Specification – Distribution Reclosers

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TABLE OF CONTENTS

1 Scope 6

2 Normative References 6

2.1 Standards 6

2.1.1 Horizon Power Standards 6

2.1.2 Australian Standards 6

2.1.3 International Standards 7

2.1.4 Compliance with Standards 8

2.2 Definitions and Abbreviations 8

2.2.1 Drawings 8

3 Requirements 9

3.1 Power System Particulars 9

3.1.1 Rated Voltages 9

3.1.2 Fault Rating 9

3.1.3 Nominal System Frequency 9

3.1.4 System Insulation Levels 9

3.1.5 Environmental Conditions 9

3.1.6 Clearances and Insulation 10

4 Pole Mounted Recloser 10

4.1 General Requirements 10

4.2 Design and Construction 10

4.2.1 Tank Design 10

4.2.1.1 Internal Breaker 11

4.2.1.2 Internal Arc Classification 11

4.2.1.3 Interrupting Medium 11

4.2.1.4 Insulation Medium 12

4.2.1.5 Tank Pressure Relief 13

4.2.2 Surge Arrester Bracket 13

4.2.3 Bushing and Terminals 13

4.2.4 Earthing 14

4.2.5 Pole Mounting Frame 14

4.2.6 Operating Mechanism 15

4.2.6.1 Operating Sequence 15

4.2.6.2 Manual Operation and Operation Counter 16

4.2.7 Recloser Control Unit 16

4.2.7.1 Cabinet Design and Construction 16

4.2.7.2 Cabinet Door 16

4.2.7.3 Internal Construction 16
4.2.7.4 Mounting Bracket 17
4.2.7.5 Cable Entry 17
4.2.7.6 Control Cable 17
4.2.7.7 Power Supplies 17
4.2.7.8 Technical Features 19
4.2.8 Protection & Control Functions 19
4.2.8.1 Overcurrent Protection (IEC and IEEE IDMT, definite time and user defined curves) 19
4.2.8.2 Earth Fault Protection (IEC and IEEE IDMT, definite time and user defined curves) 20
4.2.8.3 Instantaneous Overcurrent and Earth Fault Protection 20
4.2.8.4 Sensitive Earth Fault Protection 20
4.2.8.5 Negative Sequence Overcurrent Protection 20
4.2.8.6 Undervoltage and Overvoltage Protection 21
4.2.8.7 Under-frequency and Over-frequency Protection 22
4.2.8.8 Auto-reclose Operation Parameters 22
4.2.8.9 Cold Load Pick-up (CLP) 22
4.2.9 Control Functions 23
4.2.10 Measurement Functions 23
4.2.11 Software 23
4.2.12 Nameplates 24
4.2.13 Auxiliary Voltage Transformers 24
4.2.14 Printed Circuit Boards 25

5 Storage 25

6 Reliability 25
6.1 Life Cycle Model 25

7 Safety 25
7.1 Environmental Considerations 26
7.2 End of Life Management 26

8 Tests 26
8.1 Test Requirements 26
8.2 Test Certificates 26
8.3 Type Tests 27
8.4 Routine Tests 27
8.4.1 General 27
8.4.2 Circuit Breaker 27
8.4.3 Current and Voltage Transformers 27
8.4.4 Insulation Tests 28

9 Documentation 28
9.1 Installation, Operation and Maintenance Manual 28
9.2 Electrical Drawings 29
9.3 Bill of Materials (BOM) 29
9.4 Type Test Certificates/Reports 29
10 Marking/Packing 30
11 Spare Equipment 30
Appendix A Revision Information 32
Appendix B Quality Assurance (to be completed by stores) 33
Appendix C Technical requirements for recloser 35
Appendix D Compliance document 43
Appendix E Departures from technical specification 47
Appendix F Drawings 48
Appendix G SCADA Requirements 49
Appendix H Impact Assessment 52

1 SCOPE

This Specification details the requirements for the design and supply of outdoor pole mounted Automatic Control Recloser (ACR) and control circuit box for rated voltages from 6.6 kV up to and including 33 kV.

Tests prescribed will evaluate the performance of the *Equipment*, and must comply with this specification.

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

1) Successful completion of the appropriate tests (required by this specification) by an independent and accredited test authority.
2) 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 must 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.

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/NZS 1125, Conductors in insulated electric cables and flexible cords*, Standards Australia, 2001 (R2017) Amdt 1-2004
4. *AS 1580, Paints and related materials—Methods of test*, Standards Australia, 2006
5. *AS/NZS 2312, Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings*, Standards Australia, 2014
6. *AS 2067,* Substations and high voltage installations exceeding 1 kV a.c., Standards Australia, 2016

7. *AS/NZS 3100, Approval and test specification – General requirements for electrical equipment*, Standards Australia, 2022
8. *AS 4436, Guide for the selection of insulators in respect of polluted conditions*, Standards Australia, 1996 (R2016) Superseded
9. *AS/NZS 4680, Hot-dip galvanized (zinc) coatings on fabricated ferrous articles*, Standards Australia, 2006
10. *AS/NZS 60137, Insulated bushings for alternating voltages above 1000 V,* Standards Australia, 2020
11. *AS 60529, Degrees of protection provided by enclosures (IP Code),* Standards Australia, 2001 (R2018)
12. *AS 61869-1, Instrument transformers – Part 1: General rules*, Standards Australia, 2021
13. *AS 61869-2, Instrument transformers – Part 2: Additional requirements for current transformers*, Standards Australia, 2021
14. *AS 61869-3, Instrument transformers – Part 3: Additional requirements for inductive voltage transformers*, Standards Australia, 2021
15. *AS 62271.1, High Voltage switchgear and controlgear—Part 1: Common specifications,* Standards Australia, 2019
16. *AS 62271.100, High Voltage switchgear and controlgear—Part 100: High-voltage alternating-current circuit-breakers,* Standards Australia, 2019
17. *AS 62271.200, High Voltage switchgear and controlgear—Part 200: A.C. metal enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV,* Standards Australia, 2019
18. *AS 62271.301, High Voltage switchgear and controlgear—Part 301: Dimensional standardisation of terminals,* Standards Australia, 2022

2.1.3 International Standards

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

19. *IEC 60255.1, Measuring relays and protection equipment – Part 1 Common requirements*, International Electrotechnical Committee, 2019
20. *IEC 60270, High voltage test techniques – Partial discharge measurements*, Standards Australia, 2001
21. *IEC 60812, Analysis techniques for system reliability—Procedure for failure mode and effects analysis (FMEA)*, International Electrotechnical Committee, 2006
22. *IEC 62271.111, High-voltage switchgear and controlgear – Part 111: Automatic circuit recloser and fault interrupters for alternating current systems up to 38 kV*, International Electrotechnical Committee, 2019
23. *IEEE C37.60, High-voltage switchgear and controlgear – Part 111: Automatic circuit recloser and fault interrupters for alternating current systems up to 38 kV*, International Electrotechnical Committee, 2012
24. *IEEE C37.112, Inverse-Time Characteristic Equations for Overcurrent Relays*, International Electrotechnical Committee, 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 with the addition of a few general definitions listed below in alphabetical order.

ACR: Automatic Control Recloser

CT: Current Transformer

DTL: Drive To Lock-out

***Equipment*:** must collectively refer to various components (tank, circuit breaker, current transformers, instrument transformers, ancillary equipment and circuitry) that form the pole mounted recloser unit.

IDMT: Inverse (time relay with) Definite Minimum Time

kV: kilo Volts (1,000 Volts)

MV: Medium Voltage >1,000 Volts AC; <36,000 Volts AC

MVAr: Mega Volt Amp reactive (1,000,000 Volt Amp reactive)

MW: Mega Watts (1,000,000 Watts)

SCADA: Supervisory Control and Data Acquisition

SWEWR: Single Wire Earth Wire Return

VT: Voltage Transformer

2.2.1 Drawings

The Drawings listed below form part of this Specification. (Refer Schedule F of the Specification).

1. HPA-SD-E-0007-01 - RECLOSER GENERAL ARRANGEMENT - SURGE ARRESTOR APPLICATION

3 REQUIREMENTS

3.1 Power System Particulars

The *Equipment* must be suitable for continuous connection to a power system with the characteristics covered below.

3.1.1 Rated Voltages

The rated voltages considered in this specification are:

1) 22 kV (3 phase)
2) 33 kV (3 phase)

3.1.2 Fault Rating

The *Equipment* must meet the requirements of HP's Technical Rules [2] and be rated to withstand:

1) 21.9 kA rms for one second, for 6.6 kV
2) 25.0 kA rms for one second, for 11 kV
3) 16.0 kA rms for one second, for 22 kV
4) 13.1 kA rms for one second, for 33 kV

3.1.3 Nominal System Frequency

The nominal system frequency is 50 Hz.

3.1.4 System Insulation Levels

The system Basic Impulse Insulation Levels (BIL) are as follows:

Table 1: System Insulation Levels

Nominal System Voltage (kV_{rms})	System Highest Voltage (kV_{rms})	Lightning Impulse withstand Voltage (kV_{peak})	Power Frequency withstand Voltage (kV_{rms})
6.6	7.2	60	20
11.0	12.0	75	28
22.0	24.0	150	50
33.0	36.0	170	70

3.1.5 Environmental Conditions

The performance of equipment must meet the requirements set out in Section 4 of the *Horizon Power Environmental Conditions* [1].

3.1.6 Clearances and Insulation

The minimum electrical clearance between phase-phase and phase-earth for all high voltage parts of the *Equipment* must be not less than that specified in AS 2067 [6].

Vendors that offer *Equipment*, with cast resin (or similar material) encapsulated current carrying MV conductors, shall provide test reports to demonstrate that the cast resin or similar material shall not be affected by the operation of the *Equipment* under the service conditions detailed in this Specification. In particular, load cycling due to the different coefficient of expansion of the metallic conductor and the insulation material at different temperatures over time.

4 POLE MOUNTED RECLOSER

4.1 General Requirements

The *Equipment* must consist of:

1) Tank – housing the primary devices (circuit-breaker, current transformers, voltage transformers etc.)
2) Control unit – housing the secondary devices (protection, SCADA and communication devices etc.)

It must be possible to apply standard 22 kV rated reclosers on 6.6 kV and 11 kV networks, without any hardware modifications.

It must be possible to easily configure the recloser control unit, by means of user selectable software changes only, for application on 6.6 kV, 11 kV, 22 kV and 33 kV networks.

Vacuum is the preferred interrupting medium.

Oil must NOT be used either as an insulating or interrupting medium.

The vendor must ensure that the *Equipment* is designed to readily facilitate installation without the need for special fixing plates, temporary secondary wiring arrangements or other accessories and state:

4.2 Design and Construction

4.2.1 Tank Design

The tank must be of a metal clad design in accordance with IEC 62271.111 [22] (IEEE C37.60 [23]). The tank must be robust, to support the vibration of the re-closer during an arc fault event.

All exposed internal and external surfaces to be cleaned, prepared and treated with a coating system suitable for severe marine environments corrosion category E-M (very high, marine), in accordance with AS/NZS 2312 [5]. It is not expected that the *Equipment* will require re-coating during its anticipated lifespan.

The tank must be perfectly sealed as described in IEC 62271.111 [22], with all fittings in place to operate under all operating conditions.

All surfaces will be designed to prevent the accumulation of water. All seams must be electrically welded. Welding in all cases will be continuous. On the external areas of the tank, welding of horizontal and vertical joints must be on both sides of the joint. All metal work must be electrically bonded to the tank. If a part cannot be adequately bonded it will be constructed from a suitable insulating material instead of metal.

The Vendor must state in its Proposal:

1) the intended surface protection methods of the tank including base material selection and surface preparation (e.g. galvanising, painting, greasing, etc.),
2) the estimated life of the protective coating must also be specified, and
3) the details of all tests (accelerated aging, salt spray, fog, impact, etc.) that prove the effectiveness of the proposed protective coating. All testing must be carried out in accordance with AS 1580 [4] or equivalent international standards.

4.2.1.1 Internal Breaker

The breaker must be housed within either:

- a stainless steel tank, or
- hot dip galvanised steel tank to AS/NZS 4680 [9],

providing adequate arc fault containment.

4.2.1.2 Internal Arc Classification

Where phase conductors or switching components share a common metallic enclosure, in which there is risk of overpressure due to phase to phase internal arcing, the design must be internal fault tested in accordance with AS 62271.200 [17].

Internal fault testing must allow for Accessibility Type C (pole mount gear) as defined by AS 62271.200 [17] Annex A2 and state the minimum admissible installation height with reference to the base of the switch, in accordance with that standard. The tank must satisfy an Internal Arc Classification C for the specified test current and duration.

The prospective three phase test current must be equal to the rated short time withstand current.

4.2.1.3 Interrupting Medium

The interrupting medium must be vacuum for the *Equipment*. The vacuum bottles must be sealed for life. The tightness of the sealed bottles must meet the requirements of IEC 62271.111 [22].

Vendors must outline the precautions and tests carried out during manufacture to ensure the long term maintenance of the vacuum and long term integrity of the vacuum bottles. The Vendor must specify the lifetime performance of these systems and if they have to be replaced within the operating life of the *Equipment*.

Vendors must guarantee the number of circuit breaker operations at rated short circuit current before replacement of the vacuum bottle is necessary.

The contacts for the interrupter must be positively driven in both the open and closed directions, and in no way be dependent on the interrupter vacuum.

The level of x-rays emitted must meet requirements of AS 62271.1 [15]. Vendors must state if it is possible for Horizon Power to carry out in-situ tests on the integrity of vacuum in the bottles.

If the switching action of the contactor cannot be completed when activated by a pulse contact of 200 ms. Vendor must provide a time delayed action to ensure that the started action is completed.

The Vendor must maintain the same make and type of vacuum bottle for all circuit breakers of the same rating throughout the Standing Offer period. The make and type of vacuum bottles must not be changed without the prior approval of Horizon Power.

Tenders must state the consequences of loss of vacuum on:

- the voltage withstand capability of an open circuit switch,
- the ability of the *Equipment* to switch load current, and
- the ability of the *Equipment* to switch fault current.

4.2.1.4 Insulation Medium

The Vendor shall state the insulation medium in their Proposal.

Horizon Power supports minimising the greenhouse gas emissions in all its operations, and encourages Vendors to provide a recloser option that does not use SF_6 gas as an insulation medium.

The SF_6 gas used must comply with the requirements of IEC 62271.111 [22] and AS 62271.200 [17]. In addition, the Vendor must guarantee in his quotation that processing/recycling of the contaminated SF_6 gas is possible through its organisation. Vendors service organisation must be capable of overhauling the unit without any danger for the environment and recycling of the SF_6 gas. The circuit breaker must be serviceable by the Vendors organisation at site.

Each enclosure containing SF_6 / "SF_6-free medium" must be provided with a minimum pressure switch that directly operates a lockout relay with a flag indicator, preventing operation of the circuit breaker and activating the external alarm indication, as well as a non-return valve.

The Vendor must state in Technical Schedule if a gas non-return valve is NOT provided.

4.2.1.5 Tank Pressure Relief

Pressure relief facilities must be provided to enable the tank unit to withstand safely the effects of excessive pressure rise due to an internal fault. Details of how the pressure relief is achieved and shall be proven in the IAC Type test.

4.2.2 Surge Arrester Bracket

Mounting brackets for surge arresters (with the dimensions shown in drawing HPA-SD-E-00007-01) must be provided on the source side and load side of the *Equipment* unit's tank. Brackets must be attached to the tank adjacent to each MV bushing, to enable mounting of surge arresters. The brackets must have a corrosion-resistant, bare metal connecting zone which has the capability to conduct fault current through the surge arrester.

The brackets must be constructed to accommodate the mounting of polymeric surge arresters, fitted with a M12 (min 14 mm dia. hole) earthing stud with a minimum exposed stud length of 36 mm. The arresters must preferably be mounted onto the bracket directly. Clearances between the *Equipment* tank/metalwork and surge arresters must be such that phase to ground clearances are achieved. The arresters must be mounted parallel to and in the same plane as the associated phase insulator. The surge arrester brackets must be used as the connection point for the arrester earth. Bolts and nuts associated with the support structures must be hot-dip galvanised as per AS/NZS 4680 [9].

See drawing HPA-SD-E-00007-01 for details. The mounting arrangements must be shown in dotted lines on typical general arrangement drawing submitted with the tender.

4.2.3 Bushing and Terminals

All bushings must comply with AS/NZS 60137 [10] and the Operating Conditions stated in this technical specification. The bushings must be of high quality glazed porcelain, or cyclo aliphatic epoxy resin bushings and silicon bushing. Where porcelain components are supplied, they must be glazed and fully vitrified.

Notwithstanding the nominal system's Basic Insulation Level (BIL) at each distribution level (see Section 3.1.4), the minimum system design level for insulation creepage length is 31 mm/kV as specified in AS 4436 [8] for Very Heavy pollution areas. A dimensioned drawing of the bushing (and boot if applicable) must be supplied with the tender.

The palm of the lug must be suitable for connection using a M12 fastening.

All terminal palms must be arranged vertically and must comply with AS 62271.301 [18]. Both sides must be able to be used as contact surfaces.

Precautions must be taken to prevent the long-term erosion of the MV bushing gasket by leakage currents. This may be done so by providing a path for leakage currents by the application of conductive paint around the perimeter of the gasket, by a metal shorting strip between the bushing side of the gasket and the tank side of the gasket, or by another approved method.

4.2.4 Earthing

All metal components of the *Equipment* must be electrically bonded. The bonding method must have a current carrying capability equivalent to that of 50 mm^2, stranded, copper conductor.

The recloser tank must be fitted with an external M12 earth stud, complete with a nut, lock nut and serrated washer. It must include a clamping arrangement that can accommodate a 70 mm^2 earth copper conductor.

The control (umbilical) cable must be adequately earthed to shield the control equipment against electrical interference. The cabinet should be suitably shielded so that an externally mounted 4G / Omni / Yagi antenna will not interfere with the normal operation of the *Equipment*. Where minimum distance requirements for the mounting of an antenna apply, these should be stated.

4.2.5 Pole Mounting Frame

The tank must be supplied with a steel mounting frame suitable for mounting on a single pole:

1) steel:

   - 12-sided tapered (current standard)
   - round tapered
   - rectangular cross-section (pole constructed from two rails, universal column, or parallel flange channel)

2) timber

3) concrete

Suitable insulation must be provided for the mounting frame to eliminate rapid corrosion of steel pole in the contact areas.

The mounting brackets must have minimum two slotted mounting holes sufficient for M20 bolts in order to mount the recloser to the pole (see HPA-SD-E-00007-01). The spacing between the two bolts must be between 260 and 400 mm.

In addition, the Vendor must detail in its proposal whether appropriate clamping is available for the recloser to secure the unit to a pole without using bolts through the poles. Such clamping should suit poles of circular and rectangular cross-section.

The bracket and tank wall are to be of adequate strength to limit distortion, when mounted. Both the top and bottom bracket must be suitable to carry the total weight of the tank. Adequately rated lifting lugs must be provided and placed such that the recloser can be lifted in a safe manner, (i.e. as a balanced load) using a single hook without damage.

The minimum clearances to the structure must be as indicated on the drawing. HPA-SD-E-00007-01.

Vendors are encouraged to provide an additional or combined bracket option to accommodate mounting of a supply voltage transformer (VT).

All brackets must be suitable for the environmental conditions stated in Section 3.1.5 including adequate strength for the wind load in cyclonic areas.

4.2.6 Operating Mechanism

This *Equipment* must be suitable for three-phase tripping and reclosing. Tripping energy must be supplied from a spring mechanism automatically tensioned when the switch unit is closed.

The operating mechanism should be capable of performing of minimum 30,000 full load operations the sequence of opening and closing as specified in this specification.

Further, the operating mechanism must be capable of:

1) Closing the circuit breaker rapidly without any lag at all, for currents from zero, to rated making current capacity.
2) Holding the circuit breaker in closed position, by toggles or latches until the tripping signal is received.
3) Opening the circuit breaker without delay, immediately on receiving tripping signal. To give optimum contact level characteristics (time versus stroke).
4) Performing the auto reclosing cycle.
5) Performing the related functions such as, indication, control, alarm, and lock-out on low pressure.
6) Opening and closing the three phases of the *Equipment* simultaneously.

4.2.6.1 Operating Sequence

In the event of a fault on the section of the line controlled by an *Equipment*, the *Equipment* must automatically open, and after a minimum dead time, it must reclose and remain closed, should the line be no longer faulty. (Auto Reclose set to ON). Should the fault persist, the *Equipment* must again disconnect the section of line being controlled.

The *Equipment* must be capable of not less than three automatic reclose operations (at rated short circuit current) should the fault persist. It must then lock-out in the open position, until reset by hand or remote control. If the fault is of a transient nature, the *Equipment* must remain closed, and the operating mechanism must automatically reset.

The rated operating sequence must be the following in accordance with IEC 62271.111 [22]: O – 0.5 s – CO – 2 s –CO – 5 s – CO.

The number of operations to lock-out must be adjustable in any combination of instantaneous and time-delayed trips, up to a maximum of four, with a minimum dead time of 0.5 seconds for the first operation.

4.2.6.2 Manual Operation and Operation Counter

The *Equipment* must make provision for independent manual operation using a manual operating lever. It must be possible to operate the lever from ground level using a standard hot line stick as described in IEC 62271.111 [22]. Clear indication must be provided to an operator standing on the ground as to the status of the recloser main contacts. This must be by an indicator mechanically linked to the switching mechanism and must be clearly visible to the personnel standing on the ground.

The colours must remain vivid for the *Equipment*'s working life. Painted symbols are unacceptable. The automatic re-closing must be locked out after the manual tripping.

An operation counter must be provided. It must be readable locally and at remote end with the re-closer in operation. The operating counter must be well protected against moisture ingress. The number of operations must also be readable through the control unit.

4.2.7 Recloser Control Unit

4.2.7.1 Cabinet Design and Construction

The control cabinet must be manufactured from 316-grade stainless steel. The construction must be vandal proof such that it must not be easy to force the door open when it is locked and padlocked.

Cabinets must be protected from dust and water ingress to achieve an IP rating of IP 54 or better as per AS 60529 [11]. Cabinets must be designed and internally treated to prevent moisture condensation. The cabinet must be fitted with an external M12 earthing stud with a nut, lock-nut and a serrated washer for earthing purposes.

All metal components of the control cabinet must be electrically bonded.

4.2.7.2 Cabinet Door

The cabinet must have a hinged door. The door must be fitted with a robust fastening arrangement which can be locked with a padlock that has a shackle of 9 mm diameter (Lockwood 334 series). Means must be provided to either secure the door in a fully open position (90˚ or more), or to easily remove (without the use of tools) the door completely during maintenance or similar activities.

Good electrical contact must be maintained between the door and the rest of the cabinet at all times (excluding the condition when the door is completely removed).

A document pocket must be provided on the inside of the door for the storage of documentation.

4.2.7.3 Internal Construction

The Vendor must ensure that the equipment housed in the control cabinet can withstand the internal heating effect at the higher temperature ranges given in Section 3.1.5. The Vendor must supply documentation in support of this.

Provision must be made for:

1) a facility to terminate a 240 V AC mains auxiliary power supply (normal operation of the control for the device and the communications media).
2) two surge arrestors (auxiliary power supply and antenna)
3) (in the top of the cabinet) an equipment compartment whereby Horizon Power can mount remote control communication equipment in accordance with the SCADA requirements (Analogue, Digital or CDMA for Next-G). Provision must be included for power supply to the communication equipment. Refer to Appendix G.

4.2.7.4 Mounting Bracket

The cabinet must be supplied with a mounting bracket made of stainless steel, or as a minimum, hot-dip galvanised steel in accordance with AS/NZS 4680 [9].

The mounting bracket must be suitable to be installed on Horizon Power's standard steel poles and existing A frame steel poles. The holes must be designed such that it will be possible to slide the cabinet into position without having to remove the pole mounting bolts.

The mounting bracket must have at least two sets of vertically spaced slots in addition to mounting bolt slots for mounting by means of straps.

The control cabinet must be mounted below the switchgear tank and must be easily removable for maintenance purposes.

4.2.7.5 Cable Entry

The cabinet must make provision for bottom entry of the control cables and at least three additional cables (one being the external antenna cable). The cabinet must be pre-punched with at least one 21 mm diameter hole and one 32 mm diameter hole. The holes must be suitably blanked off.

4.2.7.6 Control Cable

An ultraviolet resistant cable as per AS/NZS 1125 [3], of minimum length 7 m, must be provided to connect the recloser tank to the recloser control. It must be adequately screened against electrostatic and electromagnetic interference, which can cause malfunctioning of the protection or control equipment. This cable must connect into both the recloser tank and the control cabinet by means of plug and socket arrangements. Robust, multi-pin, weatherproof connectors must be provided on both ends of the control cable.

It must be possible to disconnect the control cable at the recloser control while the recloser tank is energised, without causing damage or mal-operation. Care must be taken to ensure that CTs are not open circuited.

4.2.7.7 Power Supplies

The main power supply to the control unit must be from an external power source (auxiliary supply), and in addition to this, there must also be a backup battery.

The capacity of the power supply must be rated to power all the electronic modules, operate the *Equipment* (tripping and closing), and power the data communication equipment.

Details of the recloser control's power consumption must be provided in the tender documentation. The maximum current drain (considering the inputs to be in a "worst case" configuration regarding power consumption) and any inrush current parameters must be stated.

Details of the power requirements for a close operation must be provided in the tender documentation.

4.2.7.7.1 Main Power Supply Requirements

The output voltage of the external power source must be 240 V AC at a frequency of 50 Hz and meet the requirements of Class II equipment in accordance with AS 3100 [7].

The device must provide a visual indication, on the control panel and in the event log, of the status of the mains supply. A supply fail function must be provided; it must operate an alarm output for the user.

The control unit must be able to withstand loss or restoration of the supply voltage and under voltage conditions.

4.2.7.7.2 Voltage/Current Excursions

The power supply must include the necessary over-current protection to protect the supply from current excursions.

The use of fuses for over-current protection on the auxiliary input circuit(s) is not acceptable.

Information on the methods used to protect against transient over-current conditions must be provided in the tender documentation.

The power supply must include the necessary surge arresters and/or voltage limiting devices to inhibit damage due to voltage surges. The surge arrestor must be rated to withstand voltage spikes across it due to a short circuit on the Low Voltage (LV) supply. Surge arrestors must have a designed visual indication of failure.

4.2.7.7.3 Battery Backup Supply

A 12 V DC backup power supply suitable for a minimum period of 48 hours must be provided, in order that the recloser must operate from the battery supply during failure of auxiliary supply for high reliability (this includes communications).

The battery must be rated to operate and provide backup supply for the specified period under the temperature conditions in Section 3.1.5. The chargeable battery must have a life span of not less than five years at 25°C.

The recloser must be prevented from closing if the battery and capacitor system does not have enough stored energy to open the circuit-breaker for a protection trip condition. Details must be stated in the tender documentation.

The auxiliary supply shall be able to provide a 12 V DC supply capable of providing continuous 3 A to the Horizon Power supplied communications/radio equipment through suitable spring loaded terminals.

4.2.7.8 Technical Features

The control unit must include the following technical features:

1) Self-diagnostic features
2) LCD with high degree of resolution and legibility, valid for life span of *Equipment* & password protected keypad for programming purpose
3) Event log and load profile logging facilities
4) Processing of feedback from voltage and current sensors from the system. Sensing VTs or any suitable aid for loop automation
5) RS232/ USB ports for remote communication supporting Modbus and DNP3 protocols.
6) Downloading facility locally and at remote end. Preferably USB ports must be provided to download the information locally. RS232 ports may be provided instead of USB ports however this needs to be specified in the submission.
7) Suitable to accommodate additional programmable I/O modules - Non-volatile memory with enough capacity capable to record at least 150 events including distinction between local and supervisory functions and reporting of system events and display 30 different events with date and time.
8) Access to configuration level functions of the *Equipment* shall be protected by a user selectable password. All Equipment shall be supplied with the same default password.
9) The *Equipment* shall incorporate continuous diagnostics monitoring with hardware/software watchdog functions.

4.2.8 Protection & Control Functions

The following protective features must be built into the *Equipment* control unit. All protection functions must have full directional capabilities.

The ratio of drop-off current to pick up current must be at least 95% for all protection functions. ($I_{drop\text{-}off}$ / $I_{pick\text{-}up}$).

4.2.8.1 Overcurrent Protection (IEC and IEEE IDMT, definite time and user defined curves)

The protection system must provide:

1) Overcurrent protection on all three phases of the circuit supplied by the recloser. Each of up to four shots in a reclose sequence must have an independent curve time (modifier), curve modifier settings and a common Overcurrent (O/C) setting.
2) The overcurrent trip pick-up setting range must be selectable between 10 and 1260 A, in steps no greater than 1 A.

3) Delayed protection operation must be possible by selecting an IDMT protection element with Normal inverse (NI), Very Inverse (VI) or Extremely Inverse (EI) curve, or a definite time protection element with time delay from 0.05 to 10 seconds, in accordance with IEC 60255 [19], IEC 62271.111 [22] and IEEE C37.112 [23]. Traditional recloser curves must also be included in the operation.

4.2.8.2 Earth Fault Protection (IEC and IEEE IDMT, definite time and user defined curves)

The protection system must provide:

1) Earth fault protection on all three phases of the circuit supplied by the recloser. Each of up to four shots in a reclose sequence must have an independent curve, time (modifier) and curve modifier settings and a common Earth Fault (E/F) setting.
2) The earth fault trip pick-up setting range must be selectable between 10 and 1260 A, in steps no greater than 1 A.
3) Delayed protection operation must be possible by selecting an IDMT protection element with Normal inverse (NI), Very Inverse (VI) or Extremely Inverse (EI) curve, or a definite time protection element with time delay from 0.05 to 10 seconds, in accordance with IEC 60255 [19], IEC 62271.111 [22] and IEEE C37.112 [24]. Traditional recloser curves must also be included in the operation.

4.2.8.3 Instantaneous Overcurrent and Earth Fault Protection

High set Instantaneous element must be provided for over current and earth fault protection with the following settings available:

1) It must be possible to enable or disable the element. When enabled it must be active simultaneously as an overlay with all selected elements.
2) Trip setting which can be set in multiples from 1 to 30 times (in steps of 0.1) the normal pick-up level setting.
3) A definite time delay to be able to be applied to the High set, setting values from instantaneous to 2 seconds, in steps no greater than 0.05 seconds.

4.2.8.4 Sensitive Earth Fault Protection

The protection system must provide sensitive earth fault protection on the circuit supplied by the recloser. The sensitive earth fault setting must be applicable to all shots in the sequence; alternatively four settings must be available to specify the Sensitive Earth Fault (SEF) setting at each shot.

1) The trip pick up value must be programmable between 1 and 20 A, in steps no greater than 1 A.
2) The Sensitive Earth Fault (SEF) must have definite time operation with the time to trip adjustable between 1 and 30 seconds, in steps no greater than 0.1 second.

4.2.8.5 Negative Sequence Overcurrent Protection

The Negative Phase Sequence (NPS) function must:

1) Be user selectable to operate the following outputs:
   a) alarm output only,
   b) trip output only,
   c) both the alarm and the trip outputs.
2) The primary pick-up setting range must be selectable from 1 to 20 A, in step sizes no greater than 0.5 A.
3) The time delay must be a definite time, selectable from instantaneous to 10 s, in steps no greater than 1 s. At present the standard trip time setting for recloser is 2 seconds to allow for adequate grading between upstream and downstream protection devices.
4) The NPS function must be blocked if Overcurrent (O/C), Earth Fault (E/F) or Sensitive Earth Fault (SEF) function's starter picks up.
5) The NPS reset time must be instantaneous.

4.2.8.6 Undervoltage and Overvoltage Protection

The protection feature must be programmed so that it does NOT trip the breaker automatically.

1) The protection function must be user selectable to operate the following outputs:
   a) alarm output only,
   b) trip output only,
   c) both the alarm and the trip outputs,
   d) breaker close blocking when measured voltage is outside the under- and over-voltage settings,
2) The protection system must provide for under voltage protection with auto reclose with following features:
   a) Trip setting from 0.5 to 0.8 per unit voltage, in steps of 0.01 per unit.
   b) Definite time delay 0 to 60.0 seconds, in steps of 0.1 second
   c) Reset 1.0 to 10 seconds, in steps of 0.5 seconds
   d) Selection of any one phase Under Voltage, or any two phases Under Voltage to trip
3) The protection system must provide for over voltage protection with auto reclose with following features:
   a) Trip setting from 1.1 to 1.5 per unit voltage, in steps of 0.01 per unit
   b) Definite time delay 0 to 60.0 seconds, in steps of 0.1 second
   c) 1 sec to 10 seconds, in steps of 0.1 seconds
   d) Selection of any one phase Over Voltage, or any two phases Over Voltage to trip
   e) Reclose single shot delayed after voltage comes into normal range (normal reclaim time to apply)

f) Reclose time 1 to 300 seconds after voltage comes into normal range (normal reclaim time to apply)

4.2.8.7 Under-frequency and Over-frequency Protection

Preference will be given to relays with the following frequency protection functionality. Over frequency protection feature is not compulsory, however inclusion is preferred.

The frequency protection function must have an over -and an under-frequency setting and a DTL timer.

1) As the power system frequency drops below the set under-frequency level the DTL timer must start and initiate a trip and lock-out on timing out. Similarly, as the frequency exceeds the set over-frequency level, a trip and lock-out must be initiated.
2) A user selectable blocking function should be provided that will prevent the breaker from closing when the measured frequency is outside the under- and over-frequency settings.
3) A user selectable auto-reclosing function should be provided that will allow auto-reclosing of the breaker after the frequency has returned to normal, after an under- or over-frequency trip. In addition, a user configurable timer should be provided, for setting an auto-reclose time delay on return of normal frequency. The time delay must be provided with a range of 0 to 300 s in steps of 30 s.

4.2.8.8 Auto-reclose Operation Parameters

The number of sequential trips to reach lockout must be selectable to the following options (1, 2, 3 or 4).

1) The Auto Reclose feature must have the option to Enable/Disable it for the individual protection functions (Overcurrent (O/C)/ Earth Fault (E/F)/ Sensitive Earth Fault (SEF) etc.).
2) The reset time must be selectable from 5 to 180 s in 1 s steps.
3) Dead times must be separately selectable for Sensitive Earth Fault (SEF) and the combination of overcurrent and earth fault functions. The dead time between each successive reclosure must be independently selectable from 0.5 to 5 s (in steps no greater than 0.5 s) for the first reclosure, and from 2 to 1800 s (in steps no greater than 1 s) for subsequent reclosures.
4) A close instruction initiated locally or remotely during a dead time must result in lock-out, if the fault is still present upon closure.

4.2.8.9 Cold Load Pick-up (CLP)

The recloser must incorporate a 'cold load' pick-up feature to increase the probability of a successful close operation, following a period of supply interruption to the feeder being supplied by the recloser. The CLP feature must modify the Overcurrent (O/C) curves. It must not modify the Earth Fault (E/F) or Sensitive Earth Fault (SEF) curves.

1) The CLP feature must be able to be programmed IN or OUT of service.

2) When Programmed IN service, this feature must automatically apply to all supervisory initiated close operations and by operator selection, be available for local manually initiated close operations.

4.2.9 Control Functions

The following control features must be provided:

1) Trip/Close
2) Local/Remote control
3) Auto reclose –ON/OFF
4) User configurable no. of reclose cycles before locking out
5) Settable dead time

4.2.10 Measurement Functions

The measurement functions to be covered must be as described below. For three-phase reclosers, all measurements must be carried out using the 3-phase 4-wire method.

1) Instantaneous rms current in each phase and earth
2) RMS voltage P-P and P-N for each phase
3) Active Power (kW)
4) Reactive Power (kVAr)
5) Active Energy (kWh)
6) Reactive Energy (kVArh)
7) Maximum demand for the items indicated above. It must be capable of being reset from the operator keyboard
8) Power factor
9) Frequency

In addition, the control unit must have the facility to record the number and time of outages. The information must be accessible locally or remotely. The following parameters must be recorded:

1) Number of operations
2) Cumulative number of outages
3) Cumulative duration of outages
4) Time and duration of each outage

4.2.11 Software

The software provided for the *Equipment* must become the property of Horizon Power and there must be no restrictions on the number of PCs it is installed on. The software must be capable of running on the Microsoft Windows 365 operating system and be backward compatible with Microsoft Windows 10 operating system.

Where required, Horizon Power will take all reasonable precautions to ensure the software must not be passed onto third parties. The tender price for the *Equipment* units must include all software necessary for the proper functioning of the *Equipment* as described in this specification. Any software upgrades carried out during the course of the contract must be supplied to the purchaser free of charge.

4.2.12 Nameplates

A nameplate must be provided for each item of *Equipment*, labelled in accordance with IEC 62271.111 [22] and as described in AS 62271.1 [15]. It must be fitted such that it is clear of live parts in a position that is clearly visible. Bushing terminals must be clearly marked on the source and load side. The true rating of each of the component parts must be marked by etching or stamping on the plate. The serial number must also be etched or stamped on this plate. The rating plate must be made of stainless steel and must be permanently fitted by means of rivets or firmly bolted down using stainless steel bolts. Stick-on, glued-on or painted-on nameplate labels are NOT acceptable.

4.2.13 Auxiliary Voltage Transformers

Vendors are encouraged to offer a MV auxiliary VT supply option for the recloser, to provide low voltage (LV) supply where none is available.

The auxiliary VT shall be designed, manufactured and tested in accordance with AS 61689.1 [12] & AS 61689.3 [14]. The mounting of the VT to be mounted on the *Equipment* mounting bracket or tank.

Table 2: Voltage transformer requirements

System description	Primary voltage (kV)	Number of MV bushings
To suit 12.7 kV SWEWR	12.7	One
To suit 22 kV	22.0	Two
To suit 19 kV SWEWR	19.1	One
To suit 33 kV	33.0	Two

Bushings of the VT must comply with Section 4.2.3.

A name plate shall be provided on the auxiliary VT incorporating details in accordance with Clause 11.1 of AS 61869.3 [14]. These details shall be clearly visible and preferably marked on the housing. The marking shall be permanent, weatherproof and corrosion proof.

The following minimum information shall be provided:

- Manufacturer's name
- Serial number and date of manufacture
- Rated impulse withstand level

- Primary and secondary voltages
- Rated current

The primary winding of the VT shall be connected to two phases of the 3 phase 3 wire system. Connection between one phase and earth is unacceptable. The secondary output voltage of the VT shall be 240 V.

A 2 A circuit breaker shall be provided in the secondary terminal box of the VT to facilitate the isolation of the secondary wiring in the event of a fault.

4.2.14 Printed Circuit Boards

Where surface-mount components are used on printed circuit boards, the boards must also have conformal coating.

5 STORAGE

Components must be capable of being stored without deterioration within the temperature range of -10°C to +45°C for at least 24 months.

6 RELIABILITY

Vendors must comment on the reliability of the *Equipment* and the performance of the materials offered over an **operational life of 30 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 information on Failure Mode and Effect Analysis, carried out in accordance with IEC 60812 [21]. 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.

6.1 Life Cycle Model

The Vendor must provide a life cycle model of the *Equipment* offered to illustrate inspection schedules and maintenance required during the operational life of the *Equipment*. Maintenance intervals must be in line with the minimum number of switching operations for the individual units given in Appendix C. The Vendor must also specify of any additional maintenance/ inspection cycles required due to continuous operation in high temperatures as described in Section 3.1.5.

7 SAFETY

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

7.1 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. Vendors shall 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.

7.2 End of Life Management

The successful Vendor must, if selecting to offer *Equipment* with SF_6 as an insulation medium as per Section 4.2.1.4, undertake to reclaim and recycle the SF_6 gas remaining in the switchgear and dispose of toxic by-products within the SF_6 chamber along with the other parts of the *Equipment* in an environmentally responsible manner at the end of the service life of the *Equipment*.

The Vendor must submit a proposal for end-of-life management with the tender Proposal. The proposal must include all costs associated with carrying out the tasks above. The Vendor must be required to compensate Horizon Power the scrap value of the disposed switchgear (and all recovered SF_6 gas) at rates to be agreed by both parties.

8 TESTS

8.1 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.

NOTE: A condition of acceptance on imported products shall be completed to perform landing routine and sample tests completed in Australia on each batch imported. In these cases, each batch must obtain a passed landing test in order that the batch acceptance will be reflected on an acceptance list.

8.2 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.

8.3 Type Tests

The Vendor should also submit evidence of any cyclic loading tests performed on the *Equipment* offered.

The *Equipment* must have been type tested in accordance with, and found to comply with, the requirements of IEC 62271.111 [22] (IEEE C37.60 [23]).

All protection curves must have been type tested in accordance with, and found to comply with, the requirements of the following relevant specifications: IEC 60255 [19] and IEC 62271.111 [22].

The circuit breaker must be type tested in accordance with the requirements of AS 62271.100 [16].

All current transformers must be type tested as prescribed in AS 61869.1 [12] & AS 61869.2 [13], and all voltage transformers must be type tested as prescribed in AS 61689.1 [12] & AS 61689.3 [14].

8.4 Routine Tests

8.4.1 General

The following routine tests, in accordance with IEC 62271.111 [22] (IEEE C37.60 [23]), must be carried out as a normal requirement of the contract on each *Equipment*.

1) Calibration
2) Control, secondary wiring and accessory device test
3) Dielectric withstand test; 1-min. dry power-frequency
4) Partial discharge test
5) No load mechanical operation test
6) Gas leak test

8.4.2 Circuit Breaker

The vendor must carry out the routine tests required on the circuit breaker by AS 62271.100 [16].

8.4.3 Current and Voltage Transformers

All current transformers must be routine tested as prescribed in AS 61869.1 [12] & AS 61869.2 [13], and all voltage transformers must be routine tested as prescribed in AS 1689.1 [12] & AS 61689.3 [14].

8.4.4 Insulation Tests

1) Bushing insulation must be routine tested as prescribed in AS/NZS 60137 [10].

2) All insulation composed of synthetic material must be subject to tests for the measurement of partial discharge, in accordance with the provision of IEC 60270 [20]. Such tests must demonstrate that the insulation is free of discharges of magnitude greater than 20 C, when subject to a test voltage of 23 kV rms. Reports of these tests must be supplied with test reports of other routine tests. If the required level of discharge magnitude cannot be achieved, the levels that can be guaranteed must be stated in the submission.

Horizon Power reserves the right to witness any test. The Vendor must provide at least seven days' notice of when each and every test is to be carried out.

One certified copy of all test results must be supplied to Horizon Power immediately after the completion of the tests.

9 DOCUMENTATION

NOTE: All documentation must be in English.

9.1 Installation, Operation and Maintenance Manual

Manuals shall be supplied that enable the erection and maintenance of the *Equipment* to be performed in a safe and efficient manner and shall be prepared specifically for the Equipment delivered.

One manual for *Equipment* shall be submitted both in electronic (pdf).

A draft manual shall be submitted after the contract award for review by Horizon Power for approval.

The Vendor's standard or generic manual that does not completely describe all functions of the *Equipment* (as per Horizon Power requirements) supplied shall not be accepted.

The manuals shall include the following:

A concise description of each type of *Equipment*, together with a complete *Equipment* performance Specification. The function and operation of each part and circuit and any tool or accessory supplied.

Detailed installation procedures/instructions. Instructions on how to adjust any of the parts are to be included.

Complete set of drawings applicable to the *Equipment*.

Recommended comprehensive routine maintenance, parts replacement schedule and testing program.

The fault-finding procedure including a table listing fault indication, possible cause and remedy.

Recommended method of disposal at end-of-life cycle; and

Any special precautions to be taken in replacement or adjustment of any items including detailed MSDS (Materials Safety Data Sheet) documentation.

9.2 Electrical Drawings

The vendor must supply the following electrical drawings:

1) General Arrangement – ACR and control box with door open.
2) Mounting bracket
3) Single Line Diagram
4) Schematic Drawings
5) Protection Block Logic Diagram

9.3 Bill of Materials (BOM)

The bill of materials must provide the following information for each component (or subcomponent) that is replaceable or serviceable:

1) a short description;
2) the quantity;
3) a part number.

9.4 Type Test Certificates/Reports

1) Type test certificates and reports must be submitted with a tender.
2) The type test reports must include an installation instruction and bill of materials that form an integral part of the test report issued by the test authority.

10 MARKING/PACKING

The *Equipment* must be suitably packaged, such that it is “fit for use” at any location in Horizon Power’s operational area. Packaging must be capable of preventing damage whilst in storage and during transit to remote locations.

The *Equipment* must be supplied in suitable packaging which ensures that there is no deformation to any part of the *Equipment* during transportation. The *Equipment* must not be supplied on cardboard, non-waterproof fibreboard, or other footings that deform, soften or disintegrate on contact with water and high humidity preventing the use of fork-lift to handle the *Equipment*.

The Vendor is required to nominate standard pack quantities and standard packs must be clearly marked with the following information:

1) Manufacturer’s name
2) Manufacturer’s part reference number
3) Horizon Power Order Number
4) Horizon Power Stock Number
5) Gross weight in kg
6) Nett weight in kg
7) Date of manufacture
8) Manufacturer’s Serial Numbers of all packaged *Equipment* (to facilitate traceability)
9) Total mass (in kg) of SF_6 gas in all *Equipment*.

In addition the package must contain:

10) an installation instruction;
11) all necessary components and consumables required to complete the installation in accordance with the instruction i.e. accessory components, cleaning kit and earthing kit;
12) accessories required for programming the control unit (if not sent separately); and
13) Material Safety Data Sheets (MSDS).

11 SPARE EQUIPMENT

Separate prices are required with the offer for the following:

1) Any spares necessary for the continuous operation of each item of *Equipment*; and
2) Any special tools or handling equipment required for installation and/or maintenance must be stated in Appendix H of the enquiry document.

All spares must be labelled with manufacturer’s part number.

It is required that the validity period of the Proposal, as far as spares are concerned, be extended until such time as Horizon Power places an order for spares.

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# 2372709** 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
16/02/2015	0	First Issue
25/05/2023	1	First Revision: added specific fault levels for single-phase reclosers, removed requirements specific to Schneider / Nulec reclosers, and amended battery requirements.

APPENDIX B QUALITY ASSURANCE (TO BE COMPLETED BY STORES)

DOCUMENT NUMBER	HPC-8DJ-07-0003-2014			**QUALITY ASSURANCE**		**DM# NUMBER**	
DEVICE DESCRIPTION	**LABEL MATERIAL NO.**			**EQUIPMENT PURCHASE**		**ASSET OWNER**	
	ASSET ID/ STOCK NO						
MANUFACTURER			**DIMENSION**				

ITEM	OPERATION/EQUIPMENT/FACILITY	DOCUMENT REF.	WHO CHECKS	INITIAL	DATE/ TIME	QUALITY ASSURANCE CRITERIA	PASS Y/N	COMMENTS
1								
1.1	Name of Manufacturer					*******		
1.2	Week & Year of Manufacture					*******		
1.3	Horizon Power Order Number					*******		
1.4	Horizon Power Stock Number					*******		
1.5	Rating Plate Voltage					*******		
1.6	Physical Appearance							
1.6.1	Paint Colour/Galvanising 1. Recloser 2. Control Unit					*******		

1.6.2	Paint Chips 3. Recloser 4. Control Unit					*******		
1.6.3	Physical Damage					*******		
1.7	Packaging (if not already assembled)					Fit for transport to site		
2	DOCUMENTATION							
2.1	Material Safety Data Sheets					Clear, Legible and in English		
2.2	Recloser Documentation & Drawings					Clear, Legible and in English		
2.3	Test and Inspection Reports					Clear, Legible and in English		
2.3.1	Recloser					*******		
2.3.2	Circuit Breakers					*******		
2.3.3	Insulation Tests					*******		
2.4	Software and Accessories					All necessary cables for data transfer provided		

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 TECHNICAL REQUIREMENTS FOR RECLOSER

ITEM	REQUIREMENTS	UOM	RECLOSER OPERATING AT 11 kV NOMINAL SYSTEM VOLTAGE	RECLOSER OPERATING AT 22 kV NOMINAL SYSTEM VOLTAGE	RECLOSER OPERATING AT 33 kV NOMINAL SYSTEM VOLTAGE	CHECKLIST FOR VENDOR TO COMPLETE**
1.0 GENERAL						
	System highest voltage	kV (rms)	12	24	36	☐
	Nominal system Voltage	kV (rms)	11	22	33	☐
	Lightning impulse withstand voltage	kV (peak)	75	150	170	☐
	Power frequency withstand voltage (1-minute) (rms)	kV-min (rms)	28	50	70	☐
	Rated frequency	Hz	50	50	50	☐
	Internal arc withstand (1s) (rms)	kA/1 s	18.4	18.4	13.1	☐
	Rated current (rms)	A	630	630	630	☐
	Rated short-time withstand current (3 s) (rms)	kA/1 s	16	12.5	12.5	☐
	Rated making current		16	12.5	12.5	☐
2.0 OPERATION						
	Minimum number of interruptions at rated short circuit current (up to X/R = 5) without requiring maintenance or inspection		100	100	100	☐
	Minimum number of load break operations at rated current before maintenance required		3000	3000	3000	☐
	Required interrupting medium		Vacuum	Vacuum	Vacuum	☐

ITEM	REQUIREMENTS	UOM	RECLOSER OPERATING AT 11 kV NOMINAL SYSTEM VOLTAGE	RECLOSER OPERATING AT 22 kV NOMINAL SYSTEM VOLTAGE	RECLOSER OPERATING AT 33 kV NOMINAL SYSTEM VOLTAGE	CHECKLIST FOR VENDOR TO COMPLETE**
	Rated transformer magnetising breaking current	A	As per IEC 62271.111	As per IEC 62271.111	As per IEC 62271.111	☐
	Rated cable charging breaking current	A	As per IEC 62271.111	As per IEC 62271.111	As per IEC 62271.111	☐
	Rated operating sequence (total number of trips/counts to lock out)		4	4	4	☐
	Maximum break time	Sec	0.05	0.05	0.05	☐
	Mechanical life - minimum number of close/open operations - without inspection	A	3000	3000	3000	☐
	Nominal system voltage (for HV closing solenoid operation - if applicable)	kV	11	22	33	☐
	HV bushings creepage length	no.	341	682	1023	☐
	Minimum taut string metal to metal clearance in air					☐
	Phase to phase	mm				☐
	Phase to ground	mm				☐
	Phase to Structure	m				☐
3.0 PROTECTION REQUIREMENTS						
	Directional Control					
	Integrated Voltage source		Y	Y	Y	☐
	Direction control selectable		Y	Y	Y	☐

ITEM	REQUIREMENTS	UOM	RECLOSER OPERATING AT 11 kV NOMINAL SYSTEM VOLTAGE	RECLOSER OPERATING AT 22 kV NOMINAL SYSTEM VOLTAGE	RECLOSER OPERATING AT 33 kV NOMINAL SYSTEM VOLTAGE	CHECKLIST FOR VENDOR TO COMPLETE**
	Time delayed over-current and Earth Fault	-	-	-	-	-
	Phase Current setting range	A	10 to 1260	10 to 1260	10 to 1260	☐
	Earth Current setting range	A	10 to 1260	10 to 1260	10 to 1260	☐
	Current setting step size		1	1	1	☐
	Time multiplier range		0.05 to 2.0	0.05 to 2.0	0.05 to 2.0	☐
	Time multiplier step size		0.01	0.01	0.01	☐
	Minimum Operate time		0 to 2	0 to 2	0 to 2	☐
	Minimum Operate time – step size	s	0.01	0.01	0.01	☐
	Additional delay time	s	0 to 2	0 to 2	0 to 2	☐
	Additional delay time – step size		0.01	0.01	0.01	☐
	Time current characteristic	-	Selectable between a definite time, standard inverse curve (type A, IEC 60255-4) and a very inverse curve (type B, IEC 60255-4) and Extreme Inverse Curve	Selectable between a definite time, standard inverse curve (type A, IEC 60255-4) and a very inverse curve (type B, IEC 60255-4) and Extreme Inverse Curve	Selectable between a definite time, standard inverse curve (type A, IEC 60255-4) and a very inverse curve (type B, IEC 60255-4) and Extreme Inverse Curve	☐
	High set Instantaneous Overcurrent (O/C) and Earth Fault (E/F)		-	-	-	-
	Current setting range		1 to 30 times over current setting	1 to 30 times over current setting	1 to 30 times over current setting	☐

ITEM	REQUIREMENTS	UOM	RECLOSER OPERATING AT 11 kV NOMINAL SYSTEM VOLTAGE	RECLOSER OPERATING AT 22 kV NOMINAL SYSTEM VOLTAGE	RECLOSER OPERATING AT 33 kV NOMINAL SYSTEM VOLTAGE	CHECKLIST FOR VENDOR TO COMPLETE**
	Current setting step size		0.1 times over current setting	0.1 times over current setting	0.1 times over current setting	☐
	Time delay range	s	0 s (i.e. min. op time) to 2	0 s (i.e. min. op time) to 2	0 s (i.e. min. op time) to 2	☐
	Time delay step size	s	0.05	0.05	0.05	☐
	Sensitive earth fault					
	Current setting range	A	1 to 20	1 to 20	1 to 20	☐
	Current setting step size		1	1	1	☐
	Time Delay range	s	1.0 to 30	1.0 to 30	1.0 to 30	☐
	Time delay step size	s	0.1	0.1	0.1	☐
	Negative Phase Sequence Over current					
	User Selectable operation (Alarm/Trip/Both)		Y/N	Y/N	Y/N	☐
	Current setting range	A	1 to 20	1 to 20	1 to 20	☐
	Current setting step size		0.5	0.5	0.5	☐
	Time delay range	s	0 s (i.e. min. op time) to 10	0 s (i.e. min. op time) to 10	0 s (i.e. min. op time) to 10	☐
	Time delay step size	s	1	1	1	☐
	Under Voltage					
	User Selectable operation (Alarm/Trip/Both)		Y/N	Y/N	Y/N	☐

ITEM	REQUIREMENTS	UOM	RECLOSER OPERATING AT 11 kV NOMINAL SYSTEM VOLTAGE	RECLOSER OPERATING AT 22 kV NOMINAL SYSTEM VOLTAGE	RECLOSER OPERATING AT 33 kV NOMINAL SYSTEM VOLTAGE	CHECKLIST FOR VENDOR TO COMPLETE**
	Under voltage Trip		0.5 to 0.8	0.5 to 0.8	0.5 to 0.8	☐
	Under voltage Trip Time		0 to 60	0 to 60	0 to 60	☐
	Under voltage reset		0.8 to 1.0	0.8 to 1.0	0.8 to 1.0	☐
	Time delay step size	s	0.1	0.1	0.1	☐
	Over Voltage					
	Over voltage Trip		1.1 to 1.5	1.1 to 1.5	1.1 to 1.5	☐
	Over voltage Trip time		0 to 60	0 to 60	0 to 60	☐
	Over voltage reset		1.0 to 1.2	1.0 to 1.2	1.0 to 1.2	☐
	Time delay step size	s	0.1	0.1	0.1	☐
	Circuit Breaker Fail		Y	Y	Y	☐
	Over/Under Frequency					
	Time delay range	s	0 to 300	0 to 300	0 to 300	☐
	Time delay step size	s	30	30	30	☐
	Reclose Time					
	Each reclose time independent		Y	Y	Y	☐
	Reclose time		0.5 to 180	0.5 to 180	0.5 to 180	☐
	Reclose reset time		5 to 180	5 to 180	5 to 180	☐

ITEM	REQUIREMENTS	UOM	RECLOSER OPERATING AT 11 kV NOMINAL SYSTEM VOLTAGE	RECLOSER OPERATING AT 22 kV NOMINAL SYSTEM VOLTAGE	RECLOSER OPERATING AT 33 kV NOMINAL SYSTEM VOLTAGE	CHECKLIST FOR VENDOR TO COMPLETE**
	Number of trips to lockout		Up to 4	Up to 4	Up to 4	☐
	Reclose Blocking Manual & Supervisory		Y	Y	Y	☐
	Cold Load Pickup (CLP)		Y	Y	Y	☐
	CLP Controllable local & Remote		Y	Y	Y	☐
	CLP Modify Curve		Y	Y	Y	☐
	CLP Modify Pickup value		Y	Y	Y	☐
	CLP Detects Loss of Supply		Y	Y	Y	☐
	Manual Trip no Reclose		Y	Y	Y	☐
	Multiple Setting Groups		Y	Y	Y	☐
	Fully Independent		Y	Y	Y	☐
	Setting Group Change Controllable local & Remote		Y	Y	Y	☐
	Measurements					
	Instantaneous RMS current in each phase		Y	Y	Y	☐
	Phase voltages		Y	Y	Y	☐
	Watts and VArs		Y	Y	Y	☐
	Active and Reactive Energy		Y	Y	Y	☐

ITEM	REQUIREMENTS	UOM	RECLOSER OPERATING AT 11 kV NOMINAL SYSTEM VOLTAGE	RECLOSER OPERATING AT 22 kV NOMINAL SYSTEM VOLTAGE	RECLOSER OPERATING AT 33 kV NOMINAL SYSTEM VOLTAGE	CHECKLIST FOR VENDOR TO COMPLETE**
	Maximum demand measurements		Y	Y	Y	☐
	Event Recorder		Y	Y	Y	☐
	Store at least the last 50 events		Y	Y	Y	☐
	Overcurrent (O/C) and Earth Fault (E/F) independent separate trip sequences		Y	Y	Y	☐
	External Protection Trip Initiate					☐
4.0 CONTROL UNIT						
	Degree of protection of control unit in accordance with AS 60529.		IP 54	IP 54	IP 54	☐
	Battery type					☐
	Battery voltage	V	12	12	12	☐
	Auxiliary supply voltage	V	110 V and 240 V (DC & AC)	110 V and 240 V (DC & AC)	110 V and 240 V (DC & AC)	☐
	Warranty period					☐
	Software					
	No restrictions to PC numbers		Y	Y	Y	☐
	Set, Upload, Control & Analyse		Y	Y	Y	☐
	Fully function Local and Remote		Y	Y	Y	☐

ITEM	REQUIREMENTS	UOM	RECLOSER OPERATING AT 11 kV NOMINAL SYSTEM VOLTAGE	RECLOSER OPERATING AT 22 kV NOMINAL SYSTEM VOLTAGE	RECLOSER OPERATING AT 33 kV NOMINAL SYSTEM VOLTAGE	CHECKLIST FOR VENDOR TO COMPLETE**
	Microsoft Windows10 and 365 capable					☐

APPENDIX D COMPLIANCE DOCUMENT

The Vendor must indicate below whether this offer is fully compliant with the nominated clause in this Specification. A YES must 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 must be provided in Appendix F.

CLAUSE NUMBER		YES	NO	ATT.
3	REQUIREMENTS			
3.1	Power System Particulars			
3.1.1	Rated Voltages	☐	☐	☐
3.1.2	Fault Rating			
3.1.3	Nominal System Frequency	☐	☐	☐
3.1.4	System Insulation Levels	☐	☐	☐
3.1.5	Environmental Conditions	☐	☐	☐
3.1.6	Clearances & Insulation	☐	☐	☐
4	POLE MOUNTED RECLOSER			
4.1	General Requirements	☐	☐	☐
4.2	Design and Construction			
4.2.1	Tank Design	☐	☐	☐
4.2.1.1	Internal Breaker	☐	☐	☐
4.2.1.2	Internal Arc Classification	☐	☐	☐
4.2.1.3	Interrupting Medium	☐	☐	☐
4.2.1.4	Insulation Medium	☐	☐	☐
4.2.1.5	Tank Pressure Relief	☐	☐	☐
4.2.2	Surge Arrestor Bracket	☐	☐	☐
4.2.3	Bushing and Terminals	☐	☐	☐
4.2.4	Earthing	☐	☐	☐

CLAUSE NUMBER	YES	NO	ATT.
4.2.5 Pole Mounting Frame	☐	☐	☐
4.2.6 Operating Mechanism	☐	☐	☐
4.2.6.1 Operating Sequence	☐	☐	☐
4.2.6.2 Manual Operation and Operation counter	☐	☐	☐
4.2.7 Recloser Control Unit			
4.2.7.1 Cabinet Design and Construction	☐	☐	☐
4.2.7.2 Cabinet Door	☐	☐	☐
4.2.7.3 Internal Construction	☐	☐	☐
4.2.7.4 Mounting Bracket	☐	☐	☐
4.2.7.5 Cable Entry	☐	☐	☐
4.2.7.6 Control Cable	☐	☐	☐
4.2.7.7 Power Supplies	☐	☐	☐
4.2.7.7.1 Main Power Supply Requirements	☐	☐	☐
4.2.7.7.2 Voltage/Current Excursions	☐	☐	☐
4.2.7.7.3 Battery Backup Supply	☐	☐	☐
4.2.7.8 Technical Features	☐	☐	☐
4.2.8 Protection & Control Functions	☐	☐	☐
4.2.8.1 Overcurrent Protection	☐	☐	☐
4.2.8.2 Earth Fault Protection	☐	☐	☐
4.2.8.3 Instantaneous Overcurrent and Earth Fault Protection	☐	☐	☐
4.2.8.4 Sensitive Earth Fault Protection	☐	☐	☐
4.2.8.5 Negative Sequence Overcurrent Protection	☐	☐	☐
4.2.8.6 Undervoltage and Overvoltage Protection	☐	☐	☐
4.2.8.7 Under-frequency and Over-frequency Protection	☐	☐	☐

CLAUSE NUMBER	YES	NO	ATT.
4.2.8.8 Auto-reclose Operation Parameters	☐	☐	☐
4.2.8.9 Cold Load Pick-up (CLP)	☐	☐	☐
4.2.9 Control Functions	☐	☐	☐
4.2.10 Measurement Functions	☐	☐	☐
4.2.11 Software	☐	☐	☐
4.2.12 Nameplates	☐	☐	☐
4.2.13 Auxiliary Voltage Transformers	☐	☐	☐
4.2.14 Printed Circuit Boards	☐	☐	☐
5 STORAGE	☐	☐	☐
6 RELIABILITY	☐	☐	☐
6.1 Life Cycle Model	☐	☐	☐
7 SAFETY	☐	☐	☐
7.1 Environmental Considerations	☐	☐	☐
7.2 End of Life Management	☐	☐	☐
8 TESTS			
8.1 Test Requirements	☐	☐	☐
8.2 Test Certificates	☐	☐	☐
8.3 Type Tests	☐	☐	☐
8.4 Routine Tests			
8.4.1 General	☐	☐	☐
8.4.2 Circuit Breaker	☐	☐	☐

CLAUSE NUMBER		YES	NO	ATT.
8.4.3	Current and Voltage Transformers	☐	☐	☐
8.4.4	Insulation Tests	☐	☐	☐
9	DOCUMENTATION	☐	☐	☐
9.1	Installation, Operation and Maintenance Manuals	☐	☐	☐
9.2	Electrical Drawings	☐	☐	☐
9.3	Bill of Materials (BOM)	☐	☐	☐
9.4	Type Test Certificates/Reports	☐	☐	☐
10	MARKING/PACKING	☐	☐	☐
11	SPARE EQUIPMENT	☐	☐	☐

Specification No.: _____ Vendor's Signature: _____

Vendor's Company Name: _____ Date: _____

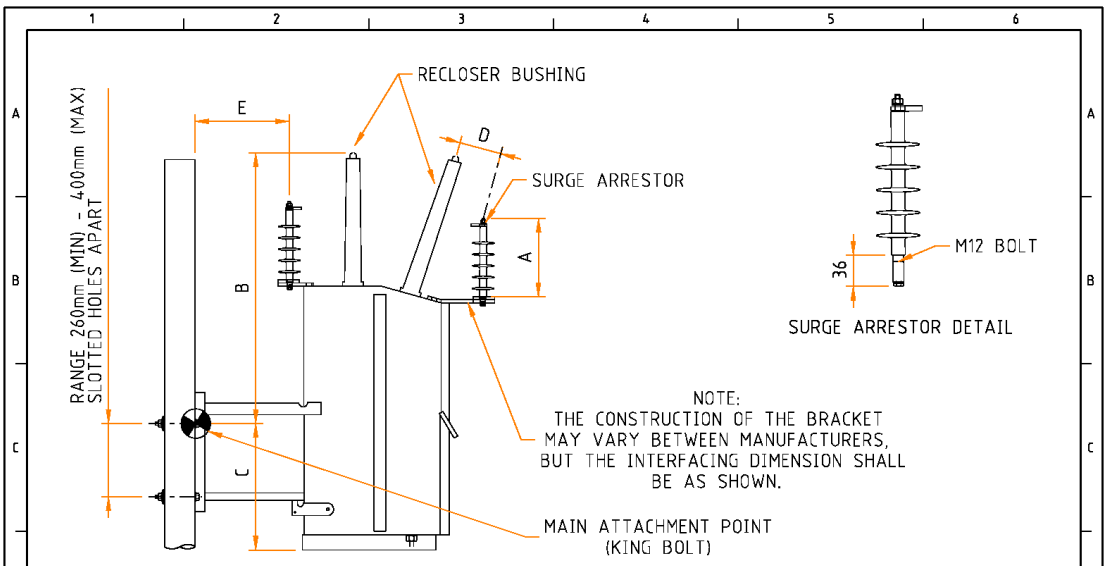
APPENDIX E DEPARTURES FROM TECHNICAL SPECIFICATION

The Vendor must nominate the Clause and describe the departure:

CLAUSE NO	DEPARTURE

APPENDIX F DRAWINGS

Drawing HPA-SD-E-00007-01



	11kV	22kV	33kV
A	200mm	300mm	400mm
B (MAX)	930mm	930mm	930mm
C (MAX)	450mm	450mm	450mm
D (MAX)	200mm	200mm	200mm
E (MIN)	310mm	310mm	390mm

NOTE:
1. D - SHORTEST DISTANCE BETWEEN SA LINE TERMINAL AND RECLOSER BUSHING.
2. E - SHORTEST DISTANCE BETWEEN HV LINE TERMINAL AND ANY EARTHED METAL OR STRUCTURE.
3. PARAMETERS A AND INTERFACE DIMESNIONS ARE VALUES SPECIFIED BY SURGE ARRESTOR MANUFACTURER (AS PER CURRENT HORIZON POWER SPECIFICATION).
4. B + C MAXIMUM HEIGHT ALLOWED FOR CLEARANCE PURPOSES.

HORIZON POWER ITEM	:		
MATERIAL SPECIFICATION	: IEC_62271-111 (IEC_C37.60)		
CORROSION SPECIFICATION	: AS/NZS_2312		
STANDARD SPECIFICATION	: AS/NZS_60265.1 AS_62271		
HORIZON POWER SPECIFICATION	: HPC-8DJ-07-0003-2014		
TEST & CERTIFICATION REQUIREMENTS	: IEC_60060-1		
INSPECTION	YES	RELEASE NOTE	YES
HORIZON POWER IDENTIFICATION	RECLOSER 3PH		

SCALE:	NTS
SHEET:	1 OF 1
DRN:	M. GEORGIEVSKI 20.10.21
CHK'D:	
APP'D:	P. SAVIG

RECLOSER GENERAL ARRANGEMENT
AERIAL CONNECTION
SURGE ARRESTER APPLICATION

HORIZON POWER

DRAWING NUMBER:	REV:
HPA-SD-E-00007-01	1

FILEPATH: DATE: 20/10/2021 2:47:39 PM BY: H089207

APPENDIX G SCADA REQUIREMENTS

G1 OVERVIEW

Horizon Power requires that all Pole Mounted Reclosers be either connected to Horizon Power SCADA HMI's ('Always On' communications), or have the facility for local PC based connection.

The following provides the details of what exists and what is required to achieve the above.

1) Horizon Power provide the following applications for remote control and monitoring from these SCADA HMI:
   a) GE PowerOn Fusion
   b) Schneider Electric Citect SCADA.
2) Horizon Power uses these PC based applications for the local and remote configuration and diagnostics tasks.
   a) Schneider Electric WSOS4 and WSOS5.
   b) ABB WinISD.

G2 COMMUNICATIONS

1) The device must provide for the following communication ports:
   a) A control and monitoring port for communications to the remote SCADA HMI using DNP3 tele control protocol.
   b) A diagnostic and configuration port for communications to the PC based application.
   c) The above ports must be easily configured to provide a range of required interfaces.
   d) Preferred ports to be provided are serial RS232 and Ethernet.
   e) The number and the type of ports provided must be specified.
2) The device must support communications over these interface media:
   a) VHF/UHF radio.
   b) Serial modems (IP web configuration) on the Telstra mobile network.
   c) Ethernet modems (IP web configuration) on the Telstra mobile network.
   d) Satellite modems.
   e) Fibre Optic modems.
   f) Any other alternative communications media supported must be specified.

G3 CONTROL AND MONITORING TELECONTROL PROTOCOL

The preferred telecontrol is DNP3 protocol to the remote SCADA HMI:

1) DNP3 must meet or exceed the requirements of DNP3 – 2001 implementation as described in the most recent version of the DNP User Group Document "DNP V3.00 Subset Definitions".

2) A complete DNP3 Device Profile Document as described in the "DNP3 Subset Definitions" is to be provided.

3) The use of other telecontrol protocol must be approved by Horizon Power SCADA

G4 PC BASED APPLICATION SOFTWARE

The device systems must be supplied with configuration and diagnostic software that meets the following requirements:

1) Supplied software is to be compatible with the software that is supported by Horizon Power's business which is Microsoft Windows 7 Enterprise.

2) The software supplied with the system must be documented comprehensively, with all the features and functions specified.

3) The software should be menu driven and user friendly to the extent that only basic computer knowledge should be required to operate it.

4) The software must have an auto-install feature whereby a setup program will prompt for options and the software will automatically be extracted to the appropriate directories with program groups and icons created.

5) The software must maintain backup files of the configuration information. It must be possible to store these backup files on a Horizon Power server.

6) A list of minimum computer hardware requirements must be provided with the specification.

7) Horizon Power must be given a Horizon Power wide license agreement for the software offered. The price of the software should be included in the price of the device system.

8) Specific aspects like bug fixes, new firmware releases and version control of software/firmware will be specified.

G5 SECURITY

This section highlights the need for password control to prevent unauthorised operations to the devices:

1) Tele control – permission to change communications settings to a device.

2) Protection/Detection – permission to change protection/detection settings to a device.

3) Operation – permission for open / close control operations of the device.

4) System – permission to open files for a particular device.

5) Details of what password control is provided.

G6 PORTABLE TESTING AND TRAINING EQUIPMENT

The following describes Horizon Power SCADA requirements for portable testing equipment:

1) The test set must replicate the control and monitoring functions of the device.

2) The test set must provide the two communications ports described above.

3) Testing of analogue signals Amperes and Volts to be provided for.

4) A portable Testing and Training set which provides for secondary current injection can be incorporated in the above test set or as a separate test set.

5) The test set or sets will be ordered separately by Horizon Power.

G7 GENERAL REQUIREMENTS

The following describes Horizon Power requirements for the SCADA communications media installation to the device:

1) Horizon Power will arrange the install of the communications media and associated hardware.

2) Horizon Power will arrange the required configurations to the device and commission the device to the SCADA HMI.

G8 TECHNICAL SUPPORT

From time to time technical support for either the supplied software or hardware is required by Horizon Power SCADA this section highlights that need to provide details of how this can be achieved:

1) Comprehensive manuals for the product.

2) List of contact details for support.

3) Website.

4) Email notifications of product updates of software and firmware.

5) Notifications of changes to product supplied to be communicated to Horizon Power SCADA.

APPENDIX H IMPACT ASSESSMENT

HORIZON POWER	**Impact Assessment**			
	Document Title:	**Distribution Recloser Specification**		
	Document No:	HPC-8DJ-07-0003-2014	**Revision No:**	0
	DM No:			

Activity	**Detail**
1. What training is required to implement this specification?	If any, would be around equipment, this will need to be included in Tender.
2. Who will require training?	Operational Staff
3. What equipment will be required for training?	General Tools used by OPS
4. What special tools/equipment will be required for training?	Depend on Tender submission
5. Time period for training to be completed	Max 3 days
6. Does the document affect the budget?	No
7. Time period for implementation of requirements after training is completed.	Nil
8. Were the critical points in the document determined?	N/A

Business Change Control	Total Implementation period	30 days
	Total training cost	Zero (covered in Contract)
	Total cost of tools/equipment	Zero (covered in Contract)
	Total cost involved	Zero

Comments: This specification is for Tendering purposes, as there are already, similar equipment in the field

Documentation will be minimal.

Assessment Compiled by:		**Recommended by (Functional Responsibility)**	
Name:		Name:	
Designation:		Designation:	
Department:		Department:	
Date:		Date:	