. High Voltage contactors shall be of the electro-mechanically latched type.
3. High Voltage contactors shall have mechanical and electrical endurance ratings of not less than 100,000 on - off operations under the test conditions specified in IEC 62271-106 for High Voltage contactors with utilization category AC3.
4. The short circuit protection of High Voltage contactors shall be achieved by the use of High Voltage current limiting fuses.

## High Voltage Fuses

High voltage fuses shall be current limiting type in accordance with IEC 60282-1.

## Three Phase Tripping of High Voltage Switch Fuses

High voltage switch fuses other than those feeding integral voltage transformers shall be fitted with mechanisms to provide three phase tripping in the event of the operation of one or more of the associated High Voltage fuses.

## Cable Terminations

1. All incoming and outgoing cable terminations shall be suitable for High Voltage dead break elbow connectors or alternatively shall be suitable for High Voltage cold fitted indoor cable terminations.
2. The connection bushings for dead break elbow terminations shall be CENELEC M16 bushings.

## Surge Diverters

Surge diverters shall be in accordance with the ratings shown on the Principal’s Drawings and shall be in accordance with IEC 60099-4 as applicable.

## Voltage Transformers

1. Voltage transformers shall have a rated secondary voltage of 110 Volts line to line.
2. Low Voltage voltage transformers shall be separately fused on both the primary and secondary sides.
3. High Voltage voltage transformers shall be separately fused on both the primary and secondary sides.
4. Voltage transformers shall be epoxy encapsulated type in accordance with AS 61869.1 and the rating data shown on the Principal’s drawings.
5. The white phase of the voltage transformer secondary winding shall be earthed. If the voltage transformer is star connected the star point shall remain unearthed.

## Current Transformers

Current transformers and Rogowski coil current sensors shall comply with the requirements of the Principal’s standard specification DS26-21. The current transformer and Rogowski coil current sensor ratings shown on the Principal’s Drawings are indicative only and other ratings complying with the above standard specification shall be acceptable.

## Metering Instruments and Protection Relays

1. Metering instruments and protection relays shall be in accordance with the specifications and rating data shown on the Principal’s drawings.
2. Suitable test links shall be provided on all protection secondary circuits so as to allow testing by secondary injection.

## Voltage Indication

The switchboard shall incorporate capacitively coupled voltage indication facilities.

## Location of Controls

All operator control devices including control switches, indicators and meters shall be located no more than 1.9 metres and no less than 0.3 metres above floor level.

## Location of Secondary Equipment

1. Secondary circuit equipment such as meters, secondary indicators, fault relays, etc. shall be housed in compartments separated from High Voltage equipment. Access to such equipment shall be possible without the need to isolate High Voltage circuits. Compartment access shall be via key operated handles incorporating the Water Corporation standard lock, Lockwood Type EL2.
2. The location of such equipment in a panel separate from the associated main switchboard panel shall be permitted, provided that control switches and ON/OFF indicators are mounted on the main switchboard panel with which these are associated.
3. The Low Voltage power feeding to each switchboard compartment shall be fitted with an isolating device located within the compartment.

## Secondary Circuit Cabling

1. Secondary circuits including metering, protection, control and remote indication circuits shall be as shown on the Principal’s drawings.
2. Conductors used for secondary circuit wiring shall be copper, shall not be less than 1.5 mm2 in cross section, shall have a minimum of 7 strands and where flexibility is required shall have a minimum of 25 strands.
3. Secondary circuit cable shall be rated 0.6/1 kV and shall be PVC V90 insulated in accordance with AS 5000.1.
4. Secondary circuit wires shall be fitted with cable markers at each end. Cable marker numbers shall correspond with the wire numbers shown on the Principal’s drawings.
5. Secondary circuit wires shall be fitted with crimp type cable terminations of a sort appropriate for the type of terminal to which the wire is connected.
6. Where secondary circuit wires pass through holes in panels or cubicles, these shall be protected against damage to insulation by use of appropriate grommets or glands.
7. Mid run cable connections or straight through cable joints in secondary circuit wires shall not be used.
8. Secondary circuit wiring shall be neatly grouped and harnessed or enclosed in PVC trunking. Secondary circuit cable looms shall be installed square with the cubicle and shall be supported frequently. Secondary circuit cable looms shall be arranged so as not to obscure equipment labels or terminal markings.
9. Secondary circuit cable looms connecting hinged panels shall be supported either side of the hinge, and the loom arranged between such supports in a generous loop to prevent cable strain when the hinged panel is moved.
10. Secondary circuit wires used to connect auxiliary contacts to external light current equipment such as PLC’s shall be loomed separately.

## Auxiliary Contacts

1. Auxiliary contacts shall be provided as detailed in the Annexure.
2. Contacts shall close to signal the indicated state.
3. Auxiliary contacts shall be brought out to terminals in the Low Voltage module associated with the particular High Voltage circuit breaker, High Voltage contactor or High Voltage switch.
4. Auxiliary contacts shall be rated at not less than 240 Volt, 2 Amp inductive.

## Corrosion Protection

All metallic parts shall be provided with appropriate corrosion protection either by metallic plating or by paint or powder coating finishes.

Gloss paint and powder coating finishes shall be such as to provide medium term protection in accordance with ISO 9223 Cat. 3 (industrial and marine) environments.

# LABELLING

## General

Each module of the switchboard and each item of equipment, including terminals, shall be labelled clearly. The inscription on the label shall correspond with the designation given on the drawings. The labels shall include Danger and Warning labels in accordance with AS 1319.

Labels shall not be fitted to removable covers or to the removable portion of plug-in equipment, but shall be fitted to the area immediately below the equipment to be identified unless otherwise specified. Labels shall be secured with either electro-plated self-tapping screws, or with Scotch Mount 4032 Double Coated Foam Tape, as appropriate.

Colours shall be permanent and free from fading. Unless otherwise approved all designation labels shall be engraved with black lettering on a white background. “Warning (Caution)” labels shall have white lettering and a red background. The minimum lettering height shall be 3mm.

Rating plates shall be fitted to each item of equipment and shall provide the information specified in the relevant standard to which the item of equipment has been manufactured.

## Isolation Labelling

Labelling shall be fitted to the switchboard which clearly describes the safe isolation procedures for the High Voltage sections of the switchboard and explains all of the interlocking involved.

## Low Voltage Supply Labelling

The Low Voltage power supply into each switchboard compartment shall be labelled with a warning label at the Low Voltage power feeder isolating devices within the compartment.

## Special Labels

As well as the other labelling specified above, the labels numbered 1, 2, 3 and 4 in the following schedule shall be fitted on the front of switchboard cubicles controlling High Voltage motors.

Label 5 shall be fitted on the front of all switchboard cubicles enclosing anti-condensation heaters.

 **Letter Height Schedule**

WARNING

THIS PUMP MAY BE OPERATED IN THE “EMERGENCY” MODE UNDER “LOCAL” CONTROL HOWEVER UNDER THAT CONDITION THE PUMP UNIT OPERATES WITHOUT HYDRAULIC PROTECTION OR SECONDARY CIRCUIT PROTECTION

**1** 6

 3

 3

 3

 3

 3

 3

**2** 6

WARNING

THIS MOTOR FUSED ISOLATOR DOES NOT ISOLATE THE CONTROL CIRCUIT

3

3

TO RESET CONTROL AFTER FAULT

1. TURN THE “CONTROL SELECTOR SWITCH” TO OFF

2. RESET THE “PROTECTION RELAY”

3. PRESS THE “UNIT LOCAL RESET” BUTTON

**3** 6

 3

 3

 3

 3

**4**  6

WARNING

THE MOTOR ANTI-CONDENSATION HEATER IS “ON” WHEN THE MOTOR IS “OFF”. TO ISOLATE THE MOTOR ANTI-CONDENSATION HEATER TURN THE MOTOR ANTI-CONDENSATION HEATER CIRCUIT BREAKER OFF AND TAG.

 3

 3

 3

 3

 3

 3

**WARNING**

CUBICLE ANTI-CONDENSATION HEATER IS THERMOSTATICALLY CONTROLLED. TO ISOLATE TURN CUBICLE L.V. CIRCUIT BREAKER OFF AND TAG.

**5**  6

 3

 3

 3

 3

 3

#  TESTS

## General

1. The Contractor shall subject the switchboard to the tests listed in this specification and shall provide appropriate test certificates detailing the test results obtained.
2. The cost of all testing shall be to the Contractor’s account.
3. All testing, apart from previous type tests, shall be carried out in the presence of, and to the satisfaction of, the Supervising Engineer or their authorised representative.

## Type Test Certificates

The Contractor shall make type test certificates available to the Supervising Engineer in order to confirm successful completion of such type tests.

Such type test certificates shall include evidence of successful completion of internal arc fault testing in accordance with AS 62271.200 specified in Annex A.

## Standard Routine Tests at Manufacturer’s Works

The Contractor shall submit the switchboard, to routine testing at the manufacturer’s works in accordance with Clause 7 of AS 62271.200 including measurement of resistance of the main circuit.

## Special Routine Tests at Manufacturer’s Works

In addition to the standard routine tests specified in clause 7.3 of this Specification, the Contractor shall carry out routine tests to verify:

* 1. the accuracy of all instrumentation and instrument transformers, and
	2. the correct operation of the current operated protection devices at the proposed operational settings specified on the Principal’s drawings.

Tests on current operated protection devices shall be carried out by secondary injection and shall test each protective device at not less than six points spread evenly over the complete operating range of the device at the specified device setting. In addition, each protective device shall be tested at one point by primary injection.

# DELIVERY AND INSTALLATION

The Contractor shall deliver, unload, unpack and assemble as necessary the complete switchboard at the site. The Contractor shall inspect the unpacked switchboard and shall ensure that the switchboard is undamaged.

The Contractor shall install the switchboard in its permanent position prior to the connection of any external main circuits. The Contractor shall carry out the onsite routine tests described hereunder. Once such routine tests have been completed successfully the Contractor shall give the Principal seven days’ notice that the switchboard’s readiness for connection.

# ROUTINE TESTS AT SITE

The Contractor shall submit the switchboard to routine testing at site as detailed hereunder:

* 1. power frequency voltage test on the main circuit at 80 % test voltage in accordance with the test methods specified in AS 62271.200,
	2. measurement of main circuit resistance,
	3. mechanical operation tests,
	4. gas tightness tests on those SF6 filled compartments which were assembled at site,
	5. measurement of gas condition after any on site filling,
	6. operational tests on all interlocks, operating and control devices,
	7. tests to verify the accuracy of all instrumentation, and
	8. tests to verify the accuracy and operation of all protective devices.

# AS CONSTRUCTED INFORMATION

The Contractor shall provide as-constructed information on all drawings detailing all changes and modifications made during the construction and installation phases of the project.

The contractor shall submit drawings in both AutoCAD and PDF formats in accordance with the Drawing Submission Process. Adequate contrast within the PDF image shall be maintained between drawing content and background to ensure the clarity and quality of the drawings.

# MANUALS

The Contractor shall supply 3 copies of comprehensive instruction manuals, written in English and covering the complete operation and maintenance requirements of all equipment supplied under the Contract.

The manuals shall be printed on high grade A4 size paper and shall be bound in a high grade A4 size loose leaf binder.

Information included in the manual shall include:

1. operating instruction,
2. safety instructions and warnings,
3. maintenance instructions and schedules,
4. recommended spare parts and special tool list,
5. as-constructed drawings,
6. detailed equipment performance specifications, and
7. test reports and test certificates.

# SPARE PARTS

The Contractor shall guarantee to hold in Australia, one complete set of the recommended spare parts for the High Voltage switchgear incorporated into the switchboard.

# TECHNICAL SUPPORT

The Contractor shall maintain an adequate level of technical support within Western Australia.

# TRAINING

The Contractor shall supply as part of the Contract training for the number of Water Corporation electrical technicians specified in the Annexure. Such training shall cover commissioning as well as first line fault finding and first line servicing of all switchgear and protective devices incorporated into the switchboard.

**Annexure to Specification**

**for**

**High Voltage Switchboard**

**Project:**

**Site Location:**

**Type of Access to Site:**

**Single Line Diagram**

(detailing all main circuit equipment
and the type and arrangement thereof) shown on drawing number

**Work by the Principal:**

The following work will be undertaken by the Principal:

**Electrical System**

Nominal voltage: kV

Highest voltage: kV

Frequency: Hz

Type of system neutral earthing (direct or impedance earthed).

System earth fault factor (as defined IEC 60071-1)

**Accessibility** (*if other than Type AFL) as* defined in AS 62271.200

**Type of Arc Gas Venting** (Clause 5.7 refers)

**Annexure to Specification**

**for**

**High Voltage Switchboard**

**Service Conditions** *(if different from normal conditions as per AS 62271.1):*

**Switchboard Ratings**

Rated Voltage: kV

Level of Loss of Service Continuity (if other than LSC2A)

Rated Normal Current for:

Main Busbars: Amp

Incoming Circuits: Amp

Outgoing Circuits: Amp

Rated Short Time Withstand Current: kA

Rated Internal Arc Fault Current: kA

Rated Supply Voltage of Auxiliary Circuits: Volt

Whether AC or DC required

Switching Interlock Diagram

(detailing all switching interlocks additional to the requirements of AS 62271.200*)*

as shown on drawing number

Type of Protection Relay and Circuit Breaker Shunt Trip Power Supply

shown on drawing number

Surge Diverter Ratings shown on drawing number

**Annexure to Specification**

**for**

**High Voltage Switchboard**

Voltage Transformer Ratings shown on drawing number

Current Transformer Ratings shown on drawing number

Type and Ratings of Instruments and Protection Relays shown on

drawing number

Auxiliary Contacts required

On H.V. circuit breakers proper:

On H.V. circuit breaker isolators:

On H.V. switches:

On H.V. contactors:

Trainingrequired for electrical technicians

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| **Type Specification for High Voltage Switchboard****Tender Technical Response Schedule** |
| **Clause No.** | **Subject** | **Noted** | **Compliance** | **Comments** |
|  |  |  | **Yes** | **No** |  |
| **1** | **General** |  |  |  |  |
| 1.1 | Scope |  |  |  |   |
| 1.2 | Site |  |  |  |  |
| 1.3 | Standards |  |  |  |   |
| 1.4 | Supervising Engineer |  |  |  |   |
| 1.5 | Principal’s Drawings |  |  |  |   |
| 1.6 | Work by the Principal |  |  |  |   |
| 1.7 | Information to be provided by Contractor |  |  |  |   |
| 1.8 | Contractor’s Drawings |  |  |  |   |
| 1.9 | Quality Assurance |  |  |  |   |
| **2** | **Service Conditions** |  |  |  |  |
| 2.1 | Electrical System |  |  |  |  |
| 2.2 | Electrical System Earth Fault factor |  |  |  |  |
| 2.3 | Location and Accessibility |  |  |  |  IAC = |
| 2.4 | Abnormal Service Conditions |  |  |  |   |
| **3** | **Type Test Requirements** |  |  |  |  |
| **4** | **Ratings** |  |  |  |  |
| 4.1 | Rated Voltage |  |  |  | Rated Volts = |
| 4.2 | Rated Insulation Level |  |  |  | Rated insulation level kV = |
| 4.3 | Rated Frequency |  |  |  | Rated Hz = |
| 4.4 | No of phases and busbars |  |  |  | Number of phases = |
| 4.5 | Rated Normal Current |  |  |  | Busbars rated Amps = |
|   |   |  |  |  | Circuit breaker rated Amps = |
|   |   |  |  |  | Isolating switches rated Amps = |
|   |   |  |  |  | Contactors rated Amps = |
|   |   |  |  |  | Incoming CT rated Amps = |
|  |  |  |  |  | Type 1 circuit CT rated Amps = |
|   |   |  |  |  | Type 2 circuit CT rated Amps = |

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| **Type Specification for High Voltage Switchboard****Tender Technical Response Schedule** |
| **Clause No.** | **Subject** | **Noted** | **Compliance** | **Comments** |
|  |  |  | **Yes** | **No** |  |
|  |  |  |  |  | Type 4 circuit CT rated Amps = |
|  |  |  |  |  | Type 5 circuit CT rated Amps = |
|   |   |  |  |  | Type 5 circuit CT rated Amps = |
| *4.6* | *Rated Short-time Withstand Current* |  |  |  | Rated short-time withstand current |
|  |  |  |  |  | (a) for switchboard kA = |
|  |  |  |  |  | (b) for earth switches kA = |
| 4.7 | Rated Peak Withstand Current |  |  |  | Rated peak withstand kA = |
| 4.8 | Rated Duration of Short Circuit |  |  |  | Rated short circuit sec = |
| 4.9 | Rated Internal Arc Fault Current |  |  |  | Rated internal arc fault kA = |
| 4.10 | Auxiliaries Rated Supply Voltage |  |  |  | *Aux. Rated supply Volts =* |
| 4.11 | Auxiliaries Rated Supply Frequency |  |  |  | *Aux. Rated supply Hz =* |
| 4.12 | Rated values of components |  |  |  |  |
| **5** | **Construction** |  |  |  |  |
| 5.1 | General |  |  |  |  |
| 5.2 | Type of Enclosure |  |  |  | Accessibility type = |
| 5.3 | Degree of Protection |  |  |  | Busbars IP = |
|  |  |  |  |  | Switching compartments IP = |
|  |  |  |  |  | Other Compartments IP = |
| 5.4 | Use of Floor Surfaces |  |  |  |  |
| 5.5 | Level of Service Continuity |  |  |  | LSC Category = |
| 5.6 | Protection Against Internal Faults |  |  |  |  |
|   | a. Cable termination compartments |  |  |  |  |
|  | b. Disconnectors and switches |  |  |  |  |
|  | c. Bolted connections and contacts |  |  |  |  |
|  | d. Instrument transformers |  |  |  |  |
|  | e. Circuit breakers |  |  |  |  |
| 5.7 | Arc Gas Vents |  |  |  | Type = |
| 5.8 | Dehumidifying Equipment |  |  |  |  |
|  |  |  |  |  | Heater rating, Volt = |
| **Type Specification for High Voltage Switchboard****Tender Technical Response Schedule** |
| **Clause No.** | **Subject** | **Noted** | **Compliance** | **Comments** |
|  |  |  | **Yes** | **No** |  |
|  |  |  |  |  | Heater rating, watt = |
| 5.9 | Switching Interlocks |  |  |  |  |
| 5.10 | High Voltage Busbar Insulation  |  |  |  | H.V. busbar insulation type = |
| 5.11 | H.V. Disconnecting & Earthing Switches |  |  |  | H.V. switch insulation type = |
| 5.12 | High Voltage Circuit Breakers |  |  |  |  |
| (a) | Type of switching dielectric |  |  |  | Switching dielectric = |
| (b) | Closing and Tripping Mechanisms |  |  |  |  |
| (c ) | Maintenance Free Elect. Endurance |  |  |  | H.V. C.B. rated on-off ops. = |
| (d) | Not for control of motors |  |  |  |   |
| (e) | C.T. Powered Protection |  |  |  |  |
| 5.13 | High Voltage Contactors |  |  |  |  |
| (a) | Type of Switching Dielectric |  |  |  | Switching Dielectric = |
| (b) | Type of Latching |  |  |  |  |
| (c) | H.V. Fuses |  |  |  | H.V. fuse rated Amps = |
| (d) | Short Circuit Protection |  |  |  |   |
| 5.14 | High Voltage Fuses |  |  |  |  |
| 5.15 | 3 Phase Tripping of H.V. Fuse Switches |  |  |  |  |
| 5.16 | Cable Terminations |  |  |  |  |
| 5.17 | Surge Diverters |  |  |  |  |
|   | (a) Surge Diverts on Motor Circuits |  |  |  | Max. continuous operating kV = |
|   |   |  |  |  | Spark over kV = |
|   |   |  |  |  | 5 kV impulse, max residual kV = |
|   | (b) Surge Diverters on Other Circuits |  |  |  | Max. continuous operating kV = |
|  |  |  |  |  | Spark over kV = |
|  |  |  |  |  | 5kA impulse, max residual kV = |
| 5.18 | Voltage Transformers |  |  |  | Number of phases = |
| (a) | Secondary voltage |  |  |  | Rated secondary Volts = |
| (b) | L.V. Fuses |  |  |  | L.V. fuse rated Amps = |

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| **Type Specification for High Voltage Switchboard****Tender Technical Response Schedule** |
| **Clause No.** | **Subject** | **Noted** | **Compliance** | **Comments** |
|  |  |  | **Yes** | **No** |  |
| (c ) | H.V. Fuses |  |  |  | *(Fitted – Yes or No?)* |
|   |   |  |  |  | H.V. fuse rated Amps = |
|   | Voltage Transformer H.V. connectors |  |  |  | Conductor sq. mm =Conductor insulation Volts = |
| (d) | Type and Rating |  |  |  | Rated kVA = |
| (e) | Earthing of Secondary Winding |  |  |  |   |
| 5.19 | Current Transformers/Sensors |  |  |  |  |
| (a) | Protection Current Transformers |  |  |  | *The following details to be attached for each current rating:* |
|  |  |  |  |  | Primary current, Amps = |
|  |  |  |  |  | Secondary current, Amps =  |
|  |  |  |  |  | Rated burden, VA = |
|  |  |  |  |  | IEC 60044-1 designation, = |
|  |  |  |  |  | 1 sec. Withstand Current , kA = |
|  |  |  |  |  | Rated Operating kV = |
|  |  |  |  |  | Rated Insulation Level, kV = |
| (b) | Rogowski Coil Current Sensors |  |  |  | *The following details to be attached for each current rating:* |
|  |  |  |  |  | Primary Current, Amps =  |
|  |  |  |  |  | Secondary current, Amps =  |
|  |  |  |  |  | Rated burden, VA = |
|  |  |  |  |  | 1 sec. Withstand Current, kA = |
|  |  |  |  |  | Rated Operating kV = |
|  |  |  |  |  | Rated Insulation Level, kV |
| (c) | Metering Current Transformers |  |  |  | *The following details to be attached for each current rating:* |
|  |  |  |  |  | Primary Current, Amps =  |
|  |  |  |  |  | Secondary current, Amps =  |
|  |  |  |  |  | Rated burden, VA = |
|  |  |  |  |  | IEC 60044-1 designation, = |
|  |  |  |  |  | 1 sec. Withstand Current, kA =- |
|  |  |  |  |  | Rated Operating kV = |
|  |  |  |  |  | Rated Insulation Level, kV = |
| **Type Specification for High Voltage Switchboard****Tender Technical Response Schedule** |
| **Clause No.** | **Subject** | **Noted** | **Compliance** | **Comments** |
|  |  |  | **Yes** | **No** |  |
| 5.20 | Metering Instruments |  |  |  | *Separate details to be attached* |
|  | And Protection Relays |  |  |  | *Separate details to be attached* |
| 5.21 | Voltage Indication |  |  |  |  |
| 5.22 | Location of Controls |  |  |  |  |
| 5.23 | Location of Secondary Equipment |  |  |  |  |
| 5.24 | Secondary Circuit Cabling |  |  |  |  |
| 5.25 | Auxiliary Contacts |  |  |  | Rated Volts = ……………………. |
|   |   |  |  |  | Rated Amps = …………………….. |
| 5.26 | Corrosion Protection |  |  |  |  |
| **6** | **Labelling** |  |  |  |  |
| 6.1 | General |  |  |  |  |
| 6.2 | Isolation Labelling |  |  |  |  |
| 6.3 | Low Voltage Supply Labelling |  |  |  |  |
| 6.4 | Special Labels |  |  |  |  |
|  |   |  |  |  |  |
| **7** | **Tests** |  |  |  |  |
| 7.1 | General |  |  |  |   |
| 7.2 | Type Test Certificates |  |  |  | Type tests available now? |
| 7.3 | Standard Routine Tests at Works |  |  |  |  |
| 7.4 | Special Routine Tests at Works |  |  |  |   |
| **8** | **Delivery and Installation** |  |  |  |  |
| **9** | **Routine Tests at Site** |  |  |  |  |
| **10** | **As Constructed Information** |  |  |  |  |
| **11** | **Manuals** |  |  |  |  |
| **12** | **Spare Parts** |  |  |  |  |
| **13** | **Technical Support** |  |  |  |  |
| **14** | **Training** |  |  |  |  |
|   | **Overall Switchboard Dimensions** |  |  |  | Length (m) = |
|  |  |  |  |  | Width (m) = |
|   |   |  |  |  | Height (m) = |
|  |  |  |  |  | Weight (kg) = |

END OF DOCUMENT