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Specification – HV Disconnecter with Earth Switch

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Document Control		
Author	Name: Paul Savig Position: Senior Standards & Plant Engineer	
Reviewed By	Name: Kai Chong Jee Position: Senior Standards & Plant Engineer	
Endorsed By	Name: Johnathan Choi Position: Standards and Plant Manager	
Approved By *	Name: Victor Cheng Position: Senior Manager Engineering and Project Services	
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1 SCOPE

This Specification sets out the technical (electrical and mechanical) requirements for the performance, testing and supply of high voltage disconnectors with earth switches and their supporting stands for the transmission system only.

Approval in terms of this specification shall be obtained by one or a combination of the following:

- a) Successful completion of the appropriate tests required by this specification by an independent and accredited test authority.
- b) Provision of test certificates from an independent and accredited test authority based upon an alternative specification, with test requirements at least equivalent to this specification.

NOTE: Verification of accreditation of the test authority shall be provided by NATA (National Association of Testing Authorities) accredited test house or by a test house possessing accreditation from a NATA MRA (Mutual Recognition Agreement) partner.

Tenderers must state any non-compliance with the specification in any tender submission and any alternative offers must be submitted in full and separately from any main offer.

2 NORMATIVE REFERENCES

2.1 Standards

2.1.1 Horizon Power Standards

- [1]. *Horizon Power Environmental Conditions*, standard number HPC-9EJ-01-0001-2013, available at <http://horizonpower.com.au/contractors-suppliers/contractors/manuals-and-standards/> under the 'Standards' heading.
- [2]. *Technical Rules HPC-9DJ-01-0001-2012*, available at <http://horizonpower.com.au/contractors-suppliers/contractors/manuals-and-standards/> under the 'Technical Rules' heading.

2.1.2 Australian Standards

The following standards are available at <http://www.saiglobal.com>.

- [3]. *AS 1627.0, Metal finishing – Preparation and pre-treatment of surfaces – Method selection guide*, Standards Australia, 1997 (R2017)
- [4]. *AS 2067, Substations and high voltage installations exceeding 1 kV a.c.*, Standards Australia, 2016
- [5]. *AS/NZS 4680, Hot dip galvanised (zinc) coatings on fabricated ferrous articles*, Standards Australia, 2006
- [6]. *AS/NZS 60137, Insulated bushings for alternating voltages above 1000 V*, Standards Australia, 2020

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- [7]. *AS IEC 60437, Radio interference test on high-voltage insulators*, Standards Australia, 2005 (R2016)
- [8]. *AS/NZS 60529, Degrees of protection provided by enclosures (IP Code)*, Standards Australia, 2004
- [9]. *AS/NZS 60947 Series, Low-voltage switchgear and controlgear*, Standards Australia, 2021
- [10]. *AS 62271.1, High voltage switchgear and control gear – Common specification for alternating current switchgear and controlgear*, Standards Australia, 2019
- [11]. *AS 62271.102, High voltage switchgear and control gear – Alternating current disconnectors and earthing switches*, Standards Australia, 2019
- [12]. *AS 62271.301, High voltage switchgear and control gear – Dimensional standardisation of terminals*, Standards Australia, 2022
- [13]. *SA TS 60815.1, Selection and dimensioning of high-voltage insulators intended for use in polluted conditions*, Standards Australia, 2020

2.1.3 International Standards

The following standards are available at <http://www.saiglobal.com>.

- [14]. *IEC 60273, Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1000 V*, International Electrotechnical Commission, 1990
- [15]. *IEC 60812, Failure modes and effects analysis (FMEA and FMECA)*, International Electrotechnical Commission, 2018

2.1.4 Compliance with Standards

Various Standards are referenced in this Specification. The Standards have reference to the year they were published. If over the life of the Tender the Standards change, the Vendor is required to conform to the new edition of the Standard.

Unless otherwise specified herein, the *Equipment* shall be designed, manufactured and type and routine tested in accordance with the referenced Australian Standards, including all amendments. Where there is no Australian Standard equivalent, International Standards or Codes as defined in this specification shall be used. The specified documents contain provisions that, through reference in the text, constitute requirements of this Specification. At the time of publication of this Specification, the editions indicated were valid. Information on currently valid national and international standards may be obtained from the Australian Standards website. <http://saiglobal.com>.

2.2 Definitions and Abbreviations

For the purposes of this specification, definitions shall apply as in the relevant Australian Standards (AS 62271.1 [10] and AS 62271.102 [11]) with the addition of a few general definitions listed below in alphabetical order.

C: Close – closing of disconnector primary contacts

Equipment: High Voltage Disconnector with Earth Switch on design stands

O: Open – opening of disconnector primary contacts

SCADA: Supervisory Control and Data Acquisition

t: Time – set period given in seconds (s) or milliseconds (ms)

3 REQUIREMENTS

3.1 General

The *Equipment* specified in this instruction is to be used for network switching applications.

Standard Horizon Power Disconnectors with Earth Switches and descriptions are listed in Table 5 of Section 11.

The *Equipment* offered that is found on inspection not to conform to this Specification shall be replaced by the Vendor at no cost to Horizon Power.

3.2 Environmental Conditions

The performance of the *Equipment* must meet the requirements set out in Section 4.1 of the *Horizon Power Environmental Conditions* [1].

3.3 Electrical Requirements

The *Equipment* shall be suitable for use on the 66 kV, 132 kV, 220 kV and 330 kV 3-phase 50 Hz effectively earthed transmission systems. The *Equipment* must be suitable for operation under the defined operating conditions and must meet the performance requirements in accordance with AS 2067 [4], AS IEC 60437 [7] AS 62271.1 [10], AS 62271.102 [11] and the Technical Rules HPC-9DJ-01-0001-2012 [2] and as set out in the table below:

Table 1: Electrical Requirements

Description	66 kV	132 kV	220 kV	330 kV
Maximum system voltage (U_m) kV	72.5	145	245	362
Lightning impulse withstand kV _{Peak}	325	650	1050	1175
Lightning impulse withstand across the isolating device kV _{Peak}	375	750	1200	1380
Power frequency withstand (60 sec.) kV _{r.m.s.}	140	275	460	520
Power frequency withstand (60 sec.) across the isolating device kV _{r.m.s.}	160	315	530	610
Switching impulse withstand kV _{Peak}	N/A	N/A	N/A	950
Switching impulse withstand between phases kV _{Peak}	N/A	N/A	N/A	1275
Switching impulse withstand across the isolating device kV _{Peak}	N/A	N/A	N/A	1095

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Description		66 kV	132 kV	220 kV	330 kV
Rated frequency	Hz	50	50	50	50
Rated short time withstand current	kA _{r.m.s}	≥25	≥40	≥40	≥50
Rated short time withstand time	s	3	1	1	1
Rated peak withstand current	kA _{r.m.s}	62.5	100	100	125
Rated continuous thermal current	A	≥1250	≥3150	≥2500	≥3150
RIV level @ 1.1 U _m /√3	μV	N/A	≤2500	≤2500	≤2500
Control relays, motor and motor contactor coil.	V _{DC}	110	110	110 or 220	110 or 220

3.4 Mechanical Requirements

The *Equipment* shall be suitable for outdoor use and mounted on galvanised steel structure meeting AS 1627 [3].

The technical performance of the *Equipment* must as a minimum meet AS 62271.1 [10] and AS 62271.102 [11].

The design and manufacturing process must confirm, that the performance characteristics of the *Equipment* is not affected by changes in the ambient conditions, such as temperature or humidity, and meet forces presented during fault and environmental conditions (see Section 3.2 Environmental Conditions paying particular attention to the wind region category). The Vendor shall submit the detailed design, materials used and manufacturing process of the *Equipment* in the Proposal.

The *Equipment* shall be suitable for use under the following conditions as set out in the table below:

Table 2: Mechanical Requirements

Description		66 kV	132 kV	220 kV	330 kV
Insulator type		Porcelain/Polymer/Composite			
Primary terminal material		Aluminium			
Creepage (≥31 mm/kV) ²	mm	≥2232	≥4495	≥7595	≥11222
Marshalling Terminal box	IP	55	55	55	55
Rated contact zone		Table 2 of AS 62271.102 [11]			
Disconnecter type		Double-break with poles mechanically coupled			
Disconnecter mechanical endurance		Class M2			

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Description	66 kV	132 kV	220 kV	330 kV
Earth-switch type (short-circuit making)	Class E1			
Earth-switch type (induced current)	Class B			
Earth-switch mechanical endurance	Class M1			

3.4.1 Disconnecter

Disconnectors shall be of a double-break design with all three poles mechanically connected, unless otherwise stated in Schedule A of Appendix C.

The design of the disconnectors shall be such that operation must only be achieved by a deliberate action as specified in clause 6.104.1 of AS 62271.102 [11].

Manual operation shall meet the maximum force limits as defined in clause 5.105 of AS 62271.102 [11]. Ergonomically designed manual operating handle shall be supplied to avoid operator injury. A Video must be submitted with the technical proposal showing the manual handle operation.

3.4.2 Pantograph Disconnecter (≥ 220 kV)

Pantograph disconnectors shall be phase segregated with one operating mechanism per phase, unless otherwise stated in Schedule A of Appendix C.

The pantograph shall be supplied with a suitably sized, stainless-steel or aluminium, lockable marshalling box to provide:

- 1) a common point for connection of inter-phase and external cabling to control boxes for all three pole.
- 2) a single point for local (motorised) control of all three phases.
- 3) a single point for local control selector switch (REMOTE-OFF-LOCAL).
- 4) an out-of-step alarm after a short delay.

3.4.3 Earth-switch

Earth-switch shall have the same short-circuit current withstand capability as its associated disconnector, unless otherwise stated in Schedule A of Appendix C.

The design of the earth switches shall be such that operation must only be achieved by a deliberate action as specified in clause 6.104.1 of AS 62271.102 [11].

Earth-switches shall be so designed that the earth-switch arms cannot swing from open to closed position or closed to an open position in the event of an operational mechanism failure.

Manual operation shall be by means of a lockable operating handle 1200 mm above ground level, requiring a manual static effort of more than 250 N to operate. A peak value of 450 N is acceptable during the initial 15° rotation. Ergonomically designed manual operating handle shall be supplied to avoid operator injury. A Video must be submitted with the technical proposal showing the manual handle operation.

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Horizon Power's preference is for the earth-switch to be integrated with the disconnecter.

3.4.4 Terminals and Contacts

Primary terminals complying with Table 1 of AS 62271.301 [12] shall be provided. The terminals shall be constructed of an aluminium flat palm number 9 with M22 holes. Terminals shall be designed to withstand static terminal loads as specified in *Horizon Power Environmental Conditions [1]*.

All bolts, washers and clamps attached to current carrying parts shall be manufactured from stainless-steel grade 304, and all nuts and string washers shall be from stainless-steel grade 316.

For disconnectors with earth switch, the earth switch shall be arranged so that moving contacts do not extend past the envelope of the disconnecter assembly when in the OPEN position.

The contacts of the equipment shall be designed such that on closing there is a wiping action accompanied by an increasing contact pressure. Preference given for disconnectors utilizing a rolling blade mechanism for higher voltage classes.

Current carrying parts that are not intrinsically corrosion resistant shall be electroplated.

The use of dissimilar metals in contact assemblies shall incorporate clear and adequate precautions to avoid the effects of electrolytic action. Details shall be included in the tender submission when such assemblies are offered.

The moving contact blade driving mechanism shall be adequately enclosed to provide protection from the formation of salt and dust deposits.

Vendors shall supply drive mechanisms and contact assemblies with

- 1) minimal requirement of lubrication to retain their free movement;
- 2) rotating bushes or bearings packed with grease to prevent the ingress of moisture, corrosion;
- 3) grease nipple installed at operator accessible level enabling lubrication to be added during routine maintenance; and
- 4) provision for the main contact blades to avoid the blade bouncing out of the fixed contact on rapid closing.

Contact heads shall have provision for contact alignment and depth adjustment.

Any fixed or moving contact fingers shall be suitably coated to reduce the mal operation of contacts. Minimum requirement will be silver coated fingers.

Suitable mechanisms shall be used to avoid cracking of Nylon bushes when in contact with galvanizing surfaces.

3.4.5 Insulators

Insulators shall be interchangeable with similar insulating components and shall comply with AS/NZS 60137 [6], IEC 60273 [14] AS 62271.102 [11] and SA TS 60815.1 [13].

3.4.6 Beam and Supports

The *Equipment* shall be supplied fully assembled ready for mounting. The beam and support shall have a minimum height of 2.55 m and manufactured from galvanised mild steel in accordance with AS/NZS 4680 [5], with metal work done to meet AS 1627 [3] having no burrs or sharp edges. All corrosion protection measures applied to the *Equipment* shall be detailed and submitted at the tendering stage.

All ferrous nuts, bolts, washers and clamps used for any purpose other than for current carrying shall be hot dip galvanised.

The Vendor shall submit complete detail and drawings of the beam and support mounting assembly.

3.5 Marshalling Terminal Box

Mechanism enclosures shall be manufactured from either aluminium or marine-grade (316) stainless steel and have hinged doors allowing clear access to control levers, push-buttons, fuses, switches and secondary terminal strips. These shall be easily accessible from ground level. Doors shall be equipped with travel stops, which shall retain the door in the open position.

Upper surfaces of enclosures shall be shaped or sloped to prevent accumulation of water.

Devices requiring adjustment/periodic maintenance shall be readily accessible and any removable covers provided shall have bolt fastenings subject to Horizon Power's approval.

All bolts shall have hexagon heads. Self-tapping screws, captive head nuts or cage nuts are not acceptable.

A gauze-covered drain hole with a minimum diameter of 25 mm and having no internal rim or ledge that is likely to obstruct drainage shall be provided at the lowest point of the enclosure.

Gaskets shall be made of neoprene or heavy-duty foam-plastic. Felt or natural rubber gaskets are not acceptable.

Note: Plastic or fibre-reinforced plastic materials for mechanism enclosures, or other applications where exposure to the elements is involved will be not accepted.

3.5.1 Control and Operation Systems

The *Equipment* control and operation systems shall comply with AS/NZS 60947 [9] and AS 62271.1 [10].

3.5.1.1 Convention

As a matter of convention, the schematic-wiring diagram for the *Equipment* shall show limit switches, relay contacts and so forth are in the normal condition when:

- disconnectors and earth switches primary contacts are open
- relay coils are de-energised
- no AC or DC supplies are connected

3.5.1.2 Electromagnetic Induction

Induced electromagnetic disturbances in the secondary system of the disconnecter shall not cause spurious operation or damage. The secondary system consists of control and auxiliary circuits, including circuits in central control cubicles, mounted at or adjacent to the disconnecter.

3.5.1.3 Control Voltage

The control relays and motor contactor coils shall be suitable for operation at 110 V_{DC} or 220 V_{DC} as specified in Schedule A of Appendix C. However, it shall be possible to change the control voltage at which the disconnecter operates by merely replacing the operating and motor contactors.

Control relays coils shall not operate if a 10- μ F capacitor, charged to 1,5 times the nominal DC control voltage, is discharged through the operating coil.

Coils electrically operated shall be suitable for operating at any DC voltage between 110% and 85% of the nominal control voltages measured at the device terminals.

3.5.1.4 Control Relays

All control relays shall be standard products that are freely available on the commercial market and shall be labelled in accordance with the schematic wiring diagram for the disconnecter.

The relays shall be provided with a normally closed auxiliary contact in series, to allow closing only when the disconnecter is open and opening when the disconnecter is closed.

Control relays shall be clearly marked with the operating voltage and actual resistance value at 20°C.

3.5.2 Mechanism Motors

Mechanism motors shall be suitable for the control voltage of 110 V_{DC} or 220 V_{DC} as specified in Schedule A of Appendix C.

Contactors with thermal overload and single-phasing protection facilities shall control direct current motors and be rated to break maximum current drawn by the motor. The contactor coils shall be able to have their current interrupted by the limit switches.

Motors shall be designed, rated and tested to AS 62271.1 [10] and for the operating voltage specified. The use of resistors to achieve voltage reduction from the control voltage is not acceptable.

3.5.2.1 Mechanism Lubricants

The behaviour of lubricants that are exposed to air shall be stable over the intervals between maintenance. The Vendor is required to identify the lubricants used and to submit details of tests carried out to prove suitability for the application.

3.5.2.2 Hydraulic-operating Mechanisms

Equipment with hydraulic-operating mechanisms are **not accepted** for use in Horizon Power.

3.5.3 Manual Operation

3.5.3.1 Closing/Opening

A means of manually opening and closing the disconnecter shall be provided, and the method used shall be explained clearly in the tender documents.

3.5.3.2 Operational Switches

All local operation of the disconnecter must be enabled through a “REMOTE-OFF-LOCAL” control selector switch which shall:

- 1) be rated for continuous current of 10 amps and shall be capable of breaking 4 amps current at 110 V_{DC} or 220 V_{DC} Class 1 as specified in Table 8 of AS 62271.1 [10];
- 2) when switched to “LOCAL”, control from the local control switch must be enabled and remote close and open circuits must be disabled;
- 3) when switched to “REMOTE”, all external open and close circuits are enabled and all circuits to the local control switch must be disabled;
- 4) when switched to “OFF”, all local and remote open and close circuits must be disabled; and
- 5) position indication of control selector switch must be capable of being provided to SCADA, with an additional normally-open (NO) and normally closed (NC) contact.

3.5.4 Auxiliary Switches

Auxiliary switches shall faithfully reproduce the main contact position. In addition to the auxiliary contacts required for control interlocking, the number and type of auxiliary contacts required for each mechanism shall cover the requirement specified in Schedule A of Appendix C. These contacts shall be independent (i.e. not changeover contacts) and fixed. Auxiliary contacts shall reproduce main contact timing to acceptable limits approved by Horizon Power. If possible auxiliary contact timing shall permit adjustment within limits to be given by the Vendor.

All spare, auxiliary switch contacts shall be wired independently to the secondary terminals. The use of auxiliary relays to multiply the number of auxiliary contacts required is not acceptable. Auxiliary switch contacts shall be protected against ingress of dust particles. Cascading of auxiliary switches via mechanical means is acceptable provided that mechanical endurance testing has been satisfactorily carried out. Proof of this shall be submitted at the tendering stage.

Auxiliary Contacts shall be Class 1 with ratings as specified in Table 8 of AS 62271.1 [10].

The minimum number of contacts on the auxiliary switch are:

- 1) Disconnecter – 10 N/O & 10 N/C
- 2) Earth Switch – 8 N/O & 8 N/C

The supplier shall state the maximum number of N/O & N/C contacts can be supplied in a single rack without compromising reliable operation.

3.5.5 Interlocks

Disconnectors or earth-switches (where fitted) must be capable of being padlocked in both the open and closed positions.

Note: The application of the padlock must prevent electrical operation of the disconnector.

3.5.5.1 Disconnector

All disconnector mechanisms shall be fitted with an electrical solenoid interlock to allow electrical interlocking with:

- 1) its associated circuit breaker/s to prevent making or breaking of load.
- 2) its associated free-standing earth-switch to prevent closing unless all poles of the earth-switch are open.

Disconnectors with integral earth-switches must be mechanically interlocked with its integral earthing switch such that the:

- 1) earth switch can only be closed when all poles of the disconnector are open; and
- 2) disconnector can only be closed when all poles of the earth switch are open.

An energising pushbutton must be provided for manual operation.

Note: Solenoid interlocks shall prevent operation when de-energised. The solenoid shall be rated for continuous operation at 110 V_{DC} or 220 V_{DC} according to clause 5.9 of AS 62271.1 [10].

3.5.5.2 Earth-switch

Any free-standing earth-switch must include a solenoid interlock to allow electrical interlocking with its associated disconnector such that the earth-switch can only be closed if the disconnector is open.

3.5.6 Anti-condensing Heaters

Suitably rated electric heaters shall prevent moisture from condensing and being deposited inside the mechanism enclosures. Heaters shall maintain a dewpoint greater than the ambient temperature and shall circulate the air constantly to all parts of the enclosure. Heaters shall be placed to avoid damage to temperature-sensitive components.

Heater elements shall be shrouded and leads, which are heated by the conduction of heat from the element, shall be insulated by heat-resistant insulating material, e.g. ceramic beads or silicone rubber.

The electrical supply for heaters will normally be single-phase 240 V_{AC}. The circuit shall have a normally open, auxiliary contact to indicate AC fail to the heater. The contact shall be on the heater side of the fuse/miniature circuit breaker. Where single heaters are provided, these shall be permanently connected.

Heater circuits shall not be equipped with local isolating switches, but with a local fuse-link and a solid link or miniature circuit breaker.

The total power drawn by heaters shall not exceed 400 W, unless otherwise approved.

3.5.7 Wiring, Terminations and Identification

Wiring for motor circuits shall be carried out in multi-stranded conductor with a minimum area equivalent to 2,5 mm² and insulated to withstand a test voltage of 2 kV to earth for one (1) minute.

Wiring for control circuits shall be carried out in wire of at least 1.5 mm² and shall be insulated to withstand a test voltage of 500 V to earth for one (1) minute.

Secondary wiring shall be identified at both ends in an approved manner (e.g. by ferruling), and shall present a neat appearance. It shall be braced, placed in plastic troughing, clipped and/or laced to prevent damage from vibration.

All secondary and equipment terminals, labels and so on shall be completely accessible after the wiring and cabling have been completed. Wiring to equipment located on swing doors or frames shall be arranged vertically over the hinge so that the wiring is twisted and not bent.

For all wires without lug terminations, the numbered ferrule may not fall off when disconnecting the wire. In this regard, the use of one or more strands of wire to retain the ferrule is not acceptable.

Where relays, miniature circuit breakers, fuses, lamps and so on are provided with the screw-down type of terminal (where the screw comes into direct contact with the conductor), crimping wire-pin terminations shall be used.

Secondary cabling provided by the Vendor shall be UV-resistant and preferably be run in the ground, in which case steel wire, armoured cable shall be used.

3.5.8 Secondary Terminals, Strips and Gland Plate

Secondary terminals to which cables will be terminated shall be of an approved type (spring loaded terminals) and shall be suitable for use with crimped or compression-type terminations.

Auxiliary switches, internal wiring and other equipment requiring connection to external apparatus shall be wired to terminal strips in the disconnect mechanism box. Horizon Power's preferred arrangement of the internal wiring to the terminals can be found in Appendix F.

Each terminal strip shall be provided with not less than 10% spare terminals and shall have a minimum of two. The arrangement of the terminal strips (vertical orientation) in the equipment shall facilitate the entry of the incoming control cables in the bottom-entry configuration.

The cabling shall be multi-core, PVC-insulated, single-wire, armoured and PVC-sheathed. It shall be complete with compression-type glands, for which a removable, undrilled, brass or aluminium gland plate of the specified minimum size (i.e. 5 mm) shall be provided at the base of the enclosure and below the terminal strip.

To facilitate control, cable entry from below and connection, the distance between any part of the terminal strip and the gland plate shall not be less than 150 mm.

3.5.9 Door Lockable Latch

The *Equipment* shall be provided with suitable/lockable latch that will prevent unauthorised access to the local operating facilities within the marshalling terminal box. The latch must have a minimum 10 mm diameter hole for attaching a padlock.

3.6 IP Rating

Equipment mechanisms, local control facilities and all parts requiring lubrication shall be protected by weatherproof enclosures. The degree of protection afforded by these enclosures shall, as a minimum requirement, comply with AS/NZS 60529 [8] according to the following classifications.

Enclosures containing exposed bearings, auxiliary switches, motors and other electrical devices shall comply with IP 55, whilst all other enclosures provided shall comply with IP 53.

3.7 Earthing Terminals

The main earth terminals shall comprise a stainless steel (grades 304 and 316) plate, welded to the beam. The plates shall be a minimum of 40 mm deep and shall be fitted with a stainless-steel bolt, washer and spring washer.

The stainless steel (304) bolt shall be a M16 x 35 mm bolt, threaded through.

The main earth terminals shall be located directly above one of the support legs.

A suitably rated connector (not copper) shall be provided between the plate and the support leg. (The beam and support structure shall provide continuity between the disconnecter and the holding down bolts.)

Flexible earthing braids shall be made of tinned copper and shall have a cross-sectional area of at least 70 mm² with terminals to suit M12 bolts. The braids shall be so placed as to not interfere with the operation of the disconnecter/earth-switch or the operator.

The dimensions and the technical details of the earthing terminals and braids shall be included in the General Arrangement Drawings.

3.7.1 Marshalling Terminal Box

Marshalling terminal box shall not only be earthed through metal contact with the steel structure but also by a separate earth having a cross-sectional area of at least 70 mm².

3.7.2 Earthing of Down Rods

Vertical down rods shall be earthed to the steel structure by means of a long flexible earth braid.

3.7.3 Earthing of Operating Handle

Fixed manual operating handles shall be earthed to both the steel structure and marshalling terminal box by means of flexible earth braids. The operation of handles shall not create stress on the earthing braids.

3.8 Corrosion Protection

Corrosion protection shall be in accordance with AS/NZS 4680 [5]. The mechanism box shall be manufactured from marine-grade (316) stainless-steel. The disconnecter beam may be manufactured from galvanised mild steel. All corrosion protection measures applied to the *Equipment* shall be detailed and submitted at the tendering stage.

3.9 Name Plate

Equipment shall be provided with a nameplate incorporating details in accordance with clause 6.11.2 and table 9 of AS 62271.1 [10]. These details shall be stamped on laser etched stainless steel plate and attached to every disconnect, earth switch and each associated device. If the *Equipment* consists of several independent poles, each pole shall be provided with a nameplate. All the letters and figures on the nameplates shall be permanently marked. The nameplates shall be securely fastened to the *Equipment* in a reliable manner, in a position where a person with normal vision standing at ground level could easily read it. The marking shall be permanent, weatherproof and corrosion proof.

The following minimum information shall be provided:

- 1) Manufacturer's name or trademark, type, and identification;
- 2) Type designation and endurance class;
- 3) Short-circuit making capacity class (earth-switch only)
- 4) Serial number and year of manufacture;
- 5) Order number;
- 6) Rated voltage
- 7) Rated lightning impulse withstand voltage
- 8) Rated switching impulse withstand voltage
- 9) Rated power-frequency withstand voltage
- 10) Rated normal current
- 11) Rated short-time withstand current and duration
- 12) Rated peak withstand current
- 13) Rated short-circuit making current (earth-switch only)
- 14) Rated frequency
- 15) Rated temperature range
- 16) Rated supply (auxiliary) voltage and frequency
- 17) Contract number
- 18) Standard to which tested (AS/NZS, IEC, BSI, etc.)

Actual ratings to which the *Equipment* has been type-tested (and not merely the values specified in Schedule A of Appendix C) shall be displayed.

3.10 Labels and Flags

All labels shall be English and shall be as follows:

- 1) Labels associated with local operation of the *Equipment*:
 - Instructions for opening and closing the *Equipment*. These instructions are "TO OPEN and "TO CLOSE" respectively.
 - Additional information required to perform these functions shall be referred to Horizon Power.

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- 2) Rating labels inside operating mechanism shall state at least the following:
 - Type designation
 - Open relay-coil voltage, current, DC resistance (at 20°C)
 - Close relay-coil voltage, current, DC resistance (at 20°C)
 - Motor voltage and current (starting peak current and nominal running current)
 - These shall be the nominal values (with tolerances) according to the routine test parameters.
 - Rating labels shall be either engraved aluminium or stainless steel and are subject to approval by Horizon Power.

Earth-switch flags shall be securely fitted to the top half of each earth-switch arm, comprising of a visible, corrosion proof 300 x 200 mm flag having 50 mm diagonal black stripes on a yellow background.

4 PACKAGING REQUIREMENTS

The *Equipment* shall be suitably packaged, such that it is “fit for use” at any location in Horizon Power’s operational area and specifically include all accessories needed. Packaging shall be capable of preventing damage whilst in storage and during transit to remote locations. The Vendor is required to nominate standard pack quantities and standard packs shall be clearly marked with the following information:

- 1) Manufacturer’s name;
- 2) Manufacturer’s reference number;
- 3) Horizon Power Order Number;
- 4) Horizon Power Stock Number (if applicable);
- 5) *Equipment* description (voltage rating); and
- 6) Package weight.

Very strong consideration shall be given to appropriate packaging provided with any *Equipment* offered under this specification, with respects to satisfying the “fit for use” criteria mentioned above.

The combined height of the pallet and *Equipment* of a standard pack shall not exceed 1,050 mm.

Each shipment shall be provided with box labels stating the part, stock, and contract number as well as the routine test reports.

Each package is to have an identifying bar code and number which identifies as a minimum the:

- Manufacturer’s part number;
- Manufacturer;
- Factory of manufacture; and
- Month and year of manufacture.

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Note: The Vendor is required to identify the cost of providing bar coding as specified in this Section separately from the other cost requirements of this specification.

5 STORAGE

The *Equipment* shall be capable of being stored without deterioration within the temperature range of -10 °C to +45 °C for no less than 24 months.

6 RELIABILITY

Vendors shall provide information on the reliability of the *Equipment* and the performance of the materials offered over an operational life of 50 years under the specified field of application and conditions of service.

Information provided shall evidence the claimed reliability and performance for the *Equipment* offered, including details on Failure Mode and Effect Analysis, carried out in accordance with IEC 60812 [15]. Failure modes should be described; taking cantilever mechanical failure as an example, the failure may be excessive deflection, or brittle fracture. Electrical failure may be material damage such as puncture, polymer degradation, carbonisation, loss of hydrophobicity, etc.

Vendors may offer their standard *Equipment* but any variation to the foregoing standards must be clearly stated in writing at the time of the proposal. The products offered in the standing offer should be equal to or better in quality and performance than the existing items as listed under this Specification.

7 SAFETY

Material Safety Data Sheets (MSDS) applicable for each different *Equipment* or chemical ingredient in the *Equipment* which is considered harmful to personnel or environment in any manner, shall be supplied with the Proposal.

8 ENVIRONMENTAL CONSIDERATIONS

Vendors are required to provide information on the environmental soundness of the design and the materials used in the manufacture of the items offered. In addition, provide a detailed outline of the steps that have been put in place to fulfil any obligations that may be required pursuant to the *Waste Avoidance and Resource Recovery Act 2001* and any amendments. In particular:

- a) Management of waste reduction;
- b) The use of re-usable packing; and
- c) Extended producer responsibility for the safe disposal of materials at the end of their life.

9 TESTS

9.1 Test Requirements

The Vendor shall prior to first delivery, complete the design, type, routine, sample and special tests and inspections as required by the relevant Australian or IEC standard.

The passing of such tests does not prejudice the right of Horizon Power to reject the *Equipment* or fitting if it does not comply with this Specification when installed.

9.2 Test Certificates

At the time of submitting the offer on the tender, single copies of test certificates, in English, shall be provided and shall be clearly marked and contain a reference number. If all the required test certificates are not submitted the tender will be rated incomplete and may not be considered.

Electronic copies of type test certificates shall be arranged in the order set out in this Specification and shall be marked clearly with the identifier and description in the contents Section. Any extra test certificates shall be marked with “extra tests” and kept separate from the required test certificates.

All tests required by the relevant Australian or International standards shall be carried out. Test certificates shall be submitted in electronic format and shall be in Adobe Acrobat (.pdf) format.

9.3 Type Tests

The tests are intended to verify the main characteristics and suitability of the design, dimensions, materials, and method of manufacture (technology).

Certified type test results shall be submitted with the Proposal, these type tests shall include those outlined in AS 62271.1 [11] and AS 62271.102 [12]. The Vendor shall, in their evaluation submission, state which tests the *Equipment* have passed.

Table 3: Type Tests

Description	Standard
	AS 62271-1 & -102 (Clause/s)
Dielectric tests	-1 (7.2)/-102 (7.2)
Radio interference voltage (RIV) tests	-1 (7.3)
Resistance measurement test	-1 (7.4)
Continuous current tests	-1 (7.5)
Short-time and peak withstand current tests	-1 (7.6) /-102 (7.6)
Verification of the degree of protection	-1 (7.7)

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Description	Standard
Tightness tests	-1 (7.8)
Electromagnetic compatibility (EMC) tests	-1 (7.9)
Auxiliary and control circuit tests	-1 (7.10)
X-radiation vacuum interrupter tests	-1 (7.11)
Short-circuit making current of earth-switches tests	-102 (7.101)
Operating and mechanical endurance tests	-102 (7.102)
Low and high temperature tests	-102 (7.104)
Position-indicating device tests	-102 (7.105)
Bus-transfer current of disconnectors tests	-102 (7.106)
Induced current of earth-switches tests	-102 (7.107)
Bus-charging current switching of disconnectors tests	-102 (7.108)

9.4 Routine Tests

Routine tests are intended to eliminate defective units and shall be carried out during the manufacturing process. Routine tests shall be carried out on every *Equipment* and should not consist of visual examination only, these routine tests shall include those outlined in AS 62271.1 [11] and AS 62271.102 [12].

The Vendor shall supply duly certified copies of the routine tests performed on the *Equipment* to Horizon Power, either prior to or upon delivery.

Table 4: Routine Tests

Description	Standard
	AS 62271-1 & -102 (Clause/s)
Dielectric test on primary terminals	-1 (8.2)/ -102 (8.2)
Auxiliary and control circuit tests	-1 (8.3)
Resistance measurement test	-1 (8.4)
Tightness tests	-1 (8.5)
Design and visual checks	-1 (8.6) "Manufacturer's Standard"

Description	Standard
Mechanical operating tests	-102 (8.101)
Earthing function verification	-102 (8.102)

10 DOCUMENTATION

10.1 Documentation to be provided with Proposals

Submitted proposals shall provide all documentation and information as requested in this specification, including any further relevant information on the *Equipment* offered. The proposal must be complete in all respects. Failure to comply may cause the proposal to be considered incomplete and hence informal.

The Vendor shall provide an electronic version of all documents in Adobe Acrobat (.pdf) format containing the information detailed below with their offer:

- Any non-compliance of the Specification shall be detailed in the Technical Deviation Schedule D of Appendix D;
- All information provided in Technical Requirements shall be in English and measurement units shall be in metric units;
- Material Safety Data Sheets;
- CAD drawings (Micro station preferred DGN format) of all *Equipment* showing all critical dimensions;
- *Equipment* data sheets showing the weight, material type, protective coatings, mechanical & electrical properties (Combined Load Charts shall be included);
- Installation instructions included in the packaging; and
- A copy of the Vendor's current Quality Assurance accreditation and category.

Should the preferred Vendor submit drawings for approval by Horizon Power, this will in no way exonerate it from being responsible for the correct and proper function of the *Equipment*.

10.2 Service History

Vendors shall state:

- Other Australian electricity supply authorities who have a service history of the items offered; and
- Contact details of those supply authorities who can verify the service performance claimed.

10.3 Training Materials

Training material in the form of drawings, instructions and/or audio-visuals must be provided for the items accepted under the offer.

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Vendors shall state the availability of training materials which could include but is not limited to the following topics:

- Handling and storage;
- Application (particularly in areas of heavy coastal pollution);
- Installation;
- Maintenance;
- Environmental performance;
- Electrical performance;
- Mechanical performance;
- Disposal at the end of service life; and
- Production process and testing.

10.4 Drawings

The Vendor shall submit complete details and drawings of the *Equipment*.

The schematic-wiring diagram for the *Equipment* shall show limit switches, relay contacts and so forth are in the normal condition when:

- Disconnect and Earth Switch primary contacts are open.
- Relay coils are de-energised.
- No AC or DC supplies are connected.

10.5 Maintenance Manual

The Vendor shall supply maintenance information in the form of maintenance manuals, field service bulletins and visual material covering the following aspects:

- 1) Extent and frequency of maintenance: For this purpose, the following factors shall be considered:
 - Environmental conditions.
 - Measurement and diagnostic tests (if any).
- 2) Scope of work to be performed: It shall include the following:
 - Recommended place for the maintenance work (indoor, outdoor, in factory, on-site, etc.).
 - Procedures for inspection, diagnostic tests, examination overhaul.
 - Reference to drawings.
 - Reference to part numbers or standard kit of parts.
 - Tools required, including special equipment or tools.
 - Precautions to be observed (e.g. cleanliness and possible effects of harmful arcing by-products).
 - Lubrication procedures.

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- Cleaning materials.
- 3) Graphical information:
 - Detailed drawings and sketches of the *Equipment* components, with clear identification (part number and description) of assemblies, sub-assemblies and essential components.
 - Expanded detail drawings, which indicate the relative position of components in assemblies and subassemblies, are expected as a preferred illustration method.
 - Graphs and similar means of portraying important information shall also be included.
 - 4) Specified operational values: Values and tolerances pertaining to which, when exceeded, make corrective action necessary, for example:
 - Resistance of the main current carrying circuits.
 - Quantities and quality of liquid.
 - Torque settings for fasteners.
 - Important dimensions.
 - 5) Specifications for materials: This includes warnings of known non-compatibility of materials.
 - Oil.
 - Fluid.
 - Cleaning and degreasing agents.
 - 6) Special tools, lifting and access equipment.
 - 7) Tests after the maintenance work: All tests shall be clearly described and shall include the parameters to be observed.
 - 8) Spare parts: Description, reference number, quantities and advice for storage.
 - 9) Time estimates: Of active scheduled maintenance time.
 - 10) Detailed information:
 - Mechanism heaters shall be working. If a thermostat is fitted ensure that the cut-out is set at approximately 25 °C.

10.6 Operational Instruction Manual

The operational instruction manual shall cover erection, assembly, operation and maintenance and shall fulfil the following specification:

- 1) It shall be specifically compiled for the disconnect/earth-switch with which it has been supplied.
- 2) Torque wrench settings, clearances, settings and other important statistics shall be listed.
- 3) It shall give a clear description of the operation, and the diagrams and description shall be easily read together.

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- 4) Routine minor and major maintenance procedures shall be given together with a list of lubricants, recommended spares and/or special tools and so on, required for these operations.
- 5) It shall contain high-quality diagrams showing details of operating components of the *Equipment*, which also identify and list separately each component making up the diagram.
- 6) Seals and gaskets requiring replacement during overhaul shall be detailed and the suppliers of these components, together with the stock number(s), shall be listed.
- 7) The names and addresses of supplies of lubricants, oils, gases, compounds and so on shall be listed.

11 EQUIPMENT LIST AND DESCRIPTION

Table 5: Standard *Equipment* list and descriptions

Specification Item No.	Description
1.1	DISCONNECTOR & EARTH SWITCH 72kV 3 POLE, 1250A, 25kA/3sec HEAVY POLLUTION (31mm/kV)
1.2	DISCONNECTOR 72kV 3 POLE, 1250A, 25kA/3sec HEAVY POLLUTION (31mm/kV)
2.1	DISCONNECTOR & EARTH SWITCH 145kV 3 POLE, 3150A, 40kA/1sec HEAVY POLLUTION (31mm/kV)
2.2	DISCONNECTOR 145kV 3 POLE, 3150A, 40kA/1sec HEAVY POLLUTION (31mm/kV)
3.1	DISCONNECTOR & EARTH SWITCH 245kV 3 POLE, 2500A, 40kA/1sec HEAVY POLLUTION (31mm/kV)
3.2	DISCONNECTOR 245kV 3 POLE, 2500A, 40kA/1sec HEAVY POLLUTION (31mm/kV)
3.3	PANTOGRAPH DISCONNECTOR 245kV 3x1 POLE, 2500A, 40kA/1sec HEAVY POLLUTION (31mm/kV)
4.1	DISCONNECTOR & EARTH SWITCH 362kV 3 POLE, 3150A, 50kA/1sec HEAVY POLLUTION (31mm/kV)
4.2	DISCONNECTOR 362kV 3 POLE, 3150A, 50kA/1sec HEAVY POLLUTION (31mm/kV)
4.3	PANTOGRAPH DISCONNECTOR 362kV 3x1 POLE, 3150A, 50kA/1sec HEAVY POLLUTION (31mm/kV)

APPENDIX A REVISION INFORMATION

(Informative) Horizon Power has endeavoured to provide standards of the highest quality and would appreciate notification of errors or queries.


Each Standard makes use of its own comment sheet which is maintained throughout the life of the standard, which lists all comments made by stakeholders regarding the standard.

A comment sheet found in **DM# 44255816** can be used to record any errors or queries found in or pertaining to this standard. This comment sheet will be referred to each time the standard is updated.

Date	Rev No.	Notes
28/05/2024	0	Initial Document Creation

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APPENDIX B QUALITY ASSURANCE (TO BE COMPLETED BY STORES)

DOCUMENT NUMBER		HPC-8DJ-25-0006-2024					QUALITY ASSURANCE		DM NUMBER	
DEVICE DESCRIPTION		LABEL MATERIAL NO.					HV DISCONNECTOR WITH EARTH SWITCH PURCHASE		ASSET OWNER	
		ASSET ID/ STOCK NO		DIMENSION						
MANUFACTURER										
ITEM	OPERATION/EQUIPMENT/FACILITY	DOCUMENT REF.	WHO CHECKS	INITIAL	DATE/TIME	QUALITY ASSURANCE CRITERIA	PASS Y/N	COMMENTS		
1	LABELLING									
1.1	Name of Manufacturer					*****				
1.2	Manufacturer's part reference number					*****				
1.3	Horizon Power Order Number					*****				
1.4	Horizon Power Stock Number					*****				
1.5	Disconnecter and or Earth-switch description					*****				
1.6	Package Weight					*****				
2	CONTENTS									
2.1	Installation Instructions					Clear, Legible and in English				
2.2	Bill of Materials					Clear, Legible and in English				
2.3	Material Safety Data Sheets (if required)					Clear, Legible and in English of all materials				
2.4	Accessories (if required)					As per Bill of Materials				

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ITEM	OPERATION/EQUIPMENT/FACILITY	DOCUMENT REF.	WHO CHECKS	INITIAL	DATE/TIME	QUALITY ASSURANCE CRITERIA	PASS Y/N	COMMENTS
2.5	Test and Inspection Reports					As per Standards referenced in the specification.		
3	PACKAGING							
3.1	Suitably stacked and secured on pallet					Packages suitably packed and prevented from coming loose		
3.2	Physical damage					Packages do not show puncture marks or other signs of damage		
3.3	Disconnect and or Earth-switch in suitable packaging					Strong enough to prevent mechanical damage		
3.4	Packaging clearly labelled					Each package easily identifiable		
3.5	Items Individually Marked					Items clearly designated and marked		
SYMBOLS AND ABBREVIATIONS								
H = HOLD POINT	S = SUPERVISOR							
W = WITNESS POINT	T = TECHNICIAN, EL = ELECTRICIAN	REVISION						
V = VERIFICATION POINT	E = ENGINEER	DATE						
S/C = SUBCONTRACTOR	PM = PROJECT MANAGER	APPROVED BY						

APPENDIX C SCHEDULES A & B: ENQUIRY DOCUMENT

C1 Technical Schedules

Completion of the listed schedules below by the Vendor shall indicate the product offered is fully compliant with the nominated Clauses in this specification. All information provided shall be in English and measurement units shall be in metric units.


Any deviation from the specification shall be listed on the “Technical Deviation Schedule D”, provided in Appendix E with motivation to Horizon Power for consideration and written approval.

C2 Technical Requirements

Schedule A: Purchaser’s specific requirements.

Schedule B: Particulars of *Equipment* to be supplied.

C2.1 Technical Schedules A and B for 66 kV Disconnectors/Earth-switches

	SPECIFICATION ENQUIRY	HPC-8DJ-25-0006-2024
	VENDOR’S NAME	
	DATE	

TECHNICAL SCHEDULES A & B

ITEM 1.1: 66 kV 3-Pole Disconnector with Earth-switch

SCHEDULE A: Horizon Power’s specific requirements

SCHEDULE B: Particulars of *Equipment* to be supplied (to be completed by Vendor)

Item	Sub-clause	Description	Schedule A	Schedule B
1.1		Manufacturer/Vendor of Disconnector/Earth-switch	xxxxxx	
1.2		Manufacturer’s/ Vendor’s catalogue number	xxxxxx	
1.3		Manufacturer’s/ Vendor’s drawing number	xxxxxx	
2.1		Disconnector Type (3-Pole)	xxxxxx	
2.2		Earth-switch Type (3-Pole)	xxxxxx	
3.	3.3	Electrical Requirements		
3.1		Max. system voltage (U_m) kV	72.5	
3.2		Lightning impulse withstand kV_{Peak}	325	
3.3		Lightning impulse withstand across isolating device kV_{Peak}	375	
3.4		Switching impulse withstand kV_{Peak}	N/A	
3.5		Switching impulse withstand across isolating device kV_{Peak}	N/A	
3.6		Switching impulse withstand between phases kV_{Peak}	N/A	
3.7		Power frequency withstand (60 sec.) $kV_{r.m.s.}$	140	

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Item	Sub-clause	Description	Schedule A	Schedule B
3.8		Power frequency withstand (60 sec.) across isolating device	kV _{r.m.s.} 160	
3.9		System frequency	Hz 50	
3.10		Rated continuous thermal current	A ≥1250	
3.11		Rated short time withstand current	kA 25	
3.12		Rated short time withstand time	s 3	
3.13		Rated peak withstand current	kA 62.5	
3.14		RIV level @ 1.1 U _m /√3	μV N/A	
4.	3.4	Mechanical Requirements		
4.1		Insulator type	Porcelain/ Polymer/ Composite	
4.2		Primary terminals		
		Material	Aluminium	
		Type	Flat Palm No9 M22	
4.3		Minimum creepage distance	mm ≥2232	
4.4		Beam/support height	mm ≥2550	
4.5		Weight	kg xxxxxx	
4.6		Disconnecter type	Double- break	
4.7		Disconnecter mechanical endurance class	M2	
4.8		Earth-switch type (short-circuit making) class	E1	
4.9		Earth-switch type (induced current) class	B	
4.10		Earth-switch mechanical endurance class	B1	
5.	3.5	Operational Requirements		
5.1		Secondary control voltage	V _{DC} 110	
5.2		Motor voltage	V _{DC} 110	
5.3		Temperature range	deg. °C -5 to 50	
5.4		Marshall terminal box IP	55	
5.5		Disconnecter Auxiliary Contacts (Normally Open)	*****	
5.6		Disconnecter Auxiliary Contacts (Normally Close)	*****	

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Item	Sub-clause	Description	Schedule A	Schedule B
5.7		Earth-switch Auxiliary Contacts (Normally Open)	*****	
5.8		Earth-switch Auxiliary Contacts (Normally Close)	*****	

**TECHNICAL SCHEDULES A & B
ITEM 1.2: 66 kV 3-Pole Disconnecter**


SCHEDULE A: Horizon Power's specific requirements
SCHEDULE B: Particulars of Equipment to be supplied (to be completed by Vendor)

Item	Sub-clause	Description	Schedule A	Schedule B
1.1		Manufacturer/Vendor of Disconnecter	xxxxxx	
1.2		Manufacturer's/ Vendor's catalogue number	xxxxxx	
1.3		Manufacturer's/ Vendor's drawing number	xxxxxx	
2.1		Disconnecter Type (3-Pole)	xxxxxx	
3.	3.3	Electrical Requirements		
3.1		Max. system voltage (U_m)	kV	72.5
3.2		Lightning impulse withstand	kV _{Peak}	325
3.3		Lightning impulse withstand across isolating device	kV _{Peak}	375
3.4		Switching impulse withstand	kV _{Peak}	N/A
3.5		Switching impulse withstand across isolating device	kV _{Peak}	N/A
3.6		Switching impulse withstand between phases	kV _{Peak}	N/A
3.7		Power frequency withstand (60 sec.)	kV _{r.m.s.}	140
3.8		Power frequency withstand (60 sec.) across isolating device	kV _{r.m.s.}	160
3.9		System frequency	Hz	50
3.10		Rated continuous thermal current	A	≥1250
3.11		Rated short time withstand current	kA	25
3.12		Rated short time withstand time	s	3
3.13		Rated peak withstand current	kA	62.5
3.14		RIV level @ 1.1 $U_m/\sqrt{3}$	μV	N/A
4.	3.4	Mechanical Requirements		
4.1		Insulator type	Porcelain/ Polymer/ Composite	

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Item	Sub-clause	Description	Schedule A	Schedule B
4.2		Primary terminals		
		Material	Aluminium	
		Type	Flat Palm No9 M22	
4.3		Minimum creepage distance mm	≥2232	
4.4		Beam/support height mm	≥2550	
4.5		Weight kg	xxxxxx	
4.6		Disconnecter type	Double-break	
4.7		Disconnecter mechanical endurance class	M2	
5.	3.5	Operational Requirements		
5.1		Secondary control voltage V _{DC}	110	
5.2		Motor voltage V _{DC}	110	
5.3		Temperature range deg. °C	-5 to 50	
5.4		Marshall terminal box IP	55	
5.5		Disconnecter Auxiliary Contacts (Normally Open)	*****	
5.6		Disconnecter Auxiliary Contacts (Normally Close)	*****	

C2.2 Technical Schedules A and B for 132 kV Disconnectors/Earth-switches

	SPECIFICATION ENQUIRY	HPC-8DJ-25-0006-2024
	VENDOR'S NAME	
	DATE	

TECHNICAL SCHEDULES A & B

ITEM 2.1: 132 kV 3-Pole Disconnector with Earth-switch

SCHEDULE A: Horizon Power's specific requirements

SCHEDULE B: Particulars of Equipment to be supplied (to be completed by Vendor)

Item	Sub-clause	Description	Schedule A	Schedule B
1.1		Manufacturer/Vendor of Disconnector/Earth-switch	xxxxxx	
1.2		Manufacturer's/ Vendor's catalogue number	xxxxxx	

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Item	Sub-clause	Description	Schedule A	Schedule B
1.3		Manufacturer's/ Vendor's drawing number	xxxxxx	
2.1		Disconnecter Type (3-Pole)	xxxxxx	
2.2		Earth-switch Type (3-Pole)	xxxxxx	
3.	3.3	Electrical Requirements		
3.1		Max. system voltage (U_m)	kV	145
3.2		Lightning impulse withstand	kV _{Peak}	650
3.3		Lightning impulse withstand across isolating device	kV _{Peak}	750
3.4		Switching impulse withstand	kV _{Peak}	N/A
3.5		Switching impulse withstand across isolating device	kV _{Peak}	N/A
3.6		Switching impulse withstand between phases	kV _{Peak}	N/A
3.7		Power frequency withstand (60 sec.)	kV _{r.m.s.}	275
3.8		Power frequency withstand (60 sec.) across isolating device	kV _{r.m.s.}	315
3.9		System frequency	Hz	50
3.10		Rated continuous thermal current	A	≥3150
3.11		Rated short time withstand current	kA	40
3.12		Rated short time withstand time	s	1
3.13		Rated peak withstand current	kA	100
3.14		RIV level @ $1.1 U_m/\sqrt{3}$	μV	≤2500
4.	3.4	Mechanical Requirements		
4.1		Insulator type	Porcelain/ Polymer/ Composite	
4.2		Primary terminals		
		Material	Aluminium	
		Type	Flat Palm No9 M22	
4.3		Minimum creepage distance	mm	≥4495
4.4		Beam/support height	mm	≥2550
4.5		Weight	kg	xxxxxx
4.6		Disconnecter type	Double- break	

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Item	Sub-clause	Description	Schedule A	Schedule B
4.7		Disconnecter mechanical endurance class	M2	
4.8		Earth-switch type (short-circuit making) class	E1	
4.9		Earth-switch type (induced current) class	B	
4.10		Earth-switch mechanical endurance class	B1	
5.	3.5	Operational Requirements		
5.1		Secondary control voltage V_{DC}	110	
5.2		Motor voltage V_{DC}	110	
5.3		Temperature range deg. °C	-5 to 50	
5.4		Marshall terminal box IP	55	
5.5		Disconnecter Auxiliary Contacts (Normally Open)	*****	
5.6		Disconnecter Auxiliary Contacts (Normally Close)	*****	
5.7		Earth-switch Auxiliary Contacts (Normally Open)	*****	
5.8		Earth-switch Auxiliary Contacts (Normally Close)	*****	

**TECHNICAL SCHEDULES A & B
ITEM 2.2: 132 kV 3-Pole Disconnecter**

SCHEDULE A: Horizon Power's specific requirements

SCHEDULE B: Particulars of Equipment to be supplied (to be completed by Vendor)


Item	Sub-clause	Description	Schedule A	Schedule B
1.1		Manufacturer/Vendor of Disconnecter	xxxxxx	
1.2		Manufacturer's/ Vendor's catalogue number	xxxxxx	
1.3		Manufacturer's/ Vendor's drawing number	xxxxxx	
2.1		Disconnecter Type (3-Pole)	xxxxxx	
3.	3.3	Electrical Requirements		
3.1		Max. system voltage (U _m) kV	145	
3.2		Lightning impulse withstand kV_{Peak}	650	
3.3		Lightning impulse withstand across isolating device kV_{Peak}	750	
3.4		Switching impulse withstand kV_{Peak}	N/A	
3.5		Switching impulse withstand across isolating device kV_{Peak}	N/A	

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Item	Sub-clause	Description		Schedule A	Schedule B
3.6		Switching impulse withstand between phases	kV _{Peak}	N/A	
3.7		Power frequency withstand (60 sec.)	kV _{r.m.s.}	275	
3.8		Power frequency withstand (60 sec.) across isolating device	kV _{r.m.s.}	315	
3.9		System frequency	Hz	50	
3.10		Rated continuous thermal current	A	≥3150	
3.11		Rated short time withstand current	kA	40	
3.12		Rated short time withstand time	s	1	
3.13		Rated peak withstand current	kA	100	
3.14		RIV level @ 1.1 U _m /√3	μV	≤2500	
4.	3.4	Mechanical Requirements			
4.1		Insulator type		Porcelain/ Polymer/ Composite	
4.2		Primary terminals			
		Material		Aluminium	
		Type		Flat Palm No9 M22	
4.3		Minimum creepage distance	mm	≥4495	
4.4		Beam/support height	mm	≥2550	
4.5		Weight	kg	xxxxxx	
4.6		Disconnecter type		Double- break	
4.7		Disconnecter mechanical endurance class		M2	
5.	3.5	Operational Requirements			
5.1		Secondary control voltage	V _{DC}	110	
5.2		Motor voltage	V _{DC}	110	
5.3		Temperature range	deg. °C	-5 to 50	
5.4		Marshall terminal box IP		55	
5.5		Disconnecter Auxiliary Contacts (Normally Open)		*****	
5.6		Disconnecter Auxiliary Contacts (Normally Close)		*****	

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C2.3 Technical Schedules A and B for 220 kV Disconnectors/Earth-switches

	SPECIFICATION ENQUIRY	HPC-8DJ-25-0006-2024
	VENDOR'S NAME	
	DATE	

TECHNICAL SCHEDULES A & B

ITEM 4.1: 220 kV 3- Pole Disconnector with Earth-switch

SCHEDULE A: Horizon Power's specific requirements

SCHEDULE B: Particulars of Equipment to be supplied (to be completed by Vendor)

Item	Sub-clause	Description	Schedule A	Schedule B
1.1		Manufacturer/Vendor of Disconnector/Earth-switch	xxxxxx	
1.2		Manufacturer's/ Vendor's catalogue number	xxxxxx	
1.3		Manufacturer's/ Vendor's drawing number	xxxxxx	
2.1		Disconnector Type (3-Pole)	xxxxxx	
2.2		Earth-switch Type (3-Pole)	xxxxxx	
3.	3.3	Electrical Requirements		
3.1		Max. system voltage (U_m)	kV	245
3.2		Lightning impulse withstand	kV _{Peak}	1050
3.3		Lightning impulse withstand across isolating device	kV _{Peak}	1200
3.4		Switching impulse withstand	kV _{Peak}	N/A
3.5		Switching impulse withstand across isolating device	kV _{Peak}	N/A
3.6		Switching impulse withstand between phases	kV _{Peak}	N/A
3.7		Power frequency withstand (60 sec.)	kV _{r.m.s.}	460
3.8		Power frequency withstand (60 sec.) across isolating device	kV _{r.m.s.}	530
3.9		System frequency	Hz	50
3.10		Rated continuous thermal current	A	≥2500
3.11		Rated short time withstand current	kA	40
3.12		Rated short time withstand time	s	1
3.13		Rated peak withstand current	kA	100
3.14		RIV level @ $1.1 U_m/\sqrt{3}$	μV	≤2500
4.	3.4	Mechanical Requirements		

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Item	Sub-clause	Description	Schedule A	Schedule B
4.1		Insulator type	Porcelain/ Polymer/ Composite	
4.2		Primary terminals		
		Material	Aluminium	
		Type	Flat Palm No9 M22	
4.3		Minimum creepage distance	mm	≥7595
4.4		Beam/support height	mm	≥2550
4.5		Weight	kg	xxxxxx
4.6		Disconnecter type	Double- break	
4.7		Disconnecter mechanical endurance class	M2	
4.8		Earth-switch type (short-circuit making) class	E1	
4.9		Earth-switch type (induced current) class	B	
4.10		Earth-switch mechanical endurance class	B1	
5.	3.5	Operational Requirements		
5.1		Secondary control voltage	V _{DC}	110/220
5.2		Motor voltage	V _{DC}	110/220
5.3		Temperature range	deg. °C	-5 to 50
5.4		Marshall terminal box IP	55	
5.5		Disconnecter Auxiliary Contacts (Normally Open)	*****	
5.6		Disconnecter Auxiliary Contacts (Normally Close)	*****	
5.7		Earth-switch Auxiliary Contacts (Normally Open)	*****	
5.8		Earth-switch Auxiliary Contacts (Normally Close)	*****	

**TECHNICAL SCHEDULES A & B
ITEM 4.2: 220 kV 3- Pole Disconnecter**

SCHEDULE A: Horizon Power's specific requirements

SCHEDULE B: Particulars of Equipment to be supplied (to be completed by Vendor)

Item	Sub-clause	Description	Schedule A	Schedule B
1.1		Manufacturer/Vendor of Disconnecter	xxxxxx	

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Item	Sub-clause	Description	Schedule A	Schedule B
1.2		Manufacturer's/ Vendor's catalogue number	xxxxxx	
1.3		Manufacturer's/ Vendor's drawing number	xxxxxx	
2.1		Disconnecter Type (3-Pole)	xxxxxx	
3.	3.3	Electrical Requirements		
3.1		Max. system voltage (U _m)	kV	245
3.2		Lightning impulse withstand	kV _{Peak}	1050
3.3		Lightning impulse withstand across isolating device	kV _{Peak}	1200
3.4		Switching impulse withstand	kV _{Peak}	N/A
3.5		Switching impulse withstand across isolating device	kV _{Peak}	N/A
3.6		Switching impulse withstand between phases	kV _{Peak}	N/A
3.7		Power frequency withstand (60 sec.)	kV _{r.m.s.}	460
3.8		Power frequency withstand (60 sec.) across isolating device	kV _{r.m.s.}	530
3.9		System frequency	Hz	50
3.10		Rated continuous thermal current	A	≥2500
3.11		Rated short time withstand current	kA	40
3.12		Rated short time withstand time	s	1
3.13		Rated peak withstand current	kA	100
3.14		RIV level @ 1.1 U _m /√3	μV	≤2500
4.	3.4	Mechanical Requirements		
4.1		Insulator type	Porcelain/ Polymer/ Composite	
4.2		Primary terminals		
		Material	Aluminium	
		Type	Flat Palm No9 M22	
4.3		Minimum creepage distance	mm	≥7595
4.4		Beam/support height	mm	≥2550
4.5		Weight	kg	xxxxxx
4.6		Disconnecter type	Double- break	

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Item	Sub-clause	Description	Schedule A	Schedule B
4.7		Disconnecter mechanical endurance class	M2	
5.	3.5	Operational Requirements		
5.1		Secondary control voltage V_{DC}	110/220	
5.2		Motor voltage V_{DC}	110/220	
5.3		Temperature range deg. °C	-5 to 50	
5.4		Marshall terminal box IP	55	
5.5		Disconnecter Auxiliary Contacts (Normally Open)	*****	
5.6		Disconnecter Auxiliary Contacts (Normally Close)	*****	

TECHNICAL SCHEDULES A & B
ITEM 4.3: 220 kV 3x1- Pole Pantograph Disconnecter


SCHEDULE A: Horizon Power's specific requirements

SCHEDULE B: Particulars of Equipment to be supplied (to be completed by Vendor)

Item	Sub-clause	Description	Schedule A	Schedule B
1.1		Manufacturer/Vendor of Pantograph Disconnecter	xxxxxx	
1.2		Manufacturer's/ Vendor's catalogue number	xxxxxx	
1.3		Manufacturer's/ Vendor's drawing number	xxxxxx	
2.1		Pantograph Disconnecter Type (3x1-Pole)	xxxxxx	
3.	3.3	Electrical Requirements		
3.1		Max. system voltage (U _m) kV	245	
3.2		Lightning impulse withstand kV_{Peak}	1050	
3.3		Lightning impulse withstand across isolating device kV_{Peak}	1200	
3.4		Switching impulse withstand kV_{Peak}	N/A	
3.5		Switching impulse withstand across isolating device kV_{Peak}	N/A	
3.6		Power frequency withstand (60 sec.) kV_{r.m.s.}	460	
3.7		Power frequency withstand (60 sec.) across isolating device kV_{r.m.s.}	530	
3.8		System frequency Hz	50	
3.9		Rated continuous thermal current A	≥2500	
3.10		Rated short time withstand current kA	40	

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C2.4 Technical Schedules A and B for 330 kV Disconnectors/Earth-switches

	SPECIFICATION ENQUIRY	HPC-8DJ-25-0006-2024
	VENDOR'S NAME	
	DATE	

TECHNICAL SCHEDULES A & B

ITEM 5.1: 330 kV 3- Pole Disconnector with Earth-switch

SCHEDULE A: Horizon Power's specific requirements

SCHEDULE B: Particulars of Equipment to be supplied (to be completed by Vendor)

Item	Sub-clause	Description	Schedule A	Schedule B
1.1		Manufacturer/Vendor of Disconnector/Earth-switch	xxxxxx	
1.2		Manufacturer's/ Vendor's catalogue number	xxxxxx	
1.3		Manufacturer's/ Vendor's drawing number	xxxxxx	
2.1		Disconnector Type (3-Pole)	xxxxxx	
2.2		Earth-switch Type (3-Pole)	xxxxxx	
3.	3.3	Electrical Requirements		
3.1		Max. system voltage (U_m) kV	362	
3.2		Lightning impulse withstand kV_{Peak}	1175	
3.3		Lightning impulse withstand across isolating device kV_{Peak}	1380	
3.4		Switching impulse withstand kV_{Peak}	650	
3.5		Switching impulse withstand across isolating device kV_{Peak}	1095	
3.6		Switching impulse withstand between phases kV_{Peak}	1275	
3.7		Power frequency withstand (60 sec.) $kV_{r.m.s.}$	520	
3.8		Power frequency withstand (60 sec.) across isolating device $kV_{r.m.s.}$	610	
3.9		System frequency Hz	50	
3.10		Rated continuous thermal current A	≥3150	
3.11		Rated short time withstand current kA	50	
3.12		Rated short time withstand time s	1	
3.13		Rated peak withstand current kA	125	
3.14		RIV level @ $1.1 U_m/\sqrt{3}$ μV	≤2500	
4.	3.4	Mechanical Requirements		

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Item	Sub-clause	Description	Schedule A	Schedule B
4.1		Bushing type	Porcelain/ Polymer/ Composite	
4.2		Primary terminals		
		Material	Aluminium	
		Type	Flat Palm No9 M22	
4.3		Minimum creepage distance	mm	≥11222
4.4		Beam/support height	mm	≥2550
4.5		Weight	kg	xxxxxx
4.6		Disconnecter type	Double- break	
4.7		Disconnecter mechanical endurance class	M2	
4.8		Earth-switch type (short-circuit making) class	E1	
4.9		Earth-switch type (induced current) class	B	
4.10		Earth-switch mechanical endurance class	B1	
5.	3.5	Operational Requirements		
5.1		Secondary control voltage	V _{DC}	110/220
5.2		Motor voltage	V _{DC}	110/220
5.3		Temperature range	deg. °C	-5 to 50
5.4		Marshall terminal box IP	55	
5.5		Disconnecter Auxiliary Contacts (Normally Open)	*****	
5.6		Disconnecter Auxiliary Contacts (Normally Close)	*****	
5.7		Earth-switch Auxiliary Contacts (Normally Open)	*****	
5.8		Earth-switch Auxiliary Contacts (Normally Close)	*****	

**TECHNICAL SCHEDULES A & B
ITEM 5.2: 330 kV 3- Pole Disconnecter**

SCHEDULE A: Horizon Power's specific requirements

SCHEDULE B: Particulars of Equipment to be supplied (to be completed by Vendor)

Item	Sub-clause	Description	Schedule A	Schedule B
1.1		Manufacturer/Vendor of Disconnecter	xxxxxx	

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Item	Sub-clause	Description	Schedule A	Schedule B
1.2		Manufacturer's/ Vendor's catalogue number	xxxxxx	
1.3		Manufacturer's/ Vendor's drawing number	xxxxxx	
2.1		Disconnecter Type (3-Pole)	xxxxxx	
3.	3.3	Electrical Requirements		
3.1		Max. system voltage (U _m) kV	362	
3.2		Lightning impulse withstand kV _{Peak}	1175	
3.3		Lightning impulse withstand across isolating device kV _{Peak}	1380	
3.4		Switching impulse withstand kV _{Peak}	650	
3.5		Switching impulse withstand across isolating device kV _{Peak}	1095	
3.6		Switching impulse withstand between phases kV _{Peak}	1275	
3.7		Power frequency withstand (60 sec.) kV _{r.m.s.}	520	
3.8		Power frequency withstand (60 sec.) across isolating device kV _{r.m.s.}	610	
3.9		System frequency Hz	50	
3.10		Rated continuous thermal current A	≥3150	
3.11		Rated short time withstand current kA	50	
3.12		Rated short time withstand time s	1	
3.13		Rated peak withstand current kA	125	
3.14		RIV level @ 1.1 U _m /√3 μV	≤2500	
4.	3.4	Mechanical Requirements		
4.1		Bushing type	Porcelain/ Polymer/ Composite	
4.2		Primary terminals		
		Material	Aluminium	
		Type	Flat Palm No9 M22	
4.3		Minimum creepage distance mm	≥11222	
4.4		Beam/support height mm	≥2550	
4.5		Weight kg	xxxxxx	
4.6		Disconnecter type	Double- break	

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Item	Sub-clause	Description	Schedule A	Schedule B
4.7		Disconnecter mechanical endurance class	M2	
5.	3.5	Operational Requirements		
5.1		Secondary control voltage V_{DC}	110/220	
5.2		Motor voltage V_{DC}	110/220	
5.3		Temperature range deg. °C	-5 to 50	
5.4		Marshall terminal box IP	55	
5.5		Disconnecter Auxiliary Contacts (Normally Open)	*****	
5.6		Disconnecter Auxiliary Contacts (Normally Close)	*****	

TECHNICAL SCHEDULES A & B
ITEM 5.3: 330 kV 3x1- Pole Pantograph Disconnecter

SCHEDULE A: Horizon Power's specific requirements

SCHEDULE B: Particulars of Equipment to be supplied (to be completed by Vendor)

Item	Sub-clause	Description	Schedule A	Schedule B
1.1		Manufacturer/Vendor of Pantograph Disconnecter	xxxxxx	
1.2		Manufacturer's/ Vendor's catalogue number	xxxxxx	
1.3		Manufacturer's/ Vendor's drawing number	xxxxxx	
2.1		Pantograph Disconnecter Type (3x1-Pole)	xxxxxx	
3.	3.3	Electrical Requirements		
3.1		Max. system voltage (U _m) kV	362	
3.2		Lightning impulse withstand kV_{Peak}	1175	
3.3		Lightning impulse withstand across isolating device kV_{Peak}	1380	
3.4		Switching impulse withstand kV_{Peak}	650	
3.5		Switching impulse withstand across isolating device kV_{Peak}	1095	
3.6		Power frequency withstand (60 sec.) kV_{r.m.s.}	520	
3.7		Power frequency withstand (60 sec.) across isolating device kV_{r.m.s.}	610	
3.8		System frequency Hz	50	
3.9		Rated continuous thermal current A	≥3150	
3.10		Rated short time withstand current kA	50	

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Item	Sub-clause	Description	Schedule A	Schedule B
3.11		Rated short time withstand time	s	1
3.12		Rated peak withstand current	kA	125
3.13		RIV level @ 1.1 Um/ $\sqrt{3}$	μ V	≤ 2500
4.	3.4	Mechanical Requirements		
4.1		Bushing type	Porcelain/ Polymer/ Composite	
4.2		Primary terminals		
		Material	Aluminium	
		Type	Flat Palm No9 M22	
4.3		Minimum creepage distance	mm	≥ 11222
4.4		Support height	mm	≥ 2550
4.5		Weight	kg	xxxxxx
4.6		Pantograph Disconnecter type	Double- break	
4.7		Disconnecter mechanical endurance class	M2	
5.	3.5	Operational Requirements		
5.1		Secondary control voltage	V _{DC}	110/220
5.2		Motor voltage	V _{DC}	110/220
5.3		Temperature range	deg. °C	-5 to 50
5.4		Marshall terminal box IP		55
5.5		Disconnecter Auxiliary Contacts (Normally Open)		*****
5.6		Disconnecter Auxiliary Contacts (Normally Close)		*****

APPENDIX D TECHNICAL SCHEDULE C: COMPLIANCE DOCUMENT

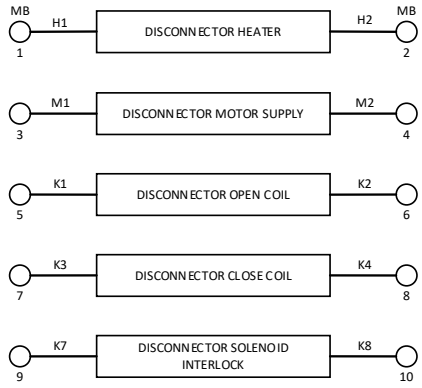
The Vendor shall indicate below whether this offer is fully compliant with the nominated clause in this Specification. A YES shall ONLY be indicated if the offer is 100% compliant with the relevant Clause. If NO is indicated and supporting documents are submitted, then mark the ATT box with the attachment number. Details of departure shall be provided in Schedule D Appendix E.

CLAUSE NUMBER		YES	NO	ATT.
3	Requirements			
3.1	General	<input type="checkbox"/>	<input type="checkbox"/>	
3.2	Environmental Conditions	<input type="checkbox"/>	<input type="checkbox"/>	
3.3	Electrical Requirements	<input type="checkbox"/>	<input type="checkbox"/>	
3.4	Mechanical Requirements			
3.4.1	<i>Disconnecter</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3.4.2	<i>Pantograph Disconnector (≥220 kV)</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3.4.3	<i>Earth-switch</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3.4.4	<i>Terminals and Contacts</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3.4.5	<i>Insulators</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3.4.6	<i>Beam and Supports</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3.5	Marshalling Terminal Box	<input type="checkbox"/>	<input type="checkbox"/>	
3.5.1	<i>Control and Operation Systems</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3.5.1.1	<i>Convention</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3.5.1.2	<i>Electromagnetic Induction</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3.5.1.3	<i>Control Voltage</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3.5.1.4	<i>Control Relays</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3.5.2	<i>Mechanism Motors</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3.5.2.1	<i>Mechanism Lubricants</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3.5.2.2	<i>Hydraulic-operating Mechanisms</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3.5.3	<i>Manual Operation</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3.5.3.1	<i>Closing/Opening</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3.5.3.2	<i>Operational Switches</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3.5.4	<i>Auxiliary Switches</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3.5.5	<i>Interlocks</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3.5.5.1	<i>Disconnecter</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3.5.5.2	<i>Earth-switch</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3.5.6	<i>Anti-condensing Heaters</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3.5.7	<i>Wiring, Terminations and Identification</i>	<input type="checkbox"/>	<input type="checkbox"/>	

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CLAUSE NUMBER		YES	NO	ATT.
3.5.8	<i>Secondary Terminals, Strips and Glang Plate</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3.5.9	<i>Door Lockable Latch</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3.6	IP Rating	<input type="checkbox"/>	<input type="checkbox"/>	
3.7	Earthing Terminals	<input type="checkbox"/>	<input type="checkbox"/>	
3.7.1	<i>Marshalling Terminal Box</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3.7.2	<i>Earthing of Down Rods</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3.7.3	<i>Earthing of Operating Handles</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3.8	Corrosion Protection	<input type="checkbox"/>	<input type="checkbox"/>	
3.9	Name Plate	<input type="checkbox"/>	<input type="checkbox"/>	
3.10	Labels	<input type="checkbox"/>	<input type="checkbox"/>	
4	Packaging Requirements	<input type="checkbox"/>	<input type="checkbox"/>	
5	Storage	<input type="checkbox"/>	<input type="checkbox"/>	
6	Reliability	<input type="checkbox"/>	<input type="checkbox"/>	
7	Safety	<input type="checkbox"/>	<input type="checkbox"/>	
8	Environmental Considerations	<input type="checkbox"/>	<input type="checkbox"/>	
9	Tests			
9.1	Test Requirements	<input type="checkbox"/>	<input type="checkbox"/>	
9.2	Test Certificates	<input type="checkbox"/>	<input type="checkbox"/>	
9.3	Type Tests	<input type="checkbox"/>	<input type="checkbox"/>	
9.4	Routine Tests	<input type="checkbox"/>	<input type="checkbox"/>	
10	Documentation			
10.1	Documentation to be provided with Proposals	<input type="checkbox"/>	<input type="checkbox"/>	
10.2	Service History	<input type="checkbox"/>	<input type="checkbox"/>	
10.3	Training Materials	<input type="checkbox"/>	<input type="checkbox"/>	
10.4	Drawings	<input type="checkbox"/>	<input type="checkbox"/>	
10.4	Maintenance Manual	<input type="checkbox"/>	<input type="checkbox"/>	
10.4	Operational Instruction Manual	<input type="checkbox"/>	<input type="checkbox"/>	

APPENDIX F TERMINAL CONFIGURATION



NOTE:
 ALL CONTACTS TO BE SHOWN FOR THE DISCONNECTOR/EARTH-SWITCH IN THE OPEN POSITION,
 THE DISCONNECTOR REMOTE-OFF-LOCAL SWITCH IN THE OFF POSITION, NO PADLOCK APPLIED.
 ALL RELAYS TO BE SHOWN IN THE DE-ENERGISED POSITION.

